TREES FROM OTHER LANDS IN NEW ZEALAND

EUCALYPTS

BY
J. H. SIMMONDS

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EUCALYPTS IN NEW ZEALAND

TREES FROM OTHER LANDS

FOR

SHELTER AND TIMBER IN NEW ZEALAND

EUCALYPTS

BY

J. H. SIMMONDS

ILLUSTRATED
WITH 76 BOTANIC PLATES AND
28 SCENIC PLATES.

AUCKLAND, NEW ZEALAND:
THE BRETT PRINTING AND PUBLISHING COMPANY.
1927.

A1.

THIS VOLUME

IS DEDICATED TO THE MEMORY OF

J. H. MAIDEN,

I.S.O., F.R.S., F.L.S.

WHOSE WRITINGS AND WHOSE PERSONAL FRIENDSHIP LAID UPON THE AUTHOR AN OBLIGATION HE COULD FULFIL IN NO OTHER WAY SO WELL AS BY TRYING TO PROMOTE THE CULTURE OF AUSTRALIAN TREES IN NEW ZEALAND.

MAIDEN WAS A DEVOTED CHURCHMAN AS WELL AS A DISTINGUISHED SCIENTIST. TO HIM ALL NATURE WAS MADE SACRED AND BEAUTIFUL BY A DIVINE PRESENCE. FOR THE HONEST AND THE TRUE HIS EXAMPLE WAS AN INCENTIVE TO WORK AND SERVICE; FOR THE SELFISH AND SLOTHFUL, A GENTLE BUT POTENT REPROOF.

FOREWORD.

THE author of this book, the Rev. J. H. Simmonds, is well known throughout New Zealand and in Australia as an enthusiastic promoter of Afforestation and Silviculture. But he is also one of the very few men in the Dominion who combine scientific accuracy with wide practical experience in the planting and rearing of trees.

The many valuable articles that Mr. Simmonds has contributed from time to time to the *Journal of Agriculture,* the *New Zealand Farmer,* and other periodicals have been largely instrumental in arousing that public interest in Forestry which is so widely manifested in this country to-day. In these articles, the author describes at length many selected species and varieties of Conifers, Broad-leaf trees, and Eucalypts. This book, however, is devoted especially to the Eucalypts, but with the expressed hope that the other great groups of timber yielders will be similarly treated in separate volumes in the near future. As an authority on the Eucalypts, Mr. Simmonds has earned the right to command attention amongst botanists and foresters in Australia, the natural home of the genus, as well as in New Zealand.

This book covers a wide range of topics relevant to its main theme. In Section III. seventy species, including all the most valued timber yielders of the genus, and some others of less importance, are described in detail, each being given a separate botanic plate. At the end of the volume is a descriptive list of all the species of *Eucalyptus* named and recorded up to the date of this publication. Based upon the very latest investigations into the character and growth of the Eucalypts, splendidly illustrated, and enriched with constant references to the classics of Eucalyptology, this book is certain to become a standard authority on the cultivation of these trees, and long to retain its position.

An original and unique feature of *Eucalypts in New Zealand* is the distribution of species in thermometiic groups. The seventy species described and illustrated in Section III. are arranged in six groups, according to the mean and exceptional degrees of temperature it is believed they will endure. The scheme is bold and admittedly tentative; but to those who will heed the grouping and instructions, it cannot fail to ensure immunity from serious loss due to the thermometric conditions of any given locality.

The list in Section VII. of the book is an alphabetical and briefly descriptive index to the 400 species described in Maiden's *Critical Revision.* This index will greatly facilitate the task of reference to Maiden's work; and for those who cannot possess the *Critical Revision* it will still serve as an exceedingly valuable botanical catalogue of the species.

In addition to sound and comprehensive scientific information, this book contains a great store of general instruction and suggestion of immense value to the practical man. For many years Mr. Simmonds had charge of Wesley Training College, first at Three Kings, near Auckland, and subsequently at Paerata. At both places he established experimental plantations of Eucalypts and other timber-yielding trees. Many species of *Eucalyptus* were included in the experiments. The author has thus had a large amount of actual experience in tree culture; and

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his directions to farmers and settlers in regard to the work of growing and tending trees and handling timber cannot fail to secure the attention and appreciation of all practical men. Far from being merely a scientific treatise, this work is, in addition, a handbook of practical Silviculture, which should prove of great and enduring value to all who take any intelligent interest in the subjects that Mr. Simmonds handles.

The plantations at Three Kings bear witness to careful research and enthusiastic and persistent effort. It is very much to be regretted that they were not all placed together in an arboretum, where they could be permanently preserved for the instruction of students and for the enjoyment of the public. We understand that the subdivision of the property for building purposes will necessitate removal of nearly all the large trees. It is not too late, however, to take advantage of Mr. Simmonds' knowledge by establishing new and more ample plantations in some suitable locality within easy reach of the city.

The necessity for replacing our rapidly declining stock of native timber trees is a matter of vital public urgency. The timber-famine predicted for many years past is already upon us; and within the next decade or two, New Zealand, like every other country, will be hard pressed to secure timber supplies adequate to its needs. Prices will advance while quality declines. The only course that can be taken to meet this threatened danger is to plant quick-growing trees. Provision is now being made for the production of softwoods in New Zealand on a fairly generous scale. But in addition to these, the country will need a large quantity of hardwoods for the numerous purposes for which timber capable of standing heavy weights or strains or shocks is required. For an adequate supply of hardwoods the Dominion must look to successive crops of home-grown Eucalypts. The fine qualities of these splendid trees, their rapid growth, and their high timber value, render them absolutely indispensable to this country. The climatic and topographical conditions that suit them best are all discussed by Mr. Simmonds; and, in addition, his book supplies elaborate instructions for dealing with the trees right up from the seedling stage to seasoned timber ready for use.

We anticipate for this book very wide appreciation. It comes at a time when there is pressing need for information and guidance in tree planting. In smaller and larger areas there are lying waste in this country many thousands of acres of poorer lands that might be producing valuable crops of timber. Planting is deferred or neglected because people do not know what trees to grow or how to make them grow. For the Eucalypts especially this book shows the way; but it has also a wider message. The author has brought to his task exceptional knowledge, ability, industry, and enthusiasm. His work is a contribution of very high value to the research and literature destined ere long to give Forestry in New Zealand status not only as a science and as an art, but also as a highly profitable national enterprise.

H. HUGH CORBIN,
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PREFACE.

THIS book has been written mainly for tree planters. Its chief aim is to turn scientific research on the *Genus Eucalyptus* to better account in the economic cultivation of selected species.

The most pressing need of industrial civilization to-day is replacement of vanishing forests. Civilized man must either plant trees on a scale far exceeding all previous schemes or prepare to see many of his arts and crafts decline for lack of wood. Softwoods will be required in successive harvests, the volume of which cannot yet be calculated. Hardwoods, in their lower ratio to the total consumption, will be in imperative and increasing demand. This book states the case for the Eucalypts, and pleads for their more competent and generous treatment in our national forestry.

It may be helpful to the student to indicate in brief outline the sources whence information has been gained for writing about these trees:—

(*a*) Standard works on the botany and technology of the genus.
(*b*) Thermal and rainfall records as issued by the official meteorologists in Australia and New Zealand.
(*c*) Personal study of species and groups of species in a large number of distinct climatic areas, in Australia and in New Zealand.
(*d*) Correspondence with botanists and foresters in respect to behaviour of species in localities not personally visited.
(*e*) Reports on cultivation of Eucalypts in South Africa, California, and India.

In travel, in research, in obtaining photographs and reports, in preparing manuscript for the press, in reading proofs, and in many other ways, the author has received from friends in both Australia and New Zealand assistance without which his task would have been much more difficult and less successful. To cite names would call up many happy memories, but the list would be too long. This brief but grateful acknowledgment must suffice.

The exceptionally fortunate circumstances under which the botanic plates for this book were obtained are stated on page 22.

People who write books would be helpless without printers. Thought must be given expression in due and appropriate material forms. Credit for the technical production of this volume falls to The Brett Printing and Publishing Company. The administrative officers of the firm have been uniformly courteous, and always prompt in attention to the wishes of their client. Experts in the several departments have shown a keen interest in their work, and have given their best in both knowledge and skill. The author's relations with all concerned have been wholly pleasant.

J. H. SIMMONDS.

Takanini,
Auckland, N.Z.,
1927.

EXPLANATORY NOTES

On some of the Technical Words used in books on Botany.

(GLOSSARY.)

Acuminate: gradually tapered and sharply pointed.

Acute: less gradually tapered to a sharp point.

Adherent: attached and holding together.

Adnate: united in growth, as one organ to another where the two are different.

Anther: the pollen-bearing portion of a stamen, consisting usually of two lobes called thecae with their connecting tissue and contents. Each theca contains two pollen sacs. Upon maturity, one slit or opening in each theca releases the pollen from its two contained sacs.

Apex: the highest or extreme point of anything.

Axil: the upper angle formed by a leaf and the twig upon which it grows.

Axillary: growing in the axils or angles of the leaves.

Bark: in coniferous and dicotyledonous trees, all the layers of tissue external to the cambium. The newly-formed layers consist of living cells, and serve to conduct tissue food prepared in the leaves to other parts of the plant. As new layers are formed within, those on the outside die. In some cases the dead bark soon scales off and falls away; in others it clings to the tree and persists in the form of a stringy, spongy, or hard coating.

Bract: a rudimentary or modified leaf in the axil of which a flower arises.

Cambium: the actively growing tissue immediately outside the wood in coniferous and dicotyledonous trees. It gives rise to new layers of wood on the inside and new layers of bark on the outside, and thus brings about increase of thickness in roots, trunk, and branches.

Cells: the microscopic units of which the plant body is built. Each cell is surrounded by a wall, which, in living tissues, is pervious to water holding mineral salts and organic substances in solution. By a process not fully understood, but suggestive of suction and propulsion, each living cell can receive fluid from one contiguous cell and pass it on to another. The process, however it may be explained, helps to make possible the upward flow of sap from rootlets to leaves. The term cell is also sometimes used to mean the cavity of a pollen sac or of an ovary.

Chlorophyll: the green pigment in the leaves of plants whereby is made possible the assimilation of carbon dioxide from the air.

Clavate: club-shaped with gradual taper from the free end to the attached end.

Conical: cone-shaped with the small end free.

Connate: united in growth, as one organ with another where the two are alike.

Cordate: heart-shaped with the small end free.

Corymb: a flower cluster consisting of several branchlets and numerous flowers, and so formed as to present an even and cushion-like appearance on the top.

Cotyledons: the seed leaves or first leaves of a germinating plant. They are often thick and fleshy, in other cases thin and membranous. They may remain below the ground or rise above it and become coloured by the light. Their chief function is storage of food for the infant plant. Grasses, palms, etc., have only one cotyledon, and are called Monocotyledons. The broad-leaf trees and many other plants have two cotyledons, and are called Dicotyledons. The Conifers vary in number of cotyledons from two to over twelve. They are sometimes called Polycotyledons.

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Crenate, Crenulate: with larger or smaller blunt or rounded teeth, as along the margins of certain leaves.

Cyme: a flower cluster with branchlets that fork and spread in an open manner and carry the flowers at their extremities.

Deciduous: falling away after the manner of dead leaves, dead petals, or loose dead bark.

Dioecious: having stamens on one plant or tree and pistils on another. (Greek *di*, two, and *oikos*, a dwelling place).

Dehiscence: the splitting of the thecae to release the pollen or of a seed vessel to emit the seeds. The splitting takes place along prepared lines of weak cohesion.

Dimorphic: growing in two distinct forms, at the same time or at different periods in the plant's life.

Exserted: protruded beyond an orifice or rim; often shortened to exsert.

Falcate: shaped like a scythe or a reaping-hook.

Filaments: thread-like objects; the slender stalklets that carry the anthers in a flower. (See Stamens.)

Fruit: any seed-vessel that has been modified by fertilization and still contains the fertilized seed.

Note.—The female parts of any flower, after they have been changed and perfected by fertilization, constitute a fruit, the vital function in the change being in all cases that whereby the ovule (or each ovule) becomes a seed.

Genus: a group of apparently related plants including smaller groups called species.

Glabrous: free from hairy or downy covering; smooth.

Glaucous: bluish green, or chalky green, the appearance being due to a powdery bloom on the surface.

Habitat: the place or region where a race or species is found growing. The adjective *natural* is often used to indicate that the place of growth has been determined without any human agency. The science of habitat is now regarded as of very great importance. It is termed by the learned *oecology*. (Gk. *oikos*, a dwelling place, and *logos*, teaching.)

Hermaphrodite: having male and female organs in the same flower.

Hispid: thickly covered with rather stiff hairs.

Inflorescence: the mode or form in which a plant produces its flowers. Fruiting or infructescence follows as its result.

Lanceolate: tapering to an acute apex and narrowing a little to the base like the blade of a lance.

Macro and **Micro:** prefixes meaning large and small respectively.

Mallee: a eucalypt with thickened woody root-stock or rudimentary stem and slender stem-like branches. It is the usual word for eucalypts of this type in South Australia, Victoria, and New South Wales. In Western Australia the word Marlock is used with similar application.

Medulla: pith; a soft narrow column found in the centre of some tree stems.

Medullary Rays: longitudinal and radiating bands of paler (parenchymatous) cells in the stems of coniferous and dicotyledonous trees. The bands extend from the centre of the stem or from intermediate points therein to the cambium tissue and bark. They serve to convey from the cambium the substances that change sapwood (alburnum) into heartwood (duramen). The bands appear as rays only when a stem or branch is cut across.

Midrib: the primary rib or vein in a leaf. It is a prolongation of the footstalk or petiole where that is present.

Monoecious: having male and female organs in separate flowers on the same plant. (Gk. *monos*, one, and *oikos*, dwelling place).

Obconical: cone-shaped with the broad end free.

Obcordate: heart-shaped with the notched end free.

Operculum: an undivided lid or cover.

Orbicular: flat and circular or nearly circular.

Ovary: the part of the pistil in which the ovules are formed and fertilized.

Ovate: flat with the outline of a hen's egg.

Ovoid: shaped like an egg.

GLOSSARY.

Panicle: a flower cluster with a central stem and several flowering branchlets. The lower branchlets are often longer than those above, the form of the cluster in that case being on the whole conical or blunt spire-like.

Pedicel: a stalklet carrying a single flower.

Peduncle: a stalk carrying a group of flowers, or a single flower that fills the place of a group.

Peltate: having the footstalk attached at the back of the leaf blade like the handle of an ancient soldier's shield.

Perfoliate: having the leaf blade united round the stem on which it grows.

Perianth: those parts of a flower that surround the stamens and pistil, or either of them separately, usually consisting of two whorls, the calyx without and the corolla within.

Petals: the leaves that form the corolla of a flower, and are in very many cases brightly coloured.

Petiole: the footstalk of a leaf.

Pilose: hairy, the hairs being soft and distinct.

Pistil: the female part of a flower, including the ovary, the style, and the stigma.

Plant: any vegetable organism from the tiniest fungus to the largest forest tree.

Pollen: the fertilizing cells or grains contained in the anthers.

Raceme: a flower cluster consisting of a slender unbranched rod furnished all round with stalked flowers, the youngest being nearest the tip. (See Spike.)

Rachis: the axis or central stemlet of a compound leaf or of a flower cluster.

Reniform: kidney-shaped. The term is applied to anthers when the two thecae diverge.

Seed: the fertilized and reproductive contents of any (phanerogamic) seed-vessel.

Sepals: the modified leaves forming the outer whorl or ring of the perianth.

Serrate: with sharp teeth at the edge like those of a saw.

Serrulate: with very fine sharp teeth at the edge.

Sessile: attached without a footstalk or stalklet, as a stalkless leaf to a twig or a stalkless flower to a peduncle.

Species: a group of plants that are apparently very closely related and may be regarded as derived from one parent stock. Such a group is stable, but not immutable. Climatic conditions and hybridism may operate to modify it. Nurserymen and foresters must therefore persistently select for propagation the individual specimens that are most vigorous and best adapted to the purposes for which the plants or trees are to be cultivated.

Spike: a flower cluster consisting of a slender unbranched rod furnished all round with sessile or stalkless flowers, the youngest being nearest the tip. (See Raceme.)

Stamens: the pollen-producing organs of a flower, each usually consisting of a slender stalk or filament and a head or anther which contains the pollen sacs. (See Filaments.)

Stellate: arranged in star-like clusters.

Stigma: that organ at the summit of the style which receives the pollen grains.

Stomata: respiration pores, of which there are countless numbers in the leaves of plants. (Singular *stoma.*)

Style: the little stem or shaft connecting the stigma with the ovary. It is pervious to the fertilizing pollen cells.

Terete: cylindrical and smooth.

Tissue: any one of the forms in which cells are shaped and grouped in the structure of a plant. If the cells rarely have length greater than breadth and depth, if they are thin-walled, and if they are rich in protoplasm, the tissue is called *parenchyma.* If the cells are long and fibre-like or spindle-shaped, with pointed and interlocking ends, thick-walled, and less rich in protoplasm, the tissue is called *prosenchyma.* Out of these two forms of tissue, subject to endless resource of modification, the *Creative Power* builds the trees of the forest as well as the herbage of the field. The student who would enter deeply into this realm of truth must obtain a good textbook on botany or attend lectures at the University.

GLOSSARY.

Tomentose: covered with soft cottony hairs.

Transpiration Current: the *ascending* sap, as it is absorbed by the root hairs, passes thence through the roots, stem, and branches to the leaves, and from the leaves gives off part of its water through the stomata in invisible vapour. This upward flow of the sap takes place through the sapwood or alburnum, which is thus essential to the life and growth of an exogenous tree. The sap immediately under the bark is a *descending* flow of tissue food prepared in the laboratory of the leaves.

Turbinate: broad at one end and narrow at the other like a top.

Umbel: a cluster of flowers that all spring from the summit of a common peduncle. The flowers may be sessile or each may have its own stalklet or pedicel. A capitulum has the seed-vessels still more closely united.

Veins: the more or less rigid (*fibro-vascular*) structures that, together with the petiole and midrib, form the framework of the leaf. This framework fulfils two main functions:

(*a*) It spreads the leaf blade to the light and so facilitates the formation of food materials.

(*b*) It provides channels for conveying the nutrient fluids to and from the leaf.

Whorl: (pro. whurl): a circle of leaves or branches round a stem; or one of the circles in the organs of a flower.

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INTRODUCTION.

WHEN the white man first saw New Zealand, fires kindled by the Natives, by lighting, and in some rare cases by volcanoes, had already at various times in the past reduced the total amount of the primeval forests. The replacing plants were mainly grasses in the south and bracken in the north. But untouched and unspoiled areas of immense extent still remained in both Islands, and along their borders in many places regeneration was in progress. The forests varied in type from south to north and from higher to lower altitudes. There were the beech forests with their roof of feathery branchlets and their almost bare floor. There were the open mixed forests admitting subdued light through their dome-like crowns to a floor richly carpeted with ferns and mosses. There were the dense mixed forests with their sub-tropical tangle of creeping and climbing plants. There were the kauri forests with their massive boles of nearly even diameter, their heavily-framed and almost continuous roof, their sparse undergrowth, and their floor laden with precious resin poured out from the exuberant life of the trees. The mixed forests with their open glades and shrub-clothed margins yielded a great wealth of nectar and berries and insects, and there accordingly might be heard throughout the year the chatter and songs of countless birds.

For these wonderful and beautiful forests European settlement meant generally a war of extermination. The best and noblest of the trees were easily destroyed; only under special conditions and in long periods of time could they be regenerated. Increasing numbers of settlers needed timber for their buildings and fences; they needed open pasture for their sheep and cattle. Felling and burning were necessary, but went too often beyond necessity. Valleys and hills were swept bare over far-flung miles in every direction. And, as if axe and fire and domestic animals were not enough, goats and deer were liberated to assure the ruin of the native forest flora by killing the seedlings and saplings.

But British people are lovers of trees. Many of the settlers deeply deplored the destruction in which they were taking part. They wished to have trees about their homes and upon the waste places of their farms. Gladly would they have restored some of the native bush had that been possible; it was not possible. Choice lay between a treeless countryside and the planting of exotics. What happened was like a decree of nature. Nurserymen everywhere became busy propagating and distributing conifers from North America, eucalypts from Australia, and

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broad-leaved trees from Europe. Many of these exotics were easily established and grew with startling rapidity to large dimensions. Many of them were known to be yielders of valuable and durable timber. Soon there began to appear in every settled part of the country belts and blocks of these welcome invaders. The State commenced the planting of widely extended exotic forests. Local bodies and syndicates awoke to share the tree-planting enthusiasm.

New Zealand will never forget and never wholly neglect her native trees. She will carefully preserve them in selected areas. Her gardeners and foresters will skilfully reproduce them in limited numbers. But we now know quite certainly that in the future our main reliance will be upon trees from other lands. Upon these we must depend for covering our waste spaces and for sheltering our homes. To these we must look for early and perpetual supplies of timber. Many trees from other lands are already with us. Many others await our welcome. All need to be better understood, and no mere catalogue will suffice for their adequate presentation.

Two great divisions of the plant world are contributing to our necessity. The *Coniferae,* most of which commence life with several cotyledons, or seed leaves, are supplying the softwood yielders. Numbers, stately beauty, and unrivalled range of utility will demand for these a separate volume. The *Dicotyledones*, which include the Eucalypts, are filling up an ample list of hardwood species. The Eucalypts, though only a single genus, must be given a separate volume. The numerous remaining available species in this division will easily fill a third volume.

There are men in New Zealand competent to write the books. There are others well able to bear the cost. A beginning of the task is being made with this volume on the Eucalypts. Learning, consecrated wealth, our inherited enthusiasm for parks and forests, and the certainty of a world-wide timber famine in the near future, should soon make possible the completion of this urgently needed service to our country.

J.H.S.

HOMES SHELTERED AND MADE BEAUTIFUL BY TREES.

R. J. Clark, Photo., Gisborne.

"PUKETITI," TOKOMARU, EAST COAST (A. B. WILLIAMS).

The splendid trees in these grounds have all been established within the brief period of 25 years.

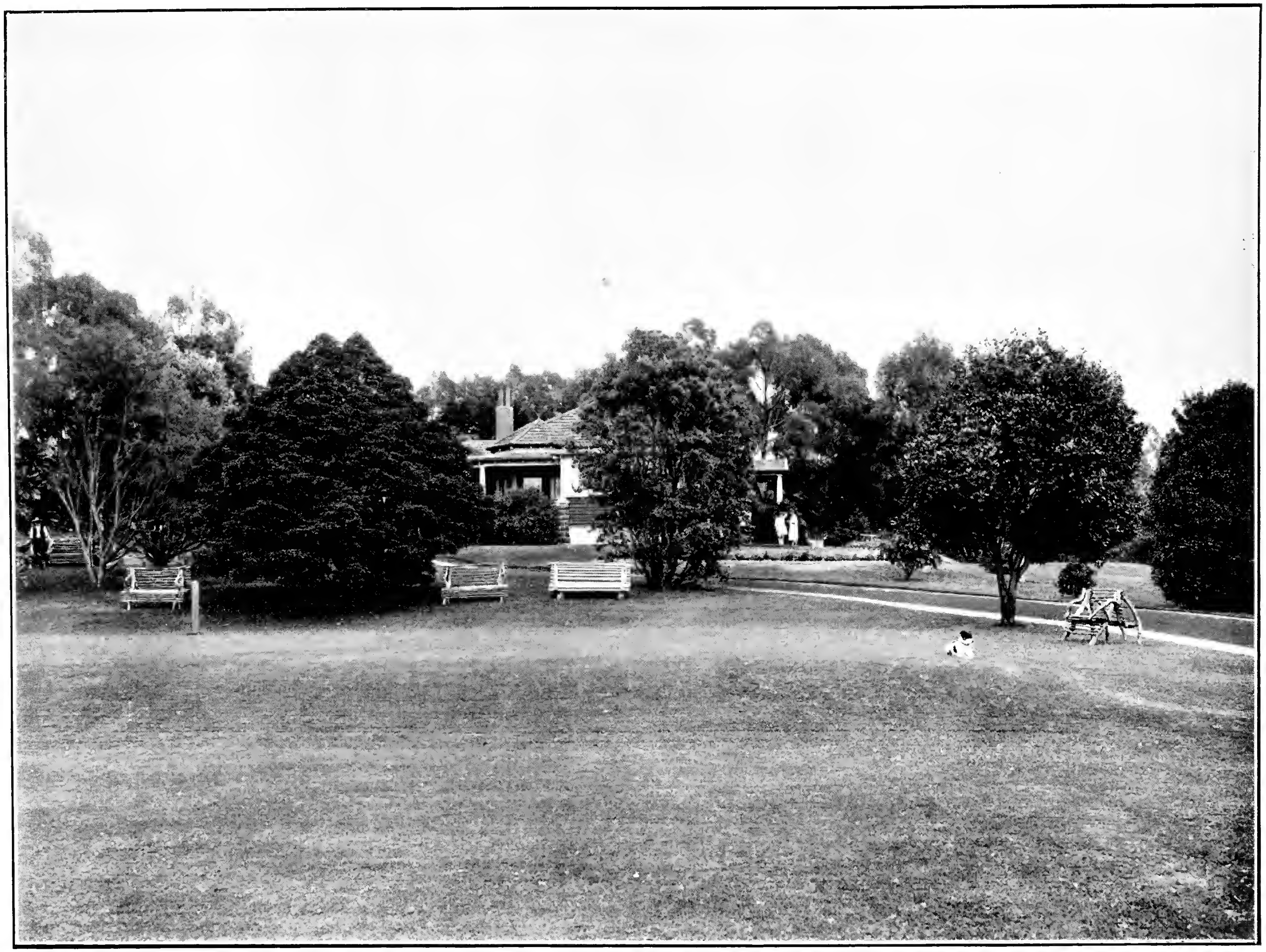
HOMES SHELTERED AND MADE BEAUTIFUL BY TREES.

Lovell-Smith, Photo., Hastings.

"TUNANUI," HAWKE'S BAY (SIR ANDREW RUSSELL).

This home looks down a valley where Conifers and Eucalypts in combination on the rising ground have for over thirty years formed defensive battalions against invading winds.

HOMES SHELTERED AND MADE BEAUTIFUL BY TREES.

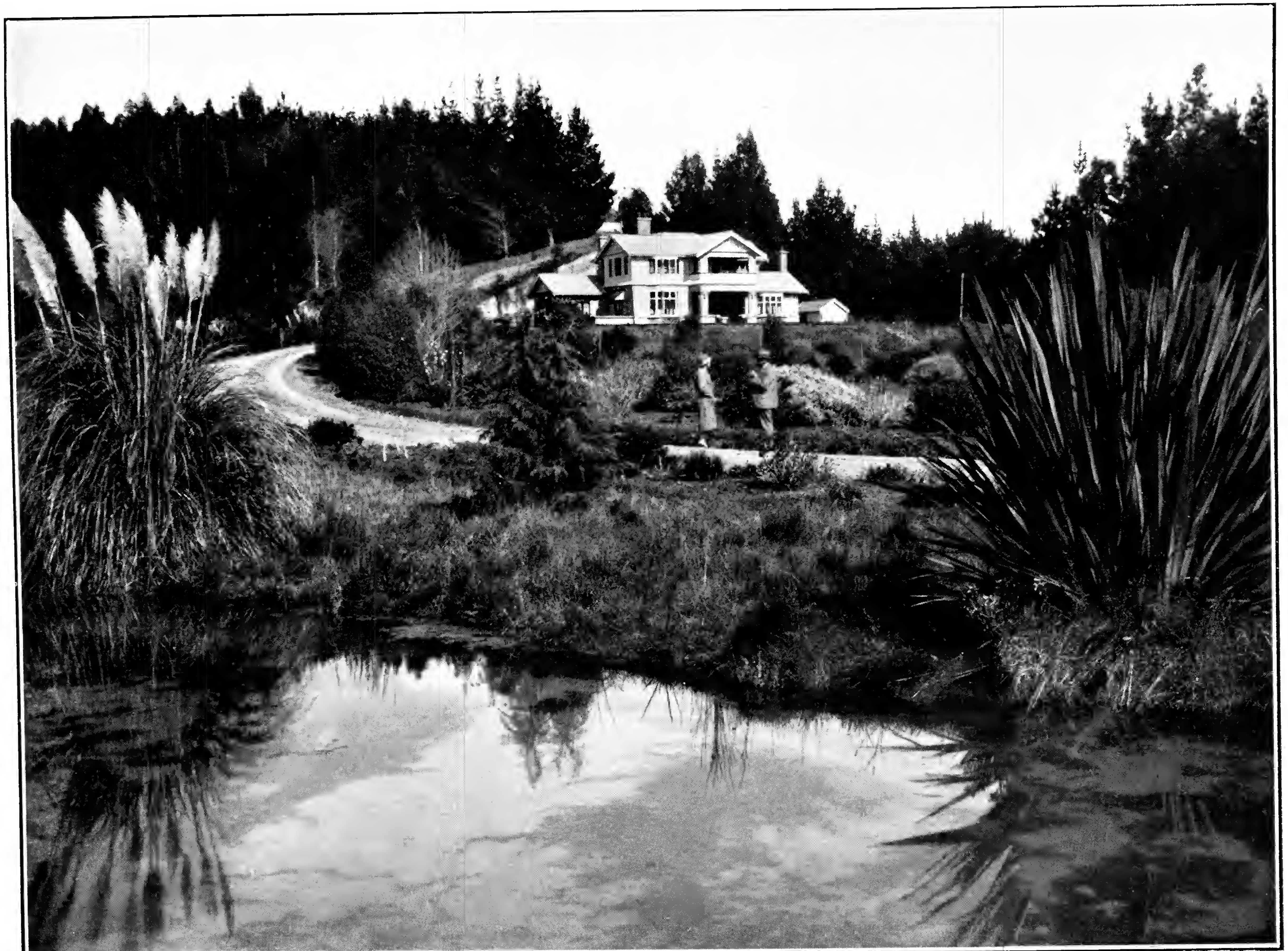


Brett Staff Photo.

"NGARURU," EPSOM, AUCKLAND (SIR JAMES GUNSON).

The beautiful Native and Exotic trees here depicted range in age from 14 to 21 years. Eucalypts in the background shut off the south-west winds and ensure for the lawns and gardens the peaceful and genial conditions of a tree-made climate.

HOMES SHELTERED AND MADE BEAUTIFUL BY TREES.



A. McCusker, Photo., Blenheim.

"LAKE TIMARA," MARLBOROUGH (R. F. GOULTER).

Here tender shrubs and flowers flourish in the shelter of sturdy forest trees only 17 to 34 years old.

HOMES SHELTERED AND MADE BEAUTIFUL BY TREES.

Wallace Poll, Photo., Hastings.

VIEW OF THE HAWKE'S BAY PLAIN

FROM THE SPLENDIDLY PLANTED GROUNDS AT "TE MATA," HAVELOCK NORTH (BERNARD CHAMBERS).

This picture tells its own story of a great landscape transformed by a tree-loving people.

PLANTED FORESTS.

Steffano Webb, Photo., Christchurch.

SCENE IN THE STATE FORESTS, HANMER, CANTERBURY.

NOTE.—The planting operations of the State Forests Service are being carried on mainly in Otago, Canterbury, and Auckland. In each of these Provinces extensive annual additions are being made to the already planted areas. The anticipation is that by 1935 the Service will have planted at least 300,000 acres. This will be exclusive of large areas planted by city corporations, syndicates, and private owners of land. But there will still be wide spaces calling for the tree planter.

THE GENUS EUCALYPTUS

SECTION I.

DISCOVERY AND ELUCIDATION OF THE GENUS.

When *Eucalyptus* trees were first discovered by civilized men they were restricted to Australia, Tasmania, New Guinea, and a few outlying localities. There are now extensive and valuable plantations of them in South Europe, North and South Africa, India, California, Florida, Brazil, and New Zealand. In all the Australian States the hardwood timber market is still supplied from the natural *Eucalyptus* forests. The necessities of settlement, followed too often by waste and neglect, have very seriously depleted those forests; but efforts are now in progress in several of the States to conserve and reproduce the best of the species on as extensive a scale as present circumstances will permit.

The Eucalypts are included by botanists in the great natural family to which the myrtles belong—the *Myrtaceae.* Their nearest kindred are found in another Australian genus called *Angophora.* In manner of growth and general appearance the Angophoras are indeed so much like the Eucalypts that we often cannot positively distinguish them until we examine their flowers and fruit. Kindred a little more remote are the very beautiful and valuable genera named *Tristania* and *Syncarpia* also indigenous to Australia. If we seek very distant relations, we may find them in our own country in the rata and pohutukawa (*Metrosideros*) and in the manuka (*Leptospermum*).

Eucalyptus trees were noted and recorded as a distinct and very remarkable group by the scientists who accompanied Captain Cook; but the honour of giving them their generic definition and name was reserved for a Frenchman named L'Héritier de Brutelle, who worked, not amongst the trees in Australia, but upon material that British botanists had collected and carried to London. Botanical names have not always been wisely selected, but the choice made by L'Héritier in this case was a happy one. The word *Eucalyptus* is a Latinized Greek compound made up of the adverb *eu,* well, and the verbal adjective *kaluptos* from *kalupto,* which means "I cover" or "envelop." *Eucalyptus* thus means well-covered, and we see its appropriateness when we learn that it was suggested by the peculiar structure of the floral bud common to all members of the genus. Instead of the stamens and anthers and style and stigma being sheathed with sepals and petals as in an ordinary flower they are completely covered by an undivided cap or lid. When the organs within are mature this covering or operculum is pushed off and falls away, leaving an apetalous (non-petalous) flower. In some cases there is a thin outer mantle over the operculum, which falls away previously or at the same time. Instead of this undivided cap or lid the several species of *Angophora* and other close kindred of the genus have distinct petals.

Though so near and so similar in other respects, they are therefore not eucalypts. Some of the eucalypts in a sub-section called *Eudesmieae* have indentations in the rim of the calyx tube (seed-cup) and markings on the operculum (lid) suggestive of ancestral division into sepals and petals. When or why these organs changed to the undivided state is an open question for further research; but that the outer operculum represents the sepals and the inner operculum the petals of the ancient flower is now accepted by botanists as a fair inference from the evidence as a whole.

The distinguished botanist Robert Brown, and others following, accepted L'Héritier's name and settled it as the permanent title of the genus. The father of Eucalyptology, the late Baron Ferdinand von Mueller, derived from it the Anglicized forms eucalypt and eucalypts to denote the species when regarded singly or collectively. British and American writers of highest standing have followed Mueller in the use of these forms. The Latin plural *Eucalypti* appears occasionally in books and papers, but has never found favour in the learned tradition. It thus appears that *Eucalyptus,* eucalypt, and eucalypts are established by the highest authority as the correct and proper terms to be used when speaking or writing in the English language about these trees or any of their products.

WORKERS AND WRITERS ON THE GENUS.

The elucidation of the eucalypts has now been in progress for over a century. It has commanded the interest and labours of many able and learned men. Baron Ferdinand von Mueller in his *Eucalyptographia, Select Extra-Tropical Plants,* and other writings; George Bentham in Vol. iii. of the *Flora Australiensis;* J. D. Hooker in his *Flora Tasmaniae;* Dr. William Woolls in his *Lectures;* F. M. Bailey in his *Queensland Flora;* A. J. McClatchie in his *Eucalypts Cultivated in the United States;* Charles Naudin writing in French on species cultivated in France; and several other writers have left us literature on the subject much of which will hold a permanent place in the classics of science. Amongst more recent writers on the genus the place of chief distinction easily belongs to J. H. Maiden, F.R.S., who was for many years Director of the Sydney Botanic Gardens and Government Botanist for the State of New South Wales; while especial mention must also be made of R. T. Baker, F.L.S., and H. G. Smith, F.C.S., joint workers during a long period in the Sydney Technological Museum. J. H. Maiden in his *Critical Revision of the Genus Eucalyptus* and his *Forest Flora of New South Wales,* two elaborate and eminently well-illustrated works, has brought together from all sources an immense amount of information in addition to his own intimate personal knowledge of the trees. A work that so completely lays under tribute the collections and writings of all the earlier students of the genus as well as the labours and contributions of living botanists and foresters as does the *Critical Revision* will be supplemented, as all progressive science must be; but as an encyclopaedia of information to the date of its completion it can never be displaced or superseded. Messrs. Baker and Smith in their work entitled *A Research on the Eucalypts and their Essential Oils* (2nd edition 1920) and other writings have developed the chemistry as well as the botany of the subject. They record the results of their laboratory work in distilling, analyzing, and standardizing the oils from a very large number of the species. They also name and describe several species that had previously been either overlooked or wrongly included in existing definitions. A still further interest attaches to their work in that they outline a scheme suggesting how it may be possible that the eucalypts have been evolved from the closely similar genus *Angophora* and subsequently varied into their present forms. Mr. Baker has separately published a beautifully illustrated work on the technology of the *Hardwoods of Australia,* in which the eucalypts claim chief space and attention. Mr. L. Rodway in his *Tasmanian Flora* and in the Government pamphlet *Tasmanian Forestry* has given us valuable information about the several species indigenous to his State, in respect both to their botanical characteristics and their uses as timber trees.

DETERMINATION OF SPECIES.

In assigning any *Eucalyptus* tree to a specific group the botanist has to consider the following tests of specific distinction:—

(*a*) The form and aspect of the tree as a Whole.

(*b*) The bark, with careful distinction between living and dead stages.

(*c*) The foliage, including seedling, sapling, and adult forms.

(*d*) The buds, flowers, and fruits, including study of the seeds.

(*e*) The timber, especially in the heartwood or mature condition.

(*f*) The oils and kinos.

The ordinary student or forester cannot be expected to work out all these tests for himself; but it is well that even he should know in outline the process that must be followed to reach certainty in any of the more difficult determinations.

(*a*) FORM AND ASPECT OF THE TREE AS A WHOLE.

In studying trees we have to distinguish between what may be called the *individual form* and the *group or specific form.* No two trees, however nearly related, will be found upon close scrutiny to be exactly alike. Each tree, like each animal, has its own peculiar constitution and temperament, and differs from all others. The soil in which it grows and the presence or absence of other trees in contiguity may also modify it as a unit. This is individual form. But if several trees are very closely related, they will resemble each other in certain common features of structure and aspect. In other words, their kinship will be suggested by a manner of growth and colouring peculiar to them as a group. The tendency in a group or species may be towards a multi-stemmed canopy, towards a short stem heavily branched from near the ground, or towards a long clean stem with little top. It may be towards an erect habit of the branches or towards a spreading and drooping habit. Each group will also have a tendency to exhibit a peculiar colouring and aspect of both bark and foliage. This is group or specific form as distinguished from individual form. Looking at any tree as a whole the experienced botanist or forester will get an impression more or less certain as to the species to which it belongs; but to exclude all risk of error he will proceed to consider the other specific characters.

(b) THE BARK.

The outer bark of *Eucalyptus* trees, like that of many other genera, tends continuously to become sapless and dry. It thus in successive layers ceases to be a living part of the tree. In some species this dead bark peels off in ribbons, scales, or sheets. The process uncovers the living bark and gives to the stems and branches of the trees a naked and pale-coloured appearance. Trees with this *deciduous bark habit* are technically called "gums." In other species the dead bark clings to the trees and forms a close fitting jacket over the living bark on stems and large branches. Trees with this *persistent bark habit* are not "gums" and should never be so called. A few species have their tops naked and their stems clothed to a greater or less height with persistent dead bark. They are said to be "gum-topped" or "half-barked"; but even these are technically not "gum trees." When we speak of certain barks as persistent we do not mean that they are free from any kind of change. All organic things change; and those barks that persistently cling to the trees are subject to weathering and waste at their exposed surfaces. Barks of all descriptions are thus in a state of continuous mutation. Living bark grows from the cambium tissue, fulfils certain functions, and then becomes dead bark. Dead bark gradually perishes and goes back to the earth, either by peeling off or through weathering and wasting at its surface. The process is analogous to the birth and life and death of leaves, and more remotely to the continual renewal of the skin in animals.

In the case of every persistent dead bark we have the phenomenon of a close-fitting dead coating surrounding a living and growing tree. It is obvious that any such coating must become rent, cracked, or fissured by the increase of the tree's diameter. It is obvious also that the manner of the rending or cracking will be determined by the peculiar texture of the dead substance. The effect of the tree's expansive force upon the persistent dead bark thus becomes an aid in determining the species, and must always be noted in connection with the texture of the bark itself.

Leaving out of account all minor distinctions, persistent dead *Eucalyptus* barks may be grouped as follows:—

1. Soft barks with long, tough fibres. These are described as fibrous or stringy, and are seen in their most characteristic forms on the trees commonly called "stringy-barks." The cracks or rents in these barks run in nearly parallel lines up and down the tree. The "blackbutt barks" of Eastern Australia are soft and fibrous and form a sub-section of this group.

2. Soft barks in which the successive layers of fibres cross each other obliquely and present, as the tree expands with growth, a reticulated or latticed appearance. These barks are found on the trees commonly designated "peppermints" and are consequently called "peppermint barks." The fibres in these barks are at first tough, but through expansion and exposure to the weather they ultimately lose their tensile strength and can then be easily broken or crushed in the hand.

3. Soft barks with short, brittle, and irregularly arranged fibres. Some of these are coarse and deeply furrowed; others are finely divided, fleece-like, felt-like, or scaly. These barks are described as sub-fibrous when the fibrous texture is

obvious to the eye, and as non-fibrous when no distinct fibres can be easily detected in them. The group includes the several forms known as "box barks" and also the "woollybutt barks."

4. Hard barks with longitudinal and sometimes transverse ridges and furrows. Of this group the most important are the ten or eleven species technically called "ironbarks"; but besides the true "ironbarks" there are several other species that carry on their stems and more or less on their main branches a coating of very firm and deeply furrowed dead bark. The "blackbutt barks" of Western Australia fall into this group, and are thus in contrast to the soft "blackbutt barks" of Eastern Australia included in group (1).

5. Hard, non-fibrous barks that sometimes appear as irregularly cracked and fissured plates at the base of otherwise smooth barked trees. These plates are often loosely attached and may at any time fall away.

In ordinary field work what one first and most observes is the surface of the tree, the presence or absence of dead bark upon the stem or stem and branches, and the character of such dead bark if present. A competent investigation into the texture of the living part of *Eucalyptus* barks could not fail to reveal distinctions that would be helpful in specific determination; but the task would be slow and difficult and would require laboratory work.

(*c*) FOLIAGE.

When studying foliage in the bush we usually give our attention first to the mature or adult trees and afterwards look round for their young offspring. In writing on the subject it will be equally convenient and more scientific to reverse the order and follow the life of the tree from the germination of the seed to maturity.

SEED LEAVES OR COTYLEDONS.

The genus *Eucalyptus* belongs to that great division of plants in which each seed contains two nutrition lobes. It is one of the genera in which these two lobes develop at germination into organs like leaves. Seed leaves or cotyledons we call these organs. In size, form, and colouring *Eucalyptus* cotyledons vary with the species, and thus in careful hands afford valuable aid in specific determination. A few seeds of each species germinated in a separate pot or small box will be sufficient for personal study or for the instruction of a class.

LEAVES OF SEEDLINGS.

Soon after the cotyledons expand, the plant throws out true leaves and begins to build a stem. It is then what we call a seedling, and we shall rightly call it a seedling so long as it retains its distinctively juvenile form and aspect. This may be for a year or more. It is well known that many trees in thus starting their lives exhibit a form of foliage very different from that which they assume as they advance towards maturity. Lovers of the New Zealand bush will be familiar with examples of such dimorphism of foliage in our own indigenous flora.

Amongst the eucalypts the percentage of species in which a distinct change of leaf form takes place is very large. In some species the amount of change, though evident, is not very great; in others the leaves of the mature or adult trees differ so much from those of the seedling that without previous knowledge we should not suspect any kinship between the two plants. Where the leaves of the seedling were stalkless or sessile and opposite we may find those of the adult tree long-stalked and attached alternately to the twig; where the seedling carried short and broad leaves we may find the adult tree carrying leaves that are long and narrow; where the veins in the leaves of the seedling were wide apart we may find those in the leaves of the adult tree near together. Quite frequently the juvenile and adult forms of leaf will be found on the same tree even after it is mature enough to bear fruit; and occasionally flowers and fruits will be seen on a twig that still carries juvenile leaves. A few species continue to produce the sessile opposite form of leaf throughout their lives, thereby, as is supposed by some authorities, representing the ancestral type of the genus. Sessile or stalkless leaves are nearly always found in opposite pairs; but there are one or two species in which they are alternately arranged.

LEAVES OF STUMP-SPROUTS.

Many trees have the capacity to produce leaf buds in two different ways. The ordinary way is to produce them in the axils of already developing leaves; but belonging to several genera are trees that, under special stimulus, can give birth to new buds from parts of the cambium tissue where there are no leaves. These latter are called adventitious buds. Certain elms and poplars, some wattles, and a good many other trees can form buds and throw up suckers along their lateral roots. Unless in very rare and exceptional cases, eucalypts never do this; but, like oaks, they are endowed with wonderful power to make new growth from any part of the stem or branches that may have been cut back or mutilated. The foliage borne by the sprouts that thus break out just below the cut or mutilation is at first and for some time closely similar to that of the seedling. It is a case of reversion to the seedling form caused in some way by the injury to the tree; and in the absence of seedlings young stump-sprouts will serve almost equally well for purposes of specific determination. Stump-sprouts are often called suckers, and their leaves sucker leaves.

Nature is much greater and much more complex than any human language. Hence science is constantly finding difficulty in expressing and recording its discoveries. J. H. Maiden and others call the leaves of seedlings and stump-sprouts "juvenile leaves" and the leaves of adult trees "mature leaves". R. T. Baker applies to the former the word "abnormal" and to the latter the word "normal". In both cases the language used may possibly be misunderstood; for in truth the leaves of a seedling or of a stump-sprout when fully grown are just as mature and just as normal as the leaves of any older tree. They are mature and normal for the plant in the juvenile stage of its life. It is nature's *norma* or rule for certain eucalypts that they shall produce leaves of one form when they are young or when they have been mutilated and leaves of another form when they are older and have not been mutilated. The truth will perhaps be expressed with least ambiguity if we simply write and speak of the two forms as (*a*) Juvenile leaves, including leaves of seedlings and stump-sprouts; and (*b*) Adult tree leaves, or leaves of the adult tree.

LEAVES OF SAPLINGS.

When our trees have passed the seedling stage but have not yet become fully mature we call them saplings. *Eucalyptus* saplings often exhibit both juvenile and adult characters. In favourable conditions they are usually very vigorous and carry leaves considerably larger than those of the adult tree. The colouring of their young foliage is often very rich and beautiful. Upon close scrutiny we shall find that in their hues and in the sheen of their leaves they show differences that may well be noted when we are endeavouring to ascertain their place among the species.

LEAVES OF THE ADULT TREE.

Adult tree leaves vary so greatly amongst the numerous species in size, shape, texture, thickness, and colouring that it is impossible to include them all in any one descriptive formula; but certain general statements may be made about them that will help us very much when we come to the definition of individual species. In all *Eucalyptus* leaves the intramarginal veins characteristic of the *Myrtaceae* are obviously present, and can be traced nearer to or more remote from the edges of the leaf. The oil glands that are the source of the strong odours emitted when the leaves are crushed or exposed to heat are also always present in larger or smaller numbers. The main lateral veins spring from the midrib at angles varying in the different species and terminate in the intramarginal vein.

In one great group of species the lateral veins go off at angles that are not very acute and form nearly parallel lines in the leaf somewhat like the lateral parts of a feather. Such leaves are sometimes spoken of as feather-veined. With this venation we often find a form of leaf in which the two sides are equal or nearly equal and the midrib approximately in alignment with the leaf-stem or petiole. The leaf in this case is balanced and presents its upper surface to the light, the under surface being shaded and consequently of paler green and less shiny. But we also find in this balanced-leaf group a very large percentage of leaves that are not equal-sided. We even find in it leaves that are strongly curved to one side. In these cases the leaf-blade maintains its balance by a compensating bend or twist in the petiole, and thus still presents its upper surface mainly to the light.

In another great group of species we find a more acute venation and associated with it a form of leaf in which the two sides are always very unequal. The stronger development of the leaf on the one side forces the midrib into a curve in the opposite direction and out of alignment with the petiole. The leaf-blade becomes falcate or scythe-shaped. Such a leaf is over-weighted on the arched or concave side and gradually falls into a vertical position with a half twist in the petiole. The two surfaces are equally exposed to the light, and as the result are of about the same shade of green.

Stated a little more technically, the meaning of the words *balanced* and *unbalanced* as applied to petiolate leaves is as follows:—(*a*) When a petiolate leaf is so formed that a straight line drawn centrally through its petiole and produced through its blade would cut the blade into two parts *equal in weight* the leaf is *balanced,* no matter what may otherwise be its shape. Such a leaf will dip less or more towards its free end, but will continue to present its upper surface mainly to the light. (*b*) When a petiolate leaf is so formed that a straight line drawn centrally through its petiole and produced through the blade would cut the blade into two parts *unequal in weight* the leaf is *unbalanced,* no matter what may otherwise be its shape. Such a leaf will not only dip less or more towards its free end, but will at the same time turn to an edgewise position and present its two surfaces about equally to the light.

DIVERSITY OF LEAF FORMS.

Eucalyptus leaves vary through such a wide range of forms that almost any statement about them must be taken with the understanding that there are exceptions. The position in which a leaf is held will be modified by the shape and strength of its stalk or petiole and by the habit of the branchlets whether drooping or horizontal. The petiole of the balanced leaf is comparatively rigid; that of the vertical leaf flexible. A few species have long-stalked poplar-like leaves that sway and turn with the slightest breeze. Others have sessile or very short-stalked leaves that can move only with the twigs upon which they grow. Others, again, have leaves so narrow that, though they may be nearly equal-sided, the under surface cannot be shaded to a distinctly paler green.

The hypothesis that the vertical or edgewise position of so many *Eucalyptus* leaves has been evolved by the necessity to economize moisture in a dry climate is interesting, but we must not hastily accept it as if it were ascertained truth. There are great areas in Australia and Tasmania where there is and probably always has been a generous annual rainfall; and as we have seen, there are a good many species whose leaves are not vertical. The immediate cause of the vertical position is the pull of gravitation upon the unbalanced leaf-blade. This is obvious from our knowledge of physical law. But if we ask what has caused so many species to produce unbalanced leaves, we raise a question the answer to which has still to be found. When Australian botanists have had time to pursue further their research upon this genus and its kindred genera over the whole range of their natural habitat, and when the palaeontologist has brought together larger numbers of ancestral fossil forms, the secret of the unbalanced leaf may become more clearly disclosed. This much is certain meantime that the eucalypts are what foresters call light demanders, and cannot reproduce themselves where the ground is heavily shaded. The distribution of their foliage in such manner that the light can pass through is therefore to their advantage by permitting seedlings to spring up and survive where otherwise reproduction would be impossible until the parent trees had fallen or died away.

(*d*) BUDS, FLOWERS, AND FRUITS.

BUDS AND FLOWERS.

Eucalyptus trees produce their floral organs in small clusters or umbels. The number of buds, flowers, or fruits in each umbel is in many species normally three, in others seven; but in the majority of cases it is indefinite. A few species have numbers up to twenty or thirty or even more. The common stalk or peduncle of the umbel may be any length up to an inch or more. The stalklets or pedicels of the several flowers are usually shorter than the common stalk. In some cases the flowers are quite without stalklets or sessile. As we have seen, the operculum or lid of the unopened floral bud, being always present and always undivided, serves as the distinguishing mark of the genus; by its shape and length it also helps us in separating one species from another. In some species it is hemispherical or like a dome; in others it is conical; in others, again, it is long and pointed like a horn. It may be round (terete) or angular, quite smooth or deeply ribbed or warty and rough. Its diameter may be anything from $\frac{1}{8}$ inch to $\frac{3}{4}$ inch or more. When the operculum is long the stamens may be found packed in a bundle without bending or folding, like wheat in a sheaf; when it is short, as in the great majority of cases, the stamens will usually be found bent inwards or inflexed.

BUDS. FLOWERS. FRUITS.

Eucalyptus flowers when expanded and mature present great differences; not only in size and structure, but also in colouring. Most of them are dull white or cream-coloured; some are scarlet, some crimson. Many of them by their abundant honey offer strong attraction to bees. It is, however, by their anthers or pollen organs that they afford their most important aid in the work of grouping. In a large number of species the two lobes or pollen thecae of the anther are divergent, and present with the connecting tissue a form very much like that of a kidney. They are spoken of as reniform or kidney-shaped. In another very large group the lobes are nearly or quite parallel. In the great majority of species the pollen escapes from the cells or sacs through longitudinal slits, but in a few through circular terminal pores. The anthers are large enough to be distinguished by the aid of a good pocket lens. The style and stigma also vary with the species and must be carefully observed.

FRUITS.

In the botanical sense a fruit is a seed-vessel containing fertilized seed. A *Eucalyptus* fruit may be considered as consisting of these three parts: (*a*) A woody outer case or cup with an opening or orifice at the calyx end; (*b*) within the woody case or cup the ovary in which the seeds were formed and fertilized; (*c*) the seeds. The ovary or seed-sac, which exactly fits into the outer woody case or cup, and becomes adherent to or a part of it, is divided into three, four, five, and sometimes six cells, and is furnished with a corresponding number of valves. While the valves remain closed they meet at their edges over the centre line of each cell, and so form a complete covering, which may be convex, flat, or concave. When the fruit becomes quite dry, either on the tree or separated from it, the valves contract at the edges and often rise at the points, thus permitting the closely packed seeds to escape from the cells. The covering over the seed cells formed by the valves while they remain closed and united is sometimes called a capsule; but this word is also sometimes applied to the seed-cup as a whole and is thus ambiguous. To avoid possible misunderstanding, it may be well to speak always of the valves as such, whether they remain still closed or have opened to release the seeds. If the valves when open are wholly below the rim of the seed-cup, they are said to be sunk or enclosed; if they project beyond it they are said to be exserted. *Eucalyptus* fruits differ very greatly in size, the smallest being as little as one-eighth of an inch, and the largest over two inches in diameter. They differ also in form, in external ornamentation, in the position of the valves, and in the percentage and aspect of their fertilized seeds. Students who have leisure and the use of a microscope will find a close comparative study of the seeds very helpful in specific determination and grouping.

Eucalyptus seed-vessels are often called "fruits" after they have shed their seed. This is by a figure of speech that applies to a part the name of the whole. Botanists know what is meant and are not subject to any risk of misapprehension. But we have also to consider general readers to whom the dual use of a technical word may become very perplexing. What we usually observe and describe in this connection is the external seed-vessel, and it seems fair to inquire whether a term may not be found that will be equally appropriate whether the vessel still contains its seed or is empty. A. J. McClatchie in *Eucalypts Cultivated in the United States* adopted the term "seed case". His meaning is clear enough, but the object suggested to the mind by the word "case" is not like anything that we see in nature. In external form *Eucalyptus* fruits are cup-shaped, goblet-shaped, or urn-shaped; from which it seems to follow that the most fitting term for denoting and describing the seed-vessel generally is "seed-cup". It is this term that will be used in the descriptions that are to follow; and if apology is needed for the innovation, it must be found in the statement that has been offered in explanation.

THE MEANING OF CAPSULE.

In general botany the word *capsule* is applied to various seed-vessels that dehisce or split open to permit the escape of the seed. In Eucalyptology it is restricted to the ovarian sac enclosed in the calyx tube and terminating above in the valves. In some rare cases(e.g. certain *Corymbosae*) this sac when quite dry may be separated from the tube. In the great majority of cases it is firmly adherent up to the valves. But in all cases it is organically distinct from the outer case or tube. In scientific accuracy it must be separately named, and the name that has been given to it is capsule. The use of this word for the whole seed-vessel obscures the distinction, is incorrect, and should everywhere be discouraged. The seed-vessel comprises the outer case or tube and the enclosed capsule. Seed-cup is just another term for seed-vessel, but a little more descriptive as applied to the eucalypts. For the meaning of *capsule* see *Critical Revision,* Vol. VI. pp. 584-586.

(*e*) TEXTURE AND COLOUR OF THE TIMBER.

When we make a cross cut through the stem of a timber tree and closely examine the section, we usually find that there are exhibited two kinds of wood—an outer cylinder next to the bark of paler colour and a central portion of darker colour. The one is called sapwood and the other heartwood. Very generally also it is possible to trace annual growth rings from the centre to the circumference. These distinctions are not always so clear in eucalypts as they are in conifers, but they can usually be made out. Sapwood or alburnum is wood in an immature state, and is often porous and open in texture. It may have a high value for certain technical purposes where it is to be used in dry situations, but it is usually very perishable when exposed to the weather or placed in contact with the ground. Heartwood or duramen is wood in a mature state, and may perhaps be more correctly called mature wood. It is stored material that has ceased to be a living part of the tree. It is usually more dense and much more durable in trying situations than sapwood. Estimates of the relative values of *Eucalyptus* timbers nearly always refer to the mature wood, and manifestly the value of a tree will rise with the percentage of sound mature wood in its whole bulk.

If we make a second cross cut through our log at a few feet from the first and proceed to split the separated portion, we may find it freely fissile or interlocked in texture and tough. It may be so interlocked that splitting is almost impossible. Tests under the saw and plane will show the texture or grain to the eye and explain why the log is fissile or otherwise. *Eucalyptus* timbers differ greatly in their colours as well as in their texture and density. In some groups of species there will be found various shades of red; in others the colours will be darker or lighter browns and greys. The red timbers are on the whole the more durable, but there are exceptions. It will rarely be possible for the forester or timber worker to determine a species quite positively by the wood alone; but the texture and colour of the wood will be valuable aids to determination when taken in connection with other characters of the tree, and should be noted whenever split or sawn specimens are available. For the scientific technologist the case is different. He has his laboratory and can make tests and comparisons that to the ordinary timber worker are impracticable. In his hands a piece of wood may declare the species to which the tree from which it was taken belonged. The work already mentioned entitled *The Hardwoods of Australia and Their Economics* by Richard T. Baker of the Sydney Technological Museum, 1919, is a splendid record of successful work in this department. It is ably written and superbly illustrated with plates showing the textures and colours of many *Eucalyptus* and other woods.

(*f*) OILS AND KINOS.

Eucalyptus trees had not long been discovered before it was realized that their leaves were in many cases richly charged with essential oils. In due time enterprising chemists set about extracting the oils from the more promising of the species then known, and putting them on the market. From these small experimental beginnings a great business has arisen, so that to-day *Eucalyptus* oils are known and valued all over the civilized world. In their constituent hydro-carbons these oils differ over a wide range, and can be placed in several distinct groups.

Messrs. Baker and Smith in their work *A Research on the Eucalypts and their Essential Oils,* 2nd Edition, under the question of evolution of the species, say that "The Genus may be considered as embracing four large groups which may be indicated, chemically, as follows:—

(*a*) Those yielding oils consisting largely of the terpene pinene; either dextro-rotatory or laevo-rotatory.

(*b*) Those yielding oils containing varying amounts of pinene and cineol, but in which phellandrene is absent.

(*c*) Those yielding oils in which aromadendral is a characteristic constituent, and phellandrene usually absent.

(*d*) Those yielding oils in which the terpene phellandrene is a pronounced constituent, with piperitone mostly present."

In a later section of the book the authors discuss the commercial applications of *Eucalyptus* oils under the following headings:—

(*a*) Pharmaceutical Purposes.—Here it is cineol or eucalyptol that forms the most valued constituent.

(*b*) Mineral Separation.—The most important agent here is the phellandrene-piperitone oil. It is used for the separation of metallic sulphides from the gangue by a process of flotation. The process, which is protected, was discovered at Broken Hill, New South Wales, by Mr. Henry Lavers, who is quoted as stating that less than a pound of the oil is sufficient to recover the values from a ton of ore.

(*c*) Perfumery Purposes.—Here the demand is for geraniol, citronellal, piperitone, and aromadendral.

(*d*) Other Uses.—Certain of the oils are used in manufacturing soaps, disinfectants, and solvents, with the prospect of an indefinite number of other uses.

The usually ruddy substance that exudes from the stems and large branches of many *Eucalyptus* trees is commonly called gum, and was responsible for the trees themselves being called gums; but it must not be confused with acacia gums or with the inflammable resins obtained from many conifers. It is a kino consisting largely of tannin and other substances. In medicine it serves as an astringent, and in the arts for various purposes. Some species exude large quantities of kino; others only a little; and some none at all. The copiousness of the exudation appears to depend to some extent upon local conditions of soil and climate. The presence or absence of kino should always be noted when we are studying a *Eucalyptus* tree in the bush.

By the aid of these determining factors botanists have made out and recorded about 400 species of this wonderful genus. The task has been difficult and slow; and as there is much unexplored country, many species may still remain to be discovered and described. Some species were easily separated from all others by their distinctive and peculiar characters; but groups were found with foliage and inflorescence so nearly alike that the greatest care was needed in coming to conclusions about them. Even when types had been settled there remained intermediate forms the right placing of which required the most patient and accurate research. Some of these intermediate forms are now regarded as hybrids and are so treated and discussed by J. H. Maiden in Volume VI. of his *Critical Revision.*

CLASSIFICATION.

One of the greatest aids to the acquisition of knowledge is classification or grouping. If the grouping is based on affinity or near kinship in the units and subgroups, and is therefore natural and orderly, we can compare one group with another. Judgment and memory are assisted, and progress in mastering the truths before us is rapid and permanent. Complaint has often been made that writers on the genus *Eucalyptus* have not been able to agree upon any scheme for classification of the species. The failure to agree has not been due to any lack of learning or industry on the part of the writers, but to the inherent difficulty of the subject. The genus is very ancient, and its ramifications are both highly evolved and widely distributed. Affinity is obvious in some cases, but bafflingly obscure in very many others. All the great writers have felt the need for classification, and each has wrestled with the problem in his own way. Bentham, with great ability and research, suggested a scheme based on the shape and mode of opening of the anthers. Mueller modified Bentham's scheme but did not adopt it. He himself outlined a scheme having regard to the texture and appearance of the external bark on mature trees, but he did not follow it in arranging his *Eucalyptographia.* One hundred species are there described in ten decades, and the species in each decade are arranged alphabetically. Messrs. Baker and Smith based a scheme on the chemical analysis of the essential oils; but they did not include all the species, nor did they make it appear certain that oil analysis would sufficiently agree with other tests of affinity to form a basis for complete grouping. J. H. Maiden, finding all proposed schemes incomplete and unsatisfactory, adopted in the earlier volumes of his *Critical Revision* and *Forest Flora* the expedient plan of describing each species as material for its illustration became available. In Vol. VI. of his *Critical Revision* he has with his usual great ability and thoroughness of research revised and restated Mueller's Cortical or bark scheme. The marshalling of data is very impressive and instructive. But Maiden was too great and too profoundly scientific to suggest that this difficult genus could be classified on any one set of characters. His research was wide, and aimed at a due inclusion of all factors in the problem. Germination of the seed, form and aspect of the plant in all stages of its life; bark and foliage; buds, flowers, and fruits; essential oils and kinos; texture and quality of the wood; geographical and climatic conditions of the natural habitat; and, lastly, the characteristics of related genera were all regarded by him as contributive to a knowledge of the affinities upon which alone a natural and permanent classification could be founded. For Maiden life ended while this great task was incomplete; but his surpassing industry has left the material by which others may advance.

A TASK FOR THE FUTURE.

The scheme for the publication of Maiden's *opera magna,* the *Critical Revision* and *Forest Flora,* was to issue each work in Parts and subsequently to bind up the Parts in sets of ten into indexed Volumes. The *Revision* is a technical work; the *Flora* more adapted to general readers. From both, science extends her generous hand to all who seek knowledge of the trees with which nature so richly endowed the Great Australia. For swift and easy reference to any one of the 400 species described in the *Critical Revision,* there was still needed a general index covering all the Parts and Volumes. The need has been met by a complete, briefly descriptive, and reference-numbered list in Section vii. of this book.

Early students of Australian botany wandered among trees that were neither named nor described. We of to-day see those trees in the shining light of successful research. They of to-morrow will discern in those trees origins and kinships that are still hidden from our eyes. From this growing knowledge there will gradually emerge for the Eucalypts a classification upon which nature herself will place the seal of approval.

SECTION II.

CLIMATIC ADAPTATION.

A complete grouping of the species on a basis of ascertained affinity still remains to be worked out; but we need not therefore be deterred from research in other directions. The question upon which the grower of the trees most pressingly needs guidance is climatic adaptation; for if he knows everything else about a species, but does not know its climatic range, he may easily waste his time and money in planting it. Nature has decreed that each species shall be at its best, or, as the scientific people say, at its optimum, in certain climatic conditions, and shall decline in vitality when and where those conditions greatly change or cease to exist. For one species the range may be very restricted, for another very far-reaching; but for all there are limits. And the general truth we have to accept is that a species of otherwise inferior merit at its best will often be more valuable than a species of otherwise superior merit at its worst. In transferring plants from their natural habitat to another country we need competent knowledge of the climatic conditions that prevail in the original habitat as well as of those that prevail in the country where the plants are to be cultivated as exotics.

CLIMATIC CONDITIONS IN AUSTRALIA AND TASMANIA.

The great continent of Australia and the island of Tasmania together present an immense range in latitude, in contour of the land, in mean annual temperature, and in maximum and minimum rainfall; and every geographical province in these countries has its eucalypts. Some of the species are restricted to tropical areas where a summer of continuous high temperature is followed by a frostless winter. Many are sub-tropical and have their home in regions where the contrast of conditions is between a torrid summer and a winter with mild frosts and cool breezes. Others grow to large dimensions where the summers are changeable and the winters cold. A few belong to the high mountains and may be found flourishing above the winter snowline. Many of the species require a moist, deep subsoil and a generous rainfall; others yield their most valuable crops on stony hills where moisture is less abundant; while there are some that can survive and grow to a useful size where the annual rainfall is less than 15 inches. Some of the well defined species have almost certainly been growing in successive generations for thousands of years where we now find them. Several species are found on both sides of Bass Strait, and have remained almost identical since Tasmania was separated from the mainland. Species common to Tasmania and the mainland, or to Victoria New South Wales and Queensland, find climatic compensation for themselves by growing nearer to sea level in southern parts of their habitat and at higher altitudes as they extend their range northwards. This, of course, is in accordance with a law of adaptation imposed generally upon plant life. But coincidently with this adjustment of altitude to latitude there has been operating for indefinite periods of time a process of accommodation to diverse conditions of temperature, the result of which may be that a species is now very sensitive to cold in one part of its habitat and strongly frost-resistant in another.

To understand the distribution of forest flora in Australia we must especially study the rainfall. The following figures based upon the normal rainfall values to the end of 1924 have been kindly supplied to the writer by H. A. Hunt, Commonwealth Meteorologist:—

Area of Tasmania and Australia = 2,974,581 square miles.

NORMAL RAINFALL VALUES TO END OF 1924.

Under 10 inches per annum	1,067,357	square miles
10 to 15 ,, ,, ,, ...	603,605	,, ,,
15 to 20 ,, ,, ,, ...	358,458	,, ,,
20 to 25 ,, ,, ,, ...	308,881	,, ,,
25 to 30 ,, ,, ,, ...	225,885	,, ,,
30 to 40 ,, ,, ,, ...	213,195	,, ,,
Over 40 ,, ,, ,, ...	197,200	,, ,,
	2,974,581	square miles

FOREST REGIONS OF AUSTRALIA.

In magnitude of the trees, and in density and purity of the forests the eucalypts attained their natural optimum in three climatically deliminated regions, as follows:—(1) Parts of Tasmania, mainly in the south and north-west; (2) An immense belt of country stretching from Bass Strait along the seaboard into South Australia and in the opposite direction over the eastern slopes and tablelands of Victoria, New South Wales, and Southern Queensland; (3) A similar but smaller region near the seaboard in south Western Australia. These regions all enjoy a reliable rainfall, the average amount of which varies according to locality from a little below 30 inches to 40, 50, and 60 inches per annum. Latitude and altitude together give these regions a range in mean annual temperature that may be stated in general terms as temperate to sub-tropical.

Stretching southward, westward to near the coast, and far into the north on the mainland is a vast interior region. Its rainfall, from being about 25 inches per annum on the average along its margins, diminishes to 20 inches, 15 inches, 10 inches, and less than 10 inches, as advance is made towards its climatic centre. All travellers agree that the wealth and persistency of vegetation over most of this region is wonderful. The eucalypts are wide-spread in adapted forms, appearing in the south as stemless but abundantly branched mallees, on the grass lands as thinly distributed small trees and shrubs, and along the water-courses as larger specimens with wide-spreading tops. Drought-resistant acacias and other small trees share the landscape with the eucalypts and in some parts wholly displace them.

In extreme contrast with this great central region, western Tasmania and parts of north-eastern Queensland have a rainfall of 80 to 100 inches. In cool Tasmania the result is a dense forest of beech (*Fagus*) with scattered taxads; in warm Queensland a tropical rain-forest in which flourish such genera as *Flindersia, Cedrela,* and *Castanospermum.* From the wetter and denser parts of these forests the eucalypts are partially or wholly excluded by their incapacity to regenerate on a heavily shaded forest floor.

The "Brush" and "Scrub" forests of the eastern mainland are intermediate in character. A typical "Brush" forest consists of closely mingled shrubs and small trees of many genera, with thinly scattered trees of larger dimensions rising above the general mass of vegetation. The Indian word for similar forests is "jungle". In Queensland, according to Maiden, the word "Scrub" is used in the jungle sense instead of "Brush"; while in New South Wales it is especially applied to the *Callitris* (cypress pine) and *Acacia* (wattle) thickets.

CLIMATIC CONDITIONS IN NEW ZEALAND.

Though relatively to Australia only a small country, New Zealand also presents great diversity in its physical and thermal conditions. It stretches from south to north nearly 1,000 miles, and each of its main Islands has plains, uplands, and lofty mountains. It thus has climatic conditions due to latitude and climatic conditions due to altitude and contour of the land. Like Tasmania, our South Island has a heavy rainfall on the west and a lighter rainfall on the east. Central Otago has less than 20 inches of rain per annum, but enjoys compensating advantages. Other parts of Otago and parts of Canterbury have a little less than 30 inches. But, speaking generally, we may say that in both Islands rainfall and soil moisture are ample for successful forestry. Coastlines where tree planting requires special knowledge and skill are extensive. Unlike Australia, New Zealand has no tropical region, and no great riverless area where vegetation has to adapt itself to very high summer temperatures and a very low average amount of moisture. We cannot expect ever to cultivate for economic purposes strictly tropical species from northern Australia. With dry country species our planting will for some years be experimental and limited. The very tender sub-tropical species will probably not flourish anywhere south of about latitude 38, and north of that only in sheltered and almost frostless areas. Hardy sub-tropical species will extend over the warm lowlands of the North Island, to northern areas in Marlborough and Nelson, and to a small extent to Banks Peninsula. Temperate country species will occupy our North Island uplands and will spread down into genial areas of Canterbury and Otago. Sub-alpine species will rise to higher altitudes in the north and extend their range to lowlands in the far south. For Westland with its heavy rainfall we must look to the species that flourish and give best results in western Tasmania or in well watered parts of Victoria.

WRONG DISTRIBUTION OF SPECIES.

In the past we have too often disregarded these climatic restrictions. Warm country trees have been planted in cold districts, and cold country trees in warm districts. In both cases we have subjected our trees to a struggle against uncongenial conditions. Depressed vitality or attacks by insect enemies have followed to disappoint us of the good results we hoped to realize. The amount of loss due to planting trees where the general climatic conditions are too mild for them is serious, as may be seen in the familiar case of *E. globulus* and the less familiar case of *E. Gunnii* when planted on the warm lowlands of the North Island; or amongst the conifers in the case of larch and spruce. But much the larger percentage of our losses with the eucalypts has been due to planting our selected species where they could not endure the ordinary or occasional degrees of cold. In Australia, as we have seen, the main restrictive factor for the large-growing eucalypts is rainfall; in New Zealand it is temperature.

EFFECTS OF LOW TEMPERATURE.

There are several ways in which eucalypts may be injured by low temperatures.

(*a*) An occasional heavy frost may cut back the growing tips of young trees without hurting the main mass of their foliage. The injury in such case will be slight and the trees will soon recover.

(*b*) Still severer cold may freeze the cambium tissue round the stems of the younger trees. The bark will then be forced away from the wood by the expansion of the frozen tissue. In a short time the trees will die back to the injured part; but the stumps will sprout again and throw up other stems that may survive and become large trees. In this case the dead stems should be cut away and the new sprouts reduced in each case to one or two of the strongest.

(*c*) If the temperature falls phenomenally low and remains low for a considerable time, tender species may be killed to the root and the area require to be replanted.

(*d*) The annual average warmth in a locality may be too low for a species. In this case the trees may live on for many years; but they will make no adequate growth. Instead of attaining normal girth and height they will remain mere stunted shrubs of dwarfy dimensions. The meaning of the evidence will be that the species must have a larger percentage of sunny days and a higher general average of warmth.

Many species that are exceedingly tender in the seedling and sapling stages become strongly frost-resistant after they have clothed their stems with a thick bark and lifted their heads high above the ground. On the other hand, seedlings of some sub-tropical species are reported to have endured 10° of frost in localities where the mean annual temperature is hopelessly too low for the successful cultivation of such species. Adult trees have sometimes been killed by frost; but in nearly all cases when eucalypts have passed the seedling and sapling stages and are growing vigorously they may be regarded as assured against even an extreme fall of the thermometer.

MODIFYING INFLUENCES.

It is impossible to state definitely and positively how many degrees of frost any particular species can endure, for the reason that many influences come in to modify the effect of a low temperature. It has been observed that within the same species individual trees and groups of trees may differ in hardiness. If we search for the cause of this difference, we shall almost certainly find it in the original geographical location of the parent trees in Australia. For, as already explained, a species with a far extended natural range may by long association have become adapted to mild conditions in one part of its habitat and to hard conditions in another part. Frost resistance is affected by the period of the year at which the low temperature occurs; for, as every farmer knows, a mild frost in summer may inflict more injury upon vegetation than a much more severe one in winter. In tree culture, moreover, we are entitled to count on the modifying influence of shelter. Trees help trees; and a judicious use of hardy species as protectors and nurses will often make the rearing of tender ones easy where otherwise it would be impossible. Even when the trees in a plantation are all of one species and all tender they will, if there are plenty of them, mutually befriend each other, and soften the effect of either a severe frost or a harsh wind.

The modifying influences just mentioned are all such as we can easily understand; but from time to time there come in other influences the nature of which will not be so obvious. When so many trees were seriously injured or killed right out by frost in Canterbury in 1899 and again in 1903, it was found that the eucalypts on the higher ground where they had been weakened by previous drought suffered very severely, while others of the same species along the rivers and water-races almost escaped injury. Whether vapour in the air along the water channels, movement of the air itself, percolation of warmer water about the roots, or the greater vitality of the trees made the difference, we do not know. The frosts were of phenomenal severity and trees of other genera besides *Eucalyptus* also suffered. Results were noted by competent observers in several localities; but no attempt appears to have made at the time to explain why nature favoured the trees that already enjoyed the advantage of being near water.

But though the frost-resistance of a species cannot be always stated in exclusive terms of the thermometer, there is an accumulating mass of experience to show that competent thermal records are indispensable for safe and profitable planting.

SALINE WINDS.

Next to a temperature above or below its capacity the worst enemy to a eucalypt in this country is a strong saline wind such as often blows from sea to land along our exposed coast lines. There are many species that simply cannot endure the full blast of such a wind. The effect upon the trees is similar to that of frost. They lose their tender growing foliage and die back. This happens repeatedly until the trees are either permanently dwarfed or killed to the root. Other species are moderately resistant, and when planted in wide belts or blocks can maintain fair vigour and growth in exposed situations. Strong sea winds are injurious to many other genera besides *Eucalyptus;* and generally the sea-side farmer will do well to protect his plantations with screens of the hardiest conifers. *Araucaria excelsa* (North Island only), *Cupressus macrocarpa, Pinus radiata* (*syn. P. insignis*), and *Pinus muricata* have proved themselves eminently suitable for such purposes. The very tender eucalypts may need protection at a distance of ten to fifteen miles from an open coast. Reasoning theoretically, we might suppose that species from inland districts of Australia would be the least able to endure our coastal conditions; but this is not uniformly the case, as we shall see when we come to describe and discuss the several species under trial in various parts of this country.

PRACTICAL APPLICATION OF RESEARCH.

If we rightly interpret the truths thus stated, we shall see that nature has herself worked out a great climatic distribution of the eucalypts, and that there is no appeal against her decree. The question for us therefore now is: How can we conform our practice to nature's law? We in New Zealand might draw parallel lines across the map and so divide each Island into zones; but in this case every zone would include several varieties of climate, and the scheme would be useless. We can and must cite as many localities as possible where the species we describe may be seen growing; but to name and delimit all suitable localities for each species would require many months of survey work and a large volume for records. A man highly experienced in plant culture will often be able to gauge the climatic conditions of a district from the aspect of existing vegetation; but the great majority of people do not possess that experience. However difficult the task may be, we must somehow construct a general key or formula that every man may apply to his own particular needs and circumstances.

If we define climate as the sum of those ever changing states due to solar radiation and to the earth's structure and magnetism, we must admit that only the scientific man with his instruments can wrestle with the problem as a whole. The farmer or tree planter cannot undertake so wide and difficult a task, but must look to those adaptations that will ensure success for his own particular enterprise. For the eucalypts a scheme is needed that will show plainly where any species is likely to grow, how it may be distinguished from other species, and what will be its value when raised to maturity.

The factors that determine the profitable range of a species are temperature, rainfall, soil, and the prevalence or otherwise of injurious winds. Of these four factors much the most important and yet the most elusive and difficult to assess is temperature.

In the scheme of grouping laid down in the next section of this book temperature in the dual and complex meaning of the word, is treated as the master-factor dominating all the species and assigning to each its place in the climatic scale. But at the same time there is devoted to each species a separate descriptive article in which information is given on the following points:—Natural habitat and requirements in respect to rainfall and soil; specific characteristics and appearance of the tree; rate of growth and ultimate size; texture, quality, and durability of the mature wood; and, lastly, the prospect for cultivating this particular species in New Zealand. Essential to the validity of any such scheme is a supply of seed from parent trees that have in the case of each species been correctly named and are of first rate vitality and form.

KNOWLEDGE OF SPECIES NECESSARY.

Cultivation of the eucalypts is greatly hindered by the inability of many growers to distinguish and name the trees in their plantations. Busy farmers and even men of leisure can rarely be persuaded to study and master scientific definitions. Very generally they do not possess the literature necessary for such a task. What is so simple and so interesting to the learned botanist is to them a privileged cult fenced round with technicalities. The difficulty is real but exaggerated. Science is simply discovered, systematized, and recorded truth. Its records must be exact, and they must be expressed in terms that will convey quite definite conceptions. Latin and Greek are eminently exact languages, and they have been freely drawn upon by all civilized peoples for scientific terms. What we may call the botanical tradition is to a very large extent recorded in such terms, and will be so handed on to posterity. But the findings of science may be, and sometimes must be, rendered into language that is more familiar and less technical. The descriptions that follow represent a well-considered endeavour to maintain the botanical tradition and at the same time to present the truth about the trees in language so plain and simple that any educated person may with little trouble understand and remember it.

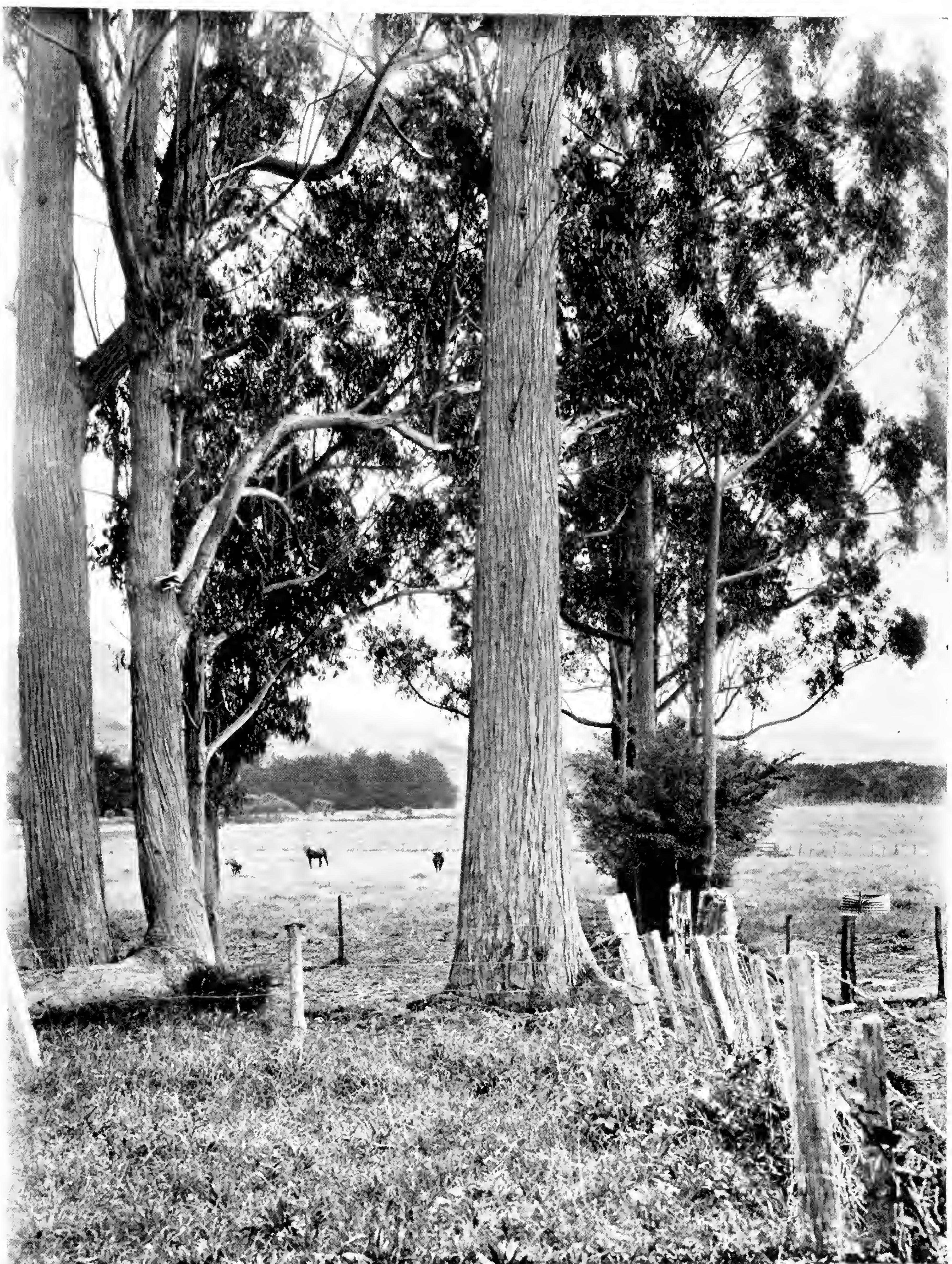
Technical words are interpreted by synonyms in the context or in the glossary. The distinctions made in this book between dead bark and living bark, between balanced leaves and unbalanced leaves, and between a fruit and a seed-vessel are fully explained in the general sections on bark, leaves, and fruits. Within the defined limits of a species the trees and all their parts vary indefinitely. The measurements and sizes given in the descriptions have usually been taken from medium specimens, and do not cover extreme forms either one way or the other. Where valuable species and species of inferior merit are under cultivation, as is the case very generally in New Zealand, it is necessary to describe them both, so that in future plantings the valuable may be propagated and the inferior avoided.

THE BOTANIC PLATES.

Each of the 70 species described in the letter-press is illustrated by a botanic plate correspondingly numbered. The plates are arranged in sets following the verbal descriptions to which they refer. Leaves, buds, flowers, and seed-vessels are depicted in natural sizes. Anthers are enlarged.

For making the drawings from which these illustrations have been produced, the writer was very fortunately able to secure the services of two artists who had worked under the late J. H. Maiden in preparing the plates for his *Critical Revision* and *Forest Flora*. The artists, Miss Margaret Flockton and Miss Ethel A. King, had access to the type specimens and other material in the National Herbarium, Sydney, as well as to Maiden's writings. In the difficult task of selecting the most suitable sprays for illustration, they were assisted by one of the Herbarium Botanists, Mr. W. F. Blakely. The drawings are of high merit, and have elicited unqualified praise from all to whom the writer has shown them.

The botanic plates for this book have been made from the drawings by experts at the Brett Printing Works, Auckland. The writer has pleasure in here recording his appreciation of the manner in which this work has been done. The figures appear throughout in faultless outline and good tone. With the letter-press descriptions and these illustrations for 70 species, there should soon be a great advance in specific knowledge of the eucalypts in this country.



Brett Staff Photo.

EUC. EUGENIOIDES.

CLEVEDON, AUCKLAND (S. F. SCOTT.)

A plantation of *E. eugenioides* and *E. pilularis* established here 63 years ago has yielded much valuable timber and given birth to numerous self-sown offspring. The principal tree in this group represents the original parents. It measures 10ft. in girth at breast height, and has an estimated content of 1,500 super. ft.

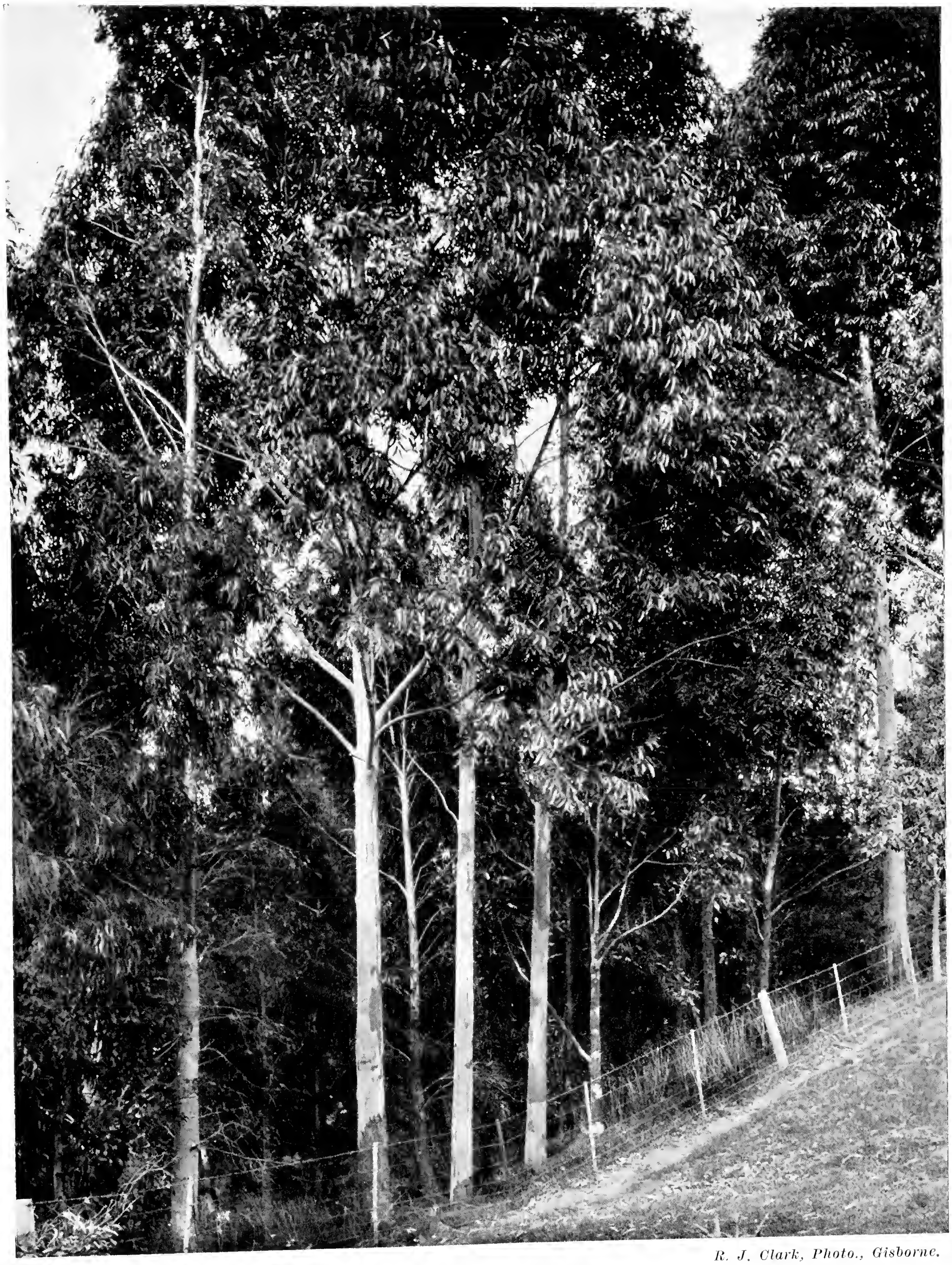
Brett Staff Photo.

EUC. PILULARIS, EUC. EUGENIOIDES, and other species.

AGE ABOUT 35 YEARS.

CLEVEDON, AUCKLAND (J. A. McPHERSON).

The transverse branches showing on the right belong to a *Pinus radiata* tree. Some of the eucalypts are now large enough for use as electric power poles, for splitting into fence posts, or for sawing into boards.



R. J. Clark, Photo., Gisborne.

EUC. SALIGNA.

Age 13 years; diameter 14 inches.

MURIWAI, GISBORNE (CLAUD H. WILLIAMS).

These splendid trees, representing one of the most valued of the species, have made over an inch in diameter growth per annum. Their foliage is exuberant, very beautiful, and perfectly immune from attack by insect enemy or disease.

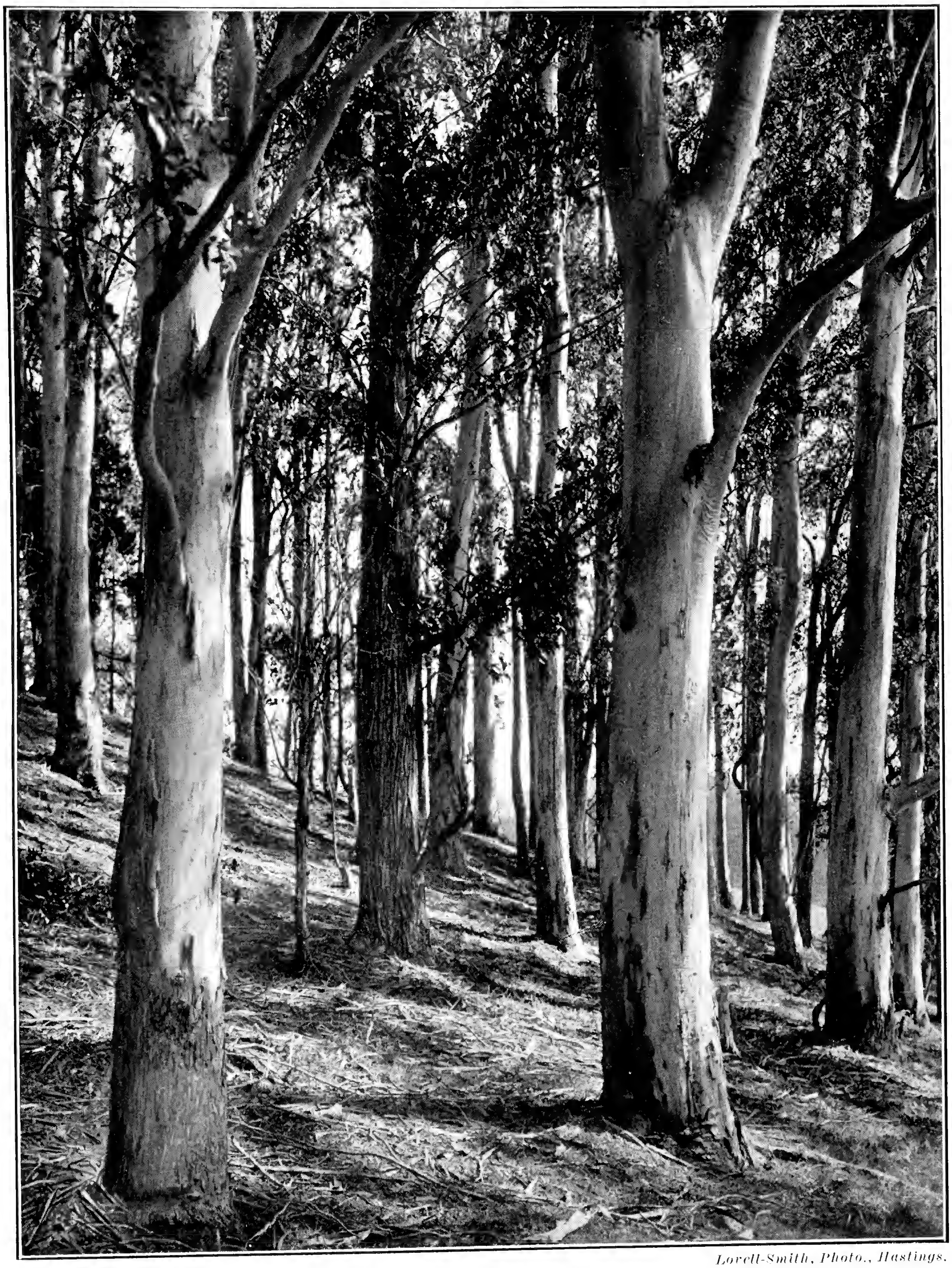
R. J. Clark, Photo., Gisborne.

EUC. BOTRYOIDES.

Age about 18 years.

MURIWAI, GISBORNE (CLAUD H. WILLIAMS).

The species mainly depicted in this group has here found a congenial home. Many specimens have made over an inch in diameter per annum, with corresponding growth in height. The foliage is abundant and faultless in condition. The splendid companion species, *E. saligna*, is giving equal promise in adjacent plantations.



Lovell-Smith, Photo., Hastings.

EUC. AMYGDALINA, EUC. RISDONI, and EUC. OBLIQUA.

Age about 40 years.

"TUNANUI," HASTINGS (SIR ANDREW RUSSELL).

Many of the poles in these plantations are now large enough to carry the heaviest power wires. *E. amygdalina* and *E. Risdoni* are long lasting in the ground.

Forest Service Photo.

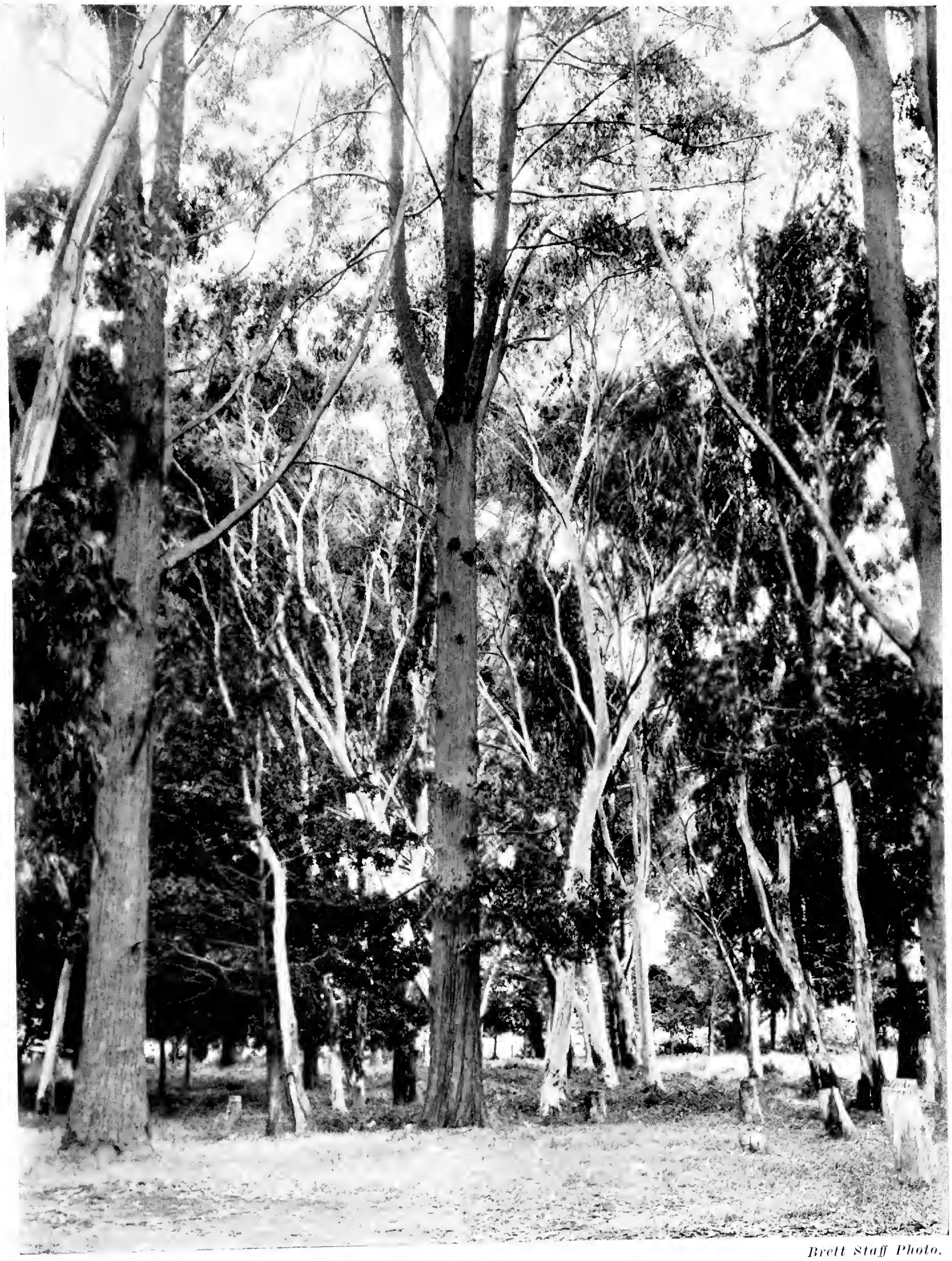
EUC. EUGENIOIDES with some other STRINGYBARKS.

Age about 33 years.

"OKUTI," LITTLE RIVER, CANTERBURY (DUDLEY RICHARDS).

These splendid pole trees, which cover several acres, were established by sowing the seed in spots prepared by grubbing.

RAILWAY RESERVE, PAPAKURA.

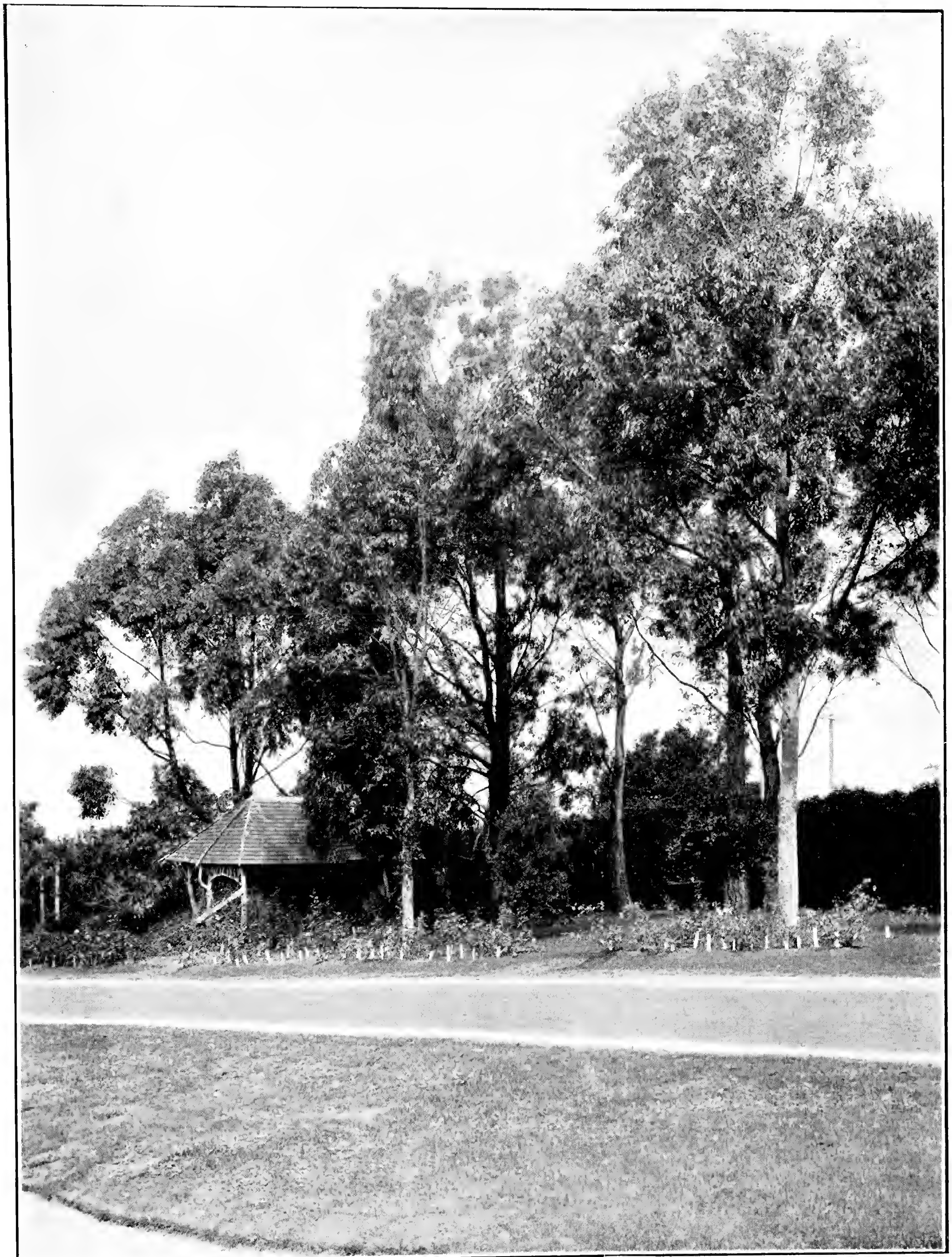


Brett Staff Photo.

EUC. FASTIGATA and EUC. CORIACEA.

Age 42 years.

The plate shows these two species in strong contrast, and speaks for itself as a warning against planting the comparatively worthless *E. coriacea* where such splendid trees as *E. fastigata* will flourish.



Brett Staff Photo.

PROMINENT TREES FROM RIGHT TO LEFT:

EUC. DIVERSICOLOR, EUC MACARTHURI, and EUC. BOTRYOIDES.

Age 15 years.

"NGARURU," EPSOM (SIR JAMES GUNSON).

The example is important as showing success with *E. diversicolor*.

SECTION III.

GROUPING AND DESCRIPTION OF SPECIES.

CLIMATIC GROUPING AND DETAILED DESCRIPTION OF SPECIES NOW GROWING IN NEW ZEALAND AND OF SOME OTHER SPECIES SUITABLE FOR INTRODUCTION.

Selected List of 70 Species.

EXPLANATORY NOTE.

The grouping here presented is based partly upon the natural distribution of the genus in Australia and Tasmania, partly upon experience gained with a large number of species in New Zealand, and partly upon results in the growing of *Eucalyptus* trees as reported from California, North and South Africa, and India. In respect to temperatures found acceptable to the several species, there are very few exact records. Careful inference has had to take the place of such records. In details the scheme is necessarily tentative. Further research and experiment may show where the range of temperatures might be restricted or extended, and where certain species might be more appropriately placed in other groups. But the scheme as it stands will serve as a general guide to the planter, and in careful hands will prevent the recurrence of costly errors in selecting and distributing eucalypts for cultivation in this country. The descriptive information is not in any way dependent upon the grouping.

GROUP I.

Species adapted to localities where frostless or almost frostless winters are followed by long hot summers. Estimated range in mean annual temperature for successful cultivation, 59° to 64° Fahrenheit and over. Probable limit of vigorous resistance to cold for seedlings and young saplings, between 28° and 33° F.

E. calophylla.	E. maculata.
E. citriodora.	E. marginata.
E. cornuta.	E. patens.
E. corymbosa.	E. propinqua.
E. gomphocephala.	E. tessellaris.

GROUP I. E. CALOPHYLLA. E. CITRIODORA.

1. E. CALOPHYLLA Robert Brown.

NATURAL HABITAT, DESCRIPTION, AND USES.

This species has its native home in south Western Australia, from about latitude 31 in the north to between 34 and 35 in the south. It is found scattered amongst other trees on low hilly country, not very remote from the sea, and appears at its best in sheltered localities where the soil is free and moisture assured. In good conditions the tree grows rapidly to a medium height and diameter, the foliage being abundant and beautiful. The dead bark persists on stem and large branches, and as the tree gains age becomes thick and rough. Leaves in the juvenile stage up to 6in. long by 4in. wide; often peltate, which means that the base of the leaf forms a united collar at the junction of the leaf stalk or petiole with the midrib, and gives the appearance of the stalk passing through the leaf into the midrib. The adult tree leaves are stalked, 5in. to 6in. long by 1½in. wide, featherveined, balanced, darker and shiny on the upper surface. Umbel with few flowers; stalk or peduncle ¾in. to 1in. long, stalklets or pedicels about ½in. long, lid of bud low and small; anthers with parallel openings. Ripe seed-cup (fruit) 1½in. deep by 1⅜in. wide, contracted towards orifice, which is without either groove or flange; valves deeply placed and wholly below rim; seeds very large and dark in colour. Mature wood pale to brown, strong, and reported to be durable in the ground.

CULTIVATION IN NEW ZEALAND.

E. calophylla has been frequently planted in New Zealand, but nearly always too far south or in otherwise unsuitable positions. It should be given competent trial in frostless localities on the East Coast or northward from Hauraki Gulf. Seed should be obtained through the Western Australia Forest Service.

The specific name is from the Greek *kalos* beautiful and *phullon* a leaf (pl. *phulla* foliage). It thus suggests that as seen by the botanist Robert Brown the tree was remarkable for the beauty of its foliage.

2. E. CITRIODORA Hooker.

NATURAL HABITAT, DESCRIPTION, AND USES.

This species has its natural habitat in eastern Queensland from just outside the tropic northward. Tree open and graceful in manner of growth, often large, with foliage so rich in lemon-scented essential oil that the odour may sometimes be detected at a considerable distance from the tree. The specific name was suggested by this odour. Dead bark non-fibrous; falls away from branches and stem, leaving a whitish nearly smooth surface. Juvenile leaves thickly studded with brown hairs; often peltate or with basal collar. Adult tree leaves up to 6in. long, rather narrow, thin, not shiny. Lid of bud low with small central projection; anthers with parallel openings. Ripe seed-cup (fruit) ⅜in. to nearly ½in. deep by ⅜in. wide, contracted towards orifice, valves deeply hidden below rim. Mature wood pale-grey to brown, easily worked, strong, durable.

CULTIVATION IN NEW ZEALAND.

This elegant and valuable tree is too sensitive to low temperatures for general planting in New Zealand. Its place will be in our northern arboreta. Specimens in the sapling stage have been noted by the writer in especially mild and protected situations near Marton, at Havelock North in Hawke's Bay, and on the Auckland Isthmus. It is scarcely likely that *E. citriodora* will ever be cultivated in New Zealand for its timber; but its elegant manner of growth and the exceedingly rich odour of its foliage entitle it to a favoured place in our northern gardens and parks. Queensland foresters who know the tree will be most competent to collect seed.

3. E. CORNUTA Labillardière.

NATURAL HABITAT, DESCRIPTION, AND USES.

In its native home, south Western Australia, a tree up to 80ft. in height. Dead bark persistent on lower part of stem and sometimes higher up the tree, rough, hard, sub-fibrous, dark in colour. Leaves in juvenile stage up to 4in. or more long by 3in. wide; adult tree leaves 4in. long and narrow. Umbel in the bud stage like a cluster of horns touching at their bases, the common stalk being about ¾in. long; lid or cap of each bud up to 1½in. long; specific name suggested by these horn-like buds; anthers with parallel openings. Ripe seed-cup (fruit) ⅜in. in diameter, usually 3-celled; valves long, protruding, often adherent (united) at their extremities after the seed has fallen out. MATURE WOOD similar in grain and colour to red ironbark, hard, heavy, interlocked, durable.

light yellow

CULTIVATION IN NEW ZEALAND.

E. cornuta has been planted in several localities in New Zealand, but nearly always too far south. Its place for successful experiment will be in our northern arboreta. The Western Australia Forest Service will be in a position to supply seed.

E. Lehmanni, which is under cultivation as an ornamental shrub in some New Zealand gardens, has an umbel similar to that of *E. cornuta,* but with all parts larger and the seed-cups more solidly compacted together. *E. macrandra* has similar buds, but short scarcely protruding valves.

4. E. CORYMBOSA Smith.

NATURAL HABITAT, DESCRIPTION, AND USES.

North-eastern New South Wales claims the honour of showing this species at its best. There, especially on the Clarence River, it is a very handsome and large tree. Southward it extends to Victoria and northward far into Queensland. It is often found on poor sandstone country, but does not anywhere ascend to a high elevation. The dead bark is persistent on stem and branches, characteristically scaly or flaky, thick and dark-coloured on older trees. The leaves in the juvenile stage are broad and already stalked; on the adult tree 5in. to 7in. long by ¾in. to 1in. or more wide, featherveined, balanced, dark green and shiny on upper surface. Umbel several-flowered; stalk (peduncle) ¾in. to 1in. long, stalklets (pedicels) ⅜in., lid of bud (operculum) small, dome-shaped; anthers with parallel openings. Ripe seed-cup (fruit) ¾in. deep by ½in. to ⅝in. wide; shaped like an urn with wide bulge in middle, narrow neck, and rim usually but not always recurved outward. Mature wood dark red, exceedingly resistant to decay in contact with the ground or in water; faulty for fine construction work on account of gum (kino) veins.

The specific name *corymbosa* refers to the habit of the tree in producing its flowers in compound clusters that are approximately even at the summit like a corymb. Used as a noun in the plural (corymbosae) it is now applied by botanists to a group of similar species including *E. ficifolia* and *E. calophylla*. By woodmen some of these species are called bloodwoods on account of the copious blood-coloured kino that exudes from their stems and large branches.

CULTIVATION IN NEW ZEALAND.

All the *corymbosae* are warm country species. In New Zealand their range will be restricted to those genial localities where the winters pass almost entirely without frost. One specimen of *E. corymbosa* has grown to a fair size and maintained good health on the Auckland Isthmus. Northward from that zone this beautiful species should do well in carefully selected areas. Success in experiment will be more certainly assured if steps be taken to obtain seed from vigorous trees in cool parts of the natural habitat, preferably in New South Wales.

5. E. GOMPHOCEPHALA A. P. de Candolle.

NATURAL HABITAT, DESCRIPTION, AND USES.

Native habitat on limestone country near sea coast in south Western Australia, latitude 32 to 33. Tree there grows to millable size. Dead bark persistent on stem and branches, sub-fibrous, matted, and even on surface. Juvenile and adult tree leaves both stalked or petiolate, the former broad and trowel-shaped, the latter narrower and up to 7in. long. Flowers four to seven in umbel set down quite close on a flat strap-like peduncle. Lid of bud domed or low conical, when mature exceeding in diameter rim of unripe seed-cup, and presenting an appearance like a button-mushroom or like a thick peg with large domed head; specific name suggested by th s peg-like appearance of the bud; anthers with longitudinal and nearly parallel openings. Ripe seed-cup up to ¾in. deep by ½in. to ⅝in. wide, bell-shaped; valves 3 or 4, protruding, claw-like. Mature wood pale-coloured, close-grained, interlocked, heavy, durable in any situation.

CULTIVATION IN NEW ZEALAND.

A species of such high merit should without further delay receive competent trial in this country; and, reasoning from natural habitat, would be most likely to succeed on limestone formation in a frostless seaboard situation, with some shelter from saline winds. Seed should be obtained through the Forest Service of Western Australia. Visitors to the One Tree Hill Domain, Auckland, may see a vigorous specimen of *E. gomphocephala* in a row of eucalypts growing on the southern boundary, near the Newmarket-Onehunga road.

GROUP I. E. MACULATA. E. MARGINATA.

6. E. MACULATA Hooker.

NATURAL HABITAT, DESCRIPTION, AND USES.

Species very abundant and at its best on low warm ridges in eastern New South Wales, less abundant in Queensland; only slightly represented in Victoria; prefers sedimentary formations, but avoids highly siliceous sandstone and slate; often associated with *E. paniculata* on poor soil. Tree when well grown tall and straight with heavy crown of somewhat rigid but beautiful foliage. Dead bark non-fibrous, curls off irregularly in patches leaving a surface that is spotted or blotched with darker and lighter shades. Specific name suggested by this spotted appearance of the bark. Leaves in the juvenile stage together with twigs hairy, very broad, often with united basal collar (peltate) at junction of stem or petiole with midrib; in the adult tree stage 5in. to 7in. long by 1in. or more wide, feather-veined, slightly darker and shiny on upper surface. Umbel normally with three flowers; stalk and stalklets usually short; lid of bud (operculum) at first double, the outer mantle soon falling away, the inner or corolline lid a smooth low dome with small central projection; anthers with parallel openings. Ripe seed-cup about ½in. deep and sometimes a little more in width, striped or grooved longitudinally, contracted towards orifice, which has a slightly recurved rim; valves usually 3, deeply placed and wholly concealed by rim. MATURE WOOD pale to dark oak-colour, fills a great place in timber supply, used for wide range of purposes, but not reliable in contact with the ground.

CULTIVATION IN NEW ZEALAND.

As an exotic in New Zealand *E. maculata* has been cut back by frost in the seedling and sapling stages as far north as Auckland; but has made promising and thrifty growth near Kamo in the Whangarei district. So valuable a tree should be given further competent trial in northern localities. Seed should be obtained through the Forest Service of New South Wales, with request to collect in areas where the trees are subject to low winter temperatures.

7. E. MARGINATA Smith. Jarrah

NATURAL HABITAT, DESCRIPTION, AND USES.

This species belongs to that fertile but somewhat exclusive tree region, south Western Australia, its natural range being latitude 31 to 35, within 10 to 50 miles of the sea. It is distributed mainly on hilly country, and yields its most durable timber where the ground is hard and rocky. The original forests, which extended from north to south 350 miles, contained large areas that were closely covered with trees over 100ft. high, and presenting in their tall straight boles an immense wealth of almost incomparable timber. The sawn product and boles have been distributed to many lands, and the forests are now described as very seriously depleted. The dead bark of *E. marginata* is fibrous and scaly and persists on stem and large branches. Leaves in the juvenile stage broad; those of the adult tree about 4in. long by 1½in. wide. Umbel with several flowers; stalk ⅝in. or more long, stalklets ¼in.; lid of bud long and pointed somewhat like that of *E. tereticornis;* anthers with divergent and connected openings. Ripe seed-cup up to ⅝in. deep and nearly as wide, 3-celled, contracted towards orifice and not recurved, rim narrow and plain; valves deeply placed, and when open still wholly below rim. MATURE WOOD deep red in colour, remarkably free from defects, easily worked, slow to burn, and exceedingly durable in either dry or wet situations.

CULTIVATION IN NEW ZEALAND.

E. marginata is in the first rank for quality and durability of timber, but in the second or third rank for rapidity of growth even in its own country. Planted as an exotic in New Zealand, it has rarely yet exceeded the dimensions of a shrub or small tree. The best specimens noted by the writer were in the railway reserve at Mount Albert, Auckland. These in 25 years had reached heights of about 30ft. and diameters of 12in. to 15in., while other species planted at the same time in the same reserve had reached heights of 80ft. to 100ft., and diameters of 2ft. to 2ft. 6in. The destruction of the plantation some years ago prevented further observations, except to note that the *E. marginata* stumps contained a good percentage of red heartwood. Further trials in warm northern localities may yield better results. Seed should be obtained through the Western Australia Forest Service.

The specific name *marginata* was suggested by a vein or thickening along the margin of the leaf, a character subsequently observed in some other species. The vernacular name jarrah belongs almost exclusively to this species.

A eucalypt somewhat similar to *E. marginata,* and found in southern parts of the same tree region, was some years ago described and named by Maiden as *E. Jacksoni.* It is a species that grows to large dimensions and yields a red coloured heartwood believed to be of very high merit for economic purposes. In view of the difficulty we have experienced in trying to acclimatize *E. marginata,* experimental attention might well be turned to *E. Jacksoni.* The Western Australia Forest Service will be able to supply seed from best selected trees.

8. E. PATENS Bentham.

NATURAL HABITAT, DESCRIPTION, AND USES.

Natural habitat in south Western Australia, on uplands not very remote from the sea, latitude 32 to 34. Trees reported to exceed 100ft. in height with corresponding diameter of bole. Dead bark of the woolly sub-fibrous type, persistent on stem and branches. Leaves in juvenile stage sessile, broad; those of adult tree 4in. to 8in. long by 1in. or more wide. Umbel with few flowers; stalk ½in., stalklets ⅛in.; lid of bud a low dome with slight central projection; anthers with nearly parallel openings. Ripe seed-cup in largest form up to ½in. deep by ⅝in. wide, but often smaller, contracted towards orifice and not recurved, rim plain and narrow; valves usually 4, wholly below rim. MATURE WOOD pale, too interlocked for easy splitting, but valuable when sawn into planks and scantling.

CULTIVATION IN NEW ZEALAND.

Reports from native home encourage trial in warm localities of North Island. Seed should be obtained through the Western Australia Forest Service.

GROUP I. E. PROPINQUA. E. TESSELLARIS.

9. E. PROPINQUA Deane and Maiden.

NATURAL HABITAT, DESCRIPTION, AND USES.

The natural home of this species is in eastern New South Wales north of the Hawkesbury River and in south-eastern Queensland. Within this genial region the trees grow to a large size and present long clean boles, even on dry sandstone country. *Propinqua* is Latin for near of kin, and has reference to the close similarity of this species to *E. punctata.* The dead bark is non-fibrous and falls away from branches and stem, leaving a patchy dull grey surface. The leaves in the juvenile stage are early stalked and broad lance-shaped; on the adult tree narrower lance-shaped; the lateral veins in both stages being nearly parallel and at rather wide angles to the midrib. The umbel may have as many as ten flowers; stalk ⅜in. to ½in., stalklets ⅛in. to 3/16in., stalk flattened; lid of bud a low cone with central point; anthers with parallel openings. Ripe seed-cup 3/16in. deep by 5/16in. in width or smaller, 3- or 4-celled, valves when open protruding. MATURE WOOD dark with tinge of red, dense, heavy, and said to be very lasting in contact with the ground.

CULTIVATION IN NEW ZEALAND.

So far as the writer is aware, *E. propinqua* has not yet been successfully introduced into New Zealand. Its high merits certainly commend it for trial in those northern localities where frosts are unknown or are very slight. Seed should be obtained from large trees of good form in a cool part of the natural habitat, such trees being competently named and certified.

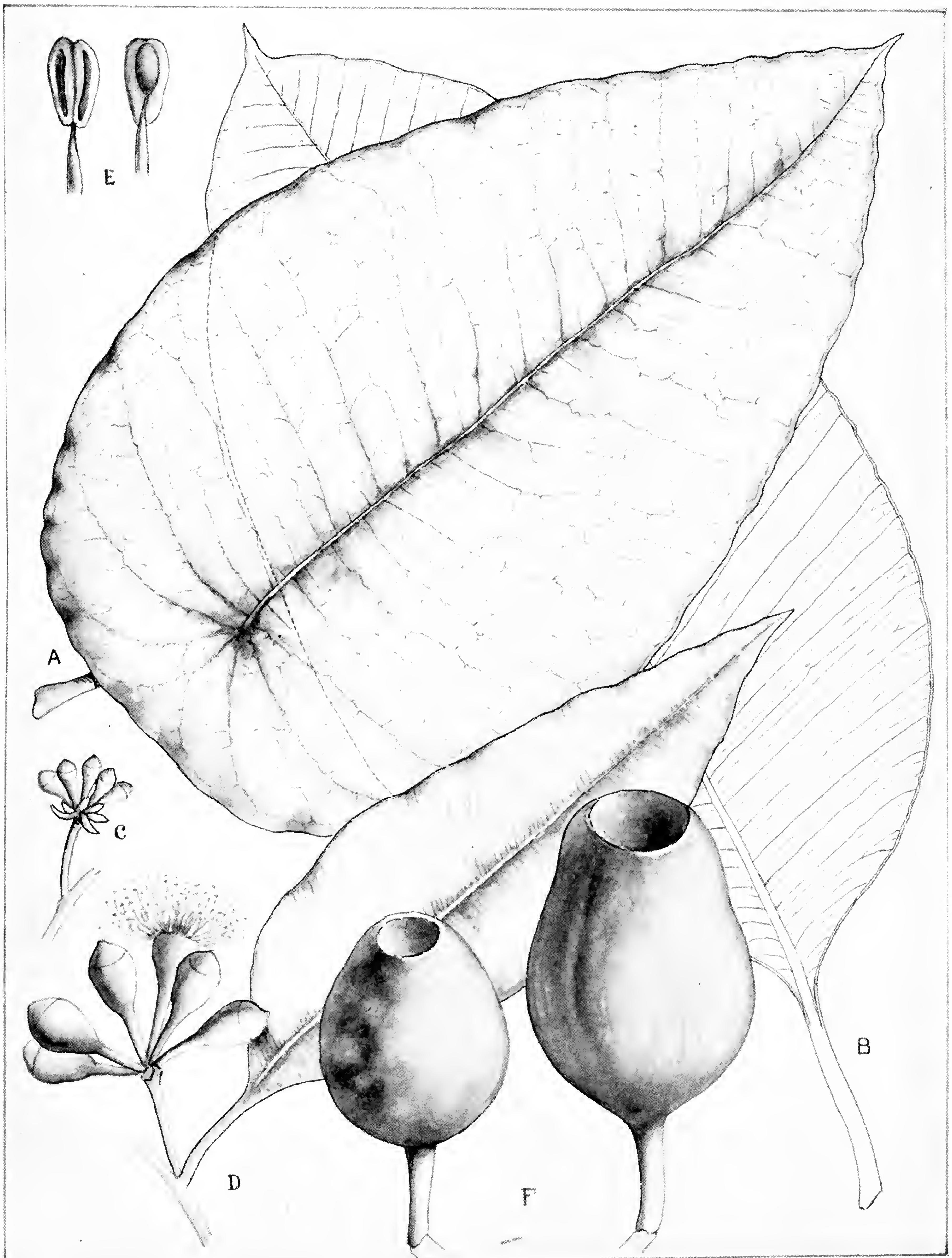
10. E. TESSELLARIS F. von Mueller.

NATURAL HABITAT, DESCRIPTION, AND USES.

E. tessellaris includes in its natural habitat the northern part of New South Wales and a great part of Queensland, extending in the latter State from near the seaboard to far inland. It is thus a species that has adapted itself to a wide range of climatic conditions. Tree medium in size with tendency to form a tall straight stem; foliage drooping. Dead bark deciduous from branches and upper part of stem; persistent on lower part of stem; there firm, and divided into small sections somewhat like a tessellated pavement; whence specific name. Leaves of adult tree featherveined, narrow, about 5in. long, thin. Umbels often in compound clusters or panicles; lid of bud low and small; anthers with parallel openings. Ripe seed-cup about ⅜in. long with thin wall and open orifice. MATURE WOOD pale to dark brown, tough, strong, used for many purposes.

CULTIVATION IN NEW ZEALAND.

For experiment with this species seed should be obtained from several parts of its natural habitat and preferably from inland areas where there are frosts in winter. Success most likely on warm lowlands north of Hauraki Gulf.

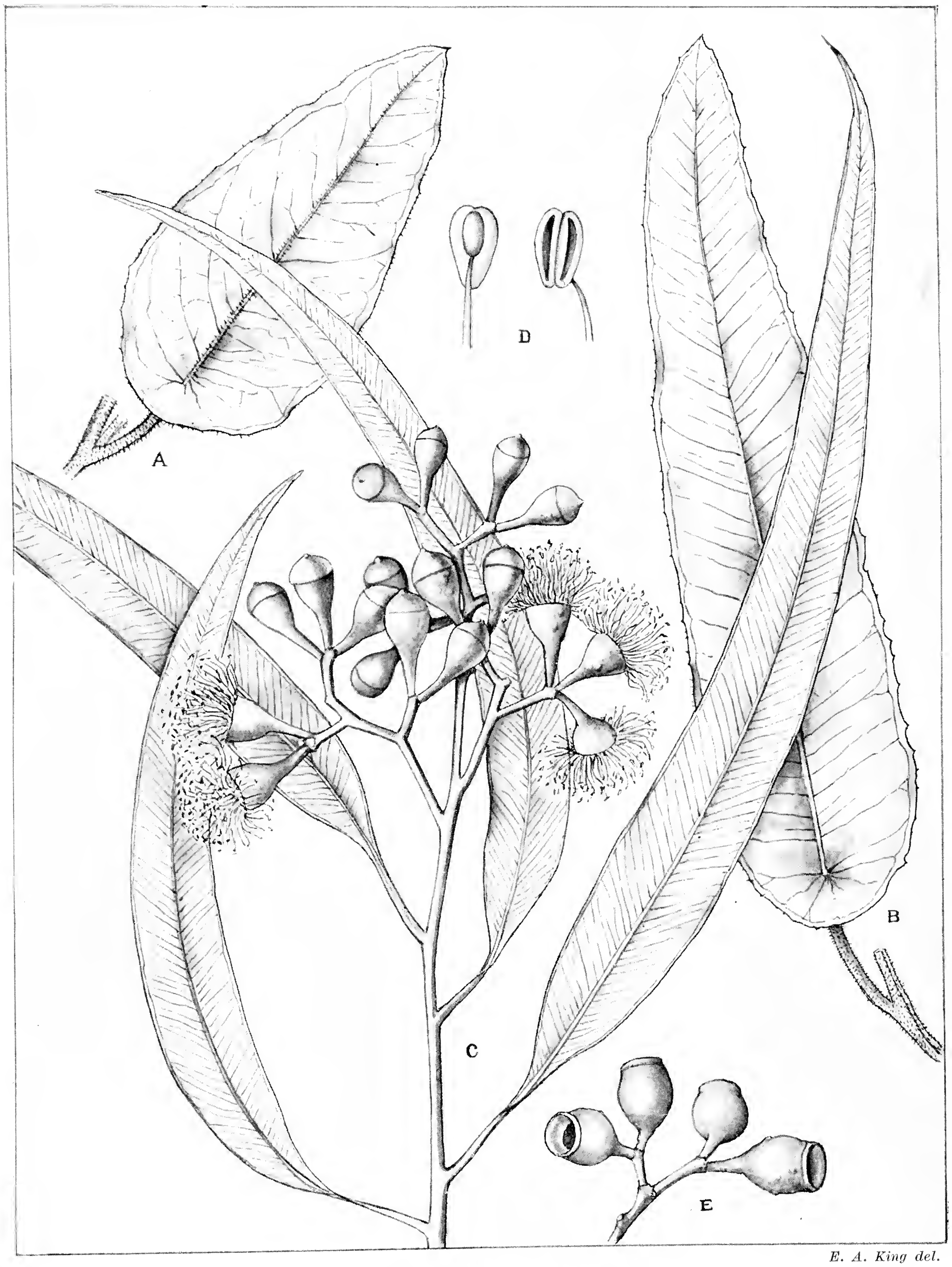


E. A. King del.

EUC. CALOPHYLLA.

EXPLANATION OF PLATE.

A. Peltate juvenile leaf. B. Intermediate leaf. C. Young buds, showing bracteoles. D. Twig with buds, flower, and leaf. E. Anther, front and back view. F. Seed-cups.

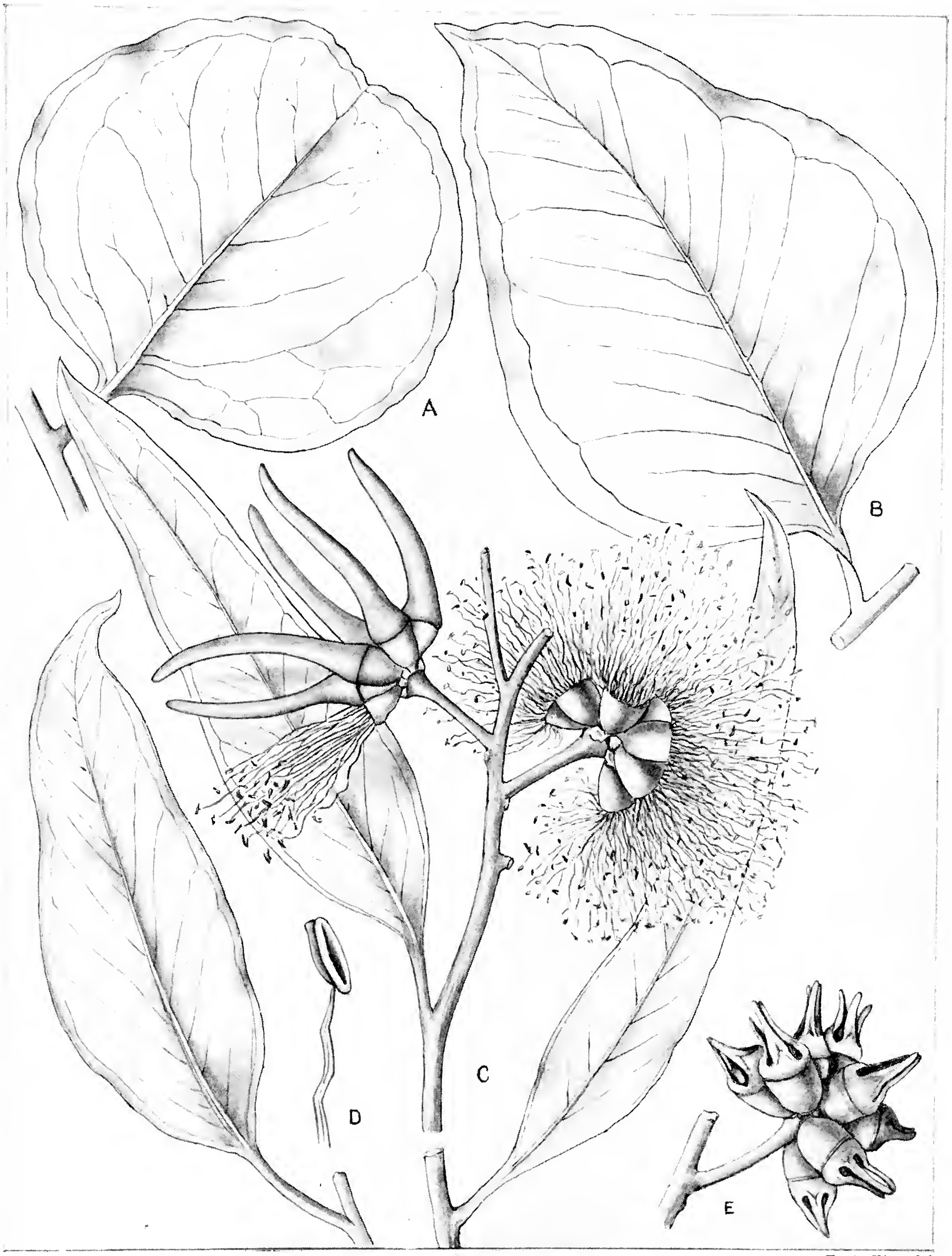


E. A. King del.

EUC. CITRIODORA.

EXPLANATION OF PLATE.

A. and B. Peltate juvenile leaves, stalks, and margins hairy. C. Twig with buds, flowers, and leaves. D. Anther, back and front view. E. Seed-cups.

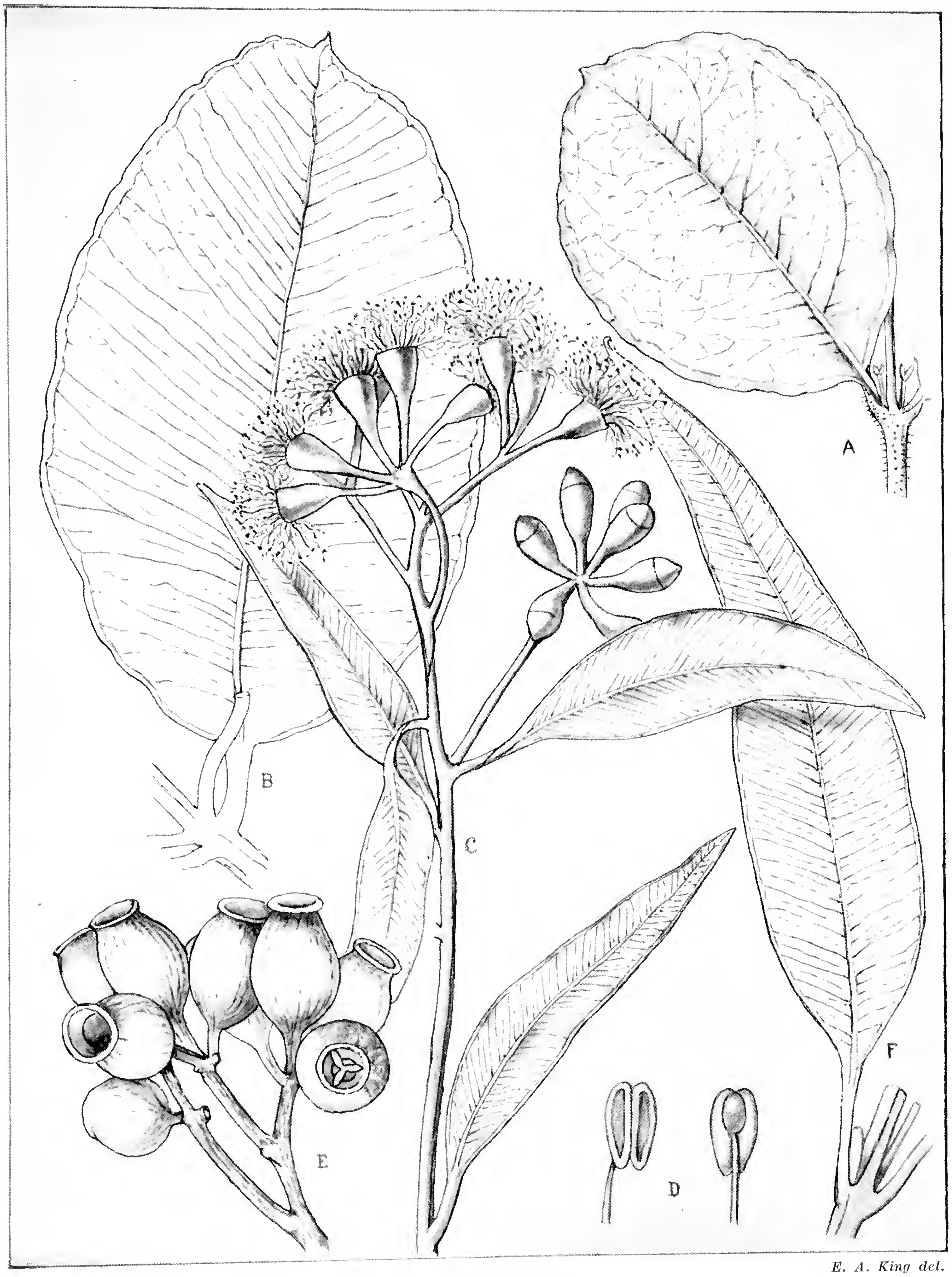


E. A. King del.

EUC. CORNUTA.

EXPLANATION OF PLATE.

A. and B. Juvenile leaves, both stalked or petiolate. C. Twig with buds, flowers, and adult leaves. D. Anther, side view. E. Umbel showing sessile seed-cups with protruding valves.

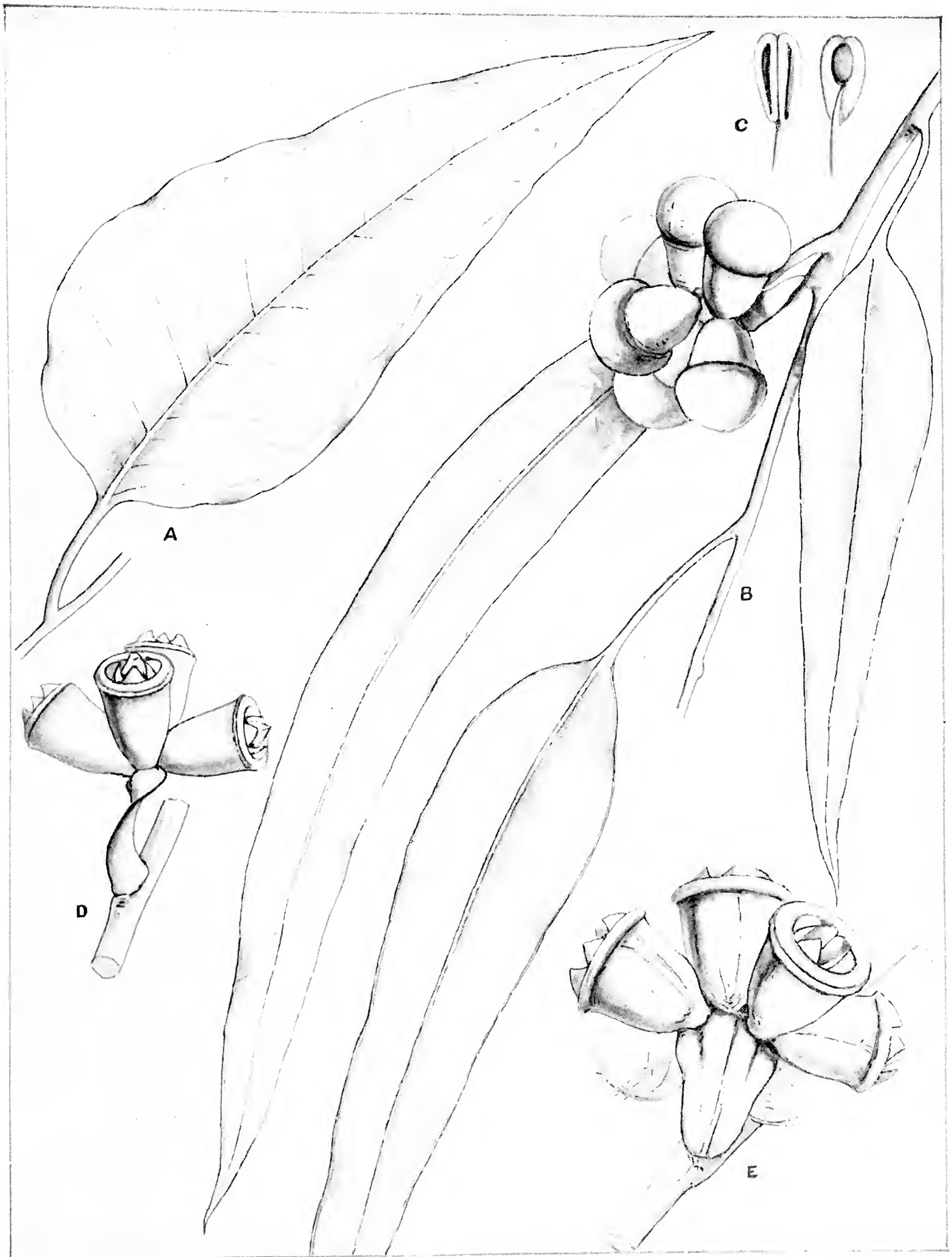


E. A. King del.

EUC. CORYMBOSA.

EXPLANATION OF PLATE.

A. Juvenile leaf with hairy petiole and twig. B. Juvenile leaf without hairs. (glabrous). C. Twig bearing buds, flowers, and small adult leaves. D. Anther, front and back view. E. Ripe seed-cups. Note urn-like shape. F. Adult leaf, still in opposite stage.



M. Flockton del.

EUC. GOMPHOCEPHALA.

EXPLANATION OF PLATE.

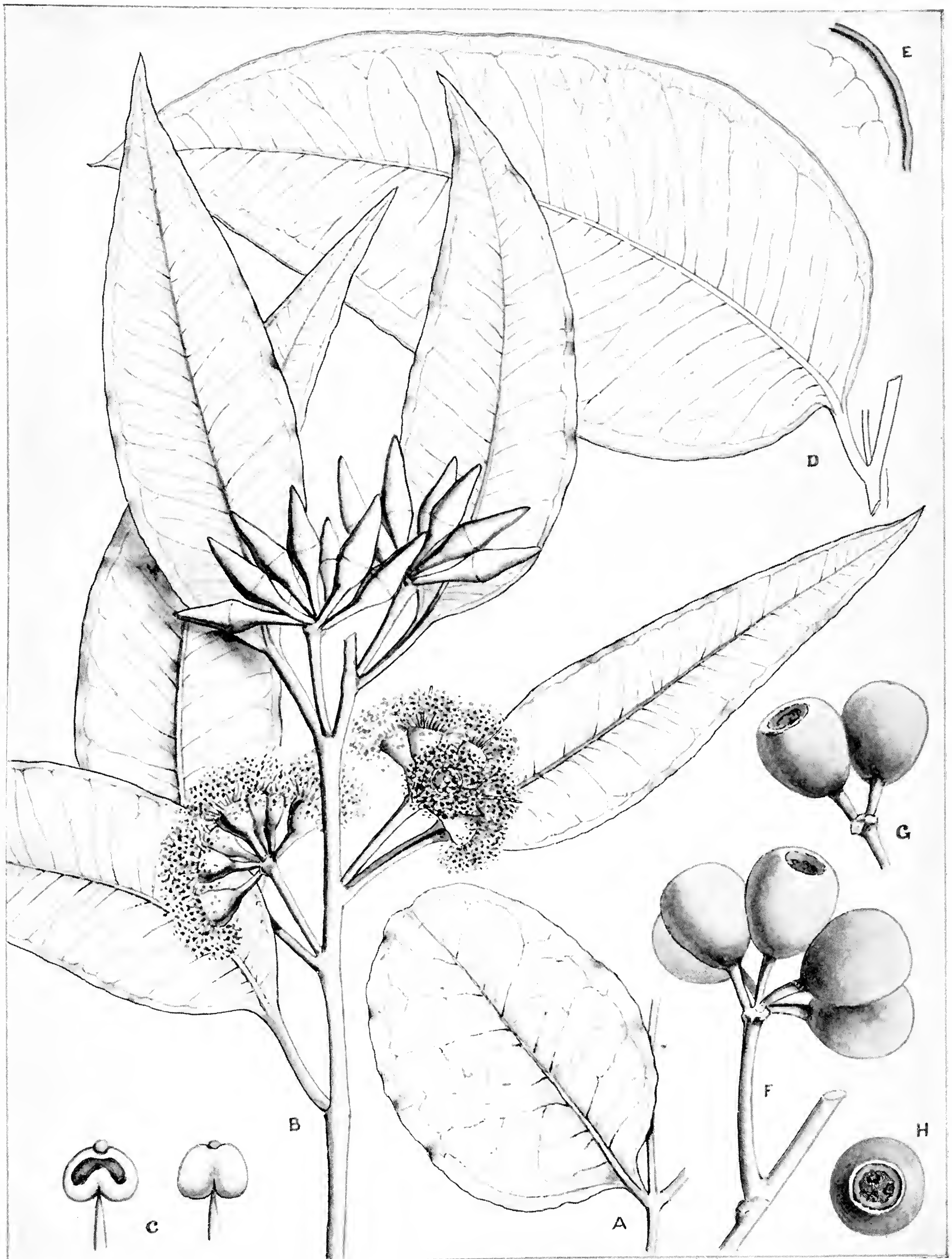
A. Juvenile leaf, stalked and trowel-shaped. B. Twig with buds and adult leaves.
C. Anther, front and back view. D. Small seed-cups. E. Larger seed-cups.

EUC. MACULATA.

EXPLANATION OF PLATE.

A. Peltate juvenile leaf; such leaves sometimes over 6in. long. B. Juvenile leaf showing advance towards sapling stage. C. Twig bearing buds, flowers, and adult leaves. D. Anther, front and back view. E. Ripe seed-cups with slightly recurved rims. F. Larger seed-cups with plainer rims. G. Narrow adult leaf.

Botanic Plate
No. 7.

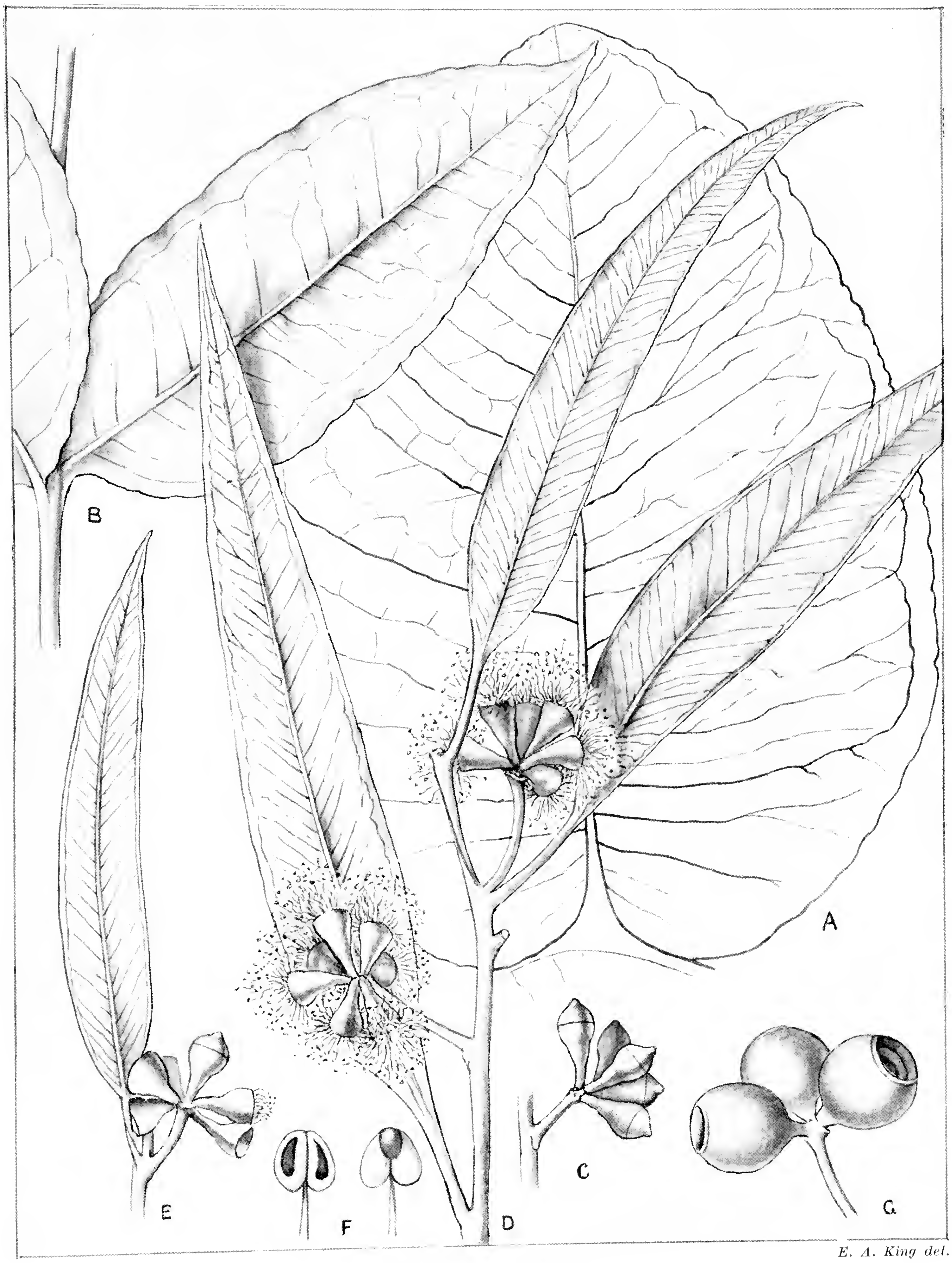


M. Flockton del.

EUC. MARGINATA. Jarrah

EXPLANATION OF PLATE.

A. Juvenile leaf. B. Twig with buds, flowers, and adult leaves. C. Anther, front and back view (enlarged). D. Unusually large leaf from flowering twig. E. Portion from edge of leaf showing thickened margin (magnified). F. and G. Seed-cups in mature state. H. Ripe seed-cup showing orifice.



EUC. PATENS.

EXPLANATION OF PLATE.

A. Large sessile juvenile leaf. B. Nearly sessile juvenile leaves. C. Buds. D. Twig with flowers and adult leaves. E. Drummond's type. F. Anther, front and back view. G. Ripe seed-cups.

M. Flockton del.

EUC. PROPINQUA.

EXPLANATION OF PLATE.

A. and B. Juvenile leaves. C. Twig with buds, flowers, and adult leaves. D. Larger buds. E. Anther, front and back view. F. Ripe seed-cups showing protruding valves. G. Somewhat larger seed-cups. H. Large adult leaf.

The seed-cups of E. propinqua are 3-celled (as here) or 4-celled.

E. A. King del.

EUC. TESSELLARIS.

EXPLANATION OF PLATE.

A. Juvenile leaves. B. Twig with buds, flowers, and adult leaves. C. Anther, front and back view. D. Shorter adult tree leaves. E. Ripe seed-cups.

GROUP II.

Species adapted to localities where slight frosts occur in winter; but where the spring is usually warm, the summer hot, and the autumn calm and sunny. Estimated range in mean annual temperature for successful cultivation, 57° to 62° F. and over. Probable limit of vigorous resistance to cold for seedlings and young saplings, between 24° and 30° F.

E. acmenioides.
E. cladocalyx. (syn. E. corynocalyx).
E. crebra.
E. Deanei.
E. diversicolor.
E. ficifolia.
E. grandis.
E. microcorys.
E. paniculata.
E. pilularis.
E. punctata.
E. resinifera.
E. robusta.
E. siderophloia.

11. E. ACMENIOIDES Schauer.

NATURAL HABITAT, DESCRIPTION, AND USES.

This species is indigenous to eastern Australia between latitude of Sydney and latitude of Rockhampton in Queensland. Tree of medium size and erect habit. Dead bark fibrous and flaky; much like that of a stringybark; persistent on stem and branches. Leaves in juvenile stage broad, sessile and stem clasping; in adult tree stage stalked, 4in. to 5in. long with acute apex, finely veined, thin, wavy or crenulate at margins, pale on under surface. Umbel with several flowers up to 7 or 8; stalk about ½in. long, stalklets ⅛in. to ¼in.; lid of bud short and contracted into rather sharp point; anthers kidney-shaped with divergent connected openings. Ripe seed-cup ¼in. deep and about the same in width, suddenly contracted into slender stalklet; 4-celled with valves in most specimens wholly below rim. MATURE WOOD pale-coloured, dense, heavy, of high value for technical work, very lasting in contact with the ground. Possessing these high merits, the timber of *E. acmenioides* comes into keen demand for the most trying uses to which wood can be applied. For fence posts, electric wire poles, and railway sleepers it is a close competitor with ironbark.

CULTIVATION IN NEW ZEALAND.

E. acmenioides is a warm country tree and must not be expected to flourish in our South Island or at high altitudes in the North Island. In the past we have treated it without regard to its climatic requirements. If, in the future, we will give it competent trial, we shall almost certainly establish it as a first grade timber-yielder in this country. Low sheltered ridges where the warm air rises from flats below and maintains an almost frostless temperature throughout the winter nights will offer best conditions for experiment. Seed should be obtained from best trees in cool parts of New South Wales. Fifty miles inland from the central coast line in New South Wales *E. acmenioides* is subject to frosts of considerable severity. With seed collected from best trees in such locality our prospect for success in cultivating the species in suitably selected North Island areas should be assured.

GROUP II. E. CLADOCALYX.

The botanist J. C. Schauer in calling this eucalypt *acmenioides* assumed similarity of its foliage to that of *Acmena floribunda,* a tree now more correctly known to science as *Eugenia Smithii.* Maiden compares the adult tree leaves to those of the peach. Either suggestion may help the student a little in his search for the species in our New Zealand plantations.

12. E. CLADOCALYX (syn. E. CORYNOCALYX) F. von Mueller.

NATURAL HABITAT, DESCRIPTION, AND USES.

Widely distributed in South Australia and Victoria, and there cultivated in the State forests. Tree of medium size producing mature wood early, and much valued for wire poles, fence posts, and railway sleepers. Dead bark non-fibrous, deciduous from branches and stem, surface of living bark dull white. Juvenile leaves already stalked, round or oval; those of adult tree about 5in. long with oily lustre on upper surface. Umbel with several flowers; stalk ½in. to ⅝in., stalklets ¼in.; bud long and narrow and crowned with low cap-like lid; anthers with parallel openings. Ripe seed-cup about ½in. deep by ⅜in. wide, contracted towards both orifice and pedicel, marked on surface with very distinct longitudinal lines; 3-celled with valves wholly below contracted rim. The specific name *corynocalyx* was suggested by the club-like shape of the buds and seed-cups. MATURE WOOD brown to dull yellow, very hard, durable in the ground, suitable for electric wire poles, railway sleepers, and fence posts.

CULTIVATION IN NEW ZEALAND.

E. cladocalyx can flourish where the summer temperature is high and the rainfall low, but it cannot endure many degrees of frost. Mention of a few localities where it has succeeded in New Zealand will be a guide to planters in the future. On a farm called "Fernglen" in North Wairarapa Sir Walter Buchanan in November, 1899, sowed about 9 acres of well prepared land with seed of this species obtained from South Australia. The result was a good take, and in twenty years' time nearly the whole of the area was covered with a dense stand of vigorous young trees in the pole-timber stage. The locality is near the sea, and the site of the plantation a little above the level of the adjacent land. In the winter nights the cold air falls to the lower levels, and leaves the trees with a temperature probably never below 28° F. The plantation is now a very valuable asset. Other vigorous specimens of *E. cladocalyx* in smaller numbers may be seen in similar nearly frostless localities in north Marlborough, at Havelock North, in the Auckland area, at "Puketiti" near Tokomaru Bay, and farther north near Kamo. Seed should be obtained from "Fernglen".

In Australia *E. cladocalyx* is essentially a dry country species, attaining its best away from the coast where the annual rainfall is as low as 20 inches. The rainfall at "Fernglen" is probably 36 inches, and this may be about the maximum permissible for the species in New Zealand.

GROUP II. E. CREBRA. E. DEANEI.

13. E. CREBRA F. von Mueller.

NATURAL HABITAT, DESCRIPTION, AND USES.

This species has its natural home in New South Wales from the lowlands westward over the Dividing Range, and in Queensland from south to far north. *Crebra* is the feminine of the Latin adjective *creber,* which means frequent or abundant, and was suggested by the distribution of the species in an immense number of localities. *E. crebra* is one of the true ironbarks and a yielder of first grade timber. Tree medium to large, branches often spreading, foliage drooping. Dead bark persistent far up the tree, deeply furrowed, very firm, ultimately dark in colour. Leaves in juvenile and adult stages not very different; on adult tree 4in. to 5in. long, narrow, same dull green on both surfaces. Umbel with indefinite number of flowers; lid of bud small and acute; anthers with parallel oval openings. Ripe seed-cup ⅛in. to 3/16in. in diameter; umbels often in compound clusters. MATURE WOOD rather dark with tinge of red, hard, strong, durable in any situation, much used for work in contact with the ground.

CULTIVATION IN NEW ZEALAND.

The extent to which this eminently valuable species can be successfully cultivated in New Zealand remains to be ascertained by competent experiment. A few thrifty young specimens are already growing in this country. They are all in localities where the climatic conditions are mild. So far as it goes, the evidence encourages further trials; but no experiment will be valid unless seed is obtained from certified and approved trees in a cool part of the natural habitat.

14. E. DEANEI Maiden.

NATURAL HABITAT, DESCRIPTION, AND USES.

The species has its natural home on the coastal tablelands and uplands of New South Wales and southern Queensland. In northern New South Wales the trees are very numerous and often of large dimensions. Some trees are short in the stem with a drooping and scrambling habit of the branches; others run up to a great height before they branch, and thus furnish long clean logs for the sawmills. Many specimens are very ornamental. The dead bark, which is non-fibrous, may persist for a few feet near the ground on old trees; otherwise it falls away from stem and branches. The newly exposed living bark has a silky sheen and is further remarkable for a colouring that is described as bluish, purplish, or sometimes brown. Leaves in the juvenile stage already stalked, round or oval with pointed apex, 2in. to 3in. in diameter, suggestive of pear tree or black poplar leaves; in the adult tree stage about 5in. long, nearly parallel-veined, balanced or with upper surface presented to the light and shiny, the under surface being dull. Umbel with indefinite number of flowers; stalk ⅜in. to ½in., stalklets ⅛in.; lid of bud low with small central projection; anthers with longitudinal and nearly parallel openings. Ripe seed-cup 3/16in. to ¼in. in depth and width, often 3-celled, tips of open valves a little above rim. MATURE WOOD red, easily worked, durable; similar to that of *E. saligna* and probably of equal merit.

GROUP II. E. DIVERSICOLOR.

CULTIVATION IN NEW ZEALAND.

It is probable that ***E. Deanei*** has been several times introduced into this country under the name of *E. saligna;* but we have nowhere yet given it separate trial under competently selected conditions. It merits better treatment. Our North Island lowlands and valleys offer many sheltered and well-watered areas where this valuable and beautiful tree would almost certainly find a congenial home and grow rapidly to large dimensions. Officers of the New South Wales Forest Service will be in a position to collect seed from large and well-formed trees where the species is at its natural optimum.

15. E. DIVERSICOLOR F. von Mueller. Karri

NATURAL HABITAT, DESCRIPTION, AND USES.

This species holds a distinguished place in the first rank of great timber-yielders. Its native home is a belt of fertile country in south Western Australia stretching from about latitude 34 south-eastward 150 miles and from near the seaboard inland. As seen by the first explorers and settlers it claimed for itself the almost exclusive occupation of large areas in that region. Its massive shaft-like stems rose far above the forest floor without a branch and supported a roof of almost continuous verdure. It is said that many of the trees reached 300ft. in total height. The student will wish to know how he may identify this wonderful tree. Its dead bark is non-fibrous and falls away from branches and from nearly the whole stem, the general aspect of the pillar-like boles being white. The leaves in the juvenile stage are round or oval and already stalked; on the adult tree 4in. to 5in. long by 1¼in to 1½in. wide, featherveined, usually balanced, deep green on the upper surface, pale beneath. Umbel with indefinite number of flowers; stalk ½in. to ¾in., stalklets ⅛in. or less; lid of bud a low smooth cone or dome, and bud as a whole with stalklet (pedicel) forming gradual taper to junction with stalk (peduncle); anthers with nearly parallel openings. Ripe seed-cup ⅜in. in depth and about the same width, on short thick pedicel, 3-celled; valves usually below rim. MATURE WOOD red, interlocked in grain, strong, of first quality for work in dry situations, as in buildings; not suitable for contact with the ground. Dealers in hardwoods should learn to distinguish the timber of *E. diversicolor* (karri) from that of *E. marginata* (jarrah). The fire test may suffice, a dry chip of *E. diversicolor* burning freely to a white ash, a dry chip of *E. marginata* burning less freely and leaving a charcoal remainder. The specific name was suggested by the difference in colour between the upper and lower surfaces of the leaf; but numerous other species show the same character.

CULTIVATION IN NEW ZEALAND.

E. diversicolor is doing well in a few North Island localities, but awaits more general and competent experiment. The conditions it appears to demand at our hands are good land, abundant moisture, efficient protection against violent winds, and a climatic area in which the temperature never falls much below freezing point. Granted these conditions, it will make thrifty growth and soon become a millable tree. Seed should be obtained through the Forest Service of Western Australia, or from a very large and vigorous specimen in the Patutahi Domain near Gisborne.

GROUP II. E. FICIFOLIA. E. GRANDIS.

16. E. FICIFOLIA F. von Mueller.

NATURAL HABITAT, DESCRIPTION, AND USES.

The familiar *E. ficifolia* of our parks and gardens comes from the same geographical region as *E. calophylla,* but from a more restricted area. In botanical details the two species are closely similar and have often been confused. When fully grown *E. calophylla* is a large forest tree; *E. ficifolia* still only a small tree usually under 30ft. high. Other points of difference are noted in the following comparison:—

E. calophylla.

Juvenile leaves: often peltate, wavy.
Flowers: normally white or cream-coloured.
Stalk and stalklets of umbel: medium in length.
Seeds: very large, without wing, nearly black.

E. ficifolia.

Juvenile leaves: rarely peltate, not so wavy.
Flowers: normally scarlet to orange.
Stalk and stalklets of umbel: very long.
Seeds: smaller, winged, pale-coloured.

A form believed to be a hybrid between the two species bears crimson to pink flowers, and is exceedingly ornamental. It is sold by nurserymen as *E. calophylla rosea.*

If difficulty is found in discriminating between the colours here mentioned, it will be helpful to remember that scarlet is a combination of red and orange and crimson a combination of red and blue. Tints vary indefinitely; but the two groups, scarlet-orange and crimson-pink, remain distinct. It may seem strange that the hybrid between *E. calophylla* and *E. ficifolia* should produce flowers of the crimson-pink type when there is usually no crimson in the flowers of either parent; but we are told on highest authority that blush pink or pale purple is by no means uncommon at the bases of the filaments of wild *E. calophylla* flowers. Other examples of bright colour in *Eucalyptus* flowers will be noted as the description of species proceeds.

CULTIVATION IN NEW ZEALAND.

Many beautiful specimens of *E. ficifolia* may be seen in sheltered gardens about Auckland and northward therefrom. Going southward from Auckland we still find it in especially genial localities as far as northern Canterbury. But it cannot endure severe and prolonged frosts.

17. E. GRANDIS (Hill) Maiden.

(E. SALIGNA, var PALLIDIVALVIS Baker and Smith.)

NATURAL HABITAT, DESCRIPTION, AND USES.

Natural distribution, from central coastal region of New South Wales into south-eastern Queensland. Optimum on alluvial flats with mild climatic conditions. Many trees are very large with tall mast-like stems. The dead bark falls away from branches and greater part of stem, leaving a dull white surface. The leaves in all stages are similar to those of *E. saligna,* but somewhat larger and coarser. Umbel with several flowers; stalk about ½in. long and flattened, stalklets very short or absent; lid of bud low with thick central projection; anthers with nearly parallel openings. Ripe seed-cup pear-shaped, about ¼in. deep and 5/16in. wide, 4-celled; valves pale-coloured or glaucous, claw-like and protruding when open. MATURE WOOD red, tough, light enough to float in water, suitable for any construction work, remarkably flexible; reputation for durability in contact with ground doubtful.

CULTIVATION IN NEW ZEALAND.

E. grandis was formerly regarded as a variety of *E. saligna,* and may have been planted in New Zealand under that name. It is recommended for trial on alluvial flats in warm northern localities. Seed should be obtained from certified and approved trees in New South Wales.

18. E. MICROCORYS F. von Mueller.

NATURAL HABITAT, DESCRIPTION, AND USES.

The native home of this species begins a little north of the Hawkesbury River, extends through north-eastern New South Wales, and thence into southern Queensland from near the seaboard to 30 miles or a little more inland; and rising as it extends northwards up to altitudes of 1,500ft. to 2,000ft. The tree attains its optimum where soil and subsoil are free and moist and is said frequently to reach heights from 100ft. to 200ft. and diameters from 3ft. to 4ft., exceptional specimens being very much larger. The dead bark is sub-fibrous, persistent on stem and branches, and ultimately thick and rough. Adult trees exude a brown to olive-green kino. In the juvenile stage the leaves are oval to broad-lance-shaped and already stalked; on the adult tree 3in. to 5in. long and about 1in. in width, thin, widely veined, slightly wavy, and paler on the under surface. Taken as a whole the foliage of *E. microcorys* has a very distinct aspect. The leaves on saplings and adult trees have a tendency to spread from the twig in two more or less regular ranks, one on either side. Very generally they are balanced and present their upper surfaces fully to the light. Carefully noted, this habit of the foliage becomes a great help in determining the species. Umbel with indefinite number of flowers up to 8 or 9; stalk about ½in., stalklets ¼in.; lid of bud very small, and bud as a whole gradually tapering into stalklet; anthers kidney-shaped with divergent openings. Ripe seed-cup 3/16in. to ¼in. wide, contracted a little at orifice, and like the unripe cup running down with gradual taper into the stalklet; open valves slightly protruding. MATURE WOOD yellowish-brown with tinge of pink in some samples, not freely fissile but easily worked with saw and plane; when dressed presenting a smooth greasy surface; in first grade for all heavy construction work, and very lasting in the ground. It is the well-known tallow-wood of the timber trade, and ranks in quality and durability with ironbark and redgum. So valuable is the timber that millable trees are keenly hunted in every accessible locality. The specific name means "little helmet" and was suggested by the lid of the bud, which is low and small.

GROUP II. E. PANICULATA.

CULTIVATION IN NEW ZEALAND.

Specimens of *E. microcorys* on the Auckland Isthmus are perfectly healthy and have grown at the rate of 3ft. in height and ½in. in diameter per annum. Other vigorous specimens may be seen 30 miles south of Auckland. The species merits competent and persistent experiment on the lowlands and in the lower valleys of the North Island, and for this purpose seed should be obtained from cold upland parts of the natural habitat. Officers of the New South Wales Forest Service should be competent to select best trees in suitable localities.

19. E. PANICULATA Smith.

NATURAL HABITAT, DESCRIPTION, AND USES.

This species belongs to that exceedingly valuable group known as Ironbarks. It is regarded by some authorities as the best of them. Its native home is along the coastal strip of New South Wales and thence into southern Queensland. It is thus restricted to a region where the temperature never falls very low and where the rainfall is generous. Within these general boundaries it finds its most congenial local conditions on low stony ridges. The trees are small to medium in size, only rarely exceeding 80ft. in height and 2ft. in stem diameter. The dead bark is non-fibrous, hard, furrowed longitudinally, pale to darker grey, persistent on stem and large branches. The juvenile and adult tree leaves are so nearly alike that one description will serve for both. They are more or less broadly lance-shaped, up to 5in. long, wavy, finely veined, mostly balanced, paler on the under-surface. Umbel with flowers up to 7 or 8; stalk compressed ¾in. long, stalklets angular ¼in.; lid of bud low-conical; anthers with terminal openings. Ripe seed-cup from 3/16in. to 5/16in. in depth and width, 4- to 5-celled, rim narrow, open valves with tips just below or a little above rim. The umbels often appear in compound clusters or panicles at the ends of the twigs, which character, though shared by several other eucalypts, suggested to the botanist, J. E. Smith, the specific name *paniculata*. The Mature wood of this species is pale in colour, and is known in the timber trade as grey ironbark. It is dense and horn-like in texture, remarkably free from defects of every kind, exceedingly strong, and in the very first rank of timbers for resistance to decay in the most trying situations. Railway sleepers and electric wire poles from mature trees of *E. paniculata* will easily claim maximum durability. The species, as we have seen, is sub-tropical, and cannot be expected to make profitable growth where the thermometer falls much below freezing point. (See E. paniculata, page 85.)

CULTIVATION IN NEW ZEALAND.

Experiments made with *E. paniculata* on lowlands of the Auckland Province are encouraging, and should be followed by further planting in numerous warm and almost frostless localities of the North. Seed should be obtained from competently certified and approved trees in New South Wales.

GROUP II. E. PILULARIS.

20. E. PILULARIS Smith.

NATURAL HABITAT, DESCRIPTION, AND USES.

The species has its natural home between the sea coast and the Dividing Range in New South Wales and Queensland. In an open situation the tree may become forked and branchy, but when surrounded by other trees of equal growth its stem will be free from branches and straight to a great height. The dead bark persists on the stem or lower part of the stem, and is there somewhat fibrous, like that of a stringybark. The juvenile or seedling leaves are lance-shaped, sessile, opposite, and often tinged with a very rich purple colour; those of the adult tree are stalked or petiolate, graceful-lance-shaped, sometimes curved to one side and occasionally wavy, deep green on the upper surface and paler beneath; the lateral veins are numerous but not regularly parallel; the intra-marginal vein is distinctly removed from the edge of the leaf. The umbel has a flattened stalk with six to ten flowers on short stalklets. The lid of the bud is conical or pointed, and stands within the rim of the calyx-tube like an egg in egg-cup. The ripe seed-cup is about $\frac{3}{8}$in. deep and a little more in width, and shaped like a nearly round bird's egg with one-third cut away; the rim is either flat or convex, and the points of the valves when open are below or slightly above it. The fruits are too large to be described as pilular. and it is possible that the specific name was originally given to a species with small pilular fruits, and then transferred in error.

In their native habitat, the trees now known to botany under the name of *E. pilularis* have often attained an immense height and diameter. Their MATURE WOOD is pale to brown in colour, excellent for either splitting or sawing, very durable in any situation, and especially suitable for fencing posts and wire-carrying poles; but of course the trees must be mature. If intended for electric wire poles, this species, like other large growers, must be planted and matured in close stands to prevent excess in diameter growth.

CULTIVATION IN NEW ZEALAND.

The seedlings of *E. pilularis* are very sensitive to frost, and do not easily bear transplantation. Where practicable the seed should be sown in October or November on perfectly clean and well cultivated land where the trees are to grow. A light sprinkling of Italian rye-grass will help to protect the young plants in the following winter; but any dense mass of either weeds or grass will almost certainly suppress and kill them. The species was introduced into New Zealand over 60 years ago, and is now represented by vigorous trees in many warm northern situations. Specimens of millable size have been noted by the writer in two Hawke's Bay localities and in three separate plantations near Papakura, a little south of Auckland. Seed should be obtained either from best acclimatized trees or from certified and approved trees in cool parts of the natural habitat.

In a personal note to the writer Mr. Maiden speaks of *E. pilularis* in the following words of high commendation:—"This is one of the most ready species to reafforest. In eastern New South Wales we have a marvellous number of little and big pure forests of this species, obtained by simply cutting out the mature trees and then fencing the area. The ready growth and straightness are wonderful. You do well to emphasise the value of this certainly exceptional forest tree."

GROUP II. E. PUNCTATA. E. RESINIFERA.

21. E. PUNCTATA A. P. de Candolle.

NATURAL HABITAT, DESCRIPTION, AND USES.

This species has its natural habitat in New South Wales and Queensland at low altitudes. The tree when grown in an open situation carries a spreading mass of branches and foliage, but will develop a long straight bole when closely surrounded by other trees. The dead bark is non-fibrous and falls away in sheets or large scales, the newly exposed patches being paler in shade, and the general aspect of stem and large branches dull mottled grey. The species is one of those whose leaves do not very greatly change in form. In the adult tree stage they are on long stalks, lance-shaped with slight curve to one side, dark green and shiny on the upper surface, and paler beneath; their lateral veins being numerous, parallel, and forming with the midrib angles of over 45°. The umbel has a broad flattened stalk with four to ten flowers on short flattened stalklets. The lid of the bud is conical and has the appearance of fitting exactly into the calyx-tube (unripe seed-cup); anthers with longitudinal and nearly parallel openings. The ripe seed-cup has the shape of half or two-thirds of an egg, with depth about 5/16in. and lateral diameter up to ⅜in.; rim flat or convex; open valves usually protruding and sometimes claw-like.

The MATURE WOOD is red or pale reddish-brown, dense in texture, and heavy. Its reputation for durability in the ground is good. Owing to its interlocked texture, large logs require sawing machinery. For farm purposes and for wire poles, the trees should therefore be matured in close plantations to keep the diameters within convenient pole sizes.

CULTIVATION IN NEW ZEALAND.

The species has not yet been systematically tested in New Zealand; but sufficient vigorous specimens have been noted to show that it could be successfully cultivated in warm and sheltered lowlands of the North Island. A few specimens planted in a sheltered situation off Hobson Bay, Auckland, fifty to sixty years ago are now very large and still flourishing trees. Seed could be obtained from these trees, or from certified specimens of good size and form in New South Wales.

22. E. RESINIFERA Smith.

NATURAL HABITAT, DESCRIPTION, AND USES.

This species has its native home in eastern Australia between the seaboard and mountains from about latitude 35 far into Queensland, and is thus adapted to hot summers, mild winters, and a generous rainfall. Tree an erect grower and said to attain large dimensions. Dead bark of flaky fibrous type; persistent on stem and large branches. Leaves stalked from early seedling stage, featherveined, balanced, pale and dull on under surface. Umbel with several flowers; stalk flattened ⅝in. or more long, stalklets ¼in.; lid of bud long and horn-shaped; anthers with longitudinal and nearly parallel openings. Ripe seed-cup about ¼in. to 5/16in. wide, nearly hemispherical, rim rising; valves when open long, acute, protruding. MATURE WOOD deep red, similar in appearance and quality to that of *E. marginata* (jarrah); very durable in the ground or in water. Tree not remarkable for yielding resin or kino; specific name therefore inappropriate.

GROUP II. E. ROBUSTA. E. SIDEROPHLOIA.

CULTIVATION IN NEW ZEALAND.

Specimens of *E. resinifera* are under observation on the Auckland Isthmus and in other northern localities, but are nowhere yet of sufficient promise to encourage more than experimental planting of the species in especially warm and genial situations. Seed should be obtained from certified trees in coolest part of the natural habitat in New South Wales.

23. E. ROBUSTA Smith.

NATURAL HABITAT, DESCRIPTION, AND USES.

Natural habitat eastern New South Wales and southern Queensland. At its best on damp lowlands not far from sea. Tree there a sturdy grower up to 80ft. or more in height. Dead bark persistent on stem and large branches, soft, brittle, ultimately very thick and deeply furrowed. Leaves in juvenile stage already stalked, often very large; those of adult tree up to 6in. or 7in. long by 2in. wide, thick, balanced, shiny on upper surface. Umbel with several flowers; stalk 1in. flattened, stalklets ¼in.; lid of bud thick, beak-like, exceeding in diameter rim of unripe seed-cup, cream-coloured; anthers with nearly parallel openings. Ripe seed-cup ⅝in. deep by ½in. wide, 3- or 4-celled; valves deeply placed, remain adherent (united) at points after escape of seed. MATURE WOOD red, hard, durable in wet ground.

CULTIVATION IN NEW ZEALAND.

E. robusta requires a warm climate and a seaboard situation. It has grown to a fair size on the Auckland Isthmus and at the Hutt near Wellington. Mr. H. A. Goudie reports having noted a vigorous young tree at Taikorea in the Manawatu. Far inland, as at Cambridge and Piako, a few specimens have survived the frosts, but after many years of life are still mere bushes. At "Sherwood", Muriwai, near Gisborne (Williams Bros.) *E. botryoides* and *E. robusta* planted together in best conditions for comparison show a ratio of growth of about six to one in favour of *E. botryoides*. Very generally in New Zealand *E. robusta* is showing liability to attack by insect enemies. It is in every respect inferior to both *E. botryoides* and *E. saligna,* and should not be further planted in this country.

24. E. SIDEROPHLOIA Bentham.

NATURAL HABITAT, DESCRIPTION, AND USES.

This is another of the ironbarks and a close competitor with *E. paniculata* and *E. crebra* for first place in that distinguished group. It has a wide natural distribution in eastern Australia, its range extending from a little south of Sydney to north of Rockhampton, and from near the seaboard westward over the lower tablelands. On the western slopes of the Dividing Range a glaucous variety is said to appear. In this great region the species enjoys a fair rainfall and mild climatic conditions, encountering severe frosts only where it ascends to higher altitudes. At its best *E. siderophloia* reaches heights up to 100ft. and diameters up to 3ft. and even 4ft.; but so keen is the demand for its timber that all larger specimens within reach of the mills are being rapidly cut out. Smaller trees cut near the ground readily sprout again, and the species is now under systematic cultivation as a yielder of electric wire poles. Determination of the species is usually easy. The dead bark persists on stem and large branches, being at first flaky and laminated, and becoming as the tree gains age coarse and hard with deep cracks and wide ridges and dark in colour. Leaves in the juvenile stage very large, sometimes measuring 7in. in length by 4½in. in width; those of the adult tree up to 6in. long by 1in. to 1½in. wide, coarsely veined and of about the same green on the two surfaces. Umbel with flowers up to 6 or more in number; stalk ¾in., stalklets ⅛in.; lid of bud horn-shaped ½in. or more long; anthers small, roundish with parallel openings. Ripe seed-cup ¼in. to ⅜in. deep by 5/16in. wide, not contracted towards orifice; valves usually 4, showing above rim when open. Mature wood dark-coloured with tinge of red, dense in texture, strong, and very resistant to decay in the most trying situations, especially in demand for railway sleepers and electric wire poles.

CULTIVATION IN NEW ZEALAND.

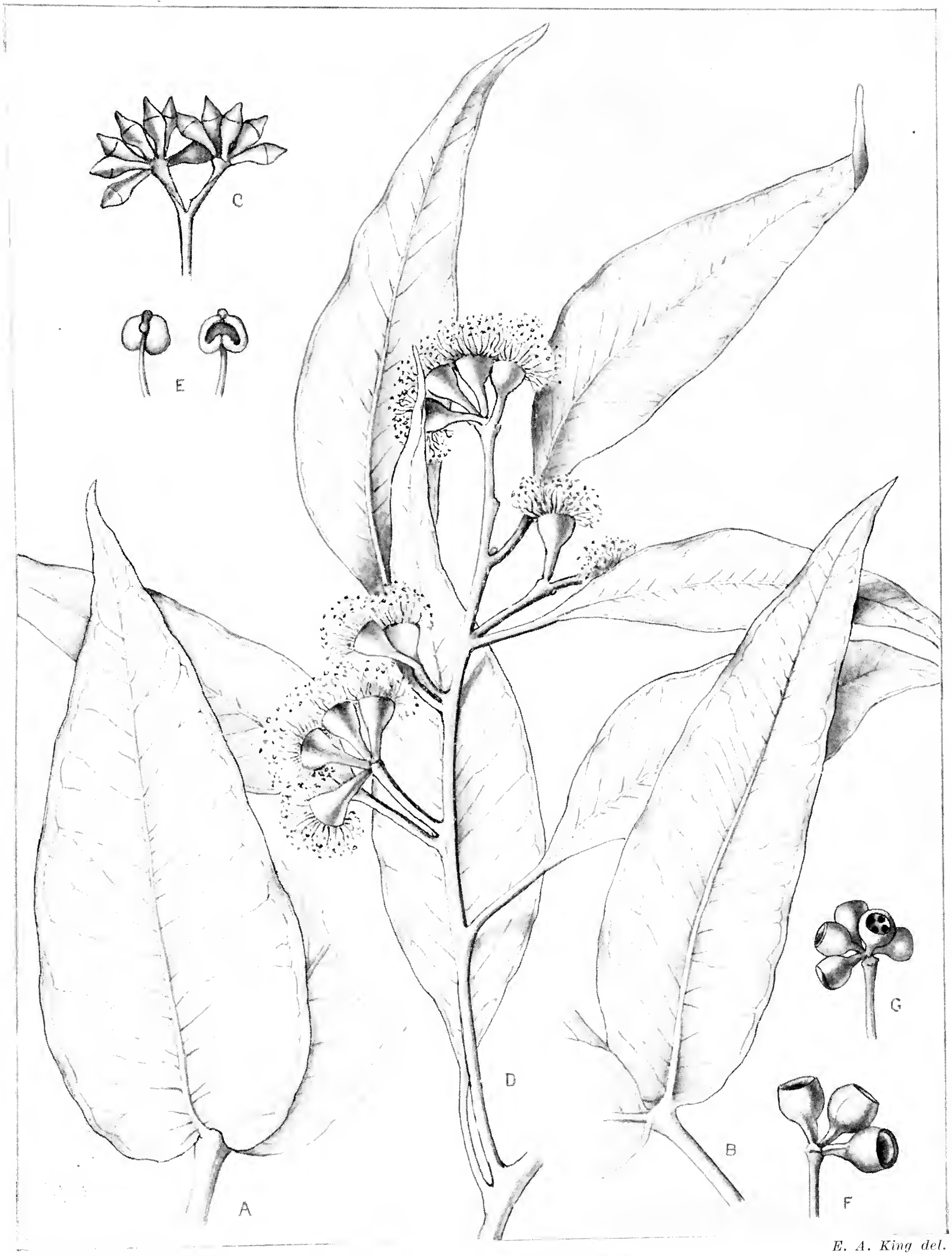
A few specimens of this species were doing well in the railway reserve at Mount Albert when the plantation there was cut down; others have been noted near Whangarei, and one in Hawke's Bay. The experiments encourage further tests in warm localities, but are insufficient to warrant extensive planting. Seed should be obtained from competently approved trees in cooler parts of the habitat in New South Wales.

It may encourage those who are trying to acclimatize the Ironbarks in New Zealand to quote here Maiden's description and estimate of their timber.

How to tell Ironbark.—It is not very easy, in a few words, to give a definition of Ironbark. Of course, if the bark is available the thing is simple enough, for most of the barks are characteristically furrowed and rugged. To describe it we must take note of a variety of circumstances. It is heavy (almost the heaviest of our hardwoods). It is hard, as may be readily seen if it be touched with a plane, or a nail be driven (or attempted to be driven) into it. Its most characteristic property, however, is a certain "gumminess" in working, which is well brought out under the plane, and its horny texture. The result is that, when planed, ironbark shows the appearance of more or less parallel striæ, or lines of close textured wood, strongly resembling horn, while between these the wood has a more open grain, showing narrow pits which may be seen, even by the naked eye, to be filled by a substance of a resinous texture. In some specimens it is not easy, however, to make out these lines of horny-textured wood, but the resin-pits appear to be always present. Ironbark is more or less curly in the grain, consequently it often gives trouble to plane to a perfectly smooth surface. If a blunt tool be used the ironbark tears in fairly regular blotches, while to get a perfectly smooth surface the wood often requires to be traversed with the plane, or even to be gone over with the steel scraper. Its hardness and weight often preclude it from use, perhaps an advantage, as otherwise the consumption of this timber would be inordinate.

Principal uses.—Ironbark is the king of New South Wales hardwoods, in fact it is not excelled in any part of the continent for combined strength and durability. It is extensively used in bridge construction, for railway sleepers, for posts, for naves, spokes, shafts, and framing, by the waggon and carriage builder; for large beams in buildings, particularly in stores for heavy goods; in a word, wherever great strength is required. For such purposes as railway-sleepers, it will last an indefinite period, and in many cases has to be taken up, not because it shows signs of decay from exposure on the permanent-way, or disintegration, because of the vibration to which it has been subjected, but because holes have been made in the sleeper by the renewal of bolts and spikes. I have specimens of sleepers which have borne the heaviest traffic of the main line, near Sydney, for twenty-five years, and which are as sound as the day they were laid.

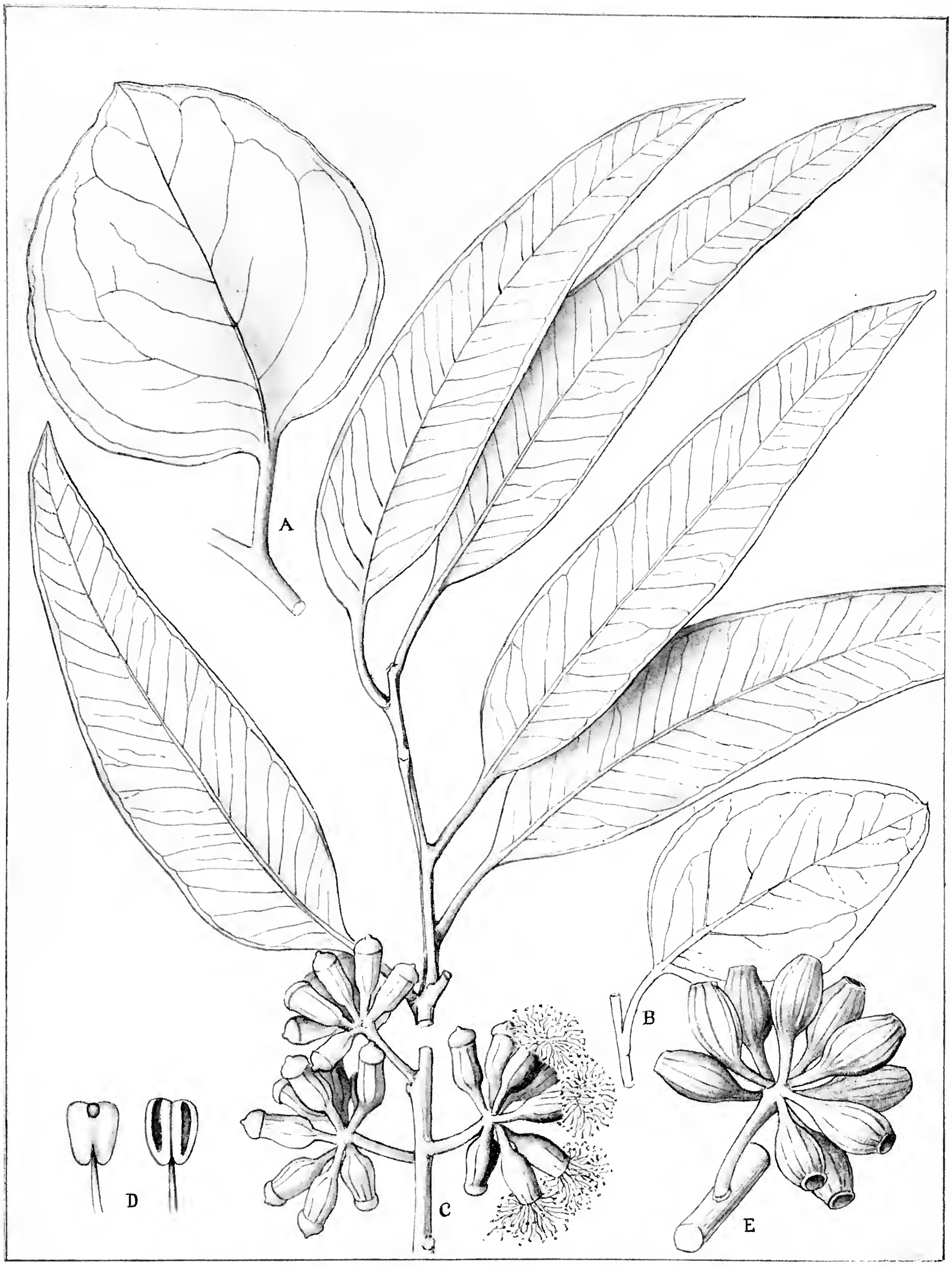
Forest Flora of New South Wales, Vol. I., 176.



EUC. ACMENIOIDES.

EXPLANATION OF PLATE.

A. Juvenile leaves in the sessile and opposite stage. B. Juvenile leaves, still opposite and nearly sessile. C. Buds: two umbels from the terminal part of a twig. D. Flowering twig with adult leaves. E. Anther, back and front view. F. Seed-cups (properly called fruits if seed still contained). G. Seed-cups, smaller but of same form.



E. A. King del.

EUC. CLADOCALYX.

EXPLANATION OF PLATE.

A. Juvenile leaf. Note long stalk and nearly orbicular shape. B. Juvenile leaf showing transition to intermediate stage. C. Twig showing buds, flowers, and (detached) adult leaves. D. Anther, back and front view. E. Ripe seed-cups. Note barrel-shape and longitudinal markings.

E. A. King del.

EUC. CREBRA.

EXPLANATION OF PLATE.

A. and B. Juvenile leaves, already stalked and narrow. C. Buds in a terminal cluster of five umbels. D. Anther, front and back view. E. Twig with ripe seed-cups in terminal clusters and adult leaves.

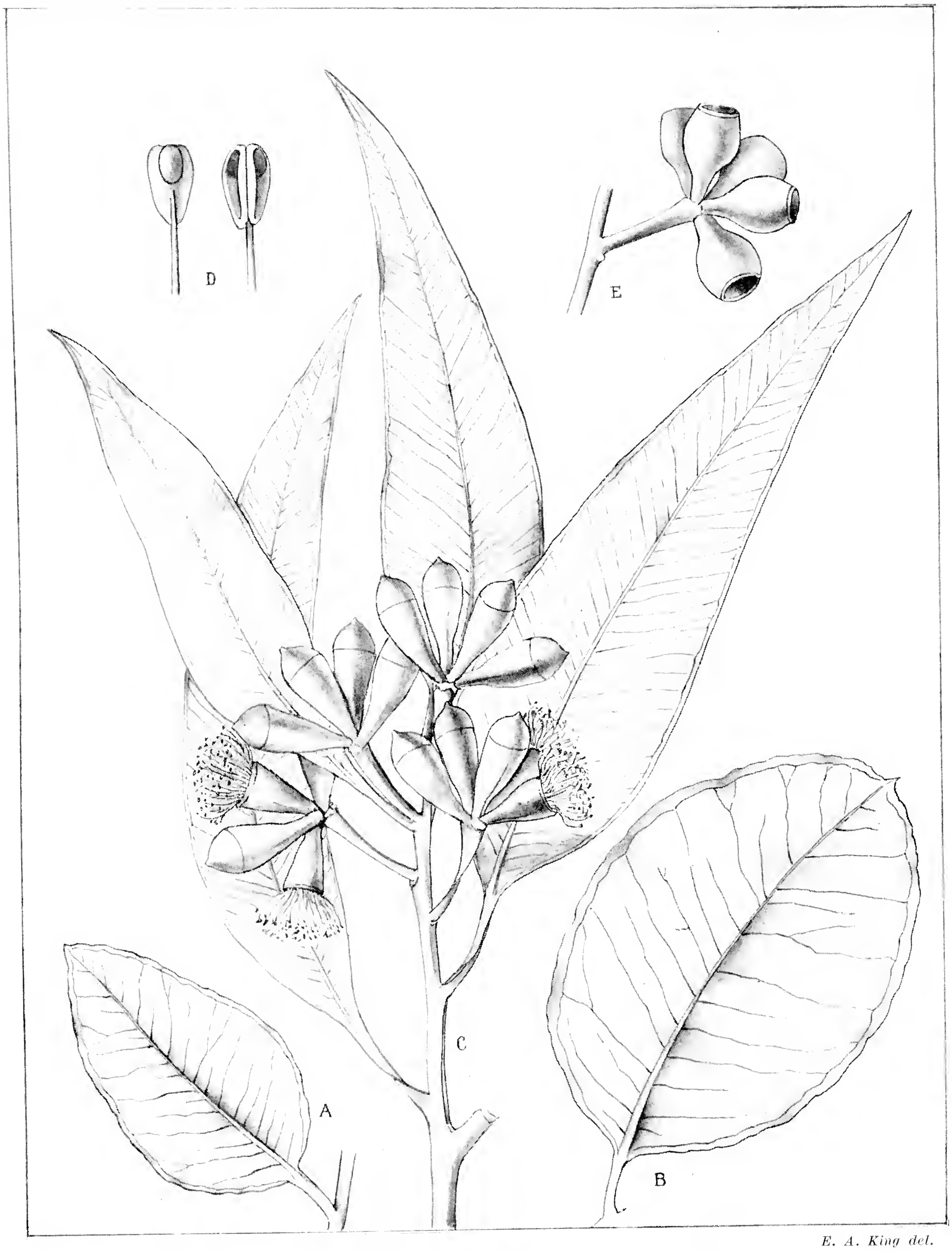
BOTANIC PLATE
No. 14.

E. A. King del.

EUC. DEANEI.

EXPLANATION OF PLATE.

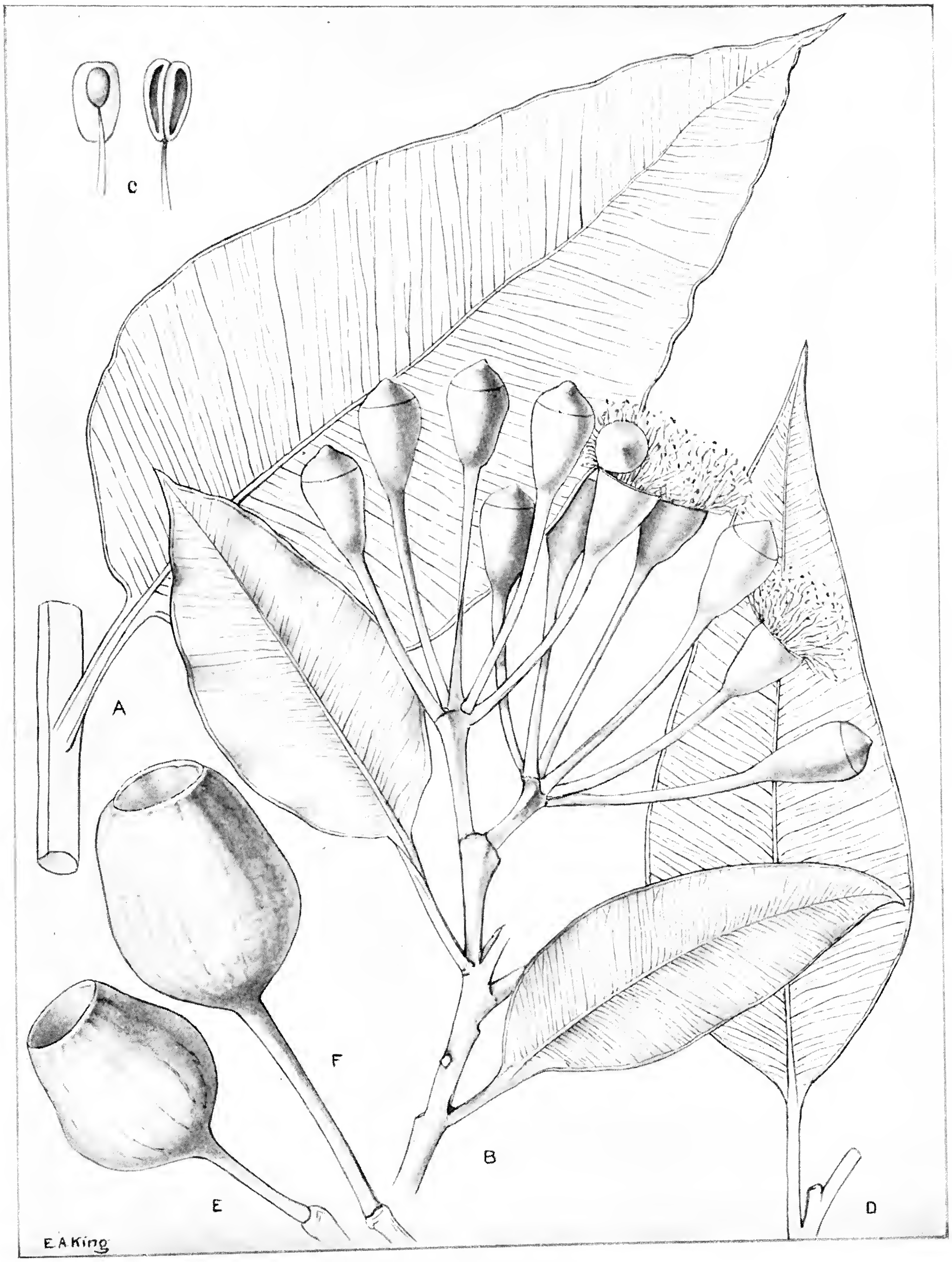
A. Juvenile leaf. Note poplar-leaf shape and long stalk. B. A smaller juvenile leaf. Note shape and stalk. C. Twig showing buds, flowers, and adult leaves. D. Anther, back and front view. E. Ripe seed-cups. Note small size, narrow rim, and slightly protruding three valves. F. Large-sized adult leaf.



EUC. DIVERSICOLOR.

EXPLANATION OF PLATE.

A. and B. Juvenile leaves. Note stalks and oval shape. C. Twig with buds, flowers, and adult leaves. D. Anther, back and front view. E. Ripe seed-cups.



EUC. FICIFOLIA.

EXPLANATION OF PLATE.

A. Intermediate or sapling leaf. B. Twig bearing buds, flowers, and adult leaves. C. Anther, back and front view. D. Larger adult leaf. E. Under-ripe seed-cup of slightly urceolate shape. F. Ripe seed-cup. Note the long stalklets in this species.

EUC. GRANDIS.

EXPLANATION OF PLATE.

A. Juvenile leaf. B. Intermediate or sapling leaf. C. Buds. Note shape of calyx tube. D. Anther, back and front view. E. Twig bearing ripe seed-cups and adult leaves. F. Larger adult leaf.

EUC. MICROCORYS.

EXPLANATION OF PLATE.

A. and B. Juvenile leaves. Note trowel-like shape. C. Twig bearing buds, flowers, and adult leaves. D. Anther, back and front view. E. and F. Ripe seed-cups. Note gradual taper to stalk.

E. A. King del.

EUC. PANICULATA.

EXPLANATION OF PLATE.

A. and B. Juvenile leaves. C. Twig bearing buds, flowers, and adult leaves. D. Anther, front and back view. Note shape and openings. E. Twig bearing ripe seed-cups and adult leaf. F. Smaller seed-cups. G. Seed-cups with valves protruding.

M. Flockton del.

EUC. PILULARIS.

EXPLANATION OF PLATE.

A. Intermediate leaves, just beyond sessile stage. B. Branchlet showing adult leaves. C. Twig bearing buds and flowers. D. Anther, front and back view. E. Ripe seed-cups.

EUC. PUNCTATA.

EXPLANATION OF PLATE.

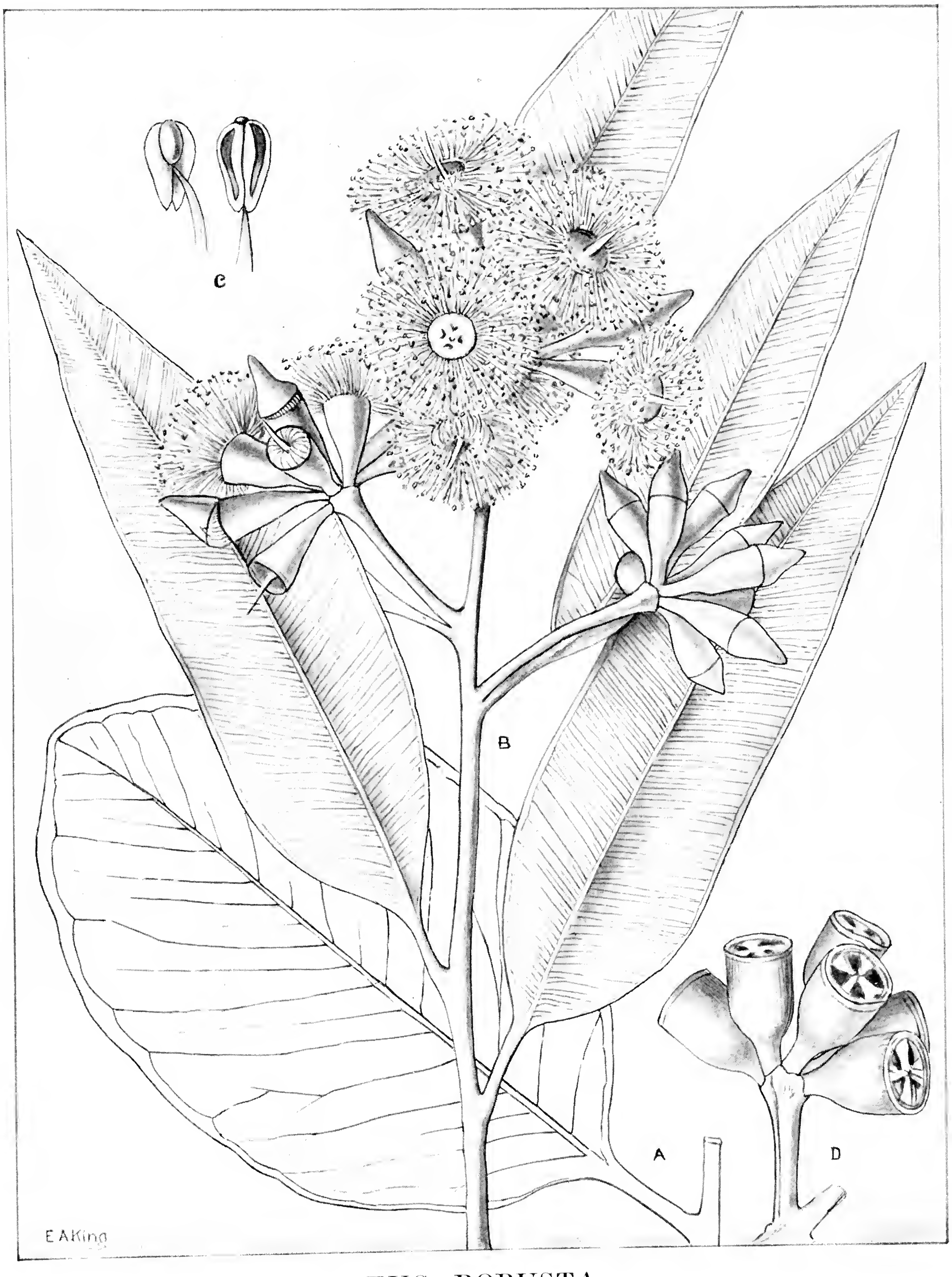
A. Juvenile leaf. Note shape and stalk. B. Smaller juvenile leaf. Note long stalk. C. Twig bearing buds and adult leaves. D. Anther, front and back view. E. Ripe seed-cups. Note protruding claw-like valves.

Botanic Plate
No. 22.

EUC. RESINIFERA.

EXPLANATION OF PLATE.

A. Juvenile leaves; still opposite, but showing transit to intermediate form. B. Twig bearing buds, flowers, and adult leaves. C. Anther, back and front view. D. Twig bearing ripe seed-cups. Note flattened peduncle and strongly protruding valves.



EUC. ROBUSTA.

EXPLANATION OF PLATE.

A. Juvenile leaf. Leaves on young plants and stump sprouts often very much larger.
B. Twig bearing buds, flowers, and adult leaves. Note venation. C. Anther, back and front view. D. Ripe seed-cups. Note peculiar structure of orifice.

EUC. SIDEROPHLOIA.

EXPLANATION OF PLATE.

A. and B. Juvenile leaves. Note size and shape. C. Twig bearing buds and adult leaves. D. Anther, back and front view. E. Larger buds. F. Ripe seed-cups. G. Ripe seed-cups. H. Large adult leaf.

GROUP III.

Species adapted to localities where mild to sharp frosts occur in winter and occasionally in spring, the summer being usually hot, and the autumn calm and fine. Estimated range in mean annual temperature for successful cultivation, 54° to 59° F. Probable limit of vigorous resistance to cold for seedlings and young saplings, between 20° and 26° F.

E. Bosistoana.	E. melliodora.
E. botryoides.	E. Muelleriana.
E. capitellata.	E. numerosa.
E. eugenioides.	E. piperita.
E. haemastoma.	E. polyanthemos.
E. hemiphloia.	E. rostrata.
E. laevopinea.	E. saligna.
E. leucoxylon.	E. sideroxylon.
E. longifolia.	E. Smithii.
E. macrorrhyncha.	E. tereticornis.

25. E. BOSISTOANA F. von Mueller.

NATURAL HABITAT, DESCRIPTION, AND USES.

In natural range this species extends from eastern Victoria northwards as far as the National Park in New South Wales. It appears to be at its best in Gippsland, where trees have been recorded with long branchless boles and with total heights up to 100ft. to 150ft. Dead bark sub-fibrous, persistent to an indefinite distance up the stem, above that falling away in ribbons. Leaves in juvenile stage already stalked, round or ovate; on adult trees rather narrow, up to 6in. long. Umbel with several flowers; stalk ½in., stalklets 3/16in. to ¼in.; lid of bud low-conical or with blunt point; anthers with divergent oval openings. Ripe seed-cup ¼in. to 5/16in. wide and nearly the same in depth, very slightly contracted towards orifice, cells 4 to 6, rim narrow. Tips of open valves slightly above or just below the rim.

The MATURE WOOD is reddish yellow; tough to split on the quarter, but backs off well, strong, and very durable in contact with the ground. R. T. Baker in *Hardwoods of Australia* says "It is suitable for heavy constructional work, heavy waggons, carriages, bridges and sleepers, and, judging from its texture, would be durable in the ground as posts, fencing, piles, &c."

CULTIVATION IN NEW ZEALAND.

E. Bosistoana has been recently planted by Mr. H. G. Groves at "Marangai" and under his direction in one or two other localities in the Wairarapa. When last seen by the writer the young saplings were growing vigorously and looking quite healthy. The species should be tried at moderate altitudes a little inland from our northern coast lines. Seed should be obtained from large and competently identified specimens in Victoria. Reports from Gippsland state that *E. Bosistoana* flourishes there on limestone formations. In our New Zealand experiments its preference appears to be for good alluvial areas. On the whole we may regard it as a species requiring a free subsoil, a medium range of temperatures, and a generous rainfall.

The specific name was given in honour of Joseph Bosisto, one of the early promoters of the *Eucalyptus* oil industry.

26. E. BOTRYOIDES Smith.

NATURAL HABITAT, DESCRIPTION, AND USES.

The species is indigenous to coastal areas of Victoria, New South Wales, and Queensland. The tree usually carries a heavy mass of dark-green foliage; sometimes it has a tendency to become bent or inclined to one side, but under forest conditions it will develop a long straight bole with a diameter up to 1ft. 6in. or 2ft. For a few years the upper part of the stem may remain smooth, but as the tree gains age both stem and larger branches become covered permanently with a thick mass of deeply furrowed sub-fibrous dead bark. The leaves in the juvenile stage and subsequently are of the nearly equal-sided or balanced type, with upper surface dark green and shiny and under surface dull. The lateral veins are rather wide apart and make with the midrib angles of over 45°. The umbel has a flattened stalk or peduncle with an indefinite number of sessile flowers; bud slightly angular with short pointed lid; anthers with longitudinal and nearly parallel openings. Ripe seed-cup ¼in. to nearly ½in. deep and usually angular at the sessile base. A full umbel of mature fruits, we may suppose, suggested to the founder of the species the idea of a cluster of berries; hence the specific name, which means "grape-bunch-like". The resemblance to grapes is rather remote, but the suggestion is a slight aid to identification.

The MATURE WOOD from well-grown trees is red, hard, heavy, and very durable in any situation, reliable reports from Australia stating that in fence posts the heartwood from quite mature trees will easily last thirty years.

CULTIVATION IN NEW ZEALAND.

Ideal conditions for *E. botryoides* are found at low altitudes a little removed from our North Island sea coasts; but the species is very hardy, and is represented by vigorous specimens as far inland as Cambridge and Rotorua, and as far south as Charteris Bay near Lyttelton. Seed should be obtained from best acclimatized trees through the Forest Service. *E. botryoides* makes very ornamental single specimens, and when cut back readily sprouts again.

27. E. CAPITELLATA Smith.

NATURAL HABITAT, DESCRIPTION, AND USES.

The species is indigenous to lowlands and upland valleys in New South Wales. The tree usually carries a heavy and dense mass of foliage. Dead bark stringy and persistent from ground to small branches. Leaves in juvenile stage sessile or almost stalkless, round or heart-shaped, often studded with minute hairs; on adult tree stalked or petiolate, thick, broad, unbalanced, and of about the same palish green on the two surfaces. Umbel on compressed or flattened stalk (peduncle); flowers sessile or on extremely short stalklets (pedicels) and up to ten or eleven in number; bud coarse, angular, with short pointed lid (operculum); anthers with divergent openings. Ripe seed-cup often remarkable for being much broader than it is deep, its appearance suggesting the idea of a plastic sphere that has been pressed into the shape of a thick disk; lateral diameters up to ½in. common; rim broad and convex; points of valves when open just below or a little above the rim. As the sessile fruits mature they press tightly against each other and become more or less flattened at the sides by the pressure. Specific name suggested by the compact and rounded form of the fruit cluster. The MATURE WOOD has a good reputation for durability, and is clean and sound when sawn into boards and scantling.

CULTIVATION IN NEW ZEALAND.

In rate of growth, *E. capitellata* holds medium rank amongst timber-yielders, and should never be planted in association with any of the very rapid growers. In New Zealand its profitable range will probably be restricted to warm localities north of the Waikato river.

E. capitellata was formerly given a wider definition and a much more extended range than at present. It included a seaboard species of small dimensions and little value subsequently named by Maiden *E. Camfieldi,* and a timber yielding tree named by Maiden and Cambage together *E. Blaxlandi* in honour of Gregory Blaxland, leader of the first party to cross the Blue Mountains. *E. Blaxlandi* flourishes at various altitudes up to 2,000ft. or 3,000ft. Its optimum is found on the uplands of New South Wales and Victoria, with a range extending from New England in the north to the border of South Australia. For cultivation in New Zealand *E. Blaxlandi* may be a much better adapted and more valuable tree than its congener. No time should be lost, therefore, in obtaining seed from certified and approved trees in cool parts of the natural habitat and in making experimental plantings in suitable parts of our own country. The botanical history of *E. capitellata* shows how extremely difficult it is separately to define closely related species, and how vitally important it is in propagating for economic purposes to breed always from right parent trees.

28. E. EUGENIOIDES Sieber.

NATURAL HABITAT, DESCRIPTION, AND USES.

This is a familiar species in eastern Australia, being extensively distributed in New South Wales and southern Queensland, and to a small extent in north-eastern Victoria. From east to west its range includes genial lowlands near the seaboard; temperate foothills and tablelands; and mountain valleys and ridges over 3,000ft. above sea level, where the trees are subject in winter to severe frosts and occasional falls of snow. In open situations the tree makes a short bole with branches spreading outward and upward and clothed at their extremities with tufts of leaves; surrounded by other trees, it readily sheds its side branches and forms a tall straight shaft crowned with a comparatively small amount of foliage. It is a pole-timber tree rather than a forest giant, and may be regarded as well grown when its total height is 80ft. to 100ft. and the diameter of its bole 1ft. 6in. to 2ft. It is one of the true stringybarks and continuously carries a fibrous coating of dead bark on stem and larger branches. Leaves in juvenile stage short-stalked, wavy, indented at edges, and paler on under surface, with stems of twigs and backs and edges of leaves studded over with tufts of minute hairs, the general colouring of the foliage at this stage being dull green tinged with russet brown. Leaves of adult tree stalked, smooth, of same green on both surfaces, 3in. to 5in. long. Umbel with numerous flowers; stalk ⅜in. long, stalklets ⅛in. or less; lid of bud short, sharp-pointed; anthers with divergent united openings. Ripe seed-cup ¼in. to 5/16in. wide, and a little less in depth, contracted towards orifice; tips of open valves below or slightly above the rim. As the fruits of *E. eugenioides* mature they touch and form a compact head; but, having short stalklets, never become so tightly compressed together as do those of *E. capitellata,* which are quite sessile.

The MATURE WOOD of *E. eugenioides* is pale-coloured, with a tinge of red in some districts. It is freely fissile, and, though very hard, easily worked with saw, plane, and carving tool. It is greatly valued for house building. This is high praise for any timber; but the mature wood of *E. eugenioides* has the further merit of long resistance to decay in contact with the ground. Reports from widely separated localities in Australia testify to its great durability when used as fence posts or wire poles, actual cases being mentioned where fences made of this wood have lasted in good condition for fifty years. But it is only fair to state that some Australian authorities do not sustain this high estimate; and we must remember that all timbers vary in quality and durability. (See *Hardwoods of Australia,* page 196.)

CULTIVATION IN NEW ZEALAND.

That the species can be successfully cultivated in New Zealand has been proved by experiments made in the Waikato near Cambridge, in the State Forests at Whakarewarewa, in the Papakura-Clevedon district, in the Wairau Valley, Marlborough, and at "Okuti" near Little River, Banks Peninsula. Many trees from these plantations have already been utilized, some sawn up into boards and scantling, others as posts and wire-carrying poles. Results encourage the expectation that *E. eugenioides* will sustain in this country the high reputation that it has so long enjoyed in its native home. Planted in suitable localities this species can give us durable electric wire poles in 35 years and very high grade sawn timber in 40 years. We must not mix the species with forest giants that may overtop and suppress it, but plant it pure or in alternate rows with a conifer such as *Cupressus macrocarpa.* The seedlings are very sensitive to frost, transplant badly, and are liable to be suppressed by weeds. It may be well, therefore, to sow the seed on clean and thoroughly prepared land where the trees are to grow, after the spring frosts are over, and with some very light cover crop to protect the plants in the following winter. A close study of New Zealand experiments shows that *E. eugenioides* requires a free subsoil, and will not succeed on a tight clay pan. It is an obvious suggestion that seed should be obtained from approved trees in parts of the natural habitat where there are cold winters, or from best acclimatized specimens.

The specific name *eugenioides* means *Eugenia-like,* and was suggested by the leaves as they are sometimes seen on vigorous saplings and younger trees. The dead bark of *E. eugenioides* is normally pale grey, very regularly furrowed up and down the tree, and persistent to the small branches. The living bark where it touches the sapwood is often stained with a yellow colouring. This last character appears in a still more obvious degree in *E. Muelleriana.* Determination of the stringybarks is often very difficult, and the presence or absence of a yellow stain in the living bark will be to the careful student a welcome addition to other specific tests.

29. E. HAEMASTOMA Smith.

NATURAL HABITAT, DESCRIPTION, AND USES.

Tree widely distributed in eastern New South Wales and found also in southern Queensland. Rarely of large size; often of drooping and scrambling habit. The dead bark falls away in non-fibrous ribbons and flakes, leaving the surface of living bark white, smooth, and sometimes marked or scribbled with fine irregular lines. Juvenile leaves very early stalked, rather broad, and vertically suspended; those of adult trees up to 6in. long, thick, unbalanced, and of same green on the two surfaces. Umbel many-flowered; stalk ⅜in. to ¾in. long, stalklets 3/16in.; lid of bud very short; anthers with divergent united openings. Ripe seed-cup in normal variety up to ¼in. deep and ⅜in. wide, in variety *micrantha* as small as 3/16in. wide; rim of cup slightly rising or domed, usually dull blood-coloured or brick-red. MATURE WOOD reddish, soft for a eucalypt, and not reputed to be very durable.

CULTIVATION IN NEW ZEALAND.

Vigorous specimens of *E. haemastoma* may be seen in several New Zealand plantations, but they are nowhere of sufficient size and promise to warrant cultivation of the species for timber production.

The student may find it helpful to remember that the specific name *haemastoma* is from the Greek *haima* blood and *stoma* mouth, and was suggested by the ruddy colouring round the rim or lip of the seed-cup. A few other species have the same character, but in a less marked degree.

30. E. HEMIPHLOIA F. von Mueller.

NATURAL HABITAT, DESCRIPTION, AND USES.

This species is a constituent of the forest flora in Victoria, New South Wales, and Southern Queensland, its lateral range extending from the seaboard over the eastern slopes of the Dividing Range. Within this great region it can make a home on any kind of land that is neither wet nor extremely dry. The trees, as the traveller in Australia usually sees them, have short stems and spreading tops, and are of little value except for fencing and fuel. But in sheltered situations they reach heights up to about 80ft. and diameters of bole up to 2ft. or 2ft. 6in. The word *hemiphloia* means half-barked, and refers to the habit of the tree in shedding its dead bark from the branches and retaining it on the stem or on part of the stem. The persistent dead bark is of the "box" type, sub-fibrous and flaky. Juvenile leaves broad, oval, already stalked; those of adult trees oval to broad lance-shaped, or sometimes very narrow, up to 5in. long, dull green on both surfaces. Umbel with several flowers; stalk and stalklets various; lid of bud conical, sometimes acute; anthers small with lateral pore-like openings. Ripe seed-cup 5/16in. deep by 3/16in. to ¼in. in width; valves wholly below the rim. A closely similar species bearing smaller fruits and called *E. microcarpa* is found in the same general habitat, but extending farther south. A kindred species with habitat on the western slopes of the Dividing Range and southward therefrom has glaucous buds and foliage, and is called *E. albens.* Its fruits are larger and more urn-shaped than those of *E. hemiphloia.*

The MATURE WOOD of all these trees is pale in colour, hard, strong, and reputed to be very durable. But reports are conflicting, and there seems to be no escape from the inference that the timber varies a great deal in quality. There is pressing need for research on the relative and absolute merits of the three species.

CULTIVATION IN NEW ZEALAND.

Specimens of a small-fruited form understood to be *E. microcarpa,* sown *in situ* at "Trecarne", Cambridge, in forty years reached heights of 80ft. to 100ft. and diameters up to 1ft. 6in., with large percentage of mature wood. Specimens with large fruits like those described for *E. albens,* planted many years ago on the Auckland Isthmus, still remain small and hopelessly slow in growth. Many growers in New Zealand have made experiments with seed imported under the name of *E. hemiphloia;* but, so far as the writer is aware, results have been almost uniformly disappointing. The plants have started well but have not attained a profitable or promising size. The Cambridge example is the only one in which any member of the *E. hemiphloia* group has given satisfaction in this country. The fault of the whole business may be that we have been breeding from wrongly selected parent trees. All members of the group might be worth growing if we could obtain seed from largest and strongest trees where climatic conditions are most like what we can offer in selected areas of the North Island. The Cambridge trees were grown from seed imported as "grey box" without any botanical name, and we have no knowledge of its source beyond the fact that it came from Sydney.

31. E. LAEVOPINEA R. T. Baker.

NATURAL HABITAT, DESCRIPTION, AND USES.

This species is reported to be at its best on basaltic ridges in the Rylstone district about 150 miles north-west from Sydney, with a considerable range extending from that centre. The tree at its optimum grows to a moderately large size, and usually presents a long straight bole free from side branches. Dead bark fibrous but brittle, persistent all up the stem. Juvenile leaves early stalked, broad at base; adult tree leaves unbalanced, dark green and very shiny on both surfaces. Lid of bud short and small; anthers kidney-shaped with divergent openings. Ripe seed-cup up to ⅜in. deep and nearly ½in. wide, rim domed with groove below; open valves protruding. MATURE WOOD pale, tough, strong, very durable in trying situations as when used for posts and wire poles. *E. laevopinea* belongs to the "stringybark" group, and in quality of timber is said to rank with *E. eugenioides* and *E. Muelleriana.*

GROUP III. E. LEUCOXYLON. E. LONGIFOLIA.

CULTIVATION IN NEW ZEALAND.

If successfully acclimatized in New Zealand, the species will be a large contributor to our future wire-pole supply. Seed should be obtained from certified and approved trees in the Rylstone district, New South Wales, and experimental plantings made without delay, preferably on basaltic or basic inland areas of the North Island.

32. E. LEUCOXYLON F. von Mueller.

NATURAL HABITAT, DESCRIPTION, AND USES.

This species is plentiful in the natural forests of South Australia and Victoria. The trees are small to medium in size. The dead bark is non-fibrous and falls away from stem as well as branches, leaving a dull white surface. Leaves in the juvenile stage sessile, broad, oval; those of the adult tree up to 6in. long by 1in. wide, of about the same green on the two surfaces. The umbel is usually 3-flowered; stalk and stalklets both ⅜in. to over ½in. long; lid of bud conical with curved apex; anthers with terminal openings. Ripe seed-cup ⅜in. to ½in. or more in depth and nearly the same in width, goblet-shaped, often 5-celled; valves wholly below rim. MATURE WOOD pale with tinge of pink, strong, and reported to be very lasting in any situation. See *Hardwoods of Australia,* page 233.

CULTIVATION IN NEW ZEALAND.

The species is much cultivated for the beauty of its flowers, which on some trees are pink to bright crimson and on others a rich cream-colour. Nurserymen are selecting to increase the percentage of crimson-flowered trees. Many beautiful specimens of *E. leucoxylon* may be seen in Hawke's Bay and a few on the Auckland Isthmus.

Through close similarity of flowers and seed-cups, the species was at one time confused with the ironbark *E. sideroxylon;* but the distinction is now well understood. Both species have large goblet-shaped seed-cups; both may be crimson-flowered; but *E. leucoxylon* differs from its congener in having broad sessile juvenile leaves and in shedding its dead bark. For planting in gardens and parks seed should be obtained from best crimson-flowered specimens at Havelock North, Hawke's Bay.

33. E. LONGIFOLIA Link and Otto.

NATURAL HABITAT, DESCRIPTION, AND USES.

This species has its natural home in eastern Victoria and in coastal New South Wales south of the Hawkesbury River, at low altitudes not very remote from the sea. Tree erect and often over 100ft. in height. Dead bark persistent on stem and large branches, at first of the finely divided "box" or "woolly" type, but becoming coarse and rough as the tree gains age. Leaves in juvenile stage already stalked, often very broad; on vigorous saplings narrower and up to 8in. or 9in. long; on old trees 5in. to 6in. long by 1in. or less wide; edgewise or vertically suspended and of same green on the two surfaces. Specific name not very appropriate as *E. goniocalyx* and one or two other species have leaves of much greater length. *E. longifolia* will be most easily determined by its flowers and fruits. Umbel usually 3-flowered, stalk or peduncle ¾in. to 1in., stalklets or pedicels ⅜in. Lid of bud long and beak-like, turning rich yellow as the bud becomes plump and mature; anthers with longitudinal and parallel openings. Ripe seed-cup on some trees up to ½in. or more in depth and ⅝in. in width, usually with broad bevel below rim and often with sharp flange below bevel; valves wholly below rim; seed-cup sometimes angular. Mature wood dark red, not so strong as ironbark, but very durable in any situation; largely milled along the south coast of New South Wales as redwood.

CULTIVATION IN NEW ZEALAND.

In the Auckland seaboard area *E. longifolia* has grown to a millable size in 30 to 40 years. Farther inland, as at "Trecarne" near Cambridge, its rate of growth has been much slower. Its profitable range in New Zealand will probably be restricted to warm and sheltered coastal localities north of about latitude 38. Seed should be obtained from competently selected trees in south-eastern New South Wales and in Victoria.

34. E. MACRORRHYNCHA F. von Mueller.

NATURAL HABITAT, DESCRIPTION, AND USES.

Species very widely distributed in eastern Australia, but not near the sea. Tree small to medium in size. Dead bark stringy; persistent on stem and large branches. Leaves in juvenile stage, already stalked, notched at edges, and together with twigs sometimes studded with tufts of minute hairs. Adult tree leaves up to 5in or 6in. long, rather thick, of same green on both surfaces. Umbel with several flowers; stalk ⅝in., stalklets ¼in. or less; lid of bud rather long and pointed, whence specific name which means big-beaked; anthers with divergent openings. Ripe seed-cup ⅜in. to ½in. wide with strikingly domed or convex rim, nearly always 3-celled, valves when open protruding and claw-like. Mature wood pale-coloured, or sometimes with tinge of red, of medium quality.

CULTIVATION IN NEW ZEALAND.

Specimens noted in Hawke's Bay and other parts of the North Island healthy, but nowhere of sufficient size and promise to warrant further planting of the species in this country, unless on a small scale in botanical arboreta.

35. E. MELLIODORA A. Cunningham.

NATURAL HABITAT, DESCRIPTION, AND USES.

This species is very widely distributed on both lowlands and uplands in eastern Australia, but always well removed from the seaboard. It nowhere forms pure forests but is seen either mingled with other trees or thinly scattered over open grasslands. Many of the specimens in open situations carry densely branched crowns clothed with abundant drooping foliage and are exceedingly beautiful. Those associated with other trees reach heights up to 70ft. or 80ft., and diameters sometimes up to 2ft. The dead bark is scaly, sub-fibrous, and usually persistent all up the stem; the living bark when freshly stripped from the tree is yellow, and has given origin to two vernacular names, "yellow box" and "yellow jacket". Juvenile leaves very early stalked, oval; adult tree leaves sometimes still oval but more often broad-lance-shaped or narrow, of same dull green on both surfaces. Umbel on short thin stalk with several flowers on short stalklets; lid of bud domed or low-conical; anthers with terminal openings. Ripe seed-cup ¼in. or less in depth and width, slightly contracted towards orifice with ring round rim; valves, 4, 5, or 6, concealed by rim. MATURE WOOD pale-coloured, hard, strong, durable in the ground, good fuel. The specific name means honey-scented, and the species merits the name by its abundant yield of high grade honey.

CULTIVATION IN NEW ZEALAND.

Fair specimens of *E. melliodora* may be seen in several New Zealand plantations; but no competent endeavour has yet been made to acclimatize the species in this country. Bee keepers everywhere within its climatic range should include it in their arboreta. Park managers should give it a place among their ornamental trees. But to ensure success seed must be obtained from approved trees in cool parts of the natural habitat. By thus suitably selecting parent trees we may ultimately be able to grow the species over a wide range in the North Island.

36. E. MUELLERIANA Howitt.

NATURAL HABITAT, DESCRIPTION, AND USES.

This species is widely distributed in eastern Australia. It is a tree of the foothills and uplands, and is found flourishing at altitudes of about 1,000ft. It is probably at its optimum in western Gippsland. In parts of its habitat it has to endure winter temperatures several degrees below freezing point. The tree is of erect habit and attains a good medium size. Dead bark fibrous, persistent on stem and large branches, dark in colour, and cracked transversely as well as up and down the tree; inner surface of living bark yellow. Leaves in juvenile stage opposite, quite or nearly sessile, shiny on upper surface; in sapling stage large, balanced, shiny on upper surface and paler beneath; in adult tree stage unequal-sided and unbalanced, dark green, and shiny on both surfaces. Umbel with several flowers; stalk (peduncle) ⅝in. long, stalklets (pedicels) short but distinct; lid of bud low with slight central point; anthers kidney-shaped with divergent openings. Ripe seed-cup ⅜in. to ½in. wide by a little less in depth, nearly spherical; valves usually hidden below rim, but sometimes slightly protruding. The fruits (seed-cups) are somewhat like those of *E. pilularis;* never so crowded in the umbel as are those of *E. capitellata* and *E. eugenioides.*

MATURE WOOD yellowish-brown, fissile, easily worked, and reported to be very durable either in the ground or in water. Some Australian authorities say that the timber of *E. Muelleriana* is superior in durability to that of *E. eugenioides.* The species thus comes to us with a highly favourable reputation.

GROUP III. E. NUMEROSA. E. PIPERITA.

CULTIVATION IN NEW ZEALAND.

Specimens of *E. Muelleriana* planted at Whakarewarewa were frosted back in the sapling stage, but sprouted again and are now tall trees with diameters up to 1ft. 6in. The species is receiving increasing attention in New Zealand, and is now being planted in several North Island localities. To ensure best results in future plantings, seed should be obtained from certified and approved trees in Western Gippsland, Victoria, or in upland districts of New South Wales. *E. Muelleriana* is one of the species to which we must look for future supplies of posts and wire-carrying poles.

37. E. NUMEROSA Maiden.

NATURAL HABITAT, DESCRIPTION, AND USES.

It is said that this species nowhere forms a continuous pure forest, but is sparsely distributed in moist valleys and on the rocky sides of gullies along the eastern ranges from Gippsland in Victoria to about the latitude of Newcastle in New South Wales. Trees small to medium in size, only rarely reaching heights much above 80ft. The dead bark is at first ribbony and deciduous from all parts of the tree; then gradually becomes persistent and of the "peppermint" type from the ground up the stem to the large branches. Leaves in the juvenile stage sessile, long, lance-shaped, thin; those of the adult tree up to 7in. long, narrow, thin, drooping. Umbel with numerous flowers, sometimes up to 30 or more; stalk and stalklets both very slender; lid of bud low, with central point; anthers with divergent and connected openings. Ripe seed-cup 3/16in. to ¼in. in depth and in lateral diameter, pear-shaped or round; stalklets or pedicels usually so slender as to be a distinguishing character of the species. MATURE WOOD white, fissile, suitable for work in dry situations but not for contact with the ground.

CULTIVATION IN NEW ZEALAND.

In looking for this species in our New Zealand plantations the student must be careful not to confuse it with *E. amygdalina* and *E. radiata*. The true *E. numerosa* has small pilular fruits on very slender stalklets. The fruits of *E. amygdalina* and *E. radiata* are hemispherical and their stalklets shorter and thicker. *E. numerosa* scarcely ranks as a timber tree, but is well worthy of a place in ornamental arboreta. Seed should be obtained through the New South Wales Forest Service.

38. E. PIPERITA Smith.

NATURAL HABITAT, DESCRIPTION, AND USES.

Species widely distributed in New South Wales, and especially abundant on the Blue Mountains. In open situations spreading and ornamental; in dense stands tall with clear bole up to 2ft. and more in diameter. Dead bark of "peppermint" type, persistent on stem, deciduous from branches. Leaves in juvenile stage at first sessile, heart-shaped at base, rounded or pointed at apex, a little paler on under surface; on adult tree stalked, 3in. to 6in. long, unbalanced, same green on both surfaces. Umbel with numerous flowers; stalk up to ⅝in., stalklets under ⅛in.; young buds angular, curved inward, and very sharp-pointed; anthers kidney-shaped with divergent connected openings. Ripe seed-cups in three forms as follows:—

(*a*) With contracted neck like an urn or decanter.

(*b*) Egg-shaped with very small orifice and thin rim.

(*c*) Spherical with wider orifice and thicker rim.

Depth of cups from ¼in. to ⅜in. If the student will carefully note the persistent "peppermint" bark and sharp-pointed, curved, and angular buds of *E. piperita,* he will easily determine the species even when the seed-cups may cause some doubt. MATURE WOOD pale, fissile, of medium quality.

CULTIVATION IN NEW ZEALAND.

E. piperita is vigorous over a wide range in the North Island, and certainly ranks as a useful timber yielder; but in nearly all localities it could be replaced by trees of superior merit, such as *E. eugenioides, E. fastigata,* and *E. obliqua.*

39. E. POLYANTHEMOS Schauer.

NATURAL HABITAT, DESCRIPTION, AND USES.

This species is widely distributed in Victoria and New South Wales, chiefly on hilly country at altitudes from 1,000ft. to 2,000ft. In favourable situations the trees reach heights up to 60ft. and 70ft. and diameters up to 2ft.; but, as usually seen, they are smaller. The dead bark falls away from the branches, but generally persists on the stem and is there of the flaky sub-fibrous "box" type; living bark and sapwood white. Leaves in juvenile stage already stalked 2in. to 3in. or more in length and nearly the same in width; on adult trees either still round or oval, or long and slightly falcate; colour dull green. Umbel with several flowers; stalk ⅜in., stalklets ⅛in.; lid of bud very low and small with slight central point; anthers with terminal and oval or nearly circular openings. Ripe seed-cup about 3/16in. in depth and in lateral diameter on very short stalklet, rim thin and often cracked; valves below rim. The umbels frequently appear in compound clusters at the ends of the twigs; whence the specific name, which means many-flowered. MATURE WOOD red, hard, valuable for technical work, and long lasting in the ground; much valued by surveyors for pegs.

CULTIVATION IN NEW ZEALAND.

It may help the student to remark here that *E. populifolia,* a similar but inferior tree to *E. polyanthemos,* is distinguished by having shiny green poplar-like leaves; *E. melliodora,* a similar but valuable tree, by the yellow colour of its living bark and sapwood; and *E. Dawsoni* by its habit of shedding nearly all its dead bark. *E. polyanthemos* will grow in many parts of the North Island, but should not be further planted unless seed can be obtained direct from certified and approved trees on upland country in Victoria or New South Wales.

GROUP III. E. ROSTRATA.

40. E. ROSTRATA Schlechtendal.

NATURAL HABITAT, DESCRIPTION, AND USES.

To this species belongs the distinction of having a more extended natural range than any other eucalypt. In every State of the great Australian Mainland it is less or more widely distributed. Everywhere in this vast habitat it has followed the course of rivers and streams, spreading only reluctantly and with inferior growth on to drier areas. It is at its best along the flooded banks of the River Murray where that river forms the boundary between New South Wales and Victoria. There, subject to annual inundation, it grows rapidly to a height of 100ft. and a diameter up to and over 3ft. It is now systematically cultivated in the forests of those States, and easily claims rank as one amongst the most valuable of the world's hardwood timber yielders. Left to itself in an open situation, the tree will form a short crooked stem with spreading branches and drooping branchlets; properly controlled under forest conditions, it will develop a long straight shaft, suitable in the pole stage for carrying electric wires or in large diameters for conversion into railway-sleepers, wood-blocks, or heavy timbers for building construction.

The dead bark of *E. rostrata* is non-fibrous and comes off the upper part of the tree in thin scales or sheets, but often persists at the base of the stem until it forms coarse plates divided by deep cracks. Leaves in the seedling stage narrow or rarely oval, and already stalked; those of the adult tree narrow, rather long, falcate, and of the same dull green on both surfaces. Umbel with 3 to 10 flowers, delicately formed in all the parts; stalk ½in. to ⅝in. long, stalklets ¼in., both very slender; lid of bud in typical form remarkable for having a rounded base equal in diameter to the calyx-tube (immature seed-cup) and then suddenly contracting into a pointed apex somewhat like the beak of a small bird, in other forms more like an acute cone; anthers with longitudinal and nearly parallel openings. The specific name *rostrata* means beak-like and was appropriately suggested by the shape of the bud. The ripe seed-cup is about ¼in. in lateral diameter, hemispherical, with rising convex rim; the valves while closed forming a low dome within the rim, and when open protruding beyond it.

The MATURE WOOD of *E. rostrata* is of a rich red colour. It is close in the grain and very heavy, but fissile and easily worked by either saw or plane. Selected specimens have been carved into beautiful designs. In resistance to decay the mature wood of this red gum belongs to a grade scarcely inferior to the best ironbark. For long years it has maintained a first-class reputation amongst railway engineers, and is still in keen demand for sleepers and bridge work. Under skilled forestry the species is now producing long straight poles of great durability for carrying electric wires. For high commendation of this beautiful timber see *Hardwoods of Australia* by R. T. Baker, page 241.

CULTIVATION IN NEW ZEALAND.

E. rostrata has grown to a millable size on the Auckland Isthmus, in the Waikato near Cambridge, and in Hawke's Bay. These and numerous other examples show great capacity in the species for acclimatization. Planted at low altitudes in the vicinity of streams and rivers or on moist but well drained flats, the species will flourish in all provinces of the North Island, and even extend its useful range to especially warm and genial localities across Cook Strait. Seed should be obtained from competently selected specimens in the Murray River State Forests. To compel an erect and vigorous upward growth, the species must be closely planted, either pure or in combination with other trees.

41. E. SALIGNA Smith.

NATURAL HABITAT, DESCRIPTION, AND USES.

This species has its native home on the coastal belt and in the gullies of the tablelands of New South Wales and southern Queensland. The tree is of erect habit, and under forest conditions in the deep glens rapidly develops a long branchless shaft crowned with abundant handsome foliage. Its dead bark everywhere falls away, leaving a smooth greenish-white surface, except at the base of the stem, where it sometimes persists in the form of thick, hard, non-fibrous plates or sheets. The leaves early pass the juvenile opposite stage, and thereafter may be described as stalked or petiolate, broad lance-shaped, nearly equal-sided and balanced, dark green and shiny on the upper surface and paler beneath, with numerous lateral veins forming oblique or medium angles with the midrib. The umbel or flower-cluster has a flattened stalk about ½in. long, and carries several flowers on very short stalklets; lid of bud conical with apex slightly curved, and base seated just within the rim of the calyx-tube (immature seed-cup); anthers with longitudinal and parallel openings. Ripe seed-cup about ¼in. to 5/16in. deep and much narrower at base than at rim, with stalklet very short; valves while closed forming a sunk pyramid within the rim and when open slightly protruding above it.

For description of the MATURE WOOD of *E. saligna* we cannot do better than quote the words of R. T. Baker in his *Hardwoods of Australia.*

"The timber is one of our finest hard red-woods, being of medium weight, easy to work, durable; it dresses well, and is in general demand throughout the timber trades. . . . It is a favourite wood with coachbuilders generally. It is used for felloes more particularly, general coach and wheelwrights' work, carriage framing, building construction, wood blocks, sleepers, shipbuilding &c. It is straight grained, open, takes a good polish and looks well in cabinet work." (*Hardwoods* 243.)

A general view of available information suggests that quite mature *E. saligna* wire poles may be expected to last 20 years without preservative treatment and from 25 to 35 years if effectively treated.

CULTIVATION IN NEW ZEALAND.

The species attains its best in situations where the subsoil is free and moist but not wet, the summers warm, and the winters mild. Specimens have already grown to a millable size in New Zealand, as at Pukeroro near Cambridge and in the Upper Tutaenui near Marton. Vigorous young trees not yet of millable size may be seen in very many North Island plantations. Hardiness, celerity of growth, and high merit of timber may all be claimed for *E. saligna;* and so far we have not anywhere seen this tree seriously attacked by insect enemies. Seed for future plantings should be obtained either from our own best acclimatized specimens or from certified and approved trees where the species is at its optimum in New South Wales.

GROUP III. E. SALIGNA. E. SIDEROXYLON.

E. saligna and *E. botryoides* are so closely related that planters and students often find difficulty in distinguishing between them. With trees in the sapling stage it may be impossible to make a positive determination. Later, when maturity has been reached, the bark habits of the two trees will appear in clearer contrast and usually dismiss all doubts. *E. saligna* is a smooth-barked tree from near the ground; *E. botryoides* is heavily clothed with rough dead bark from base to branches. The specific name *saligna* means willow-like, but does not help us in distinguishing this species from many others.

42. E. SIDEROXYLON A. Cunningham.

NATURAL HABITAT, DESCRIPTION, AND USES.

This is one of the most widely distributed of the ironbarks, being a constituent of the native forests on hilly country in Victoria, New South Wales, and southern Queensland, and ascending the eastern slopes of the mountains to altitudes of about 2,000ft. It is a species that can grow on poor land provided the substratum permits free penetration of its roots. The tree is small to medium in size. Its natural tendency is to develop a crooked stem with open and spreading top. It must therefore be planted in close stands or with other trees to ensure the formation of straight stems of sufficient length for wire poles.

The dead bark persists on the stem and large branches. On older trees it is very hard and thick, deeply furrowed, and of a dark "burnt greasy cake" shade. The leaves in the juvenile stage are usually very narrow and already stalked; on the adult tree of medium length and width, leathery, and of the same slaty or dull silver green on the two surfaces. Umbel with three to five flowers; stalk and stalklets both about ½in. long; lid of bud conical or long and contracted towards apex; anthers with terminal openings. Ripe seed-cup about ⅜in. deep and of nearly equal width, presenting with its stalklet a shape somewhat like that of a goblet; valves often five in number, deeply sunk below rim. In this and one or two other species the dead stamens usually remain adherent to the interior of the orifice after the valves have opened and the seed has fallen from the cells.

The MATURE WOOD of this ironbark is deep red in colour, dense, and very heavy. Its reputation for strength and durability is not quite equal to that of *E. paniculata;* but it is a true ironbark with the general merits of that distinguished group. All reports agree that the quite mature red heartwood of this species will last a very long time in contact with the ground or in any other trying situation.

CULTIVATION IN NEW ZEALAND.

Our experience in New Zealand strongly tends to confirm these reports from Australia. Many specimens of *E. sideroxylon* were about forty years ago planted with other eucalypts on railway reserves south and north of Auckland. Within recent years some of the trees have been cut down and utilized for fence posts. The stems of these trees contained a very high percentage of red heartwood of a density and appearance that could leave no doubt about good lasting quality. Time has yet to decide how long these posts will last, but a period of thirty years seems to be quite reasonably anticipated.

GROUP III. E. SIDEROXYLON. E. SMITHII.

For us in New Zealand this ironbark is especially valuable because of its capacity to accept a wide range of our climatic conditions. Competent experiment may or may not in future extend the profitable range of other members of the ironbark group beyond the limits at present understood to be imposed upon them. *E. sideroxylon* has already flourished and grown to a useful size not only in the Auckland area, but as far inland as Piako and Cambridge and as far south as the Hastings district in Hawke's Bay. With this and many other eucalypts we need competent help in Australia to ensure that the seed we use shall be derived from the largest and hardiest parent stocks.

E. sideroxylon produces a large percentage of trees that bear pink to deep crimson flowers. Such trees in parks or large gardens make exceedingly ornamental specimens, and will be increasingly appreciated as they become better known.

The specific name *sideroxylon* is from the Greek *sideros* iron and *xylon* wood. It thus literally means "iron wood".

43. E. SMITHII R. T. Baker.

NATURAL HABITAT, DESCRIPTION, AND USES.

This is one of the numerous species that have only within recent years become known to science. Its native home is in damp valleys of northern Victoria and the southern half of New South Wales. In the latter State it is fairly abundant and highly valued for its essential oil. The tree is of medium dimensions, branchy and spreading in open situations; tall with straight, clean bole when growing amongst other trees. Dead bark persistent on lower part of stem and sometimes all up the stem, sub-fibrous, ultimately thick and dark in colour. How long? Juvenile leaves sessile, lance-shaped, acute-pointed; those of adult tree narrow, falcate, of same green on both surfaces, rich in essential oil of very pleasant odour. Umbel usually 7-flowered; lid of bud short with blunt-pointed apex; anthers kidney-shaped with divergent connected openings. Ripe seed-cup about ¼in. in diameter; valves when open claw-like and protruding. Mature wood brown or grey, hard, strong, and of fair durability. In both stages of its foliage ***E. Smithii*** is closely similar to ***E. viminalis;*** but it differs from that species in having a seven-flowered umbel and in the odour of its essential oil.

CULTIVATION IN NEW ZEALAND.

E. Smithii has been successfully cultivated on the Auckland Isthmus; as at the site of the old Three Kings College, and at "Ngaruru", St. Andrew's Road, Epsom, (Sir James Gunson). The species would probably flourish in sheltered lowland valleys all round the North Island. Seed should be obtained through the Forest Service of New South Wales.

The specific name was given in honour of H. G. Smith, who worked so long with R. T. Baker in the Technological Museum, Sydney.

GROUP III. E. TERETICORNIS.

44. E. TERETICORNIS Smith.

NATURAL HABITAT, DESCRIPTION, AND USES.

This species, it is said, formerly grew in great abundance and to very large dimensions on good lowland country in Gippsland. In less majestic forms nature gave it a wide distribution in other parts of Victoria. For its present optimum we are referred to north-eastern New South Wales and southern Queensland. *E. tereticornis* is a closely similar tree to *E. rostrata,* but less drooping in the habit of its branchlets and foliage. The dead bark of both is non-fibrous and falls away in sheets or large scales, or sometimes persists for a few feet near the ground. Both species have stalked juvenile leaves, those of *E. tereticornis* being usually broad and sometimes orbicular; those of *E. rostrata* usually narrow. The adult tree leaves of both are long, falcate, and of a dull green hue on the two surfaces. In *E. rostrata,* as we have seen, all the parts of the umbel are small and delicately formed; in *E. tereticornis* they are closely similar in form and arrangement but larger and coarser. *Tereticornis* means round-horned and was given as specific name to this tree because its buds are horn-shaped, either blunt conical or long and pointed. Several other eucalypts have horn-shaped buds; but the character serves here to distinguish two trees that are very closely related. The anthers of both species open with longitudinal and nearly parallel slits. The ripe seed-cups of both have rising rims and valves that when open strongly protrude.

The MATURE WOOD of *E. tereticornis* is of a deep red colour and very durable in any situation. It is so much like that of *E. rostrata* that the two cannot be easily distinguished.

CULTIVATION IN NEW ZEALAND.

Further comparing the two trees as so far tested in New Zealand, general preference must be given to *E. rostrata,* for the reason that it appears to surpass *E. tereticornis* both in climatic range and in yield of timber.

EUC. BOSISTOANA.

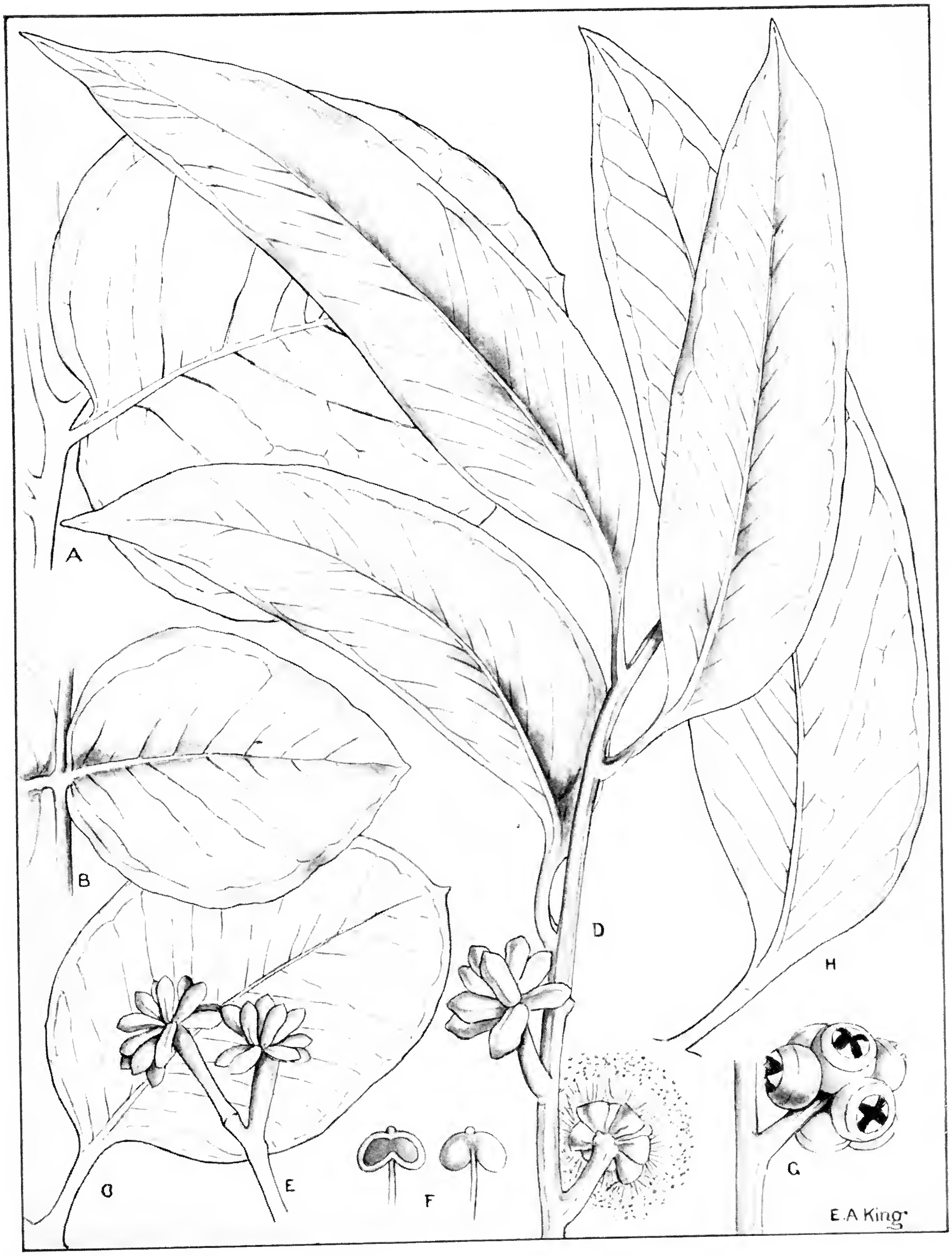
EXPLANATION OF PLATE.

A. Juvenile leaf. Note shape and stalk. B. Twig bearing buds and adult leaves.
C. Anther. Note shape and openings. D. Seed-cups; valves below rim.
E. Seed-cups; valves slightly protruding.

EUC. BOTRYOIDES.

EXPLANATION OF PLATE.

A. Juvenile leaf; such leaves often much larger. B. Twig bearing buds, flowers, and adult leaves. C. Anther, front and back view. D. Umbel of ripe seed-cups.



EUC. CAPITELLATA.

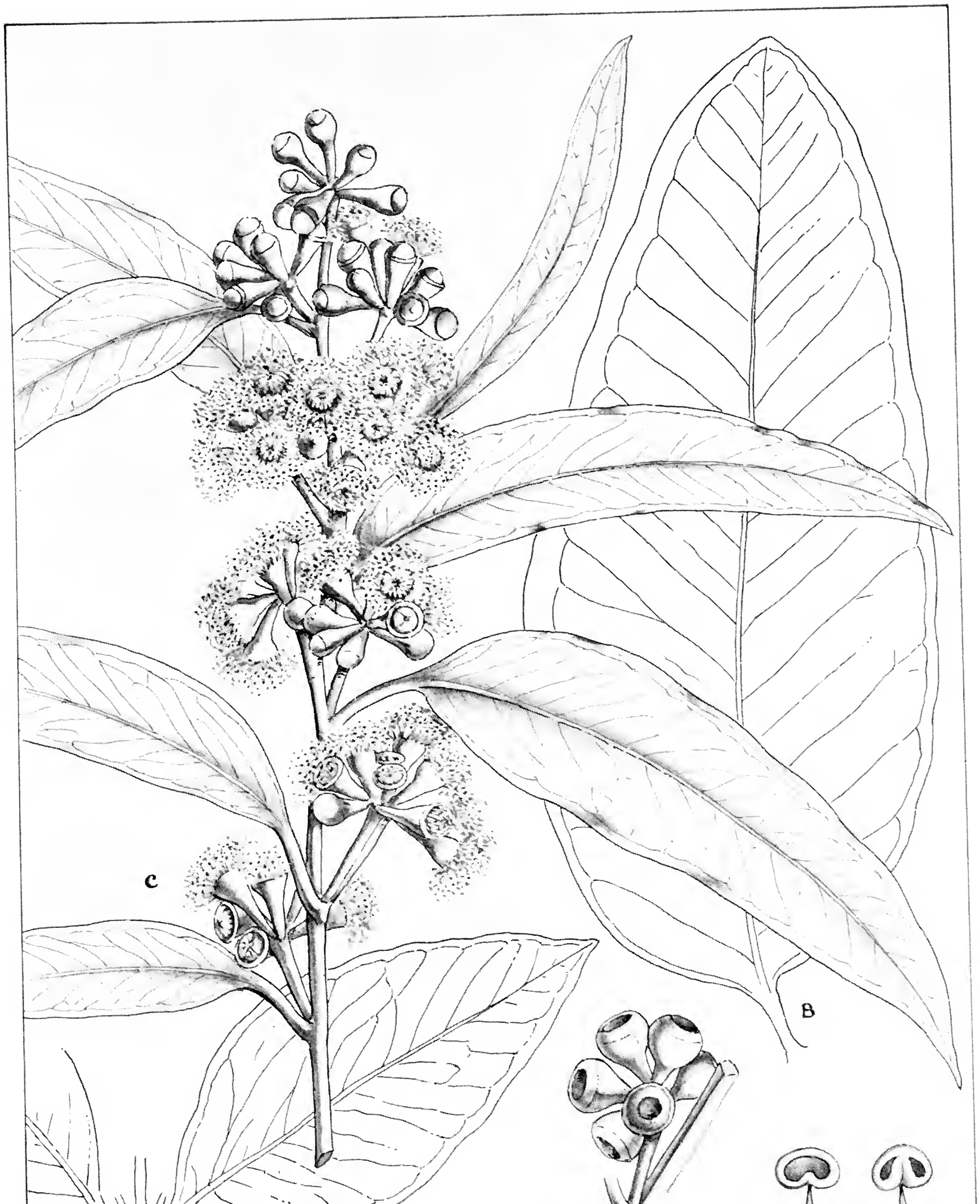
EXPLANATION OF PLATE.

A. Juvenile leaf. B. Juvenile leaf, nearly sessile. C. Leaf in intermediate stage. D. Twig bearing buds, flowers, and adult leaves. E. Smaller buds. F. Anther, front and back view. G. Ripe seed-cups. H. Large adult leaf.

EUC. EUGENIOIDES.

EXPLANATION OF PLATE.

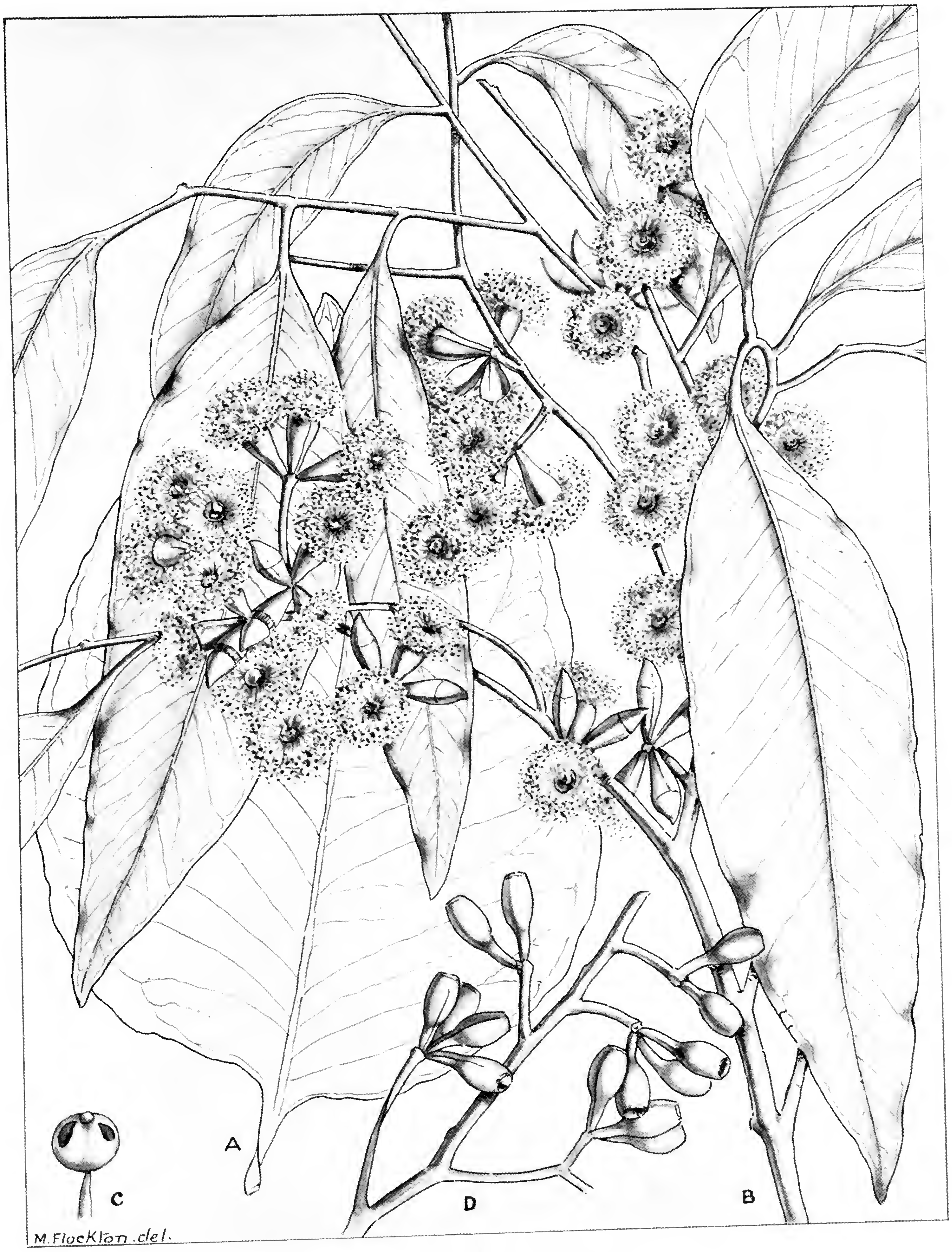
A. Juvenile leaves. Note indented margins and minute stellate hairs. B. Juvenile leaves. C. Leaf in intermediate stage. D. Twig bearing buds, flowers, and adult leaves. E. Anther, front and back view. F. Ripe seed-cups.



EUC. HAEMASTOMA.

EXPLANATION OF PLATE.

A. Juvenile leaves. B. Larger juvenile leaf. C. Twig bearing buds, flowers, and adult leaves. D. Two anthers, front view only. E. An umbel of ripe seed-cups. Note rims of cups.



EUC. HEMIPHLOIA.

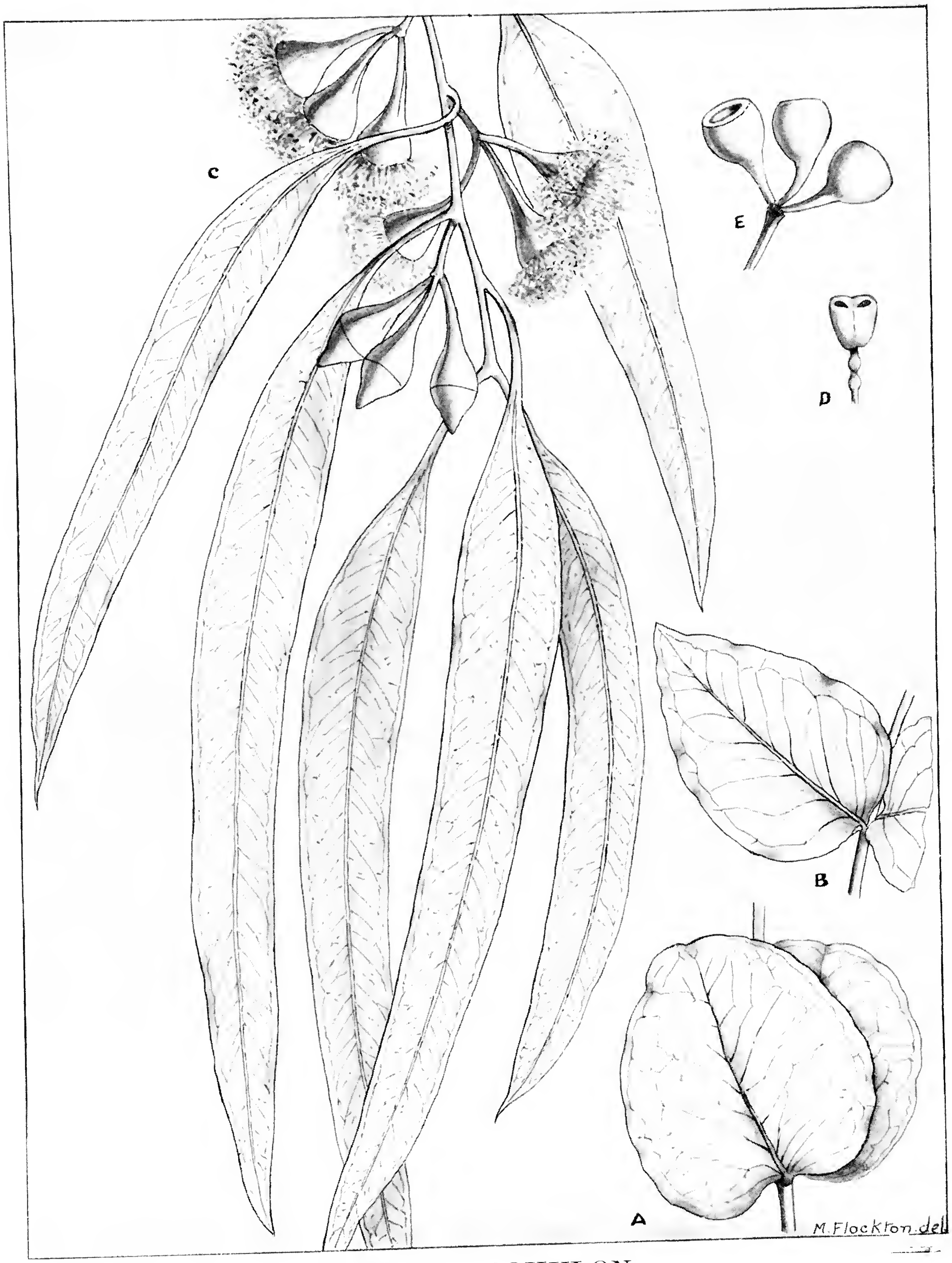
EXPLANATION OF PLATE.

A. Juvenile leaf. Note size and shape. B. Twig bearing buds, flowers, and adult leaves. C. Anther. Note shape and position of openings. D. Seed-cups. Note deep goblet-shape.

EUC. LAEVOPINEA.

EXPLANATION OF PLATE.

A. Juvenile leaves in opposite stage. B. Juvenile leaf in intermediate stage. C. Twig bearing buds and adult leaves. D. Anther, front and back view. E. Seed-cups with low rims. F. Seed-cups with full rims and protruding valves.



EUC. LEUCOXYLON.

EXPLANATION OF PLATE.

A. Juvenile leaves in sessile stage. B. Juvenile leaves in nearly sessile stage. C. Twig bearing buds, flowers, and adult leaves. D. Anther. Note terminal position of openings. E. Seed-cups. Note goblet-like shape.

EUC. LONGIFOLIA.

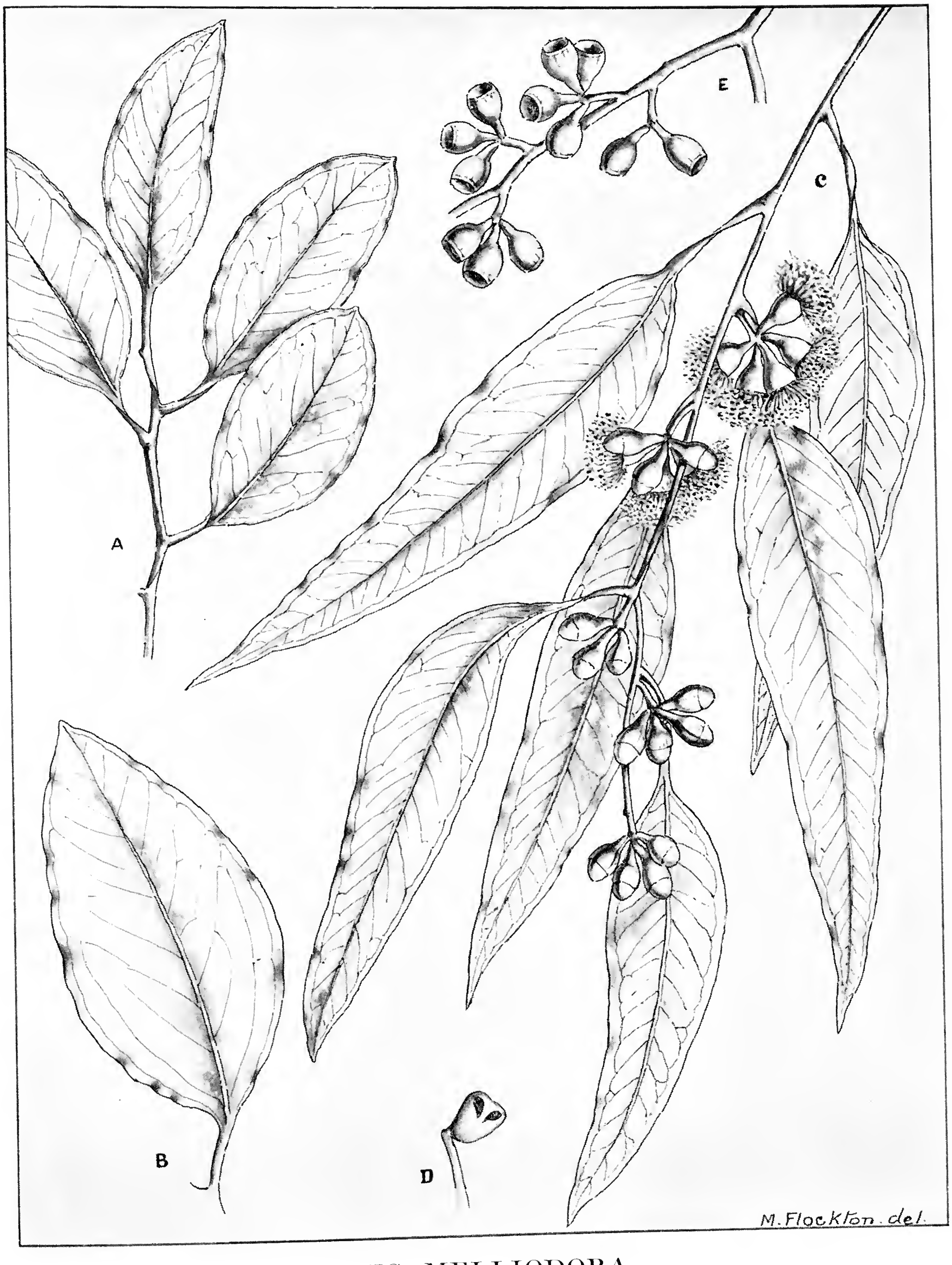
EXPLANATION OF PLATE.

A. Juvenile leaf. B. Adult leaves. C. Buds, flowers, and unripe fruits. D. Anther, side view showing one opening. E. Seed-cups. Note size and shape of rim.

EUC. MACRORRHYNCHA.

EXPLANATION OF PLATE.

A. Juvenile leaves in opposite stage. B. Juvenile leaves, opposite but not quite sessile. Note indented margins and stellate hairs. C. Intermediate or sapling leaf. D. Twig bearing buds, flowers, and adult leaves. E. Anther, front and back view. F. Umbel of ripe seed-cups. Note rising rim, protruding valves, and 3-celled orifice.



EUC. MELLIODORA.

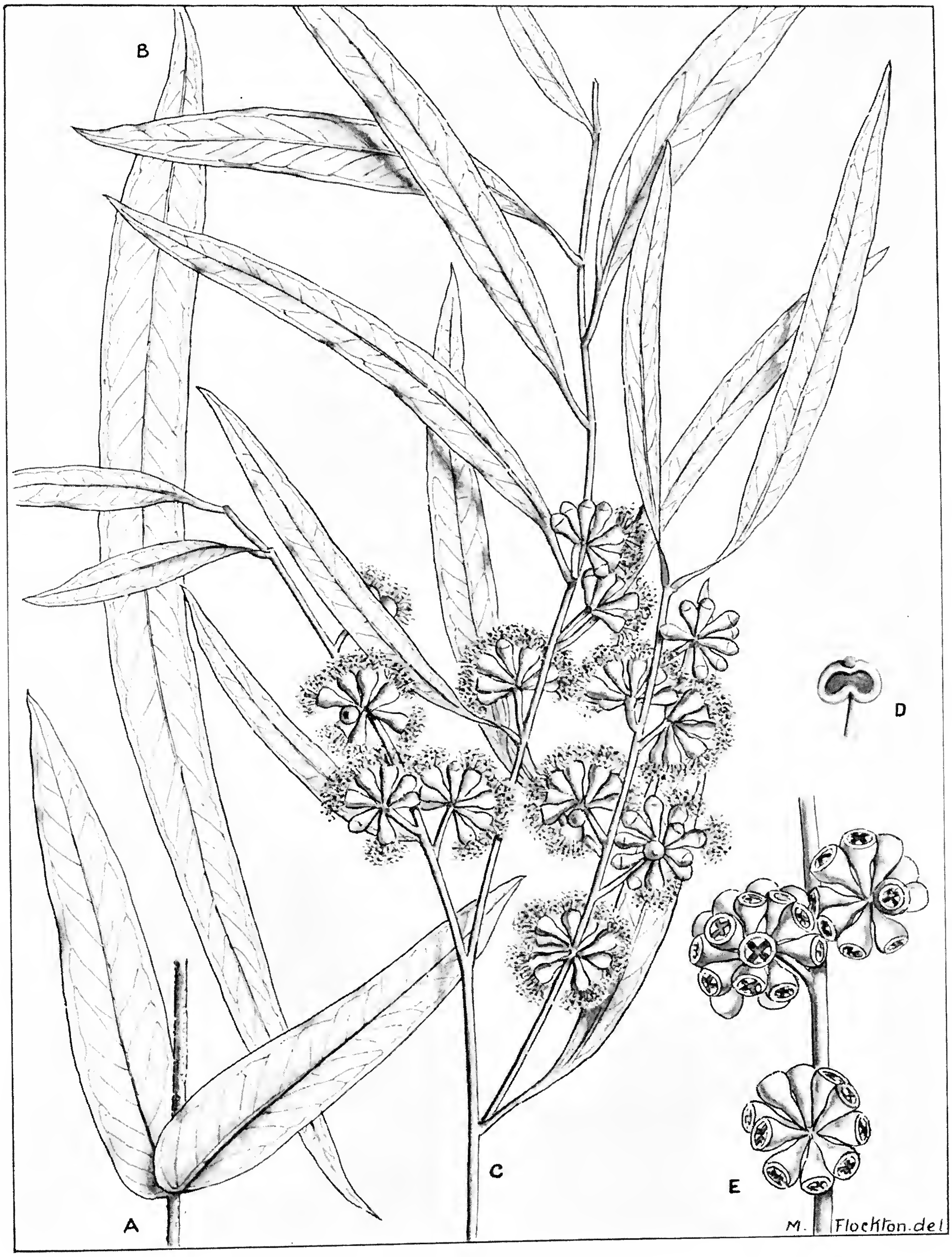
EXPLANATION OF PLATE.

A. Small juvenile leaves; elliptical and stalked. B. Larger juvenile leaf. C. Twig bearing buds, flowers, and adult leaves. D. Anther. Note shape and terminal openings. E. Seed-cups in a cluster of four umbels.

EUC. MUELLERIANA.

EXPLANATION OF PLATE.

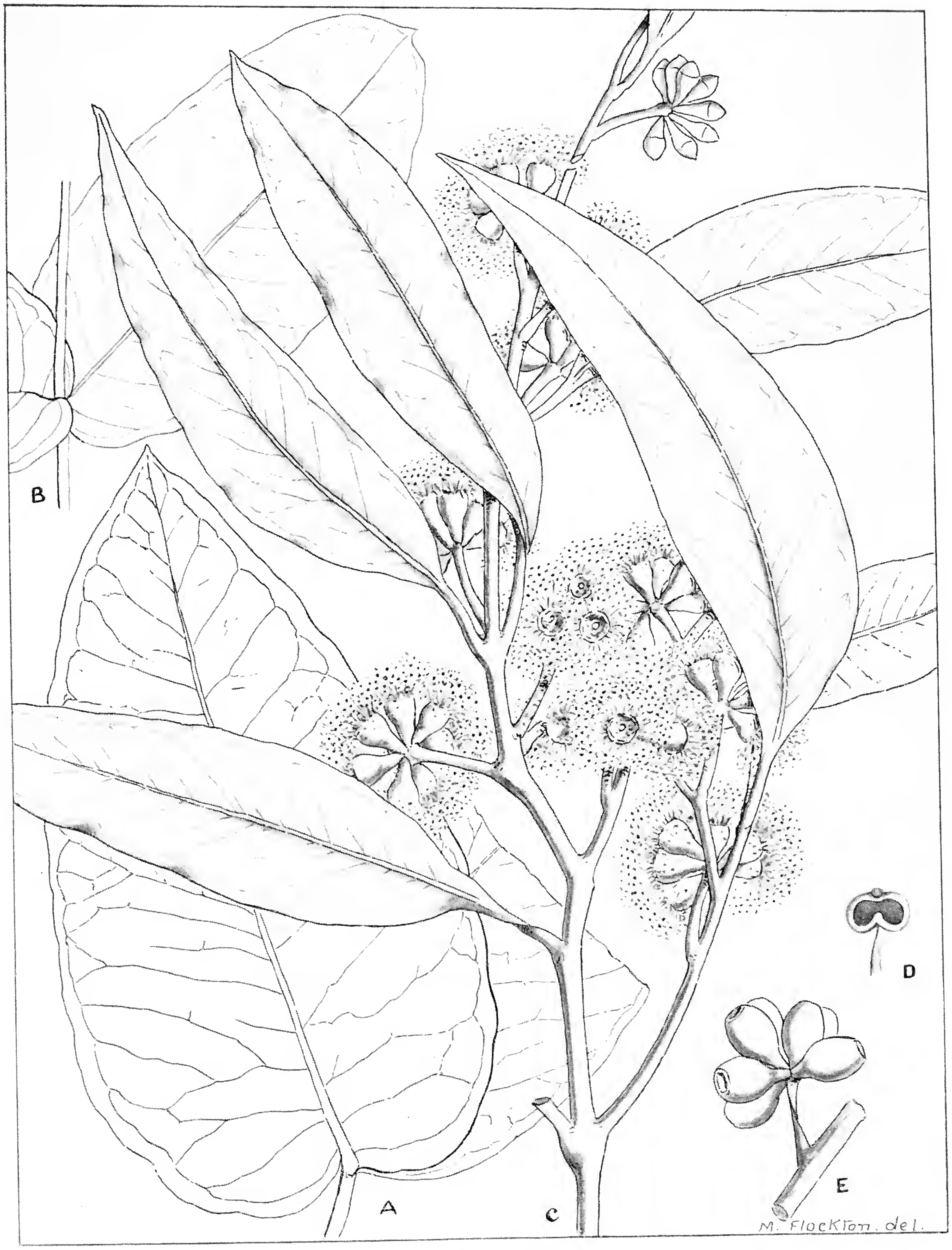
A. Juvenile leaf. B. Twig bearing buds, flowers, unripe fruit, and adult leaves. C. Anther, front view. D. Seed-cups. Note similarity to those of *E. pilularis*.



EUC. NUMEROSA.

EXPLANATION OF PLATE.

A. Juvenile leaves in sessile opposite stage. B. A large intermediate leaf. C. Twig bearing buds, flowers, and adult leaves. D. Anther, front view. E. Seed-cups. Some trees growing in N.Z. bear nearly spherical seed-cups on very slender stalklets.



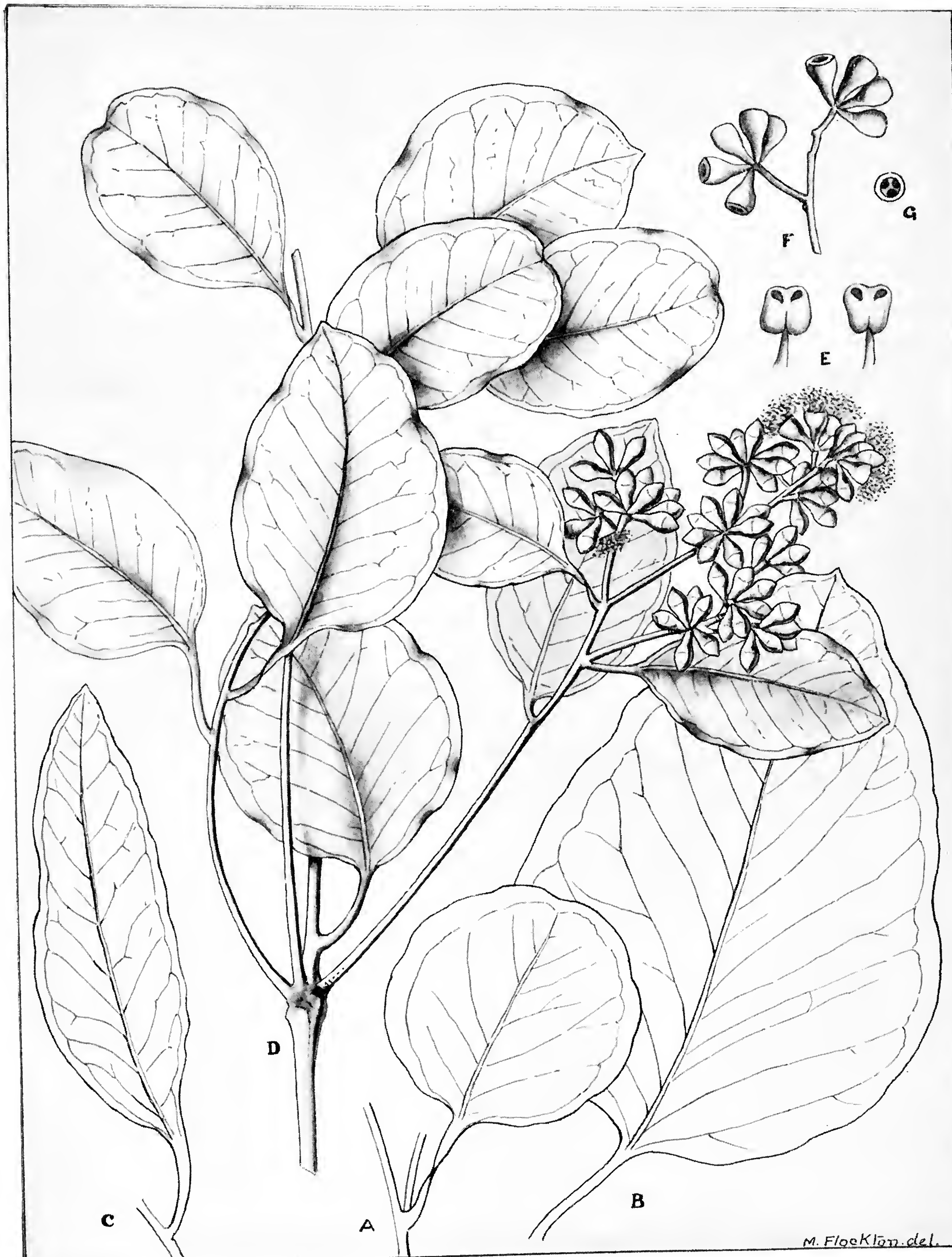
EUC. PIPERITA.

EXPLANATION OF PLATE.

A. Juvenile leaves in the sessile opposite stage. B. Smaller juvenile leaves. C. Twig bearing buds, flowers, and adult leaves. D. Anther, front view. E. Seed-cups; egg-shaped.

NOTE.—The young buds of *E. piperita* are sometimes angular, curved, and sharp-pointed; the seed-cups sometimes urn-shaped with narrow neck.

Botanic Plate
No. 39.



EUC. POLYANTHEMOS.

EXPLANATION OF PLATE.

A. B and C. Juvenile leaves. D. Twig bearing buds, flowers, and adult leaves. Note that the adult leaves are similar to those of the young plant. E. Anthers. Note shape of lobes and position of openings. F. Seed-cups. G. Orifice of seed-cup showing three cells.

EUC. ROSTRATA.

EXPLANATION OF PLATE.

A. and B. Juvenile leaves in opposite stage but long-stalked. C. Buds with short points. D. Buds with longer points. E. Anther, back and front view. F. Twig bearing seed-cups and adult leaves.

EUC. SALIGNA.

EXPLANATION OF PLATE.

A. Juvenile leaves. B. Larger juvenile leaf. C. Twig bearing buds, flowers, and adult leaves. D. Anther, front and back view. E. Seed-cups. Note that the valves spring from within the cup and slightly protrude beyond the rim.

Botanic Plate
No. 42.

EUC. SIDEROXYLON.

EXPLANATION OF PLATE.

A. B. C. Juvenile leaves. D. Twig bearing buds, flowers, and adult leaves. E. Anthers. Note shape and mode of opening. F. Seed-cups. As shown here, the umbel of this species is usually 3-flowered. G. Seed-cups larger and more numerous in the umbel. H. Orifice of seed-cup showing five cells.

Botanic Plate
No. 43.

EUC. SMITHII.

EXPLANATION OF PLATE.

A. Juvenile leaves. Note that they are closely sessile and tapering. B. Twig bearing buds, flowers, and adult leaves. C. Anther, front and back view. D. Seed-cups. Note rising rim and short valves. E. Intermediate or sapling leaf.

EUC. TERETICORNIS.

EXPLANATION OF PLATE.

A. Juvenile leaf. Note nearly orbicular shape and long stalk. B. Twig bearing buds, flowers, and adult leaves. C. Anther, front and back view. D. Seed-cups, with valves very prominent. E. and F. Seed-cups with valves protruding but less prominent.

GROUP IV.

Species adapted to localities where there are light falls of snow some years, where hard frosts occur in winter and early spring, but where summer and autumn are usually warm and without extremes. Estimated range in mean annual temperature for successful cultivation, 52° to 57° F. Probable limit of vigorous resistance to cold for seedlings and young saplings, between 16° and 22° F.

E. aggregata.	E. Maideni.
E. Andrewsi.	E. obliqua.
E. fastigata.	E. oreades.
E. globulus.	E. ovata.
E. goniocalyx.	E. Sieberiana.
E. Macarthuri.	E. Stuartiana.

45. E. AGGREGATA Deane and Maiden.

NATURAL HABITAT, DESCRIPTION, AND USES.

This little known species is indigenous to moist areas in north-eastern Tasmania and south-eastern Australia. Its dead bark is matted and woolly or sometimes flaky on the surface; persistent on stem and large branches. Leaves in juvenile stage round or oval, wavy at margins, and very early stalked; on adult trees either equal-sided or unequal and falcate, with a length of 5in., and the two surfaces of about the same shade of green. The umbel is normally seven-flowered, the stalk and stalklets being very short and slender. Lid of bud a very small low cone; anthers with nearly parallel openings. Ripe seed-cup 3/16in. to ¼in. in diameter; three-celled; valves when open protruding. MATURE WOOD pale, tough when fresh; reputation for durability not good.

CULTIVATION IN NEW ZEALAND.

On first sight *E. aggregata* may be mistaken for *E. Macarthuri;* but the confusion will at once cease when we compare the oval and stalked juvenile leaves of *E. aggregata* with the lance-shaped and sessile juvenile leaves of *E. Macarthuri.* As noted by the writer in several North Island localities, *E. aggregata* is a wide-spreading and very ornamental shade tree. It might well be given a limited place in our parks and public domains; but planters must be warned against including it in their list for timber production.

46. E. ANDREWSI Maiden.

NATURAL HABITAT, DESCRIPTION, AND USES.

This species has its natural distribution on the high country of northern New South Wales and southern Queensland. Its optimum appears to be at altitudes between 2,500ft. and 3,000ft. above sea level, where the winter temperature often falls several degrees below freezing point. The trees attain heights from 80ft. to over 100ft., and yield good sized logs for the sawmills. The dead bark is intermediate between the "peppermint" and "stringybark" types, and persists on stem and large branches. Juvenile leaves early stalked and sometimes very broad; those of adult tree up to 6in. long, of same green on the two surfaces. Umbel with 6 to 9 flowers; lid of bud low; anthers kidney-shaped with divergent but united openings. Ripe seed-cup ¼in. wide and a little less in depth; rim thick, slightly convex, and dull red; valves small and nearly concealed by rim. MATURE WOOD pale, fissile, highly valued locally for quality and durability.

CULTIVATION IN NEW ZEALAND.

Thrifty specimens may be seen in the State forests at Whakarewarewa and in the plantations at Wesley Training College, Paerata. The species merits generous trial on our northern uplands and in lowland areas of the South Island. Seed should be obtained from competently selected trees in the Glen Innes district, New South Wales.

47. E. FASTIGATA Deane and Maiden.

NATURAL HABITAT, DESCRIPTION, AND USES.

The native home of this species is on the eastern uplands of Victoria and New South Wales. The tree grows very rapidly to a large size, branching heavily in open situations, but forming a long clean bole when closely surrounded by other trees. The stem and large branches are covered with persistent dead bark, which is distinctly fibrous, but not quite so tough as that of some other stringybarks. The leaves in the juvenile and adult stages are not very different. They are stalked, thin, broad, but in the adult stage with gradual taper to both apex and stalk (petiole), edgewise or vertically suspended, and of about the same green on the two surfaces. The sloping or tapering shape of the adult tree leaf is an obvious character, and, together with the shape of the bud, gave choice to the specific name *fastigata*. The umbels are usually produced in *pairs* in the axils (angles) of the leaves, the number of flowers in each being often large. Lid of bud pointed but short; anthers kidney-shaped with divergent openings. Ripe seed-cup about ¼in. deep by 5/16in. wide, whip-top-shaped, and almost invariably three-celled; the three valves while closed forming with the rising rim a smooth dome, and when open protruding beyond it.

The MATURE WOOD is pale in colour, very freely fissile, excellent for sawing into boards and scantling, suitable for furniture, and adapted to most of the purposes for which ash wood is used. How long the quite mature wood will last in contact with the ground, we have not yet sufficient experience to say. Reports from New South Wales, together with the appearance of the fresh timber and of logs that have for a considerable time been lying on the ground exposed to the weather, seem to warrant an expectation of ten to fifteen years. Effective application of preservatives might add another ten years to that period.

CULTIVATION IN NEW ZEALAND.

The value of an otherwise well commended timber tree is greatly increased by rapidity of growth and wide climatic range. *E. fastigata* can claim both of these merits. Numerous trees in the Railway Reserve at Papakura, when only thirty-two years old had reached heights up to 100ft., and diameters of 3ft. to 4ft.

Similar specimens may be seen in a reserve just below the Railway Station at Cambridge. On private property near Hinuera there were, some years ago, several specimens one of which had reached a total height of 154ft., a clean millable bole of over 70ft., and a diameter at breast height of 3ft. The species is represented in many other North Island localities, of which the following may be selected for mention:—Whakarewarewa; "Puketiti", near Tokomaru Bay; "Te Mata", near Havelock North; and "Marumarunui", near Opunake. In the South Island several large trees have been noted in Charteris Bay near Lyttelton and a few vigorous saplings as far south as Heriot in Otago. Young seedlings are sensitive to frost, but the wide range of existing large trees proves that this difficulty can be overcome.

E. fastigata was formerly included as a variety under *E. regnans;* but its more branchy habit of growth, its persistent fibrous bark extending to upper stem and branches, and the rising or domed rim of its fruit distinguish it from that species and entitle it to separate specific rank. Seed should be obtained from our own best acclimatized trees.

48. E. GLOBULUS Labillardière.

NATURAL HABITAT, DESCRIPTION, AND USES.

This is one of the species distributed by nature on both sides of Bass Strait. It has attained its largest dimensions and won its highest honours for quality of timber in south-eastern Tasmania. The blue-green colour and angular stems of the young plant, the tall smooth bole and dark green pendent leaves of the adult tree, the warty lid of the bud, and the ripe seed-cup with its ridged and creased exterior, have been made so familiar to people in New Zealand by exotic specimens that there is no need to give a detailed description of the tree. It is very important to remark, however, that the species exists in two forms with respect to the manner in which it produces its flowers. In the one form the flowers are single or solitary and the ripe seed-cup 1in. or more in lateral diameter. In the other form the flowers are normally three on the one stalk and the ripe seed-cup only about ⅝in. in diameter. We in New Zealand understand that the single-flowered form is identical with the "blue gum" of south-eastern Tasmania, and that the three-flowered form belongs to the mainland. Most of our New Zealand specimens are single-flowered; and where three-flowered trees have been noted they have been regarded as inferior in both rate of growth and quality of timber. Planters are advised to propagate only from best single-flowered trees.

CULTIVATION IN NEW ZEALAND.

Although endowed with wonderful vitality, *E. globulus* is really very exacting with respect to both climate and soil. Its natural optimum is in a cool part of Tasmania not very much above sea level, the latitude being about the same as that of Christchurch. Where the species exists in a somewhat varied form on the Australian mainland it has found climatic compensation by rising to an altitude of 1,000ft. to 3,000ft. It is thus a cool country tree. In ignorance or disregard of this truth, we planted it all over our warm North Island lowlands where the winters are too mild for keeping it in strongly resistant health. Again, in its native Tasmania it attained its best where the soil was rich in alumina and well watered. We, still in ignorance or in disregard of natural truth, planted this tree further south on poor dry country, and on good and well-watered country without discrimination. Wherever the winters have been too mild or the land has been too dry and poor, this species has been severely attacked by insect enemies. On the rich lowlands of Canterbury and Otago, where both climate and soil are congenial, it is still resistant and flourishing. The lesson is obvious, and must be applied not only to *E. globulus* but to all other trees.

Important! i.e. locality or soil climate or both.

The sapwood of *E. globulus,* like that of all other trees, will soon decay if exposed to the weather or placed in contact with the ground. The quite MATURE HEARTWOOD is dense and strong and long lasting. The writer has made many inquiries amongst experienced and trustworthy farmers in New Zealand, and has found that the expectation of life for best posts of this species ranges from sixteen to twenty years. There are good and inferior strains of this as of most other trees. The best strain has tall straight stems with smooth bark and large single flowers. Only from the most carefully selected specimens should seed be taken for any future plantings.

In every case where a species has been growing in widely separated localities for a very long period of time, we must be prepared to detect in it some amount of variation, and must not be surprised if we occasionally find reason to suspect hybridism. More has been written about *E. globulus* than about any other eucalypt; but we still need a searching and critical comparison between the Tasmanian and mainland forms of the species.

49. E. GONIOCALYX F. von Mueller.

NATURAL HABITAT, DESCRIPTION, AND USES.

This species has its natural home in the damp mountain valleys of Victoria and southern New South Wales, at altitudes of from 2,000ft. to 4,000ft. It is said to be also found in South Australia. Reports indicate that it attains its optimum in western Gippsland where the mountain slopes face southward. The trees there grow to large dimensions and mingle with other millable eucalypts. The dead bark is non-fibrous and falls away irregularly leaving the branches of the tree smooth and the stem blotched and patchy. Juvenile leaves very broad at base and sessile, often large; adult tree leaves long, unbalanced, and of nearly the same deep green on the two surfaces. Umbel with several flowers up to seven; stalk up to ¾in. long, stalklets very short or absent; lid of bud short and pyramidal or longer and acute; anthers with nearly parallel openings. Ripe seed-cup ¼in. to 5/16in. in lateral diameter, and a little more in depth, pear-shaped but very angular, almost sessile, usually 3-celled; open valves nearly hidden by rim. MATURE WOOD pale, moderately fissile, strong, with reputation for durability generally good.

CULTIVATION IN NEW ZEALAND.

An inferior species of *Eucalyptus* called *E. elaeophora* is closely similar to *E. goniocalyx* in botanical characters, but is distinguished by having persistent "box" bark all up the stem and by usually having larger and coarser seed-cups.

GROUP IV. E. NITENS. E. MACARTHURI.

Both species are represented by scattered specimens in New Zealand, and planters are warned against the risk of cultivating the almost useless *E. elaeophora.* Seed of *E. goniocalyx* should be obtained under competent direction from best trees at high altitudes in south-western Gippsland, Victoria. With such seed experiments should be made in both Islands, in the North up to 1,000ft. to 2,000ft.; in the South up to 500ft. above sea level. Where the species has failed to endure moderate frosts in New Zealand there is reason to suspect that it has been propagated from seed collected at a low altitude, and consequently from a strain weak in resistance to cold.

The specific name *goniocalyx* is a compound of the Greek *gonia* corner or quoin and *calyx,* and was appropriately suggested by the angular shape of the immature seed-cup.

E. NITENS Maiden.

This eucalypt is found in the same habitat as *E. goniocalyx* and was until recently regarded as a variety of that species. The tree at its optimum is very tall and very large in girth. Dead bark non-fibrous, deciduous from branches and stem, except for a few feet near the ground where it sometimes persists; newly exposed living bark smooth and shining. Leaves in juvenile stage sessile, broad; on adult tree stalked, of same green on the two surfaces, generally long and occasionally exceeding 1 foot in length. Umbel with flowers up to seven; bud as a whole angular and curved; anthers as in *E. goniocalyx.* Ripe seed-cup ¼in. to 3/16in. in depth and width, contracted towards both pedicel and orifice, open valves slightly protruding or just below rim. MATURE WOOD pale, straight in grain, tough, durability not yet tested. *E. nitens* ranks as a giant in its native home and should be given competent trial on our North Island uplands. The Forest Service of Victoria will be able to obtain seed from certified specimens of large size and good form. The specific name *nitens* means shining, and is appropriate as applied to living bark, foliage, and fruit of this tree.

50. E. MACARTHURI Deane and Maiden.

NATURAL HABITAT, DESCRIPTION, AND USES.

This species has its native home in south-eastern New South Wales. It there flourishes on moist areas along the banks of streams at altitudes from 2,000ft. to 2,500ft. In an open situation the tree develops a widely spreading top with drooping foliage; in a dense stand it early sheds all side branches and develops a tall straight bole. Dead bark persistent on stem and large branches, sub-fibrous, brittle, ultimately very thick and deeply furrowed. Leaves in juvenile stage sessile, opposite in pairs, equal-sided, broad at base, acute towards apex. Adult tree leaves stalked, rather narrow, falcate, and of same green on the two surfaces. Both forms of leaf may sometimes be seen on the same tree, with juvenile leaves and fruit on the same twig. Umbel normally 7-flowered, with all parts delicately formed; stalk ⅜in., stalklets ⅛in.; lid of bud low-domed with minute central point; anthers with nearly parallel openings. Ripe seed-cup about ¼in. in lateral diameter, 3-celled, points of open valves slightly above rim.

The MATURE WOOD is pale with very slight tinge of red, coarse in grain, liable to form wide radial cracks in drying; durable up to 20 years in contact with the ground. Some trees are freely fissile, others tough to split. For the general purposes of a farm the timber of this tree is very valuable.

CULTIVATION IN NEW ZEALAND.

As might be expected from its natural habitat, *E. Macarthuri* can endure a good many degrees of frost. It is very easily propagated either by sowing *in situ* or by transplanting from the seed bed. It has found a particularly congenial home on the pumiceous lands in the Hamilton-Cambridge-Putaruru area, and there has grown rapidly to a very large size. Experiments to ascertain its useful range at higher altitudes and farther south are in progress. It is essentially an inland tree and must not in any case be planted within reach of severe saline winds. Seed obtained from the best acclimatized trees can be supplied by the Forest Service. The specific name *Macarthuri* was given in honour of Sir William Macarthur, who did much to promote knowledge and appreciation of the eucalypts in the earlier years of research.

51. E. MAIDENI F. von Mueller.

NATURAL HABITAT, DESCRIPTION, AND USES.

This species has its natural distribution on the uplands of north-eastern Victoria and south-eastern New South Wales at altitudes of 1,000ft. to 2,000ft. It is one of the least known of the eucalypts, and yet possibly for our country one of the most important. At its optimum the tree reaches heights up to and over 150ft., and diameters up to 3ft. and even 4ft., with a long shaft-like bole free from side branches. Dead bark non-fibrous; deciduous from branches and stem, leaving bluish-white surface of living bark. Leaves in juvenile stage broad and sessile or on very short stalks; those of saplings and adult trees stalked, narrower, and up to 8in. long; lateral veins wide apart and forming oblique angles with midrib. Umbel with several flowers; stalk thick, ⅜in. to ⅝in. long, stalklets ⅛in. less or more; lid of bud low with blunt projection in centre, and bud as a whole sometimes slightly warty; anthers with longitudinal and nearly parallel openings. Ripe seed-cup ½in. or less in lateral diameter, plain or with two slight ridges at sides, rim sloping to orifice, open valves slightly protruding and claw-like.

MATURE WOOD pale yellow, hard, interlocked in grain, and reputed to be both strong and very durable. Small but quite mature poles are said to serve well and last long when used for carrying electric wires.

CULTIVATION IN NEW ZEALAND.

E. Maideni somewhat resembles *E. globulus,* but it is clearly distinct from that species, and probably more resistant to cold. A few scattered specimens have been noted by the writer in this country, but all in situations where it was evident that they had come from seeds accidentally mixed with other species. No time should be lost in obtaining seed from competently certified and approved trees on the mountains of Victoria or New South Wales, and in making experimental plantings 1,000ft. to 2,000ft. above sea level in the North Island and on low foothills in the South Island.

It is interesting to us in New Zealand to learn that this species has already found favour and is being extensively planted in South Africa. J. H. Maiden, who for many years acted as honorary purchaser of Australian tree seeds for the South African forestry services, states at page 404 Vol. vii. of his *Forest Flora* that during recent years far more seed of *E. Maideni* has been supplied to that country than of any other two species of *Eucalyptus*. Official reports to hand show that the species is doing well in several localities and is regarded with much appreciation by experts in tree culture. The species should find equally congenial conditions in New Zealand.

The specific name was given in honour of the distinguished botanist J. H. Maiden.

52. E. OBLIQUA L'Héritier.

NATURAL HABITAT, DESCRIPTION, AND USES.

This is one of the most interesting and important in the whole long list of the eucalypts. It has survived and maintained its botanical identity on both sides of Bass Strait through the long period that has elapsed since Tasmania was rifted from the Australian Mainland. It has flourished in pure and mixed forests in successive generations of gigantic trees. Since the white man settled in these countries it has yielded immense quantities of merchantable timber. In Tasmania it is a tree of the valleys and lower hill country; in Victoria and New South Wales it has climbed the coastal ranges to altitudes of 2,000ft. to 4,000ft., and extended northwards as far as New England. It is a stringybark and carries a persistent fibrous coating all up both stem and branches. The leaves of young plants and stump-sprouts are broader than those of the adult tree, but otherwise the two forms are not very dissimilar. Both are stalked or petiolate and very unequal-sided, with the stalk oblique to the midrib. Those of the adult tree are 4in. to 6in. long, curved to the weaker side, unbalanced, edgewise or vertically suspended, and of the same rich green on both surfaces. Umbel with numerous flowers; stalk about ½in. long, stalklets ⅛in. to ¼in.; lid of bud low and bud as a whole when mature pale-yellow and club-shaped; anthers with divergent openings. Ripe seed-cup about ⅜in. in depth and nearly the same in width, shaped like a pear with a piece cut off the calyx end or an egg with part of one end cut away.

The MATURE WOOD is of a pale-oak colour, easily split, and excellent for sawing into boards and scantling. It is said that stout posts split out of thoroughly mature trees will last fifteen years or more. The species, though indigenous to both Australia and Tasmania, is at its best in the south-eastern portion of the latter country, where the trees were so large and the natural crop so heavy that sawmills at work for many years still have some supplies before them. The Government pamphlet, "Tasmanian Forestry", states that *E. obliqua* is "esteemed as the most valuable general-purpose timber produced in Tasmania", and mentions wharf and bridge construction, house-building, railway-sleepers, and wood-paving amongst the uses to which it is applied. The output is immense, and the demand continuous. The wood now enters largely into furniture manufacture, and is known as Australian "oak."

CULTIVATION IN NEW ZEALAND.

The species is represented with us by many hundreds of specimens in various parts of the North Island, in Marlborough, and in northern Canterbury. Many of the trees have long been large enough for the sawmill. A few in various localities have already been split or sawn up and utilized. When once established *E. obliqua* reproduces itself very freely by natural distribution and germination of the seed; but the seedlings do not transplant well, and therefore in starting a plantation the seed should be sown *in situ,* or the plants worked in boxes or mossed. Seed should be obtained from the best trees in south-eastern Tasmania or from the best acclimatized trees in Canterbury.

The case of *E. obliqua* is similar to that of *E. globulus.* Distribution on the mainland and also in Tasmania during a very long period of time may be assumed to have resulted in some amount of variation. We recommend derivation of seed from Tasmania in the belief that the species is there at its optimum in respect to both volume and quality of timber.

53. E. OREADES R. T. Baker.
Syn. E. ALTIOR Maiden.

NATURAL HABITAT, DESCRIPTION, AND USES.

This species is distributed on the upland country of New South Wales, and especially about canyons of the Blue Mountains. Tree of medium size, usually without side branches. The dead bark falls away in ribbons from branches and major part of stem leaving a white surface. Leaves in both stages stalked; on young plants broad, sometimes slightly glaucous; on adult trees long, unbalanced, deep green on both surfaces. Umbel normally with seven flowers; lid of bud conical; anthers with divergent connected openings. Ripe seed-cup 5/16in. to ⅜in. in diameter, usually 5-celled. MATURE WOOD pale, fissile; sawn up by mills into valuable boards and scantling.

CULTIVATION IN NEW ZEALAND.

Specimens at Tarukenga near Rotorua in 30 years reached height of 100ft. and stem diameter of 2ft. A study of the species in its natural home and at Tarukenga leads to the conclusion that it is of great promise for cultivation in New Zealand. Inland localities where the winters are cold without alpine severity will offer suitable conditions for experiment. Officers of the Forest Service at Whakarewarewa know the Tarukenga trees and will be able to supply seed collected therefrom; or application may be made to the Forest Service of New South Wales with request to collect from best trees in a cool part of the habitat.

GROUP IV. E. OVATA.

54. E. OVATA Labillardière.

NATURAL HABITAT, DESCRIPTION, AND USES.

As now broadly defined by J. H. Maiden under Labillardière's name, the species here described includes Hooker's *E. acervula* of Tasmania and R. T. Baker's *E. paludosa* of the mainland. Baker's *E. camphora* is also doubtfully regarded as a variety. As seen on poorer land in Tasmania *E. ovata* is sometimes a small tree or mere shrub; but mingled with other trees where the land is good and moisture abundant it grows to a moderately large size and yields long clean boles 2ft. or more in diameter for the sawmills. On the mainland it is indigenous to the southern and south-eastern uplands, and is there a tree of medium size with tendency to spreading habit of branches.

The species has been planted in a great many localities in New Zealand. Through confusion of botanical names twenty-five to thirty years ago, it was often planted as *E. Gunnii* or as *E. Stuartiana.* This confusion has ceased; but unfortunately we are too generally left in doubt whether the seed from which our trees have been propagated was collected in Tasmania or in Australia. Rightly or wrongly, we are inclined to give Tasmania credit for the parentage of our most satisfactory specimens and plantations.

Our best trees are of erect habit, and have grown in twenty-five years to total heights of 70ft. to 90ft., with diameters of 1ft. 6in. to 2ft., the boles being straight and shaft-like. The dead bark persists on the lower part of the stem and there becomes scaly and rough but not stringy; from the upper stem and branches it comes off in flakes or long ribbons, leaving a surface that is greenish-grey in colour. The leaves of young seedlings may at first be sessile and opposite, but in all cases they soon become stalked, and thence through the juvenile and sapling stages are very generally oval in shape and more or less wavy at the margins. On the adult tree they are narrower and longer. It was, we may be sure, the conspicuously oval shape of the leaves on younger trees that suggested the specific name *ovata.* The leaves are pendent and of about the same deep green on the two surfaces. The umbel bears normally seven flowers but may have less or more; stalk 3/8in. to 1/2in. long, stalklets 1/8in. or less; lid of bud domed, conical, or pointed; anthers with longitudinal and nearly parallel openings. The ripe seed-cup is about 1/4in. deep by 5/16in. in width at the rim. It is especially remarkable for its rapid taper from the rim to the stalklet, and is further distinguished by a slight groove and flange just below the rim. A whipping-top or cone standing on its apex will serve for illustration of the shape. The valves when open slightly protrude beyond the rim. If trees are found bearing seed-cups with rising rims and strongly protruding valves, there will be reason to suspect that they have been grown from seed collected on the mainland, not in Tasmania.

The MATURE WOOD of the Tasmanian *E. ovata* is described as pale in colour, interlocked in texture, tough to split, very liable to warp when sawn up into boards and scantling, but of high merit and great durability after it has been carefully seasoned. When in Tasmania in 1921 the writer was told that all the *E. ovata* product of one mill was being sent to a factory in Melbourne for carriage construction works. New Zealand will need increasing quantities of timber for similar purposes, and this tree may be destined to help largely in supplying the demand. We have not yet any adequate record of tests for durability of mature *E. ovata* posts and poles in the ground. If tests now in progress prove satisfactory, this species can easily be made to furnish very large numbers of poles in all cooler parts of the North Island.

CULTIVATION IN NEW ZEALAND.

Amongst the very many localities in which *E. ovata* is represented by vigorous and perfectly healthy stands in this country may be mentioned the following:—The State Forests at Whakarewarewa and Waiotapu, "Puketiti" near Tokomaru Bay (A. B. Williams), and "Annedale", Wairarapa. Splendid single specimens and small groups of trees may be seen in hundreds of places. Seed for future plantings should be obtained through the Forest Service at Rotorua, or from competently certified trees of good form and large dimensions in Tasmania.

55. E. SIEBERIANA F. von Mueller.

NATURAL HABITAT, DESCRIPTION, AND USES.

This is another of the species found on both sides of Bass Strait. It is a mountain species. Its range in Tasmania is restricted to a limited area in the north-east at altitudes of 1,000ft. to 1,500ft. On the mainland it is distributed very generally through the mountain forests of Victoria and New South Wales, and there finds a congenial home on poor rocky country at altitudes of 2,000ft. to 4,000ft. The tree as seen at its best in these forests has a straight branchless stem 40ft. to 60ft. or more long, and crowned with abundant dark green foliage. The dead bark persists on stem and larger branches; on young trees it is scaly, on old ones sub-fibrous, thick, firm, and deeply furrowed, the general colouring being dark grey modified by warm brown in the newly opened furrows. Leaves in the juvenile stage already stalked, broad, unbalanced, suspended edgewise to the light, and together with twigs usually covered with a slight glaucous bloom; those of the adult tree with lateral veins at very acute angles to the midrib, long, vertically suspended, and of same dark shiny green on the two surfaces. Umbel with several flowers; stalk flattened, stalklets angular; lid of bud short and blunt, and bud as a whole club-shaped; anthers with divergent connected openings. Ripe seed-cup ⅜in. long by 5/16in. wide, pear-shaped, rim flat, or countersunk with edge then sharp; open valves below rim. MATURE WOOD pale, fissile, of high merit for work in dry situations, reputation for durability in contact with the ground conflicting.

CULTIVATION IN NEW ZEALAND.

In the Rotorua region, 1,000ft. or more above sea level, *E. Sieberiana* has grown very vigorously and reached millable dimensions in thirty years. Contrary to what might have been expected with a mountain species, it has also flourished on North Island lowlands and shown good resistance to strong saline winds. It has been barred from a wider range by extreme sensitiveness of the seedlings to low temperatures; and the obvious inference is that for all future plantings we must obtain our seed from colder parts of the natural habitat, say, 3,500ft. to 4,000ft. above sea level in Victoria. The species is placed in Group IV. on the assumption that it will in future be propagated only from the hardiest parent stocks.

56. E. STUARTIANA F. von Mueller.

NATURAL HABITAT, DESCRIPTION, AND USES.

This species is represented by scattered groups and single trees from central Victoria to southern Queensland, at various altitudes up to 3,000ft., flourishing on damp flats or struggling for existence on dry ridges. The growth tendency of the tree everywhere is towards a form in which the bole is short with branchy and spreading top. Dead bark persistent on stem and branches, sub-fibrous. Juvenile leaves sessile, round or heart-shaped, usually glaucous. Adult tree leaves when first formed at tips of growing twigs glaucous, changing as they become mature to deep green on both surfaces, up to 8in. long, vertically suspended, often with double twist in petiole. Umbel with short stalk and very short stalklets, usually 7-flowered; lid of bud short with low point; anthers with parallel openings. Ripe seed-cup about ¼in. in depth and width, 3-celled, rim rising; open valves wholly above rim (exserted). MATURE WOOD reddish-brown; reputation for quality and durability not good.

CULTIVATION IN NEW ZEALAND.

E. Stuartiana has found a place in a great many New Zealand plantations, but has nowhere become a profitable timber yielder. Its service will be that of a shelter tree in open paddocks, or as a wind-break tree combined with a conifer such as *Pinus muricata.* Seed for these purposes could be obtained from typical specimens in the Karaka district south of Auckland. Through misunderstanding in earlier years, *E. Stuartiana* was credited with merits it did not possess. We now know that it can nearly everywhere be replaced by much more valuable species. It is a species that may even become a weed if allowed to spread beyond control. Further planting is not recommended.

APPENDIX TO GROUP IV.

(*a*) *E. globulus.*—Since the description of this species was written, as on pages 61 and 62, the three-flowered form therein mentioned has been separately named and described as *E. bicostata.* The name *E. globulus* is now restricted to the form indigenous to Tasmania, in which the flowers are usually single or solitary and the seed-cups large.

(*b*) *E. oreades.*—This name is correct and will stand. *E. altior* as a synonym will be discontinued.

EUC. AGGREGATA.

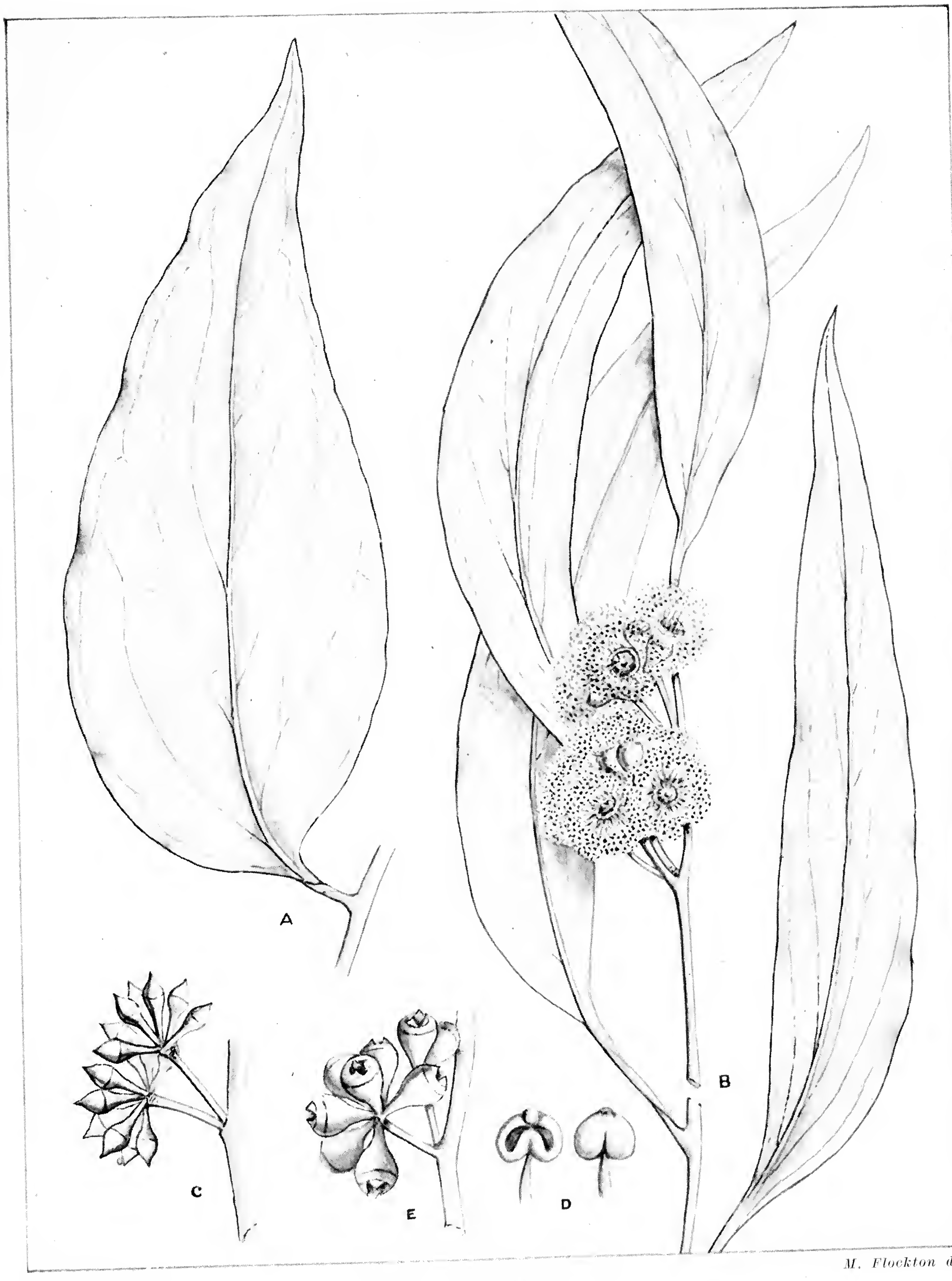
EXPLANATION OF PLATE.

A. and B. Juvenile leaves; note that they are not quite sessile, but are short-stalked.
C. Twig bearing buds, flowers, and adult leaves. D. Anther, front and back view.
E. Ripe seed-cups; note similarity to those of *E. Macarthuri.*

EUC. ANDREWSI.

EXPLANATION OF PLATE.

A. Juvenile leaves. B. Juvenile leaf; note large size and edgewise position. C. Twig bearing buds, flowers, and adult leaves. D. Anther, front view only, openings connected. E. Ripe seed-cups; note nearly flat rim.



EUC. FASTIGATA.

EXPLANATION OF PLATE.

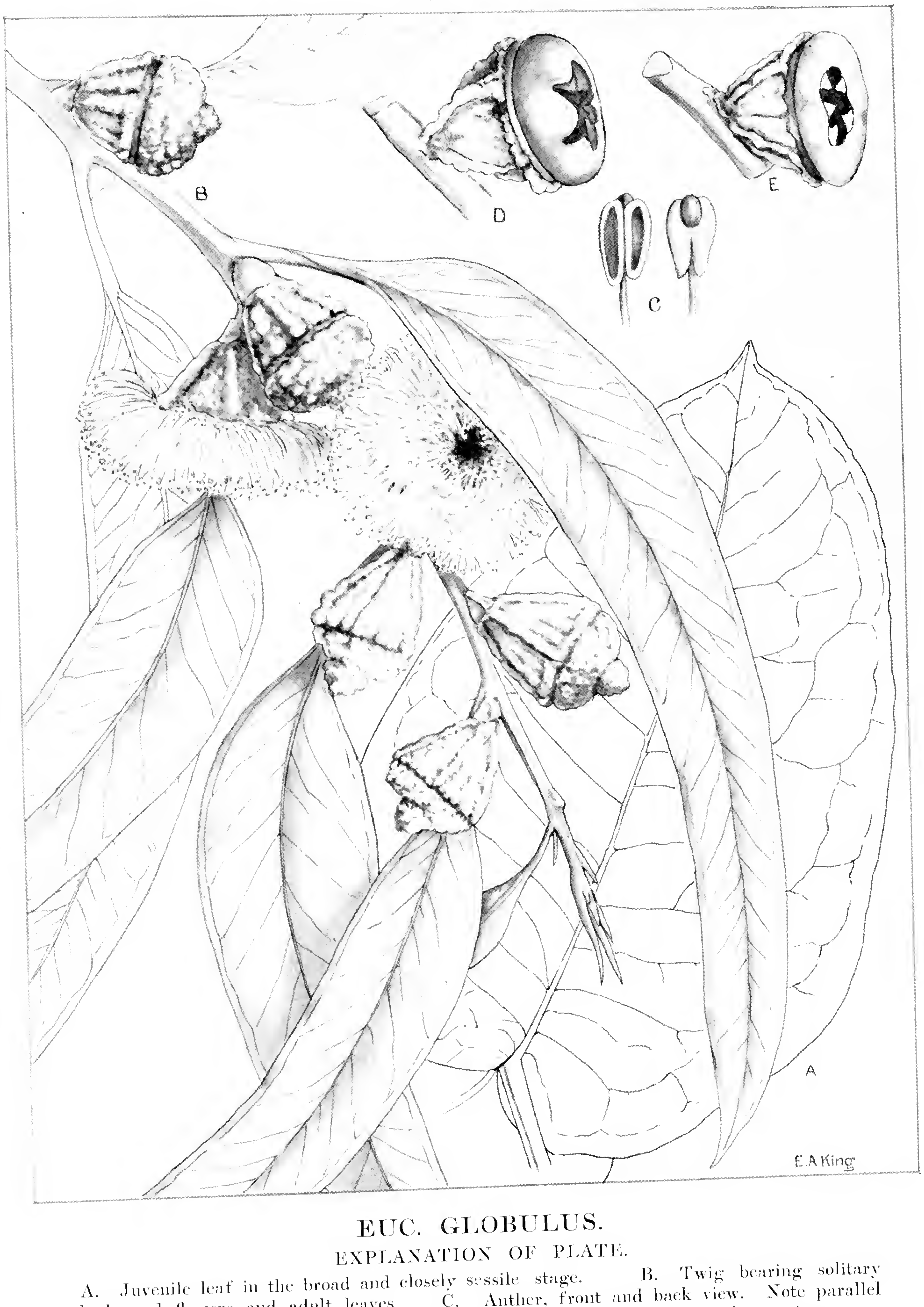
A. Juvenile leaf. B. Twig bearing flowers and adult leaves; note tapering shape of the leaves. C. Buds; note shape of lid. D. Anther, front and back view. E. Ripe seed-cups; note rising rim and protruding valves. Note that the umbels are in pairs.

EUC. BICOSTATA AND EUC. GLOBULUS.

EXPLANATION OF PLATE.

A. Juvenile leaf. B. Twig of *E. bicostata*, bearing buds, fruits, and adult leaves. C. Anther, front and back view. D. Bud of *E. globulus*. E. Ripe seed-cup of *E. globulus*. F. Buds of *E. bicostata*. G. Ripe seed-cups of *E. bicostata*.

NOTE.—Until now these two species have been confused. See note page 69.



EUC. GLOBULUS.

EXPLANATION OF PLATE.

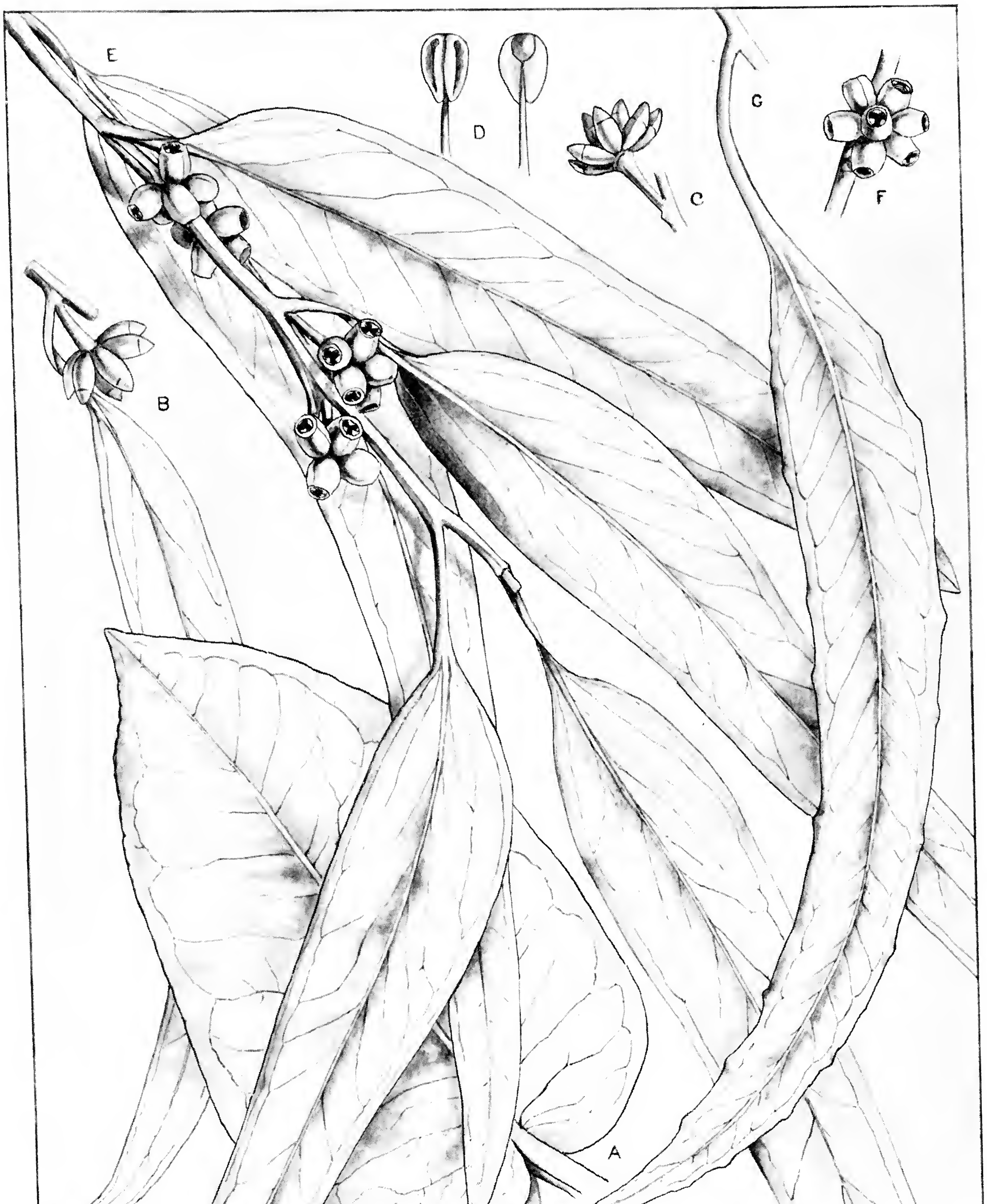
A. Juvenile leaf in the broad and closely sessile stage. B. Twig bearing solitary buds and flowers and adult leaves. C. Anther, front and back view. Note parallel openings. D. Seed-cup, typical form. E. Seed-cup with flatter rim.

NOTE.—These figures have all been drawn from specimens collected in Tasmania, and represent the species as now restricted to the solitary-flowered form indigenous to that country.

EUC. GONIOCALYX.

EXPLANATION OF PLATE.

A. Juvenile leaves. B. Juvenile leaves; sessile, very large. C. Twig bearing buds, flowers, and adult leaves. D. Anther, front view only. E. Seed-cups with flat rim. F. Seed-cups with countersunk rim.



EUC. NITENS.

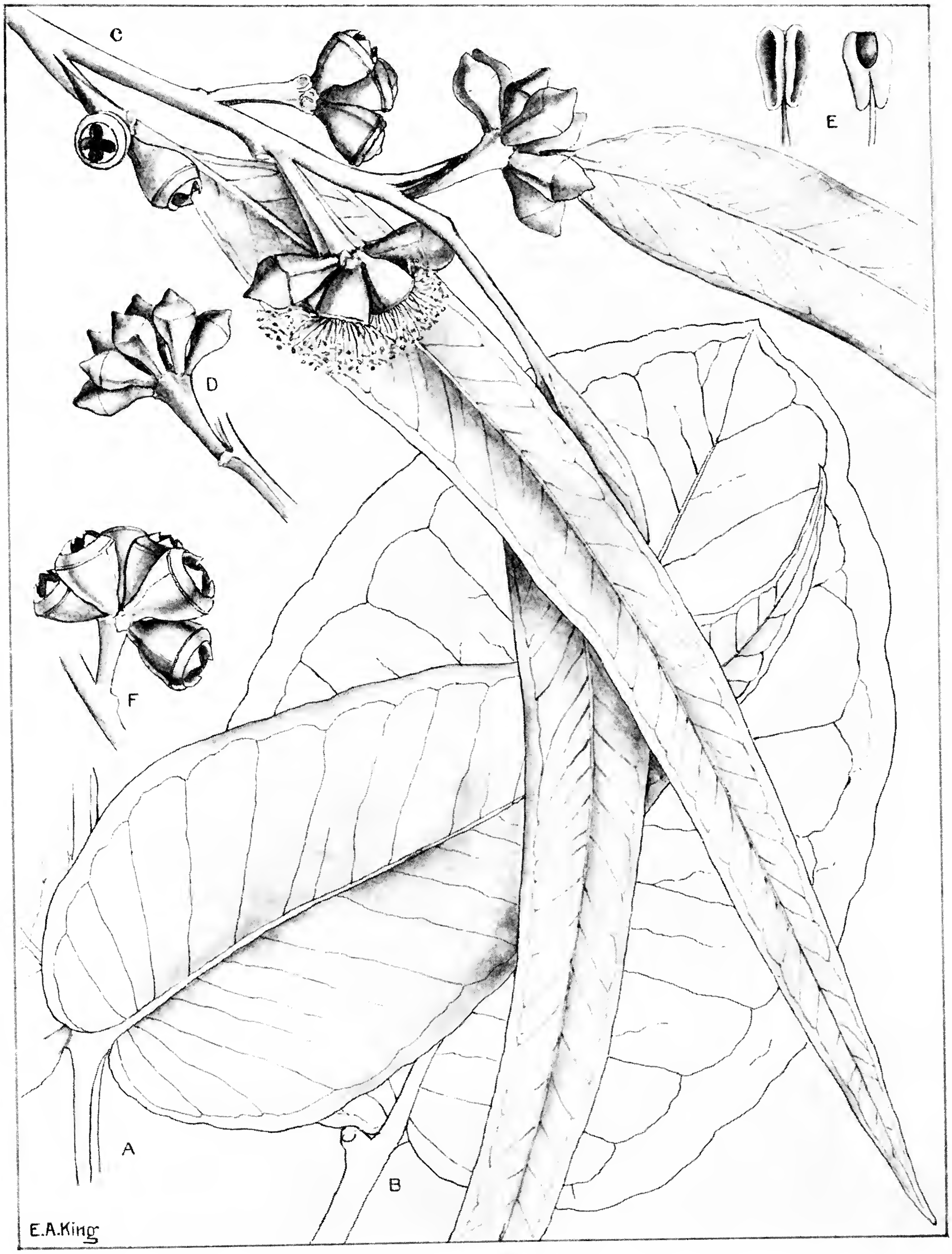
EXPLANATION OF PLATE.

A. Juvenile leaf in broad sessile stage. B. Umbel with six nearly mature buds. C. Umbel with seven buds, a little less mature. D. Anther, front and back view. E. Twig bearing ripe seed-cups and adult leaves. F. Umbel with normal number of seven seed-cups. Note that the cups are 3-celled. G. Adult leaf with toothed margins.

EUC. MACARTHURI.

EXPLANATION OF PLATE.

A., B. and C. Juvenile leaves. In New Zealand we often find the juvenile leaves like those in figure C., but much longer. D. Buds with flowers; specimens from two different twigs. E. Anther, front and back view. F. Twig bearing ripe seed-cups and adult leaves.



EUC. MAIDENI.

EXPLANATION OF PLATE.

A. Juvenile leaf. B. Broad juvenile leaf. C. Twig bearing buds, flowers, seed-cups, and adult leaves. D. Smaller buds. E. Anther, front and back view. F. Ripe seed-cups; note that the umbels are several-flowered.

EUC. OBLIQUA.

EXPLANATION OF PLATE.

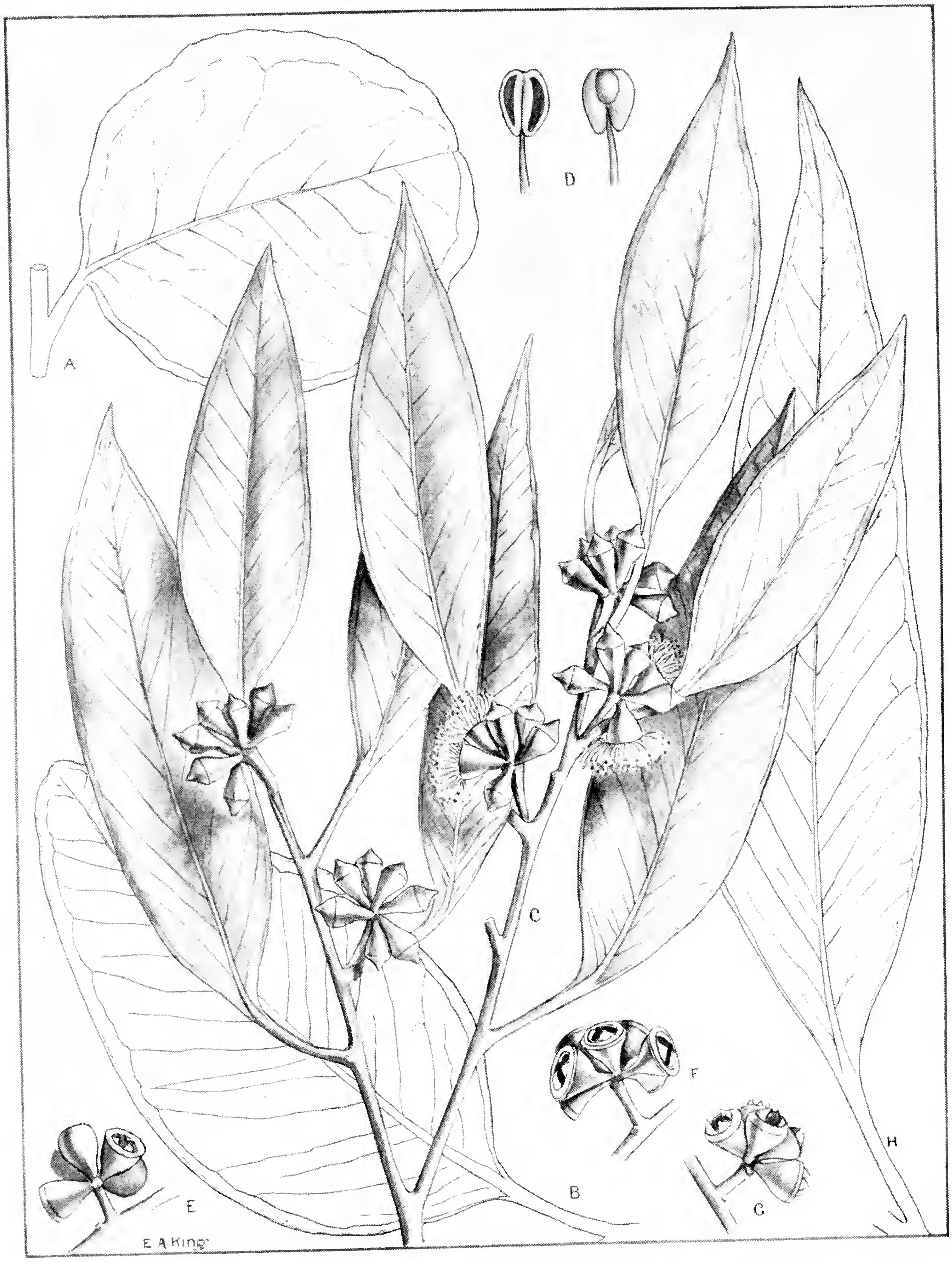
A. Juvenile leaf; note size and shape. B. Twig bearing buds, flowers, and adult leaves. C. Anther kidney-shaped; figure omitted. D. Ripe seed-cups. E. Orifice of seed-cup.

NOTE.—In some specimens the seed-cups of this species are deeper and more ovoid in shape.

EUC. OREADES.

EXPLANATION OF PLATE.

A. Juvenile leaf; note shape. B. Intermediate or sapling leaf. C. Twig bearing buds, flowers, and adult leaves. D. Anther, front and back view, openings connected. E. Smaller seed-cups. F. Larger seed-cups. G. Orifice of seed-cup showing five cells.



EUC. OVATA.

EXPLANATION OF PLATE.

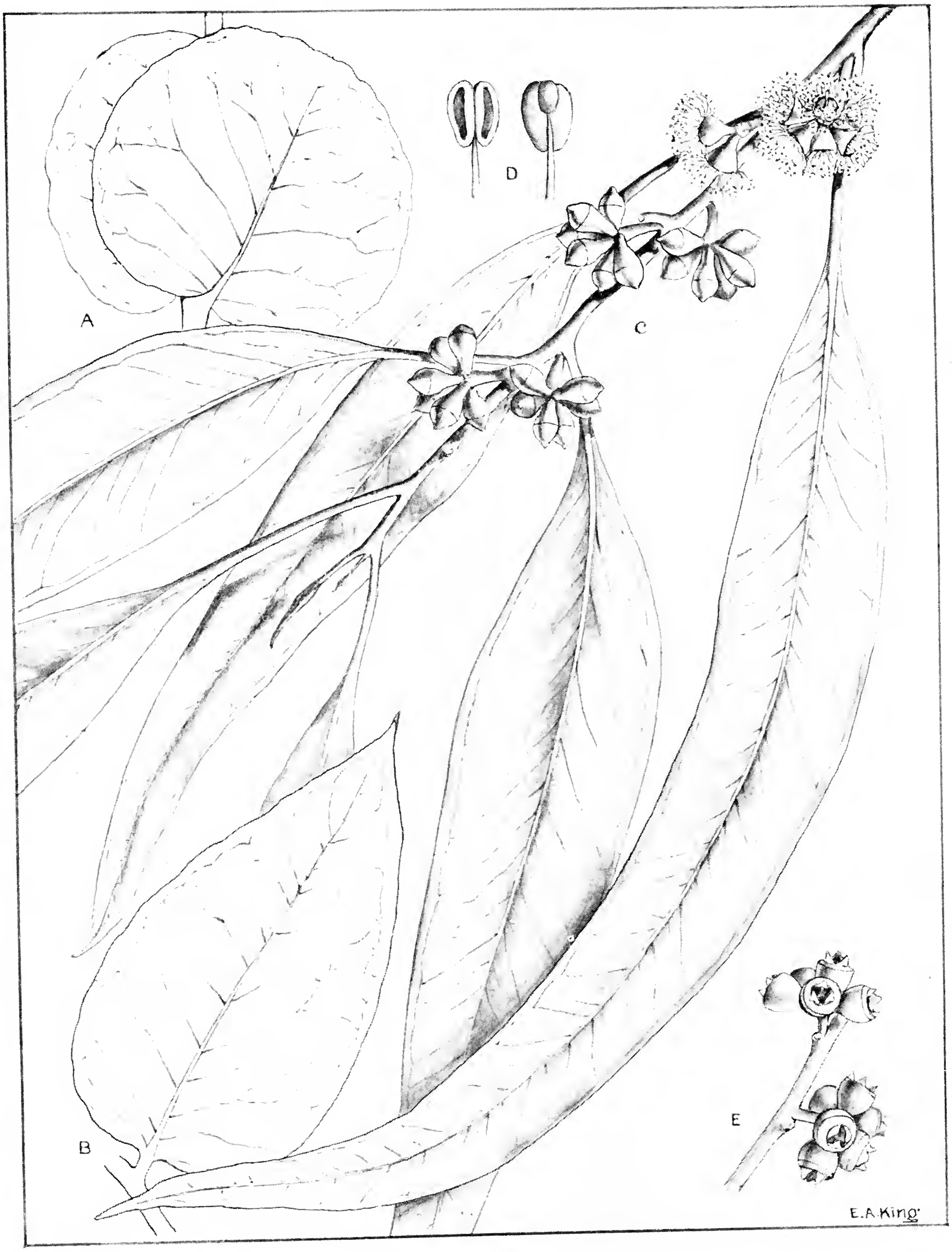
A. Juvenile leaf; stalked and nearly orbicular. B. Intermediate or sapling leaf.
C. Twig bearing buds, flowers, and adult leaves. D. Anther, front and back view.
E., F. and G. Seed-cups, showing variations. H. Large adult leaf.

EUC. SIEBERIANA.

EXPLANATION OF PLATE.

A. Juvenile leaf. B. Juvenile leaf; note size and edgwise position. C. Twig bearing flowers and adult leaves. D. Buds; note that the lid is low and blunt. E. Anther, front and back view; openings connected. F. Ripe seed-cups; form with flat rim.

NOTE.—A form exists in which the rims of the seed-cups are countersunk.



EUC. STUARTIANA.

EXPLANATION OF PLATE.

A. Juvenile leaves; sessile and round, as usually seen. B. Intermediate or sapling leaf.
C. Twig bearing buds, flowers, and adult leaves. D. Anther, front and back view.
E. Ripe seed-cups; 3-celled, valves protruding.

GROUP V.

Species adapted to localities in which there are moderate falls of snow most years, and where very hard frosts occur at intervals from late autumn to early spring; the summer season being variable, but usually warm and genial. Estimated range in mean annual temperature for successful cultivation, 50° to 55° F. Probable limit of vigorous resistance to cold for seedlings and young saplings, between 12° and 18° F.

E. amygdalina.	E. radiata.
E. coriacea.	E. regnans.
E. Dalrympleana.	E. Risdoni.
E. gigantea (syn. E. Delegatensis).	E. viminalis.

57. E. AMYGDALINA Labillardière.

NATURAL HABITAT, DESCRIPTION, AND USES.

In earlier botanical literature this name was applied to at least six distinct eucalypts, all but one of which have since been separately named and defined. The very tall trees mentioned by Baron F. von Mueller in his *Eucalyptographia* and *Select Extra-Tropical Plants* were soon given separate specific rank as *E. regnans* by Mueller himself. Three Australian members of the original group were a good many years ago named respectively *E. dives, E. numerosa,* and *E. radiata,* and a Tasmanian member *E. nitida.* The name *E. amygdalina* remains, and is restricted to certain eucalypts widely distributed in Tasmania but nowhere found on the mainland. The difficulties of the botanist have by this procedure been greatly reduced; but they have not been ended. For what we actually find in Tasmania in this connection is not a narrow and rigidly defined type, but a group or series in which we have to reckon with a large amount of variation. Botanists have endeavoured to divide the series into two sections and to give each section specific rank. Trees with wider leaves, slightly larger fruits, and some amount of dead bark clinging to their stems are assigned to *E. amygdalina.* Trees with extremely narrow leaves, smaller fruits, and smooth-barked stems are given the name *E. linearis,* after the botanist Dehnhardt who so named a cultivated specimen in Italy. But between these selected types are intermediate forms that obviously link the two together. Maiden's view of the problem is recorded at page 169 Vol. i. of the *Critical Revision,* where he says:—"The idea becomes stronger with me that *E. linearis* Dehnh. may prove to be a perfectly smooth-barked form of *E. amygdalina,* with unusually thin, linear leaves. If so, this form of *E. amygdalina* might be named var. *linearis.*" Rodway, in a private letter dated April 22nd, 1926, presents a similar view in the following even more emphatic words:—"We recognise two forms of *E. amygdalina,* namely, Black Peppermint (*E. amygdalina* Lab.) and White Peppermint (*E. linearis* Dehn.). These run absolutely into one another. Both the forms produce a strong wood of great resistance to decay."

GROUP V. E. AMYGDALINA.

Observation in Tasmania followed by the study of many exotic specimens in New Zealand has made it easy to understand and appreciate the conclusions thus expressed by Maiden and Rodway. *E. amygdalina* and *E. linearis* together stand for a group of indefinitely differing but very closely related trees and shrubs. Some of the trees grow large enough to provide logs for the sawmill and poles for carrying electric wires; others are small and of little economic value. Some trees carry dead bark of the "peppermint" type on their stems; others shed their dead bark right down to the ground. Juvenile leaves are on some plants sessile, but more frequently they are petiolate. On some adult trees the leaves are ⅜in. or more wide; while on others they are almost linear. In inflorescence the differences are less marked. The umbel is several-flowered, the lid of the bud a small low dome with central projection. The anthers are reniform. The ripe seed-cups are pear shaped or hemispherical and vary in lateral diameter from 3/16in. to a little over ¼in.; the valves being level with rim or slightly protruding.

The MATURE WOOD of *E. amygdalina* is light brown to dark brown in colour. When well grown and thoroughly ripe for use, it is dense, strong, and very lasting in the most trying of situations. It was chiefly under the name of Black Peppermint that the timber won its reputation for durability; but, on the authority of the Tasmanian State botanist, Mr. L. Rodway, we may now regard that reputation as belonging equally or almost equally to the White Peppermint.

CULTIVATION IN NEW ZEALAND.

Success in cultivating *E. amygdalina* in New Zealand will depend primarily and mainly upon obtaining a supply of seed from large and vigorous parent trees. If we breed from dwarfs and weaklings, we must expect crops of dwarfs and weaklings. After seeing the species in its various forms in Tasmania and then studying our own exotic specimens, it is impossible to resist the inference that much of the seed we have used here must have been taken from plants of small dimensions and inferior strain. In view of so much evidently wrong selection it is gratifying to find that the best Tasmanian forms have gained a footing in several New Zealand localities. It will be sufficient to cite three examples. They are as follows:—(1) "Tunanui", near Hastings (Sir Andrew Russell). Some of the trees here carry persistent sub-fibrous dead bark on their stems, while others are smooth nearly down to the ground; most of them are large and good. (2) "Cheviot Hills", North Canterbury (Lady Campbell). Here, again, there are trees with more or less persistent dead bark on their stems and others from which nearly all dead bark has fallen away. Some of the specimens are large enough and tall enough for carrying the heaviest electric power wires. (3) "Happy Valley", near Motunau, also in North Canterbury (L. H. Campbell). The specimens here are numerous, but of younger age, and have scarcely yet settled their bark habit.

E. amygdalina appears to be capable of flourishing on drier and poorer country than is required by most of the valuable eucalypts. If we add this merit to the great durability of the mature wood, the species will stand well commended for further and more extended trial in this country. But only right seed will produce right trees. Choice lies between obtaining such seed from largest and best typical specimens in Tasmania and seeking permission to collect from best acclimatized specimens at "Tunanui" or at "Cheviot Hills."

GROUP V. E. CORIACEA. E. DALRYMPLEANA.

58. E. CORIACEA A. Cunningham.

NATURAL HABITAT, DESCRIPTION, AND USES.

This species has its natural habitat in Tasmania and in south-eastern Australia. It appears in scattered specimens at moderate altitudes, but is mainly an alpine species, growing in scrubby form up to 5,000 feet and even 6,000 feet above sea level. The dead bark is non-fibrous and falls away in sheets and scales, leaving a white smooth surface, except at the base of the stem where it sometimes persists in the form of coarse plates. Leaves in juvenile stage soon short-stalked, oval or round, often very large; on adult trees long-stalked, thick, leathery, 5in. to 6in. long, unbalanced. At low altitudes the two surfaces of the leaf are of the same deep green and so shiny that they reflect the sunlight almost like polished metal; at high altitudes both leaves and twigs may become glaucous. The lateral veins of the leaf in this species form extremely acute angles with the midrib, some of them running almost throughout the length of the leaf. The specific name *coriacea* means leathery and as applied to the leaves is appropriate. Umbel with several flowers; stalk ⅜in., stalklets ⅛in.; lid of bud low, blunt; anthers kidney-shaped with divergent connected openings. Ripe seed-cup pear-shaped up to ⅜in. in depth and a little more in width, 3-celled, rim flat or slightly countersunk, valves wholly below rim. MATURE WOOD pale, fissile, often not very durable.

CULTIVATION IN NEW ZEALAND.

E. coriacea makes beautiful arboretum specimens and is of value for fuel and shelter where better species will not grow. It cannot be recommended for timber production. On poor open country it spreads rapidly by natural distribution of its seed. It is thus liable to become a weed, and should never be allowed to get out of control. It cannot withstand severe saline winds. There is reason to believe that nearly all our New Zealand specimens of *E. coriacea* have been derived from parent trees growing at low altitudes in the natural habitat. If the species were cultivated from alpine seed, we might find it useful for shelter on some of our own cold uplands. In this case it would be properly included in Group VI.

59. E. DALRYMPLEANA Maiden.

NATURAL HABITAT, DESCRIPTION, AND USES.

This is a species of the high mountain slopes where it has to endure very low temperatures. It is reported to be at its natural optimum in the mountain country of south-eastern New South Wales. Finding there wholly congenial conditions, it forms forests of tall, shaft-like stems crowned with dull green foliage. Many of the trees are very large. The dead bark is sub-fibrous, and comes off in long ribbons, leaving the stems and branches of the trees with a white or dull white general aspect. In the juvenile stage the leaves are sessile and broad; on the adult tree stalked, 5in. to 6in. long, curved to one side, and of the same dull green on the two surfaces. The umbel is 3-flowered, stalk and stalklets short; lid of bud domed or conical; anthers with longitudinal and nearly parallel openings. Ripe seed-cup about 5/16in. in depth and width, usually 3-celled, rim rising; valves when open claw-like and protruding. Mature wood pale pink, much used for general building purposes. This splendid tree was long confused with *E. viminalis,* but it differs from that species in having broad juvenile leaves and in the duller hue of its adult foliage. The two species are further separated by their choice of habitat, *E. Dalrympleana* favouring cool mountain sides from 3,000ft. to 5,000ft. above sea-level, while *E. viminalis* keeps to the plains and river valleys at lower altitudes than 3,000ft. Maiden suggests that certain eucalypts found in Tasmania and hitherto assigned to *E. viminalis,* but producing seedlings with broad sessile leaves, may belong to *E. Dalrympleana.*

The specific name was given in honour of Richard Dalrymple Hay, who had for long years been Chief Commissioner of Forests in New South Wales.

CULTIVATION IN NEW ZEALAND.

For our New Zealand uplands we urgently need additions to our timber-yielding species, and *E. Dalrympleana* should prove one such species. Seed should be obtained from competently named and selected trees in the Tumberumba district in New South Wales, and trial plantings made on uplands and foot-hills of both Islands. Strict care must be used to avoid propagating the similar but greatly inferior *E. rubida.*

60. E. GIGANTEA Hooker f.; E. DELEGATENSIS R. T. Baker.

NATURAL HABITAT, DESCRIPTION, AND USES.

This is a mountain species found on both sides of Bass Strait. Its altitude range in Tasmania is between 500ft. and 1,500ft.; in Victoria and New South Wales up to and over 4,000ft. At its best the tree develops a long branchless bole crowned with a mass of luxuriant foliage. The dead bark persists on the stem from the ground upwards ten, twenty, or twenty-five feet, and is there matted and fibrous; above this it falls away in ribbons, leaving a surface that is of a pale bluish-grey or greenish-white colour. In the juvenile stage the leaves are already stalked, usually very broad, dark in colour, unbalanced, and suspended vertically or edgewise to the light; on the adult tree they are 4in. to 6in. long by 1in. to 2in. wide, also unbalanced, and of about the same green on the two surfaces. The umbel carries numerous flowers; stalk ½in., stalklets ⅛in.; lid of bud low and dome-like; anthers kidney-shaped with divergent connected openings. Ripe seed-cup ⅜in. or a little more in lateral diameter, pear-shaped; rim descending; valves wholly below rim. Mature wood pale, fissile, clean in grain, free-working under the saw, and of high merit for general building construction; durability in contact with the ground probably ten to twenty years, according to degree of maturity and treatment.

CULTIVATION IN NEW ZEALAND.

In all the world trees that can grow rapidly to a millable size and yield good timber above the winter snow-line are limited in number. New Zealand is in pressing need of such trees. *E. gigantea* is one of these exceptional and specially adapted trees. We have planted it to a limited extent, but not always in suitable localities. Without another year's delay supplies of seed should be obtained from best trees in the Tumberumba district, New South Wales, and trial plantings made on the uplands and foot-hills of both Islands.

GROUP V. E. RADIATA. E. REGNANS.

61. E. RADIATA Sieber.

NATURAL HABITAT, DESCRIPTION, AND USES.

Natural home of species on cool uplands in south-eastern Australia, from moderate altitudes in Victoria up to 3,000ft. to 4,000ft. in New South Wales. Tree up to 100ft. or more in height with stem diameter sometimes over 3ft.; in open situations branchy and spreading with abundant drooping foliage; in dense stands producing a long clean bole. Dead bark of "peppermint" type, persistent on stem and large branches. Leaves in juvenile stage sessile, opposite, thin, lance-shaped; on adult tree stalked, pendent, of about the same green on the two surfaces; in both stages rich in sweetly fragrant oil. Umbel with numerous flowers; stalk and stalklets short; lid of bud low-domed; anthers with broad, divergent, and connected openings. Ripe seed-cup 3/16in. to ¼in. in diameter, hemispherical, rim flat or convex; tips of open valves just below or slightly above rim. MATURE WOOD pale, fissile; reputation for durability in contact with the ground generally doubtful, but exceedingly good in some localities.

CULTIVATION IN NEW ZEALAND.

E. radiata has been planted in New Zealand during the last 30 to 40 years under the name of *E. amygdalina,* with resultant vigorous specimens in both Islands. Success in future plantings most likely in North Island at altitudes of about 1,000ft., in South Island at 200ft. to 500ft. Best source of seed probably Bago State Forest, New South Wales.

Since the above was written the following statement has been obtained from Mr. W. A. W. de Beuzeville, State Forest Officer in the Bago-Batlow forest region:—"*E. radiata* is one of our best timbers for all purposes. I have seen blocks of this timber taken out of the ground after 30 years, and they were still in a good condition. (This applies to ground on which it grows.) We use it largely locally for telephone posts, rough building, and especially for 'T. and G.' flooring and lining, and also for railway sleepers. Recently about 5,000 sleepers were put in at Batlow. It is locally a very large and tall tree, often 150 to 180 feet high. It is generally a very useful timber." Planters should make quite certain that their *E. radiata* seed has been obtained from best trees in the Bago-Batlow forest area.

62. E. REGNANS F. von Mueller.

NATURAL HABITAT, DESCRIPTION, AND USES.

This is a mountain species indigenous to Tasmania and south-eastern Australia. Like its congeners, it follows the law of compensation between latitude and altitude, its limit above sea level being about 1,000ft. in Tasmania, about 2,500ft. in Victoria, and about 3,500ft. in New South Wales. It is the species that has given cause for so many reports about surprisingly tall individual trees. In ordinary forestry a tree 200ft. high is rare, and phenonemal. In the *E. regnans* forests at their best such a tree is only one in a multitude equally tall; and towering above these are exceptional giants that can claim at least another 50ft. of crown.

GROUP V. E. REGNANS.

Girths are proportionate to these stupendous heights. The species appears to have attained its optimum in the humid mountain valleys of Victoria. Seen there in perspective the white branchless stems of the trees form colonnades that no temple erected by the hand of man could ever rival. The leafy roof 100ft. to 150ft. above the forest floor admits a softened light, and scattered everywhere along the naves and aisles of the great cathedral are tender shrubs and graceful tree ferns. Vast areas of such forest have been invaded by the sawmills; in some places trees and even stumps have entirely disappeared. But enough remains to fill the tree-loving visitor with wonder and enthusiasm; and wherever permitted busy nature is raising another generation of the same trees to cover the denuded areas.

E. regnans is easily distinguished from most other eucalypts. Its dead bark persists in the form of a fibrous jacket at the base of the stem to a height of 10ft. to 25ft.; from the branches and upper part of the stem it falls away in ribbons, leaving a clear white surface. Juvenile leaves thin, indented at edges, creased or wrinkled, already stalked. Adult tree leaves 5in. to 7in. long by 1in. to 1½in. in width, unbalanced, vertically suspended, and of same rich green on both surfaces. Umbels usually in pairs in the axils (angles) of the leaves; stalk ½in., stalklets 3/16in; lid of bud low and short-pointed; anthers very small with divergent openings. Ripe seed-cup ¼in. deep and a little more in width at rim, tapering towards stalklet, 3-celled; rim nearly flat with points of open valves slightly protruding.

The MATURE WOOD shows distinct annual growth rings as do the conifers, and in texture is nearer to the soft-woods than most other eucalypts. R. T. Baker in *Hardwoods of Australia* writes about it as follows:—"It is very pale, almost white, straight in the grain, free-working, seasons quickly and well. It resembles in texture and physical properties the Ashes and Hickories of the Northern Hemisphere. It is used extensively for general house building, coach and carriage work, and recently has come very much into vogue in the furniture and cabinet trades." The State in which the timber is most abundant and most appreciated is Victoria.

CULTIVATION IN NEW ZEALAND.

E. regnans is an inland species and always demands effective protection against strong sea winds. It must have a free and moist substratum with generous rainfall. Granted these conditions, it should flourish up to altitudes of about 300ft. in Otago, Westland, Canterbury, Marlborough, and Nelson. In the North Island, with advance towards lower latitude, it may be expected to extend its altitude to 700ft. and 1,000ft. Experiments already made with this species are most encouraging. Scattered vigorous specimens large enough for the sawmill may be seen in Hawke's Bay, Wairarapa, and several other localities. Between fifty and sixty years ago a few trees were planted along the margin of a paddock in the valley above the Waitati railway station, Otago. The paddock was neglected and went back into manuka and bracken, but the eucalypts flourished. The time soon came when they fruited and scattered their seed on the wind. About twenty years ago a fire through the scrub opened the surface to the sunlight and promoted germination of the seed. The result is a forest of trees in the pole stage covering many acres. Seed for all requirements in this country can be collected from these splendid Waitati trees.

GROUP V. E. RISDONI. E. VIMINALIS.

63. E. RISDONI Hooker f.; variety elata, Bentham.

NATURAL HABITAT, DESCRIPTION, AND USES.

E. Risdoni is indigenous exclusively to Tasmania. It is one of the species in which the trees often begin to bear flowers and seed-vessels while they are still very small and still wholly or partially clothed with juvenile foliage. What has been called the tall variety (*elata*) is now understood to be the same tree in its fully adult form, change from one form to another being retarded or accelerated by soil and situation. As we know the tree in New Zealand it early passes the juvenile stage and grows rapidly to a height of 50ft. to 70ft. The branchlets have a drooping habit, the young leaves and buds being more or less touched over with a glaucous bloom. The dead bark is non-fibrous and falls away from branches and stem in patches, leaving a surface of dull grey aspect. Leaves in juvenile stage sessile, opposite, frequently united at their bases or connate, heartshaped or broad lance-shaped; on adult trees stalked, 5in. to 6in. long, rather narrow, pendent. Umbel with several flowers; stalk ½in., stalklets ⅛in.; lid of bud low, dome-like; anthers kidney-shaped with wide divergent openings. Ripe seed-cup 5/16in. to ⅜in. wide and a little less in depth, in shape like a broad spinning-top, rim convex, flat, or countersunk, sometimes divided into an inner and outer ring by a shallow groove; tips of open valves just below or slightly above rim. MATURE WOOD brown, dense, fissile; reputed to be very durable in contact with the ground.

CULTIVATION IN NEW ZEALAND.

Many specimens have grown to a good pole size in cool parts of the North Island and in northern Canterbury. Like *E. amygdalina*, *E. Risdoni* appears to be able to flourish on rather dry and poor country. The species may certainly be included in the list of fence post and wire-pole yielders, and should be given further trial wherever it has already done fairly well. Strictest care should be used to collect seed only from largest and best acclimatized specimens.

64. E. VIMINALIS Labillardière.

NATURAL HABITAT, DESCRIPTION, AND USES.

Tasmania, South Australia, Victoria, and New South Wales all possess *E. viminalis* as an indigenous constituent of their forest flora. It attained its optimum in the well-watered upland valleys of the south-eastern mainland States at altitudes of 1,000ft. to 2,500ft. Reports crediting it with altitudes up to and over 4,000ft. probably refer to its close congener *E. Dalrympleana*. In what may be regarded as its typical form *E. viminalis* is a very tall tree with clean stem and heavy crown of spreading branches and drooping foliage. The dead bark is sub-fibrous and falls away from branches and stem in ribbons and sheets, except at the base of the tree where it may persist to a height of a few feet. The newly exposed surface of the living bark is white with a tinge of green and so smooth that it shines in bright sunlight as if it had been polished or touched over with white enamel. The leaves in the juvenile stage are sessile, opposite in pairs, lance-shaped, thin; on the adult tree stalked or petiolate, long, narrow, unbalanced, and of about the same green on the two surfaces. The umbel is normally 3-flowered, and in the bud stage takes the form of a cross; stalk ¼in. to ⅜in., stalklets ⅛in. or less; lid of bud conical; anthers with curved longitudinal openings. Ripe seed-cup ¼in. deep by 5/16in. wide; usually 4-celled; the valves while closed forming with the rising rim a dome, and when open strongly protruding.

The MATURE WOOD of *E. viminalis* is straw-coloured, sometimes pinkish, but never red. It is tough and strong, but sufficiently fissile to be split with maul and wedges. In parts of Australia large quantities of it are sawn up into material for house building and for heavy carriage work. For resistance to decay in contact with the ground it would take about third grade in a complete list of the durable *Eucalyptus* timbers. In the Waikato stout heartwood posts split out of trees not less than thirty years old are reported to have lasted fifteen years and to be still in good condition. Wire poles matured in close stands to an age of forty years and allowed a base diameter of 1ft. 6in. should last twenty years without preservative treatment and longer with effective treatment. Bark and sapwood should be stripped off both fence posts and wire poles.

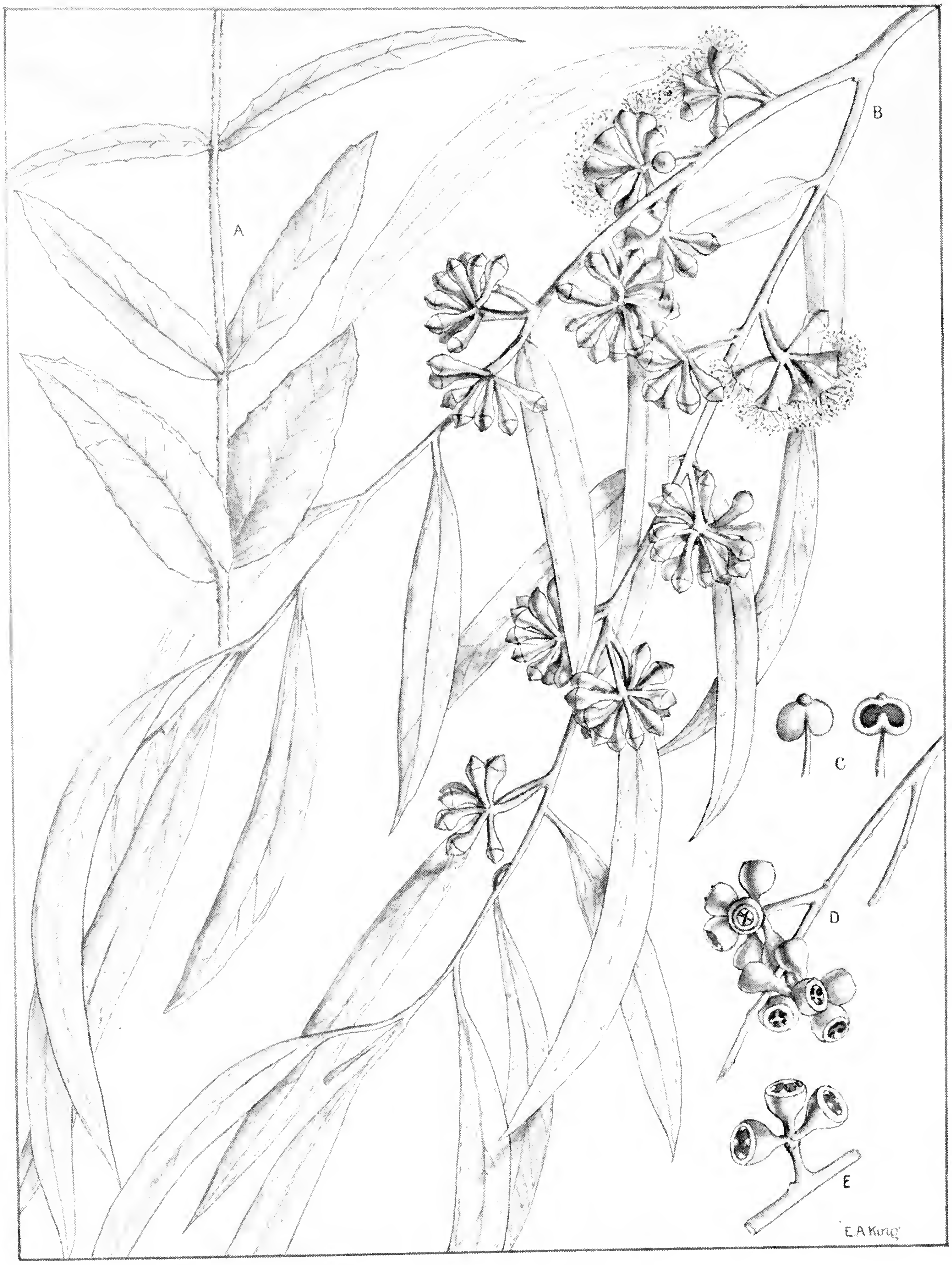
Some trees usually included in *E. viminalis* have more than three flowers in the umbel and carry their dead bark all up the stem. Such trees are probably hybrids, possibly between *E. viminalis* and *E. Macarthuri.* They are usually of inferior merit and should be strictly avoided in collecting seed.

CULTIVATION IN NEW ZEALAND.

E. viminalis has grown with phenomenal rapidity to very large dimensions on the pumiceous lands of the Waikato. It has done almost equally well in parts of the Hawke's Bay region. Marlborough has produced many splendid specimens. But for more extended stands of this species in the large pole stage we must go to northern Canterbury. A close study of these examples confirms what Australian foresters have already told us, that this species must have for its best development a deep and free subsoil, abundant moisture, and a cool winter climate. It is essentially an inland species, and wherever planted near the sea must be protected against the saline winds by a screen of other trees. Planted on frostless lowlands or on a dry shingly substratum, it will fail of its maximum vitality and may then be unable to resist the attacks of insect enemies. Seed for future plantings should be obtained from largest and best acclimatized typical specimens. The species is very easily propagated, either by sowing *in situ* or by transplanting.

APPENDIX TO GROUP V.

E. Risdoni.—Further research in Tasmania and in New Zealand may show that what has been known as *Variety elata* of this species merits separate specific rank and a new name. Meantime all small and dwarf trees should be rigidly avoided in collecting seed.



EUC. AMYGDALINA.

EXPLANATION OF PLATE.

A. Juvenile leaves; note indented margins and roughness of stemlet. B. Twig bearing buds, flowers, and adult leaves. C. Anther, back and front view. D. Ripe seed-cups. E. Larger seed-cups.

Botanic Plate
No. 58.

E. CORIACEA.

EXPLANATION OF PLATE.

A. Juvenile leaf. B. Twig bearing buds, flowers, and adult leaves; note extremely acute venation of leaves. C. Anther, front and back view. D. Ripe seed-cups; note orifice. E. Larger and coarser seed-cups.

EUC. DALRYMPLEANA.

EXPLANATION OF PLATE.

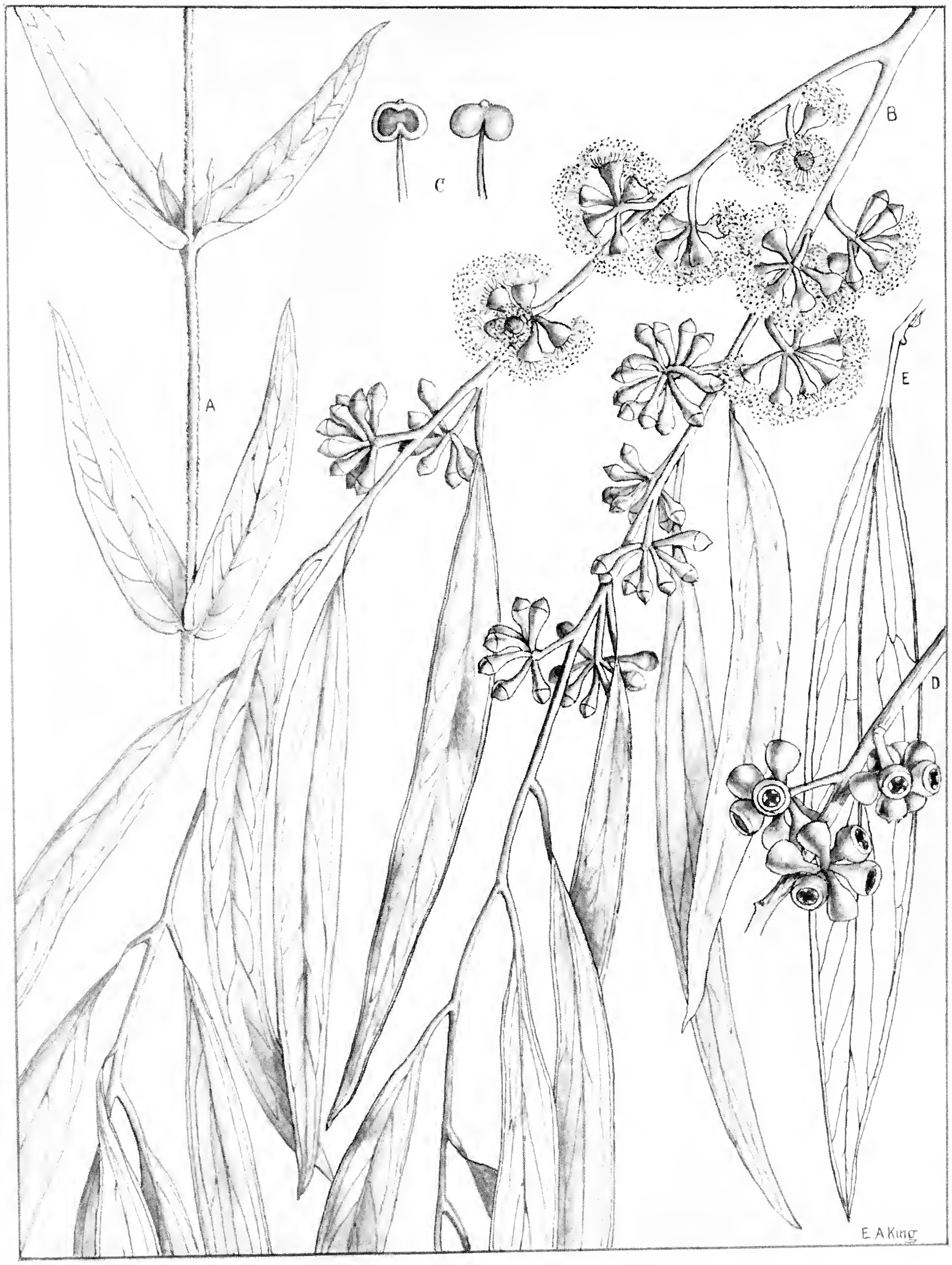
A., B. and C. Juvenile leaves; note that they are sessile in opposite pairs, and of various sizes. D. Large juvenile leaf; still in sessile stage. E. Twig bearing buds, flowers, and adult leaves. F. Anther, front and back view. G. Immature buds showing variation. H. Ripe seed-cups.

EUC. GIGANTEA.

EXPLANATION OF PLATE.

A. Juvenile leaf; size often larger. B. Twig bearing buds, flowers, and adult leaves. C. Anther, front and back view. D. Full head of ripe seed-cups. E. Seed-cups showing variation. F. Large adult leaf.

Botanic Plate
No. 61.

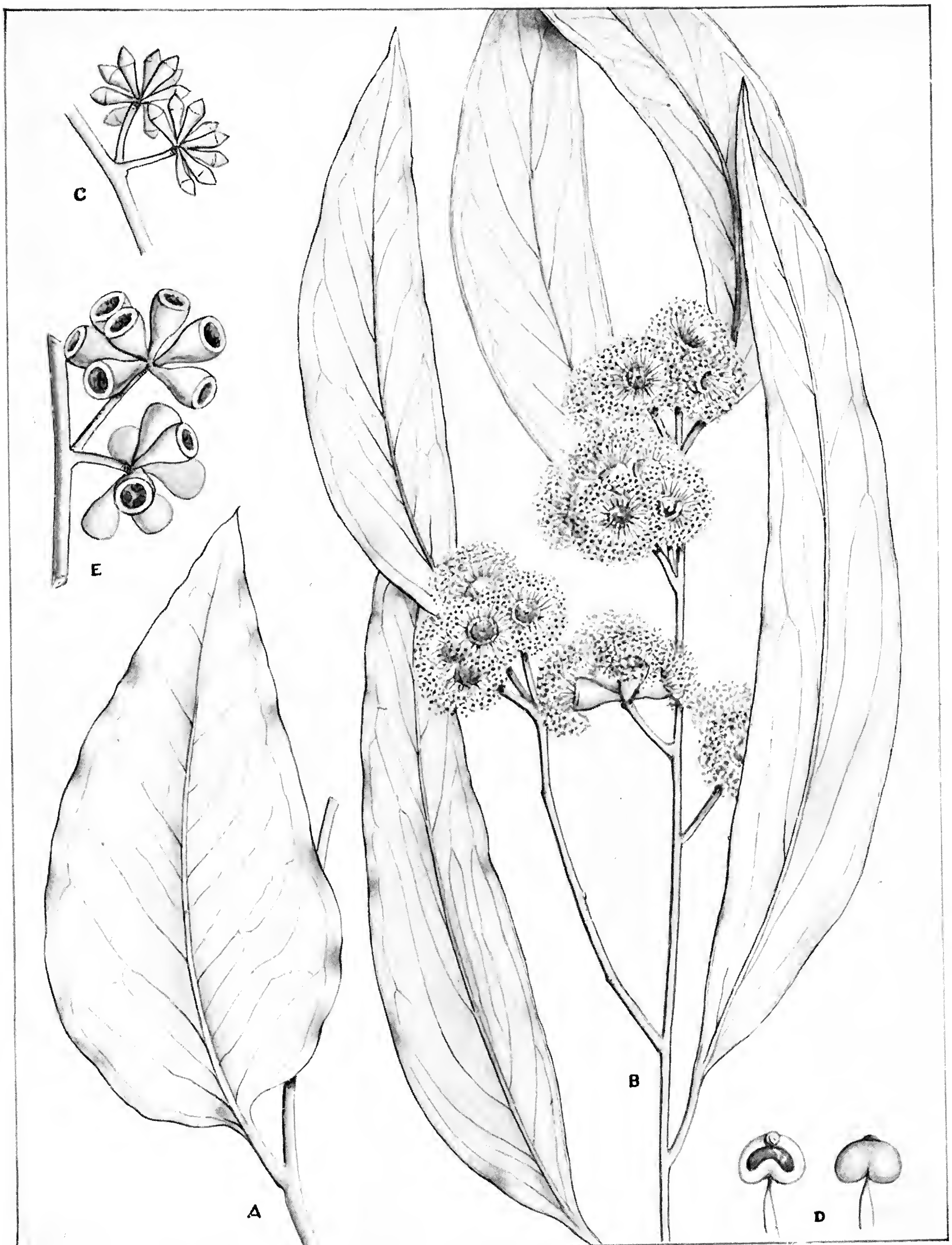


EUC. RADIATA.

EXPLANATION OF PLATE.

A. Juvenile leaves; as usually seen; often longer. B. Twig bearing buds, flowers, and adult leaves. C. Anther, front and back view. D. Ripe seed-cups. E. Large adult leaf.

Botanic Plate
No. 62.

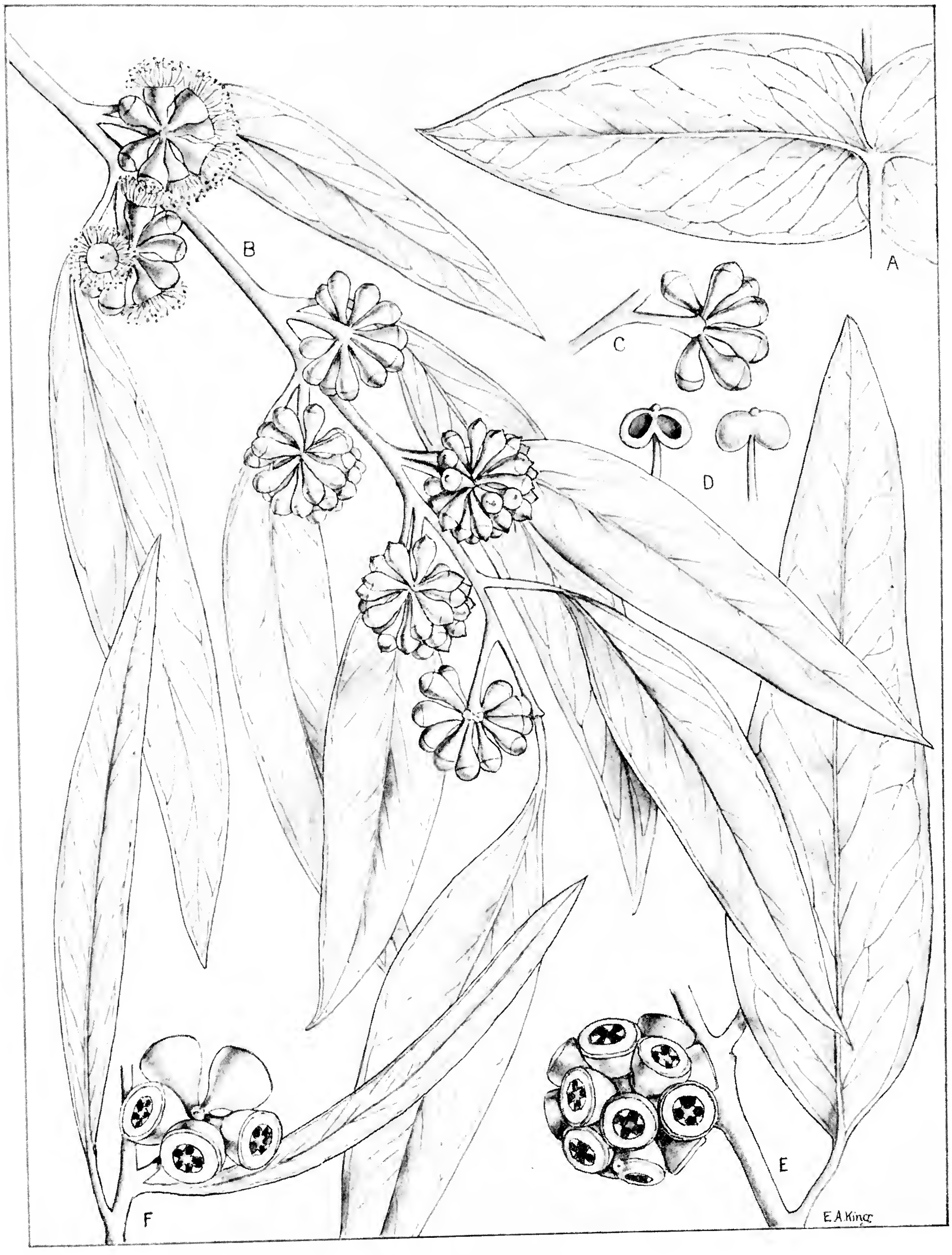


M. Flockton del.

EUC. REGNANS.

EXPLANATION OF PLATE.

A. Later juvenile leaf. The very early juvenile leaves are more wrinkled at margins. B. Twig bearing flowers and adult leaves. C. Buds. D. Anther, front and back view. E. Ripe seed-cups. Note that the umbels are usually in pairs as in *E. fastigata.* Carefully compare the seed-cups of these two species.



EUC. RISDONI

EXPLANATION OF PLATE.

A. Juvenile leaves. B. Twig bearing buds, flowers, and adult leaves. C. Larger buds. D. Anther, front and back view. E. Head of seed-cups and large leaf. F. Seed-cups with narrow adult leaves.

EUC. VIMINALIS.

EXPLANATION OF PLATE.

A. Juvenile leaves as usually seen. B. Juvenile leaves, possibly of another species.
C. Twig bearing buds, flowers, and adult leaves. D. Anther, front and back view.
E. Ripe seed-cups, usual form. F. Ripe seed-cups, unusual form.

In N.Z. we often see a form like E., but with rim more prominent.

GROUP VI.

Species adapted to localities where there are heavy falls of snow, where severe and prolonged frosts occur from late autumn to middle spring, and where the summer season is variable. Estimated range in mean annual temperature for successful cultivation, 48° to 53° F. Probable limit of vigorous resistance to cold for seedlings and young saplings, between 8° F. and 14° F.; for a few species lower than 8° F.

E. coccifera.	E. Muelleri. (syn. Johnstoni).
E. cordata.	E. unialata.
E. Gunnii.	E. urnigera.

65. E. COCCIFERA Hooker f.

NATURAL HABITAT, DESCRIPTION, AND USES.

This is a very distinct species. It is restricted in natural habitat to the mountains of Tasmania at altitudes of about 4,000ft. On the track up Mount Wellington near Hobart it appears in vigorous shrubby form after all other eucalypts have been left behind. It sheds its dead bark and presents a white or grey surface on stem and branches. The leaves in the juvenile stage are round or oval and sessile; in the adult tree stage stalked, about 3in. long, and of same dull or glaucous green on both surfaces. Umbel 3 to 6-flowered; stalk ½in., stalklets extremely short or absent; calyx tube or unripe seed-cup warty and rough; lid of bud low; anthers with broad, united, and divergent openings. Ripe seed-cup sessile, over ½in. wide; rim broad, smooth, and slightly convex; orifice and valves in centre of the disk-like rim and very small. MATURE WOOD pale, durability in ground not recorded.

CULTIVATION IN NEW ZEALAND.

E. coccifera can scarcely take rank as a timber yielder, its height perhaps never exceeding 30ft. But its capacity to endure very low temperatures entitles it to a welcome place in our list of ornamental and wind-resistant plants for frosty uplands. Associated there with larch and other especially hardy trees, it can help to give the farmer shelter, fuel, and rough stakes for the fences. Vigorous specimens may be seen in the State forests at Waiotapu, on the upper Canterbury Plains, and in Otago and Southland. Seed may easily be obtained from such specimens.

66. E. CORDATA Labillardière.

NATURAL HABITAT, DESCRIPTION, AND USES.

Native home of the species southern uplands of Tasmania. Tree small, probably never over 50ft. in height. Dead bark thin, deciduous. Leaves sessile, heart-shaped, slightly crenulate or indented at the edges. Umbel 3-flowered; stalk about ⅜in., stalklets very short or absent; lid of bud a low cap with central projection; anthers with longitudinal and nearly parallel openings. Ripe seed-cup up to ½in. wide by ⅜in. in depth, the shape being somewhat like that of a very short urn, open valves very slightly above rim. MATURE WOOD pale, utility not known. *E. cordata* is one of the few species of *Eucalyptus* that retain the sessile form of leaf throughout life.

CULTIVATION IN NEW ZEALAND.

E. cordata is not a timber yielder, but it may find a very welcome place in parks and gardens where there is demand for shrubs and trees that can endure severe frosts. The sessile, heart-shaped, glaucous leaves with clusters of fruits make a very handsome and striking appearance. A specimen rather badly suppressed by larger trees may be seen in the Botanic Gardens, Christchurch, and one or two in the State Forests Grounds, Rotorua.

A species found on the south-eastern mainland and called *E. cinerea* on account of its ashy appearance is very similar in botanical characters to *E. cordata*. The mainland tree differs from its island relative by sometimes breaking into the stalked form of leaf, by having entire margins to its leaves, and by producing somewhat smaller fruits. In the Langdale Domain, Wairarapa, young trees representing the two species may be seen growing near together.

67. E. GUNNII Hooker f.

NATURAL HABITAT, DESCRIPTION, AND USES.

In earlier *Eucalyptus* literature the definition of this species was extended to include as varieties the trees now grouped by Maiden under the name *E. ovata,* viz. *E. acervula* and *E. paludosa*. A stricter definition excludes these trees and restricts the specific name *E. Gunnii* to (*a*) the Tasmanian mountain tree locally called "cider-gum" and (*b*) certain closely similar forms found at high altitudes in Victoria and New South Wales. As thus understood *E. Gunnii* is a medium-sized to large tree, of branching habit when grown in open situations, but capable of forming a long clean bole when surrounded by other trees.

The dead bark is non-fibrous and comes off in sheets or scales, leaving the stem and branches more or less smooth and of a pale greenish-grey colour. Leaves in the juvenile stage short, round or oval, sessile or on very short stalks; those of adult trees stalked, nearly equal-sided, about 3in. long by ½in. to ¾in. in width. Umbel very constantly 3-flowered; lid of bud a low conical cap; calyx tube (unripe seed-cup) small, deep, narrow; anthers with longitudinal and nearly parallel openings. Ripe seed-cup up to ⅜in. in depth and a little less in width. Valves usually three in number and in the Tasmanian form deeply enclosed.

The MATURE WOOD of *E. Gunnii,* like that of all other alpine eucalypts, is pale in colour. It is said to be extremely hard and very heavy. Owing, however, to the high altitudes at which the trees grow in their native habitat, it has come very little into use. There are no available reports on its resistance to decay when placed in contact with the ground. Until, therefore, competent tests can be made in our own country we must be content with a favourable inference from the density and good appearance of the wood. For best posts and poles twenty years in good condition would seem a reasonable anticipation.

GROUP VI. E. GUNNII. E. MUELLERI.

CULTIVATION IN NEW ZEALAND.

On the cultivation of this exceedingly interesting and important species in New Zealand the writer reported in 1916 as follows:—

"The species has found a congenial home in the State plantations at Waiotapu, on the higher Canterbury Plains, as at Racecourse Hill, and especially in Southland, where it is represented by many vigorous and very beautiful specimens. A belt on two sides of the homestead enclosure on the property of Mr. P. C. C. McLeish, in the Drummond district, is particularly worthy of mention. The trees, now thirty-six years old, are in a vigorous growing condition, and stand up firm and erect without any indication of having suffered from prevailing winds. An average specimen carefully measured with the Abney level and steel tape was found to have a height of 100ft. and a girth of 6ft. 9in. Many of the boles are straight and clean, and the majority of them would cut into good boards and scantling if put on the sawmill. Timber from such trees cannot fail to be of considerable value in the near future, and no time should be lost in putting it to the test of competent experiment." *Journal of Agriculture, April 20th, 1916.*

The photograph reproduced at the end of this Group shows these trees as they now appear with an additional nine years of growth upon them.

Since 1916 several large and vigorous specimens have been noted at "Ngatarua" (G. W. Batley) in the Taihape district, at an altitude of 2,200ft., and others near Tapanui in Otago. We have assumed that the seed from which all these fine specimens of *E. Gunnii* were propagated was collected in Tasmania. Whether this is correct or not, the evidence on the whole shows how altitude and latitude are correlated in the acclimatization of plants. The mountain *E. Gunnii* flourishes at high altitudes in our North Island and at low altitudes in cool parts of the South Island. It may exist in a dwarf and stunted form on warm and frostless lowlands in the North, but will never there attain its optimum. This capacity to flourish where the winters are cold makes *E. Gunnii* a very precious accession to our forestry. Seed for future propagation of the species should be collected from our own largest and best specimens where the winters are cold.

68. E. MUELLERI T. B. Moore.
Syn. E. JOHNSTONI Maiden.

NATURAL HABITAT, DESCRIPTION, AND USES.

To find this species in its natural habitat we must go to southern Tasmania and ascend the mountains to an altitude of about 2,000ft. The winters in that latitude and at that altitude bring severe frosts and occasional heavy falls of snow. Mount Wellington near Hobart has many specimens mingled with its general flora; but the optimum of the species appears to be farther inland. In the National Park, for example, many trees reach heights of 150ft. to 200ft. with diameters up to 3ft. 6in. The boles are remarkably free from branches and form long straight shafts. The dead bark is non-fibrous and falls away from all parts of the tree, or may persist for a few feet at the base of the stem. The newly exposed living bark is reddish-brown. In the juvenile stage the leaves are sessile and round or heart-shaped; in the adult tree stage they are stalked, oval to oblong, and up to 4in. in length. The umbel is normally 3-flowered, its stalk being under ½in. long and its stalklets so short that the fruits become sessile; lid of bud warty and very low with blunt projection in centre; anthers with longitudinal and nearly parallel openings. Ripe seed-cup ½in. wide by 5/16in. deep, ridged at sides, 3-celled; open valves slightly protruding and claw-like. MATURE WOOD described as pale with slight tinge of red, hard, heavy, and very durable.

CULTIVATION IN NEW ZEALAND.

It is to our discredit in New Zealand that this splendid frost-resistant tree has not yet been successfully cultivated in this country. In conducting new trials planters must rigidly observe these two conditions: (*a*) Seed must be obtained from large and vigorous trees such as may be seen in the Tasmanian National Park, and in no case must seed be accepted if collected from shrubby or doubtful specimens. (*b*) Planting must be done in suitable localities on cool uplands in both Islands. Experiment may show that this species should be in Group V.

69. E. UNIALATA Baker and Smith.

NATURAL HABITAT, DESCRIPTION, AND USES.

The eucalypt bearing this name has its native home in Tasmania. Expert opinion inclines to the view that it is a hybrid between *E. globulus* and *E. viminalis.* In general aspect of foliage and bark the tree is like *E. globulus.* The buds and fruits are in threes like those of *E. viminalis,* but larger and coarser. The ripe seed-cups measure up to ½in. in diameter. The specific name refers to a prominent wing or angle showing on each cup. The valves strongly protrude and are claw-like.

CULTIVATION IN NEW ZEALAND.

The reason for mentioning this eucalypt here is that certain vigorous trees in the State Forests at Rotorua are believed to be identical with it. The case is one in which there is need for competent research. Forestry can make no safe use of these trees until it has ascertained (*a*) that they reproduce true to the hybrid type, and (*b*) that they yield a valuable and durable timber. Foresters and students should test these two questions without delay.

70. E. URNIGERA Hooker f.

NATURAL HABITAT, DESCRIPTION, AND USES.

This is another contribution from Tasmania. Its native home is on the mountains of that country at altitudes of 3,000ft. to 4,000ft. It is not found in Australia. In some situations the trees remain small and shrubby; in others they are of erect habit and attain heights up to 50ft. The dead bark falls away leaving a blotched and brownish-grey surface. Leaves in the juvenile stage sessile, heart-shaped or round; in the adult tree stage stalked, about 4in. long, lance-shaped, of deep shiny green on both surfaces. Umbel normally 3-flowered; stalk slender and about ¾in. long, stalklets 3/16in.; lid of bud cap-like with low central projection; anthers with longitudinal and nearly parallel openings. Ripe seed-cup ⅝in. long by ⅜in. or more wide, contracted towards orifice and usually recurved at the rim; valves deeply placed and wholly below the rim. The specific name was suggested by the distinctly urn-like shape of the seed-cup. It is appropriate; but several other eucalypts have urn-shaped fruits, and might almost equally well have claimed the epithet. The MATURE WOOD of *E. urnigera* is pale in colour, wavy in grain, and adapted for use in cabinet work. Of its behaviour in contact with the ground we have no record.

CULTIVATION IN NEW ZEALAND.

The species is not commended as a timber yielder, but as an addition to our list of ornamental shelter trees for colder parts of the country. Beautiful specimens now growing in Southland would supply seed for future propagation. In middle and northern New Zealand this and other sub-alpine species should be tested at altitudes up to and over 3,000ft.

There has been found in several New Zealand localities a eucalypt that may possibly be a hybrid between *E. urnigera* and *E. globulus*. Two of the specimens, one in the Christchurch Botanic Gardens and one at Teddington on Banks Peninsula, grew to large dimensions. Dead bark deciduous. Juvenile leaves sessile. Adult tree leaves stalked, deep green, with oil dots numerous and remarkably pellucid. Umbel 3-flowered; buds and fruits very strongly biangular. Ripe seed-cup about ½in. in depth and width; orifice crater-like with valves at bottom of depression. Seed supposed to have come from Tasmania, but parent tree or trees not since located. Named *E. biangularis* and published in *Critical Revision.* Should be given trial in parks and gardens where there are severely cold winters.

APPENDIX TO GROUP VI.

E. Gunnii.—Some botanists are of opinion that this species is indigenous exclusively to Tasmania. On this view the mainland trees hitherto included in it are specifically distinct and should be separately named and described.

E. Muelleri.—It is now understood that this name will be suppressed in favour of *E. Johnstoni.* The climatic range for *E. Muelleri* in New Zealand is not yet known.

EXPERIMENTAL PLANTATIONS.

ESTABLISHED BY THE AUTHOR, 1898-1914.

THREE KINGS, NEAR AUCKLAND.
FORMER SITE OF THE WESLEY TRAINING COLLEGE.

The planted areas lie within the bounds of a long extinct volcano. The planting was done partly on slopes of the original tuff crater and partly on decomposed lava and scoria. Exotic conifers, oaks, nuts, eucalypts, and some native trees were included in the selections. Where browsing animals have been excluded, the plantations now form miniature forests with richly carpeted floor and increasing undergrowth of native shrubs. The blocks and belts of trees arrest the prevailing winds and soften the frosts of winter. The soil is good; the rainfall generous.

The eucalypts range in age from 13 to nearly 30 years. About 80 species were tested. The experiments strongly demonstrated the demand of the eucalypts for climatic grouping. Such species as are included in Group i. soon showed their need of a higher mean annual temperature. At the reverse extreme species included in Group vi. languished because the mean temperature was too high for them. Some of the species included in Group v. grew rapidly to large dimensions, but gave cause to suspect that their optimum would be attained further south or at higher altitudes.

The species best adapted for cultivation at Three Kings were found in Groups ii., iii., and iv. But even here there was room for discrimination. Some of the species in Group ii. demanded hotter summers, some of the species in Group iv. colder winters, than the genial even climate of the Auckland Isthmus could offer them. But allowing for all deductions, it is no exaggeration to say that a thousand vigorous and very beautiful specimens are to-day finding a congenial home at Three Kings. Many of them represent species with a high reputation for the value of their timber, and thus claim economic status as well as beauty.

PAERATA.
WESLEY TRAINING COLLEGE FARM.

Here a great deal of the soil is heavy adhesive clay. For best results in tree culture, it needs subsoil ploughing and underground drainage. Planting was begun in 1914, and some time will be required yet for competently testing results. The three species of *Eucalyptus* that give best promise are *E. botryoides, E. pilularis,* and *E. saligna;* but many others are doing well. The trees were planted in chain-wide belts for shelter against the westerly winds. Some species have had their tender foliage cut back by these winds. Others have not suffered any injury. The large number of species planted and the conditions of planting present an object lesson to all who are planting or intend to plant in this or in any similar locality.

EXPERIMENTAL PLANTATIONS.

SOME OF THE THREE KINGS RESULTS.

Species.	Year of Planting.	Diameter.	Condition.
E. botryoides	1908; 1914	20 in.	Splendid
E. capitellata	1910	15 in.	Good
E. diversicolor	1914	12 in.	Good
E. eugenioides	1909	18 in.	Excellent
E. fastigata	1904; 1914	20 in.	Vigorous
E. longifolia	1907	15 in.	Good
E. Macarthuri	1904	24 in.	Vigorous
E. microcorys	1910; 1912	15 in.	Excellent
E. obliqua	1908	18 in.	Good
E. ovata	1907	20 in.	Vigorous
E. paniculata	1898; 1908	16 in.	Healthy
E. pilularis	1907	20 in.	Splendid
E. piperita	1904	20 in.	Good
E. regnans	1914	16 in.	Excellent
E. rostrata	1904	22 in.	Healthy
E. saligna	1908; 1914	20 in.	Splendid
E. sideroxylon	1898	16 in.	Good
E. Smithii	1914	20 in.	Sturdy
E. tereticornis	1904	16 in.	Fair
E. viminalis	1914	20 in.	Vigorous

NUMEROUS OTHER EXPERIMENTS.

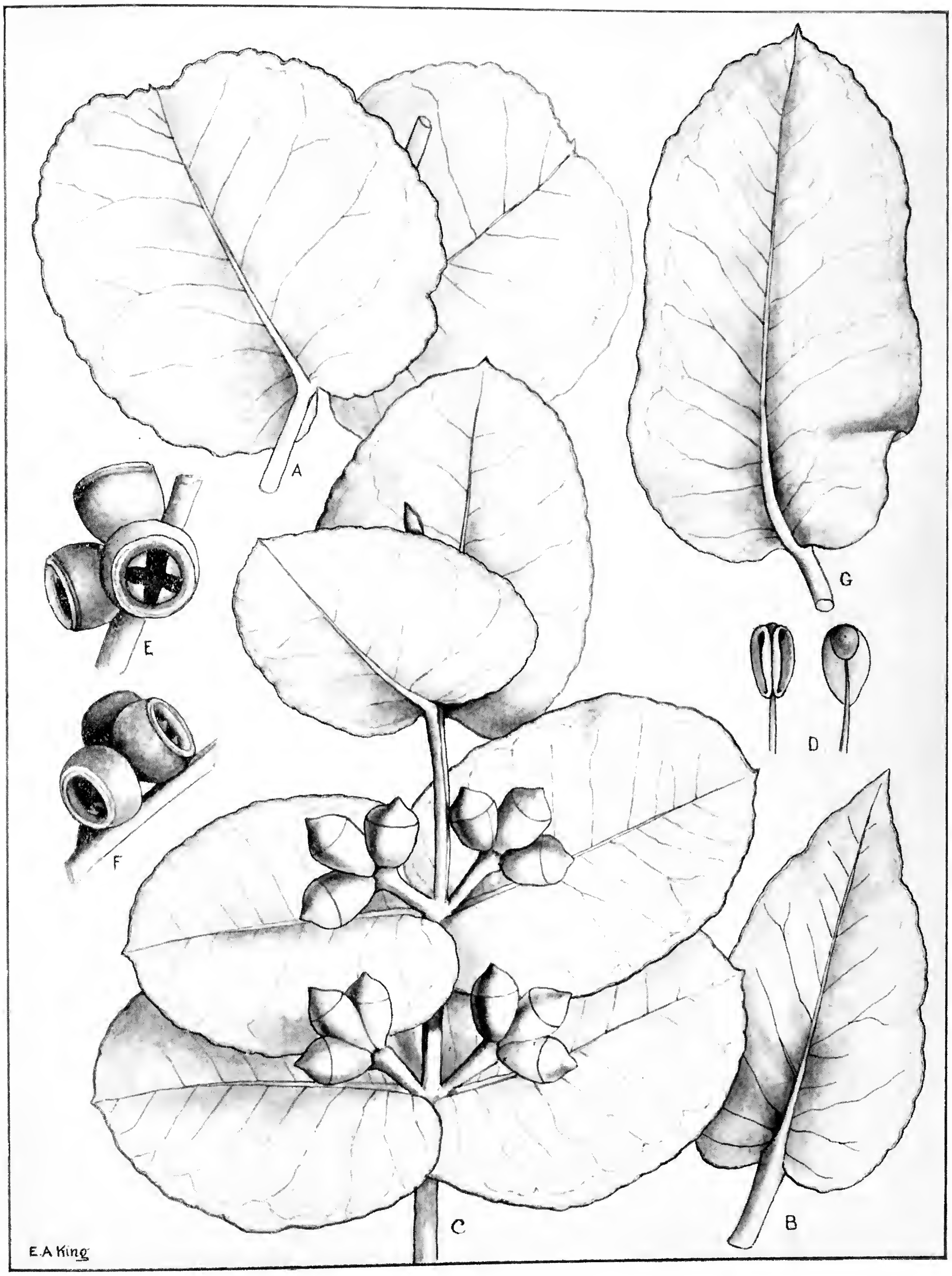
A very large number of tree lovers in New Zealand are either themselves experimenting with Eucalypts or are closely watching the experiments of others in neighbouring localities. The following may be named as representing widely separated climatic areas:—

Keeley & Son,	Cambridge.
Claud H. Williams,	Muriwai, Gisborne.
Bernard Chambers,	"Te Mata," Havelock North.
H. G. Groves,	"Marangai," Masterton.
A. R. Fannin,	"Hiwimania," Taihape.
E. Maxwell,	"Marumarunui," Opunake.
R. F. Goulter,	"Lake Timara," Blenheim.
Orton Bradley,	Charteris Bay, Banks Peninsula.
James Deans,	"Homebush," Canterbury.
R. McDonald,	Heriot, Otago.
Charles Calvert,	Myross Bush, Southland.
Forest Officers,	All Districts.
Nurserymen,	All Districts.

EUC. COCCIFERA.

EXPLANATION OF PLATE.

A. Juvenile leaves. B. Narrower juvenile leaves. C. Twig bearing buds, flowers, and adult leaves. D. Anther, front and back view. E. Ripe seed-cups. F. Seed-cups showing variation.



EUC. CORDATA.

EXPLANATION OF PLATE.

A. Juvenile leaves; broad and blunt. B. Juvenile leaf; narrower and pointed.
C. Twig bearing buds and adult leaves; note that the leaves in adult stage are still sessile.
D. Anther, front and back view. E. Larger seed-cups. F. Smaller seed-cups.
G. Leaf found on tip of adult branch.

EUC. GUNNII.

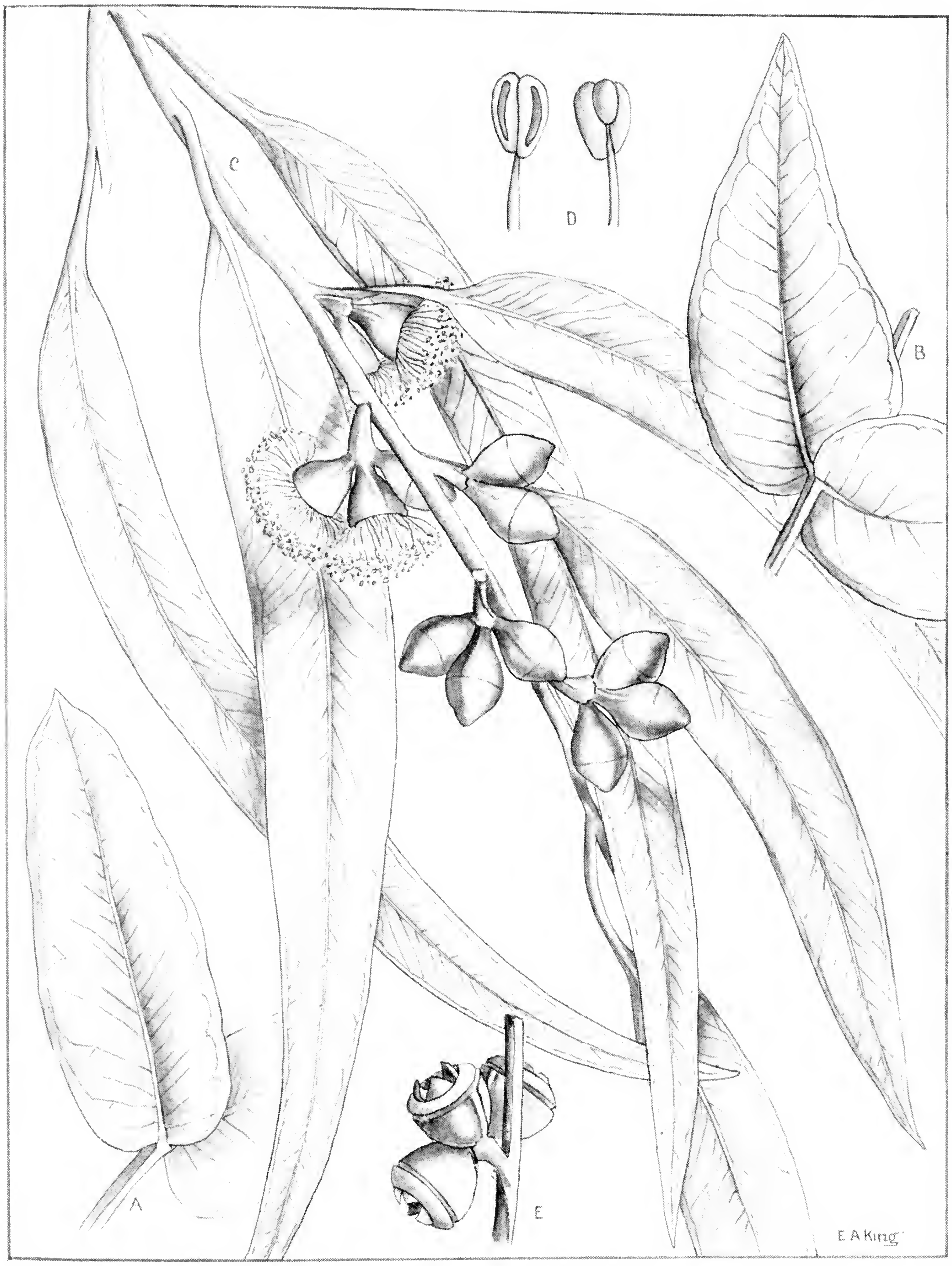
EXPLANATION OF PLATE.

A. Juvenile leaves. B. Broader juvenile leaves. C. Twig bearing buds, flowers, and adult leaves. D. Buds with longer pedicels. E. Anther, front and back view. F. Seed-cups and adult leaf.

EUC. JOHNSTONI.

EXPLANATION OF PLATE.

A. Juvenile leaf a little beyond the sessile opposite stage; note crenulate margin. B. Juvenile leaves in sessile opposite stage. C. Intermediate or sapling leaf. D. Twig bearing buds and adult leaves. E. Anther, front and back view. F. Unripe seed-cups with valves still closed. G. Ripe seed-cups with valves open.



EUC. UNIALATA.

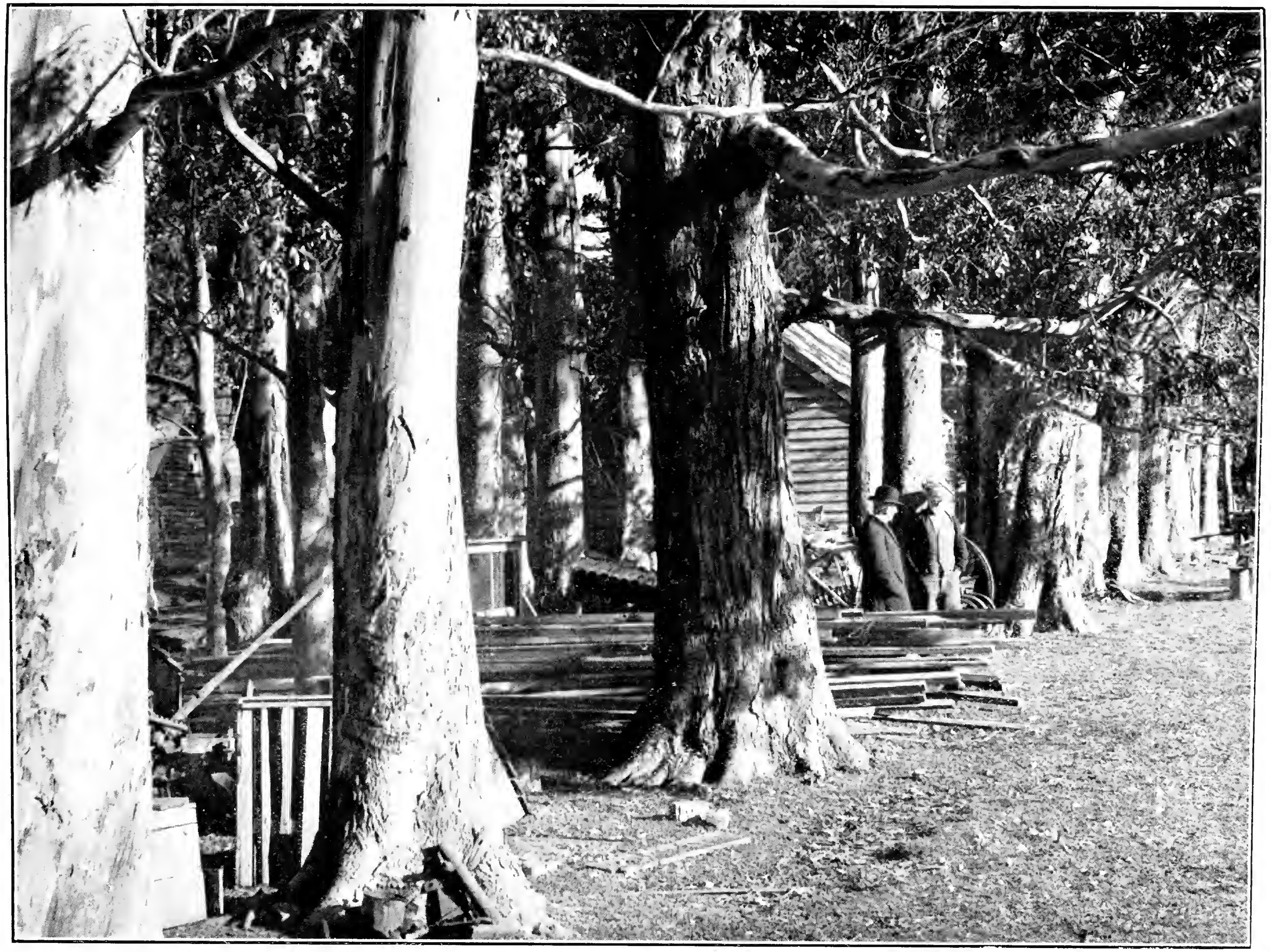
EXPLANATION OF PLATE.

A. and B. Juvenile leaves showing different forms. C. Twig bearing buds, flowers, and adult leaves. D. Anther, front and back view. E. Ripe seed-cups.

EUC. URNIGERA.

EXPLANATION OF PLATE.

A. Juvenile leaves. B. Twig bearing buds, flowers, and adult leaves. C. Anther, front and back view. D. Large seed-cups and unusually broad leaf. E. Seed-cups with longer pedicel. F. Leaf showing variation in form.



A. J. Campbell, Photo., Invercargill.

EUC. GUNNII.

Age 45 years.

DRUMMOND, SOUTHLAND (P.C.C. McLEISH).

These are the largest specimens of *E. Gunnii* in N.Z., and probably the largest yet grown anywhere. Girth measurements 4ft. above ground for four of the trees are as follows:—12ft. 7in., 12ft. 4in., 11ft. 10in., and 11ft. 8in.

A. J. Campbell, Photo., Invercargill.

EUC. GUNNII.

Distant view of the trees at the McLeish Homestead, Drummond, Southland.

SECTION IV.

CULTIVATION OF THE EUCALYPTS FOR TIMBER PRODUCTION.

SELECTION AND ARRANGEMENT OF THE PLANTING GROUND.

Areas where there is hard-pan or extended impervious rock must be avoided in planting trees of almost every kind. Loose boulders or broken rock mixed with the soil and subsoil will be no serious detriment, provided the tree roots can freely make their way outward and downward to firm holding and permanent moisture. Some of the timber-yielding eucalypts grow slowly, and rarely exceed small to medium heights and diameters. These can flourish on soils and subsoils that a farmer might regard as poor and dry. Amongst them are species that produce heartwood of great density and durability. Generally their period for reaching a good pole timber size is long. It may be as much as sixty or seventy years. The very rapid growers that can give us poles for carrying wires and large logs for the sawmill in thirty years are necessarily more exacting. They demand deeper roothold and a more abundant supply of moisture. Preference in New Zealand is likely to be given mainly to the best of the species that grow rapidly to large dimensions.

The question of selecting an acre or two for eucalypts on an ordinary farm will be simple. The farmer will place his block or belt where it will serve as a windbreak and be generally most convenient. If he has an unploughable gully, he may find that the best and most economical situation for his plantation.

It is when the planting has to be done on a more extended scale in hilly and steep country that the problem becomes difficult. We may then have widely different qualities and conditions of soil in close contiguity. With varying altitudes and a deeply uneven surface of the land, we may also expect to find a great diversity of winter temperatures. Hollows and pockets that are warmed by the sun's rays in the day time will be filled by heavier and colder air at night, while the warmer and lighter air will be forced up to the intermediate levels. Life may be abundantly possible to tender species in the favoured localities, and quite impossible to them only a few hundred yards away.

No large square block of such country could be all profitably planted with the same kind of tree. The first thing to be done in such case is to make a soil survey and to lay down a working plan. Latitude and local climatic conditions must be closely noted as well as the soil. Winter temperatures must be either definitely ascertained or very carefully estimated all over the block. Prevailing winds must also be duly observed and indicated. In the resultant plan, valleys and flats and hollows where the subsoil is deep but frosts severe will be marked as available either for strongly frost resistant eucalypts or (subject to expert advice in every case) for such conifers as *Sequoia sempervirens, Sequoia gigantea,* or *Pinus ponderosa.* Knolls and plateaux that are made safe and genial through the winter nights by warm air forced up from the lower levels will be reserved for the tender and more valuable of the eucalypts. Higher up the slopes will be found areas suitable for *Pseudo-tsuga Douglasii* and *Pinus radiata.* Still higher up may be dry and exposed ridges that can be more successfully clothed with *Pinus laricio* or other hardy but slower growing pine.

The conifers will befriend the eucalypts by creating forest conditions and by their protective shelter. In some places it will be necessary to plant belts of hardy pines across the mouths of the valleys to arrest the inrush of harsh prevailing winds. If the situation is near the coast and the winds are charged with salt from the sea, the need for the pine screen to protect the less resistant hardwood trees will be especially imperative. All these groups of trees will in their place and time contribute to a valuable harvest of timber.

Planting over country that presents great diversity in conditions of soil, temperature, and wind force must necessarily be difficult; and generally private owners of land who propose to undertake such a task will do well to seek the advice and assistance of trained and experienced foresters. First principles will be the same everywhere; plans and choice of trees must vary indefinitely to suit local conditions.

All planting of timber trees should be carried out with due thought for the future harvesting of the crop. Many of the eucalypts and some of the conifers grow very rapidly to large dimensions; and we must remember that their value as yielders of either fuel, fencing material, or sawn lumber will depend largely upon the facility with which we can convey their material to the homestead or to the sawmill. Within a few years there will be the thinnings to be brought out, and later the large logs. In view of all this, the initial working plan for any considerable area of hilly country must reserve tracks down the valleys and along the contours for future roads or truck lines. It must, where practicable, also provide that the trees shall be planted in straight rows up and down the slopes, so that the thinnings and logs may be easily dragged down to the truck lines. By prudent foresight the planter may ensure for the future woodman both a clear track and the maximum available assistance from gravitation.

SOWING AND PLANTING.

SOWING IN SITU.

The simplest and easiest way in which to start a plantation of eucalypts is to sow the seed where the trees are to grow. The conditions that favour success of the method are closely similar to those that determine success in sowing clovers and grasses, and therefore can be easily understood by any farmer or settler. The method is called sowing *in situ,* and it may be practised either on land that has not been cultivated or on land that has been prepared by cultivation.

SOWING IN SITU.

(a) SOWING ON LAND THAT HAS NOT BEEN CULTIVATED.

Nature starts her new crops without cultivation. She has no ploughs, or harrows, or rollers. But she prepares the soil for the infant plants by enriching it with decayed leaves. In many instances what is so abundantly possible to nature is possible also to us; but we must make no errors. Some genera can start and grow where the ground is heavily shaded; others require a great deal of light. Eucalypts are light demanders. A little shade is good for them when they are young and tender, but they soon require the open sunlight. The seed can germinate and grow quite well in a thin sward of grass or in open scrub, but it will fail wherever the ground is very closely covered with tall vegetation. Fire is the arch destroyer of plant food; but we often cannot avoid its use in bringing land under economic control. Heavy scrub must be cut down and burnt; and the stronger and cleaner the burn the better will be the prospect for a good take with tree seeds, as in the case of clovers and grasses. Nature usually provides an abundant supply of seed, either preserved in a dormant state upon the ground or fresh from the trees. In surface sowing upon unworked land we must imitate her generosity and make sure that the conditions are right for germination. The method is recommended only for places where the plough cannot be used. Another method adapted to unploughable country is to sow the seed in spots regularly spaced and prepared by grubbing or by turning of the sod.

(b) SOWING ON LAND THAT HAS BEEN PREPARED BY CULTIVATION.

In raising tree plants *in situ* the ideal method undoubtedly is to sow the seed on land that has been thoroughly cultivated. In both Islands there are splendid stands of eucalypts that were started in this way. But the land must be clean as well as worked to a fine tilth. The words "thoroughly cultivated" must be understood to mean that weeds of all sorts have been either killed right out or reduced to a negligible amount. *Eucalyptus* seedlings are at the start small and weak and slow of growth. They cannot fight their way through a mat of sorrel and twitch and yarrow and lotus. A very thin sprinkling of grass will shelter and help them; but a dense carpet of tangled weeds laid over them while they are still only an inch or two high will be fatal. Wet land must be drained; sour land must be fallowed and sweetened as well as cleansed of weeds. Land naturally very poor or badly impoverished by cropping should have a generous dressing of manure. A mixture rich in phosphates and nitrogen will be best for the purpose; and to create quite ideal conditions the manure should be distributed, not with the seed, but just before the last harrowing in the preparatory cultivation.

When the land has been thus thoroughly prepared and the time has arrived for sowing, half a pound to a pound per acre of fresh clean seed should be distributed regularly *on the surface;* either over the whole area or in lines ten to twelve feet apart. The arrangement in lines is much to be preferred. It permits of the plants being cultivated for a year or two, and is convenient when the time comes for thinning or clear cutting the crop; but it is not absolutely necessary. For facility in sowing, either by hand or with a drill, the seed may be mixed with dry sand or fine dry earth. If no manure or insufficient manure has previously been applied to the land, quite dry blood and bone may be mixed with the sand and seed immediately before sowing. If the ground is heavy and damp, the seed will be sufficiently covered by a touch over with chain harrows. If it is light and dry, a roller should follow the harrow; or the ground may be firmed and the seed covered by driving a mob of sheep two or three times over it. *What Eucalyptus seeds need is a very light covering on a surface that is firm without being hard, and moist without being wet. Deep covering will prevent germination and kill the seed. Obviously, seeds sown in lines should not be cross-harrowed.*

(*c*) SEASONS FOR SOWING IN SITU.

There are two seasons in the year when *Eucalyptus* seeds may be sown—autumn and spring. In districts where the winters are very mild the sowing may be done in autumn, February and March being the best months. Plants started in either of these months or even in April, and carried without injury through the winter, will be able to take full advantage of the next spring and summer growing season, and this will be nearly equal to the gain of a year as against waiting to sow in the spring. But in the numerous localities where severe frosts fall early and there are many cloudy days, the prospect for carrying infant eucalypts through the winter in open situations will be too doubtful. In general practice it will be safer and better to wait for the spring. September will be right if the land is then dry and the weather warm; but in many cases there will be reason to wait until October or even November. The risk with late sowing is that dry weather may set in and kill off the young plants before they can get their roots down to permanent moisture.

TRANSPLANTING.

Though so simple and easy, sowing the seed where the trees are to grow cannot become the exclusive practice. Transplanting will often be more convenient for small areas, and some planters will prefer it for their general work, however extensive. There are several ways in which transplanting may be carried out, every one of which merits careful explanation.

(*a*) USING SURPLUS PLANTS FROM A SOWN AREA.

A man who has laid down a patch by sowing where he wishes the trees to grow may find in a few months that parts of his ground are carrying far more plants than are necessary. These surplus plants need not be wasted. They can be used to fill up blanks or to extend the plantation. While the plants are still small, any of the species may be successfully transplanted from a sown patch provided each plant is lifted and replanted with a block of unloosened earth adhering to the roots. A narrow keen-edged spade is the best tool for the work. With it a cut is made on three sides of the plant; then the tool is driven deeply in on the fourth side and the separated block with its contained plant lifted out. If the soil holds well together, the blocks can be collected and carried to the planting ground in a wheelbarrow or cart. Each block is then pressed firmly into a prepared hole, so that the base of the plant may be a little below its former level with the surface of the ground. *E. Macarthuri, E. viminalis,* and a few others may be transplanted with quite bare roots provided the work is quickly and skilfully done; but generally success will depend upon keeping the roots protected by some unloosened earth. The surer method will take more time; but in view of the great prospective value of the trees, every available plant should be used and each given its best chance.

(*b*) PROPAGATING FROM SEED BEDS.

Surplus plants from a sown area will be but rarely available. In general practice transplanting must be done from seed-beds in the nursery. Where there are propagating houses or frames the plants may be started therein; but such conveniences, though desirable, are not indispensable. We have seen that extensive sowings may be successfully made where the trees are to grow. In a similar manner sowings may be made on small areas for the exclusive purpose of removal. The preparation of the soil will be exactly the same but on a smaller scale. If sand and vegetable mould are available to mix with the soil, they will make germination of the seed more rapid and certain. A patch worked out of a clean grass paddock will, of course, give better results than a weedy old garden. The seed may be sown in bands six inches wide and covered by sprinkling earth over it; or it may be sown in very shallow drills and covered by raking and treading, just as we sow onion seed. For planting out early in the following winter or in the succeeding spring the plants should be started in September, October, or November. The risk with early sowing is that the plants may become too large before we can handle them; with late sowing, that dry weather may set in and either prevent the germination of the seed or kill the plants as soon as they come up. In a very wet season young plants may be lost through "damping off", which means that they succumb to some form of cryptogamic parasite. The remedy then is to rework the ground and sow again. A reasonable amount of skill and perseverance will soon provide as many hundreds or thousands of plants as may be desired. There will then be the option of several different methods of treating and preparing them for transference to the permanent planting ground.

(1) *Boxing.*

While the plants are still only two or three inches high they may be pricked out into shallow boxes or trays filled with vegetable mould or humus. The plants should be evenly spaced in straight rows about 2½ inches apart each way, with their tender roots as little bruised or broken as possible. As each box is completed, it must be lightly sprayed with water and placed in a position where it will be sheltered from harsh winds and at the same time partly shaded from the direct rays of the sun. In dry weather further sprayings must follow frequently. Within a month the plants will have formed new rootlets and made some additional leaf growth. They must then be placed in more exposed positions and gradually hardened. Two or three weeks before the early winter planting season, say, in the first or second week of April, a sharp knife is to be run between the rows of plants in the boxes both ways so as to cut all long roots, this operation to be immediately followed by a good spraying with water. By the middle of May the plants will have again formed new rootlets. Thereafter at any convenient time during the early winter or in the spring the planting out may be done with assured certainty of success. The plants are carried to the permanent ground and passed along the lines in the boxes. Each unit, with its little square block of protecting humus intact, is then lifted out with a trowel and settled in a place already prepared to receive it. The prepared place will not be a deep hole, but a turned sod cleft in the centre with a spade. An ounce or two of blood and bone manure under the sod will enable the young eucalypt to win in the race with weeds. Wooden trays measuring inside 2ft. 2in. in length and 1ft. in width will be found very convenient for carrying out this method. In the State Forests nurseries kerosene or benzine boxes are used, each being cut into two lengthwise. The important thing to be remembered in boxing is that each plant must be allowed room to grow and a sufficient share of the humus to protect its roots when it is removed from the box. Crowding too many plants into a box is false economy and defeats its own aim. A less spacing than 2½ inches each way will mean that some plants will have their roots stripped bare when they are removed from the box and that there will be losses. It will be more satisfactory to have in each box 35 plants every one of which will grow and do well, than to have therein 60, 10 to 20 of which will fail and need to be replaced in the lines the following season.

(2) *Potting.*

Another method similar in effect to the one just described is to put each plant while still very small into a paper or earthenware pot. The potted plants are placed together in a frame or other suitable place and kept moist by occasional spraying with water until they have recovered from the shock of removal from the seed-bed. Then they are hardened by exposure to more open and trying conditions. When the season for planting arrives, the plants are carried to the permanent ground and comfortably settled in prepared places. Paper pots will by this time be in a state of decay, and may be either left on the plants or carefully removed. Generally it will be better to remove them and nip off any spiral or straggling roots, thus avoiding the risk of a bad root system in the future life of the tree.

(3) *Mossing.*

Another method for protecting the roots of the plants is mossing. The best moss for the purpose is the long sphagnum found very commonly in damp hollows and swamps; but other kinds may be used. The plants are lifted while they are still small, preferably two or three weeks after wrenching, and the roots of each wrapped in a pad of moss, which is then tied with a strip of flax so as to form an oval ball. Any long roots that would reach beyond the moss must be cut off as it is bad practice in balling plants to fold or bend back any of the roots. Immediately after mossing, the plants are either sprayed or dipped in a tub of water. They are then placed upright in the ground in a close row. Within two or three weeks they will form new rootlets which will strike into and through the moss. Any time after that, when season and weather are favourable, the plants may be carried to the prepared ground and with the moss about their roots undisturbed, planted in their permanent positions. In preparing plants for long journeys or in cases where planting may be indefinitely delayed, success will be more assured if a small piece of scrim or manure sack is firmly wrapped and tied over the ball of moss. Plants prepared in this way may be put out at almost any time within a year from the mossing, provided they are freely watered if handled in dry weather.

(4) *Wrenching and Puddling.*

Wrenching is well understood and constantly practised by professional nurserymen and gardeners. It immensely increases the chances of success in lifting and moving evergreen plants, and is especially important in handling eucalypts. The principle of it is the severance of all long roots without removing the plant from the soil; and the almost immediate result is the formation of a denser and more fibrous root system. Wrenching is usually done as soon as rains begin to fall in autumn; but it may be done during summer provided there is sufficient moisture in the ground to ensure a prompt formation of new rootlets. Early sown plants that are becoming too large may be checked and retarded by this process. A second and later wrenching may then be found desirable. In dry seasons every wrenching should be immediately followed by a liberal spraying with water.

In nursery practice the plants are lifted three weeks to a month after the autumn wrenching, sorted into sizes, counted into small bundles, puddled, and lined in, or replanted in a close row, to be further hardened for the final planting. Instead of lining in, the puddled plants may be immediately rolled in wet sacks, carried to the planting ground, and permanently planted. Many of the eucalypts so strongly resent transplantation that the greatest care is needed to ensure success in handling them. It is for this reason that so much stress is laid in this place on watering and puddling. A good puddle is made with equal parts of clay and thoroughly decayed cow-yard manure mixed to a thin paste with water. If the weather is dry, the planter should carry each fresh supply of plants taken from the wet sacks in a bucket with their roots just submerged in puddle. If upon planting out it is found that, in spite of wrenching, the plants have made too much growth and are likely to die back, they may be cut down to within two or three inches of the ground and thus given a chance to sprout again from near the root. Overgrown plants have in many instances been saved in this way.

(5) *The Bamboo Method.*

There may be mentioned here yet another method of propagating eucalypts. It consists in raising the plants and conveying them to the permanent planting ground in short sections of the hollow stems of bamboos. In South Australia, where immense numbers of plants have been raised in this way, the bamboo *Arundo donax* has been used and grown expressly for the purpose. The little tubes, all cut to one length with a suitable circular saw, are placed upright close together in a bed of sand or soil on the floor of a shade-house and filled with humus. Two or three seeds are then dropped into the orifice of each tube. When the plants have made a start in the shade-house bed they are lifted out and placed in boxes to be hardened off and prepared for despatch to the planting ground. If several plants are found in a tube, it is easy to reduce them to the strongest. Whether this method is practicable in New Zealand depends upon the possibility of growing a sufficient quantity of suitable bamboos. In view of the rising cost of wood for boxes and paper for pots, the question may be worth consideration and experiment.

SUMMARY OF METHODS.

SUMMARY.

Of all the methods of transplanting that have been described, the simplest and cheapest is that which consists in merely wrenching and puddling the plants and then carrying them to the permanent ground wrapped in wet sacks. With the *good* transplanters it will be successful to a very high percentage of the plants handled. But it does not meet the case of the *bad* transplanters. These cannot endure the exposure of their roots even for a short time. A method must be found for them, therefore, by which the shock of such exposure will be avoided. Boxing, potting, mossing, and bambooing are all methods that protect the roots. For general practice in New Zealand boxing is perhaps the best. It is expensive, but when properly carried out thoroughly effective and satisfactory. In careful hands it should not show a loss of two per cent. But the advice already given about restricting the number of plants in each box or tray must be duly heeded; for obviously, if the plants are densely crowded, some will be injured by the trowel and others will be stripped of humus in removal from the box.

It may be worth while to remark in this connection that the principles upon which success depends in transferring infant eucalypts from the seed bed to the permanent planting ground are really the same in all the methods that have been suggested. Briefly stated, they are as follows:—

(1) Each plant must be brought to a condition in which it has a fibrous root system, a firm woody stem at least ⅛ inch in diameter at the base, and a moderate amount of well hardened foliage.

(2) The roots of each plant must be effectually protected from injury throughout the process of removal.

(3) The plants must be kept continuously moist, but never allowed to remain long in water or in an excessively wet condition.

(4) Rain water, or other water free from objectionable minerals, must be used for spraying and puddling, and should always be applied at a temperature one or two degrees above that of the surrounding air at the time of application.

(5) The spots in which the plants are to be permanently placed must be prepared beforehand by breaking or turning of the sod.

(6) Planting must invariably be done when there is no risk of frost, and when conditions generally are favourable to immediate new root growth.

NURSE PLANTS.

In starting and maintaining her forests, nature uses nurse plants to a lavish degree. The nurses belong to many genera and families of the plant world, and are adapted to all the climates in which it is possible for forests to grow. The most widely distributed nurse of our New Zealand forest flora is the common manuka (*Leptospermum scoparium*). It was this plant chiefly that made possible the spread and perpetual regeneration of our most wonderful tree the Kauri. Given time, and protected in the use of her methods, nature could again clothe our waste spaces with indigenous forest verdure. But nature does not count the years. She renders no annual report to managing directors and pays no heed to expectant shareholders. Economic forestry, while accepting nature's laws, must lay all its plans and adjust all its methods in view of an early reckoning with the auditor and the banker.

State Forests officers and private tree planters have often taken advantage of the nursing conditions offered by native scrub. Where the scrub has been evenly distributed and of suitable density and height, results have been eminently satisfactory. Valuable but tender species have been established where otherwise it would have been wasted time to plant them. The problem suggested for consideration and solution is that of localities where no nurse plants of any description at present exist, and where frosts and winds are both severe. We must suppose that the land has no plant cover but grass, and then ask ourselves how it can be clothed with beautiful and useful trees. Hardy pines will accept the conditions; so also will a few of the very hardy eucalypts. But species that start their lives in a highly tender and precarious condition will perish almost as fast as we plant them. If we are to persist and succeed in the attempt to extend the range of these valuable but difficult species, we must provide them with nurses. Whether this can be done and whether it will pay for the doing are questions that can be answered only by competent experiment.

The ideal nurse plant will be readily propagated. It will be tall enough and strong enough to protect the tree plants in their first winter. It will be easily prevented from overgrowing and suppressing the tree plants. It will not be dangerously inflammable. If persistent in the plantation, its presence will always be beneficial to the trees. It will never become a weed. Of all the plants at present available the one that seems most completely to satisfy these requirements within its own climatic range is tree lucerne (*Trifolium tagasaste*). Given a good start in October, this plant may be expected to reach a height of four feet by the middle of the following April. It can thus give good shelter to the tree plants in their first winter. By their second winter it will be seven to eight feet high, firmly rooted, dense, and sturdy. Experiments with tree lucerne as a nurse plant will be most successful on land that has been sweetened and prepared by cultivation. The tree seed should be sown in lines twelve feet apart and the lucerne seed in intermediate lines. This will give a spacing at the start of six feet between the permanent plants and the nurse plants. The scheme will require a generous amount of seed in both cases, and will be greatly helped by a sprinkling of blood and bone manure along the lines. If the trees are rapid-growing eucalypts, they will soon dominate the nurse. With a good take they will be crowded in the lines, and will need thinning from time to time as they grow and develop.

Tree lucerne is friendly to other vegetation and palatable to stock. In the green stage it is resistant to fire, but when mature and dry yields fuel of high quality. As a floor cover in the plantation it would promote health and vigour in the larger trees. Many flourishing specimens of this plant may be seen in the Auckland region, in Hawke's Bay, in the Wairarapa, about Wellington, and in Marlborough. When planted in damp hollows it has sometimes been injured by frost. This suggests that there is a climatic limit beyond which it will no longer be able to serve our purpose. When that limit has been reached we must look for other plants to take its place. With a great and varied plant world round us, we

NOTE.—In any complete list of nurse plants tree lupine (*Lupinus arboreus*) would claim a favoured place. It is hardy over a wide range of conditions, and persists for several years without becoming unduly tall.

surely need not be long in making a successful choice. There is the common manuka ready to serve us under cultivation as it has so well done in a wild state. The scheme for its use would be to sow it in lines twelve feet apart, allow it to grow for two or three years, and then plant or sow the eucalypts in intermediate lines. There are the acacias—many species of them. With the aid of Australian botanists, selections of these could be made until the best could be ascertained and adopted. There is the common cypress (*Cupressus macrocarpa*). Granted suitable soil conditions, this tree finds a congenial home anywhere over a wide range in both Islands. As a nurse it would need to be planted in lines sixteen feet apart and six feet apart in the lines. The eucalypts would be planted or sown in intermediate lines after the cypress had become large enough to shelter them. Later the cypress would become an associated timber yielder of great value. There is larch (*Larix Europaea*). In the Rotorua State Forests this tree has the distinguished honour of having nursed one of the finest stands of Californian redwood (*Sequoia sempervirens*) in the Dominion. Suitably managed it might be made to nurse such eucalypts as *E. pilularis* and *E. saligna.*

Trees of all kinds can befriend and shelter other trees. Plantations give quietness and comfort to the homestead and farm. Forests modify climatic conditions over wide regions. Thus does the otherwise impossible in raising the choice products of the earth become increasingly possible.

SPACING, PRUNING, AND THINNING.

It looks well and is convenient to have planted trees in straight lines and equally spaced. The lines may be made straight by using ranging sticks or a tight wire. Spaces can be measured with a rod or by links in the wire. The distance apart at which trees should be started is a difficult question and does not admit of an inflexible rule. It is obviously desirable that all trees grown for their timber shall be early denuded of their side branches and forced up to a maximum length of straight, clean bole. The ideal method wherever it can be practised, and especially for small areas, is to plant the trees rather wide apart and prune off the side branches by means of ladders and saws. The pruning process begins at the base of the tree and follows up in a succession of operations, a sufficient amount of foliage being always left fully to maintain the tree's vitality and vigour. The cut for removing each branch or branchlet must be clean and close to the stem. The cost of this method bars the way to its general adoption. It is cheaper to secure the same object in a less complete degree by planting the trees so close together that the side branches will die and fall away while they are still very small. Conifers and broad-leaved trees have sometimes been planted as close as four feet apart each way. For eucalypts the maximum spacing permissible for complete suppression of side branches is perhaps six feet apart each way. But all close planting assumes that when the trees have reached the tall sapling stage the plantation will be heavily thinned.

Here, again, the knowledge and skill of the forester are required. In a dense plantation of saplings some units will be dominant, others sub-dominant, others suppressed; some will be shapely, others ill formed. It will rarely be feasible to take out every alternate tree and maintain the even spacing. It is the weak and defective units that must go; the strong and well formed that must remain. The result will be to give an ample percentage of the good trees a fair chance in the competition for root nutrition and light. Close planting thus ensures for the forester proper control of his plantations, and enables him to maximize the future crop while meantime making some profit out of the thinnings. Spacing of six feet each way gives 1,210 trees per acre; and it may be laid down as a general principle that at the start every acre of planted ground must carry at least 1,000 trees. But methods must adapt themselves to circumstances. If it is probable in any given case that thinning will be neglected, it may be well to make the original spacing 8 feet or even 10 feet each way and take the risk of rather strong side branches.

The foregoing remarks refer to cases where the seedlings are raised in the nursery and separately planted out. Where the seed is sown *in situ* the problem is somewhat different. If it is sown broadcast nature may have to be allowed to do the thinning by suppressing the weaker plants, as she does in a natural forest. If the seed is sown in lines and there is a good take, it is certain that the plants will be crowded along the lines. To compensate for this it may be well to place the lines 12ft apart. Thinning can then be done at any time after the saplings are large enough for use.

Eucalypts, if cut down while still vigorous, very persistently sprout again from the stump. This is troublesome when our object in cutting is merely to thin the plantation. Later when we make clear fellings in blocks, it will be a great advantage. Each stump will throw up several coppice shoots, the rate of growth will be very rapid, and the resultant crop of poles very heavy. Thinning will again be needed, and will consist in removing one or more of the poles from each stump. Where it is intended that eucalypts shall sprout again they should always be cut down close to the ground, each stump being left with a clean sloping surface.

FOREST CONDITIONS.

The necessity for forcing growth upward and suppressing side branches condemns all planting of timber trees in single rows or in very narrow belts. The single row is the extreme form of excessive spacing. It gives the trees unrestrained growth on two sides and encourages heavy branching low down. In a belt or block of trees the outside units can branch freely in one direction. If the belt is narrow, the percentage of heavily branched units will be large. In any very narrow belt it will be much too large. The only way to produce a sufficient percentage of tall, clean trees suitable for the sawmill is to plant in wide belts or compact blocks. The minimum width permissible for any plantation where timber production is concerned appears to be about one chain. That is too narrow for best results; but on smaller farms it may sometimes be as much as circumstances will allow. A model plantation of an acre on a small farm would be two chains wide by five chains in length. Even if the main purpose of the planting is shelter for stock, the single row or very narrow belt stands condemned, for the reason that the wind drives through between the stems of the trees and causes unpleasant and dangerous draughts.

PURE AND MIXED PLANTING.

The eucalypts are all light demanders. If we plant rapid growers and slow growers together, the former will overtop and suppress the latter. A similar result will follow if we plant rapid growing conifers and slow growing eucalypts together. There are two cases in which successful mixing is possible. The first is that where the trees included, whether all eucalypts or conifers and eucalypts, make equal annual height growth and can all keep their growing crowns clear. Such a mixture is ornamental, but offers only doubtful economic advantages. The second case is that where the mixture consists of tall light-topped eucalypts and an under storey of some shade bearer. Here the difficulty is to find the shade bearer. In parts of Australia *Pinus pinaster* has been suggested as an under storey tree. We in New Zealand have talked about *Cupressus macrocarpa* in this connection. Trial plantings competently conducted in several localities will be needed in forming a safe judgment in either case.

The practical test of all planting is the reaping. Small plantations of trees about farms and homesteads will probably be always managed somewhat irregularly. In the case of larger plantations and forests it appears to be an economic necessity that the trees shall be clear felled in successive blocks or sections. The whole of the product on each section must be removed within a limited period and the ground promptly restocked. Selective felling is very costly, and, unless skilfully done, very wasteful. If all the trees on a section are equal in maturity, they may all be cleared away in the same year. If they are at differing stages of maturity, the owner will be put to the expense and loss of selective felling. Even the reservation of seed trees for natural restocking of the ground is difficult and often not satisfactory. Only the experienced forester knows how to do it.

But there are other aspects of the problem besides those that are severely practical and economic. Trees are living things with a long history of adaptation behind them. Where a species has been growing for thousands of years in association with certain other species and genera we must consider well before we isolate it or give it alien companions. In the unspoiled *Eucalyptus* forests of Tasmania and south-eastern Australia we see two well established forms of plant society in close contiguity to each other. The several species of *Eucalyptus* indigenous to a region, together with a few other large trees, blend in a society of giants. In any given locality one species may predominate, but others are nearly always present. That this blending of the giants has some mutual benefits may at least be assumed as probable. Spread out in all directions beneath the great timber trees is another society, whose units, representing many genera, are usually small and slender. Mingled with this undergrowth are many shade bearing acacias of humble dimensions. A forest floor so clothed and furnished is a natural laboratory producing humus and fixing nitrogen. It contributes immediately and continuously to the health and vigour of the great timber yielders, and assures for the soil perpetual fertility.

Looking impartially at both the practical and biological aspects of our problem, we seem to be warranted in making three definite inferences as follows:—(*a*) Pure planting or nearly pure planting in sections will be found most convenient when the time comes to fell the trees and market the product. (*b*)

Suitable mixing of the large-growing species and genera may have a beneficial influence upon the health and vigour of the trees. (*c*) An exuberant and mingled undergrowth will contribute to the wellbeing of the forest in a still greater degree, and may even entirely obviate the need for mixing the timber yielders.

The choice of large-growing trees for mixing in any locality will be made easy by information given under the specific descriptions. The formation of an undergrowth will require intelligent direction and a little persistent effort. Our indigenous flora can give us pittosporums, coprosmas, and other shade bearing plants. Australian botanists will be able to name for us the most suitable of the acacias. Tree lucerne is already with us and can be propagated from locally grown seed. When seed of these various plants has been obtained, broadcast sowing will be the nearest approach to nature's method for its distribution. These plants will cause no trouble in the felling of the trees. In the restocking of the ground they will serve as nurses for the more tender of the new tree plants.

The theory here propounded of a mixed vegetation over the *Eucalyptus* forest floor may be challenged. In New South Wales, while forestry was under the eminently able direction of Mr. R. Dalrymple Hay, it was laid down as a first principle that the forest floor should be cleared of all debris and growths except seedlings and coppice shoots of the approved timber yielders. To form a judgment we must compare conditions. In N.S.W. the task of the forester is mainly that of reducing to order natural forests that have in many instances been damaged by the inroads of timber getters or by fire. Instead of clear felling and complete restocking, there is imposed the necessity for following up with perpetual regeneration and continuous selective felling. In New Zealand we are starting entirely new plantations and may treat them in any way that shall seem most convenient. We have also to consider the cooler and damper conditions under which many of our plantations will grow.

THE PERIL OF BARE EARTH.

To the writer of this book the question of undergrowth in the forest seems only like one aspect of a very much greater biological and economic problem. Geologists tell us that the land surfaces of the earth were formerly much higher and much more extended than at present. Valleys and terraces and contours everywhere bear witness to ancient erosion. The tonnage of soil and silt carried down from continents and islands to the ocean bed in any thousand years admits no calculation or estimate. And nature knows only one way to arrest erosion. That is to cover the surface of the land with vegetation. Naked earth must yield to the bite of frost, the lashing of wind, and the swift rushing of water. Only vegetation can protect and save it. All plants contribute to this service. Mosses and ferns and herbs and grasses and trees all enrich and conserve the soil surface of the earth. A great and complex forest is nature's supreme achievement in combating the eroding forces and in storing fertility.

To man was committed the custody of this protective earth covering. The story of his trust is long and sad. In what we call the ancient world the death of forests by the hand of man was followed by the death of cities and by the desolation of wide landscapes. We of to-day who count ourselves scientific are only half wise.

THE PERIL OF BARE EARTH.

The printed page that falls at our doors every morning convicts us of halting logic. We carefully record the few scores or hundreds of sheep that are drowned in some phenomenal flood. We rarely pause to reflect that the swollen river is every time dyed brown with precious humus and soil from our fields and hillsides. Sheep can be replaced. The loss of soil is irreparable. No power on earth can ever bring it back.

We are spending great sums in teaching people how to plant trees and how to grow crops. But of what ultimate avail will all this be unless we at the same time teach them to save from erosion and wasting the soil surface of the land whereon alone trees can be planted and crops can be grown. Forestry and agriculture are both confronted with the menace of a poorer world in which to plant and sow.

All our methods and practices must be tested by this master truth. Nature warns us to keep all surfaces covered. If we do not cover them usefully, she may cover them with stubborn plants that we shall call weeds. Nature warns us to maintain the forest floor as nearly as possible after her own manner. She persistently spreads thereupon a carpet of decaying leaves and tender undergrowth. Necessity may compel us sometimes to use fire as a protection against fire; but all burning of the forest floor is an outrage against nature. It may undo in a day the gains of a century.

We think lightly of browsing animals; but in a plantation or forest they are scarcely less destructive than fire. Their pitiless voracity prompted by pleasure in destruction soon kills out all seedlings and smaller growths. Their sharp hoofs penetrate the soil and wound the roots of the larger trees. Freely admitted to our tender and beautiful New Zealand bush they rapidly reduce its constituent flora. Within years that will take no long counting they will perpetrate a ruin that admits of no recovery. The planted belt or forest may offer less that is tender and succulent. To assume therefore that browsing animals will therein do no harm is to fail in observation. The forest floor is a vital part of the forest. Given over to an alien and destructive life, it must ever fail of its best service to the trees. It falls too near to the condition of bare earth to fulfil its natural function.

When the white man took custody of streams and rivers in this unique land, he found them fringed with shrubs and trees that held the banks without unduly impeding the flow of the waters. Axe and fire and browsing animal stripped away this protecting vegetation. The rains were not heavier than in former years, but they gathered more quickly into rushing torrents. Banks were undermined, and soon the steady roar of the stream was punctuated by great falls of earth into its turbid bosom.

Frosts, winds, rains, and floods will not halt because they are hurting us. Only when we cover the land with grass and crops and gardens and forests will they cease their hurting and combine to bless.

NATURAL REGENERATION.

To say that conifers and eucalypts will spread by the natural distribution of their seed is merely to affirm that what has been going on through all the ages in which forests of these trees have existed will still go on wherever the seed can germinate and the seedlings can survive. Up and down New Zealand there are hundreds of examples of such natural regeneration. *Pinus pinaster* has spread so freely in some localities as almost to become a weed. What nature can do in a few years with *Pinus radiata* may be seen in the Taupo region, where a few parent trees have now numerous and far scattered offspring. *Pinus Torreyana* was some years ago spreading fast in the uncultivated part of the Sanatorium Grounds at Rotorua. *Sequoia sempervirens, Pseudo-tsuga Douglasii,* and *Larix* are all producing seed and seeking opportunity to raise new generations of their kind.

Even more impressive is the natural fecundity of the eucalypts. At Waitati in Otago a few specimens of *Euc. regnans* have in fifty years given birth to a small forest. At "Okuti", Little River, a splendid stand of *E. eugenioides* has invaded an adjoining area with a chain wide belt of seedlings. At Clevedon in the Auckland region a self sown generation of *E. pilularis* could now send logs to the sawmill. *E. fastigata, E. obliqua, E. rostrata, E. Macarthuri, E. Gunnii,* and *E. viminalis* are all demonstrating their capacity to regenerate without human aid.

So far we have dealt with our question as a mere matter of observation. What use can we make of the truth disclosed? At their best and in the aggregate the forestry operations of all nations do not promise adequately to meet the prospective demand for timber and wood pulp. Is there any possible scheme by which the natural capacity of the trees to scatter their seed and raise new crops could be made more productive? In this and in other countries are large areas of inferior land awaiting the tree planter. His coming to them by ordinary methods is too slow. To hasten the conquest of these waste spaces why not plant in each region a few belts of suitable trees at intervals across the track of the prevailing winds and leave nature to do the rest? The suggestion is beset with difficulties, and worst of all is the menace of fire. But New Zealand has now a highly efficient Forest Service and Schools of Forestry, as well as a growing band of enthusiastic and capable private tree planters. What nature can do for them, they will know how to appreciate; and what difficulties are presented, they will be competent to overcome. New Zealand has already been commended for her skill and enthusiasm in planting forests; and it may be that here is another opportunity to lead in successful experiment.

Some suggestions on Fire Prevention will be found on the next page.

PREVENTION AND CONTROL OF FIRE.

THE INTEREST AND DUTY OF ALL.

Every up-to-date forest service provides systematically against the risk of loss by fire. Forests are intersected by roads or by wide open fire-breaks. Open spaces, other than public roads, are either ploughed or closely grazed. Outlook stations are established and maintained upon hill-tops commanding far-reaching views. Telephones connect these stations with each other, and with the central administrative office. Depots for housing tools and other fire-fighting appliances are placed at convenient intervals through the forest. At a few suitable places beside the public roads there are constructed safety areas where small fires may be lighted for boiling water. Visitors are put upon their honour to see every spark extinguished before they leave. Forest officers have power to expel or arrest irresponsible and careless trespassers. The public are encouraged to regard the forest as their own property, and freely to lend their aid in protecting it.

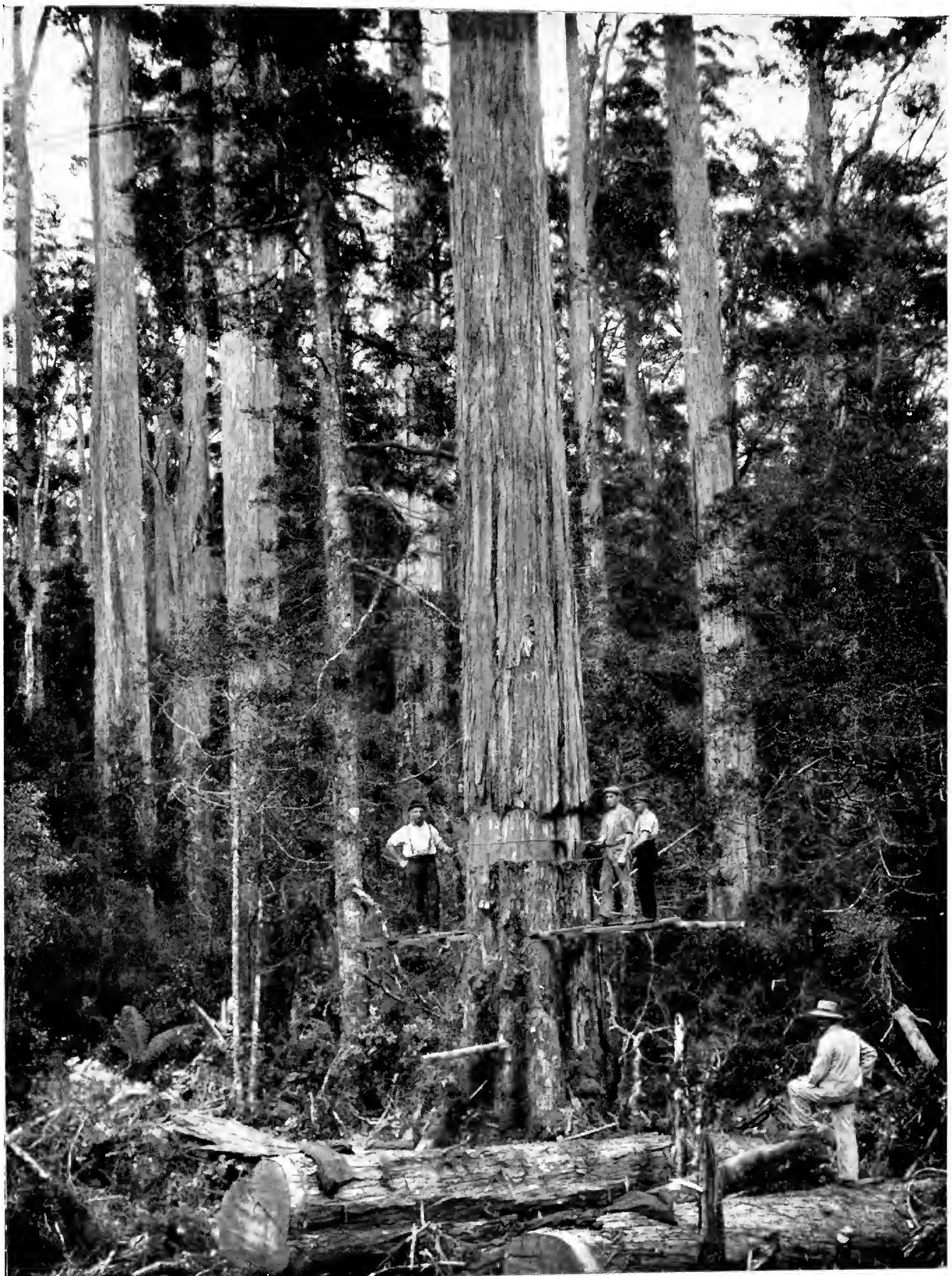
In the State Forests of the Rotorua-Waiotapu region, organization is now so complete that the whole forest and nursery staff could be mobilized against an incipient fire within half an hour from the first alarm.

Syndicates entrusted with the capital of investors should emulate the State in keeping fire risks down to the lowest possible level. Private planters can minimize risks by placing their plantations where they will be surrounded by cultivated or closely-grazed paddocks.

Efficiency in fire prevention is never fully reached until we forecast the driest summer and the most violent wind. Provision for showery seasons, or for average seasons, is not enough. We must make it impossible for fire to destroy our trees when the sky has long been swept of clouds and the grass beneath our feet is like tinder.

A fallacy too generally creeping in amongst tree planters is the assumption that thick-barked trees will not be injured by fire. What we know from experience is that thick-barked trees can endure fire better than thin-barked trees. We do not know, and have no warrant to affirm, that trees of any species will remain uninjured if their external bark is destroyed by fire or other alien agency. It will be nearer to the truth and much safer, to assume that trees of all kinds will be injured and weakened in value by having fire about their stems and beneath their branches, even though their crowns may escape. Many trees will succumb to one burning; the most resistant will be ruined by repeated burnings.

An even worse fallacy is the assertion sometimes made that devastating fires are inevitable. It has not been proved to be an incurable necessity that railway engines and traction engines shall sow the wayside with sparks. It has not been shown that the man who uses fire to clear his land cannot confine the flames within his own boundaries. It has not been suggested that travellers and picnickers are to be excused when they throw down still burning matches into dry grass. No one pleads tolerance for the miscreant who wilfully lays fire to his neighbour's property. Risks from all these causes could be promptly reduced if the mass of the people had the will to reduce them. The need is for an annual campaign of instruction and appeal from parents to children, from teachers to scholars, from the Press to its readers, and from the Government to all the people.

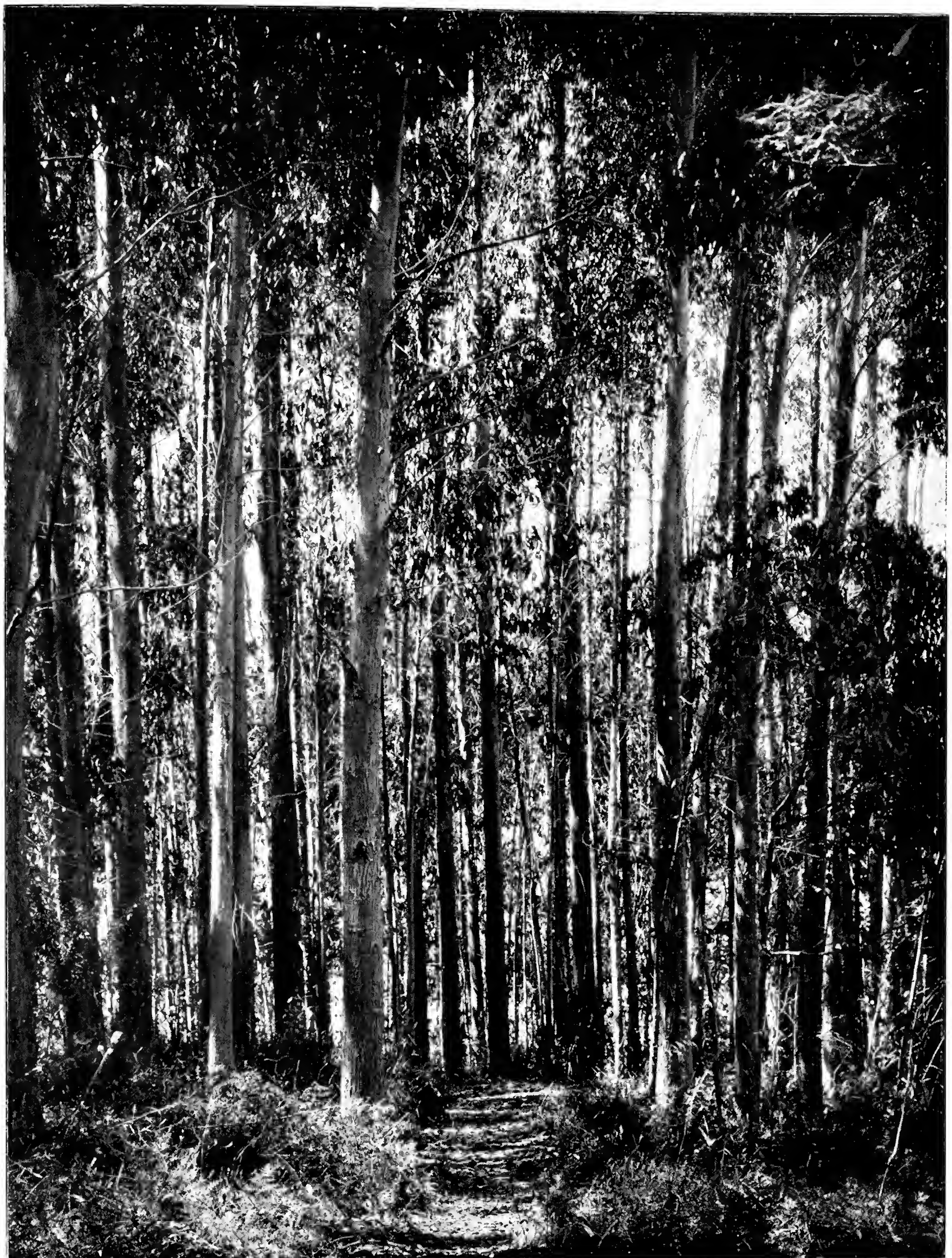


Beattie, Photo., Hobart.

EUC. OBLIQUA.

FELLING A GIANT.

The plate shows the workmen standing on a skilfully constructed light staging, with the saw-cut about 12ft. above ground. The object of this is to avoid the heavily buttressed and possibly hollow base of the stem.

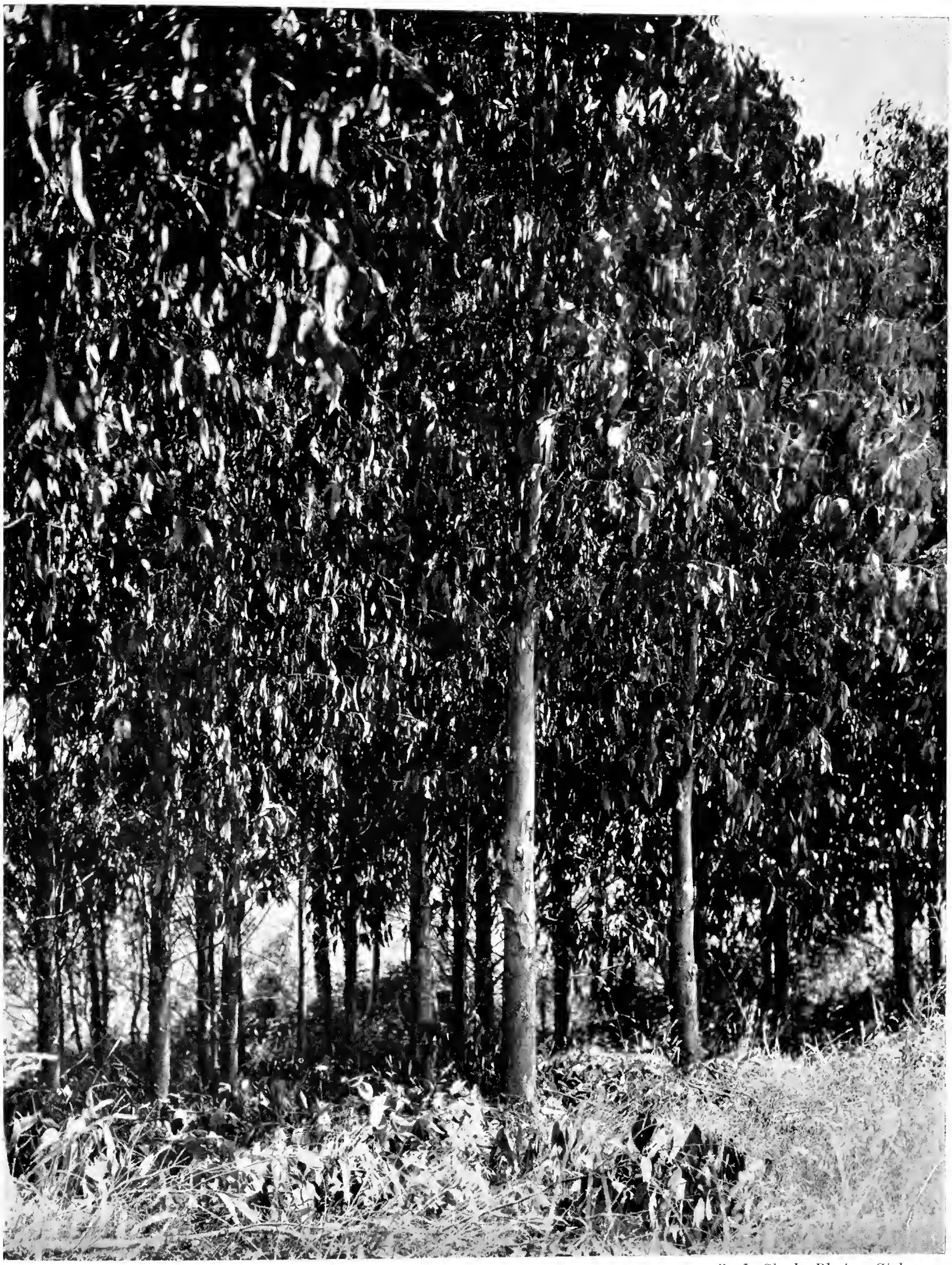


R. J. Clark, Photo., Gisborne.

EUC. OBLIQUA.

"PUKETITI," TOKOMARU (A. B. WILLIAMS).

This remarkably vigorous plantation of Stringybarks was started in 1909 by sowing the seed between rows of potatoes.



R. J. Clark, Photo., Gisborne.

EUC. GIGANTEA.

"PUKETITI," TOKOMARU (A. B. WILLIAMS).

Planted 1917.

These young trees are clean and very vigorous; but for best results the species will probably require a somewhat cooler climate than that of "Puketiti."

R. J. Clark, Photo., Gisborne.

EUC. REGNANS with one EUC. OBLIQUA on right.
MURIWAI, GISBORNE (C. H. WILLIAMS).

The plate shows the *E. regnans* habit of shedding its bark from upper part of tree. Some of these trees, now only 18 years old, are over two feet in diameter.

AN EXAMPLE OF NATURE'S FOREST MAKING.

H. C. Gore, Photo., Dunedin.

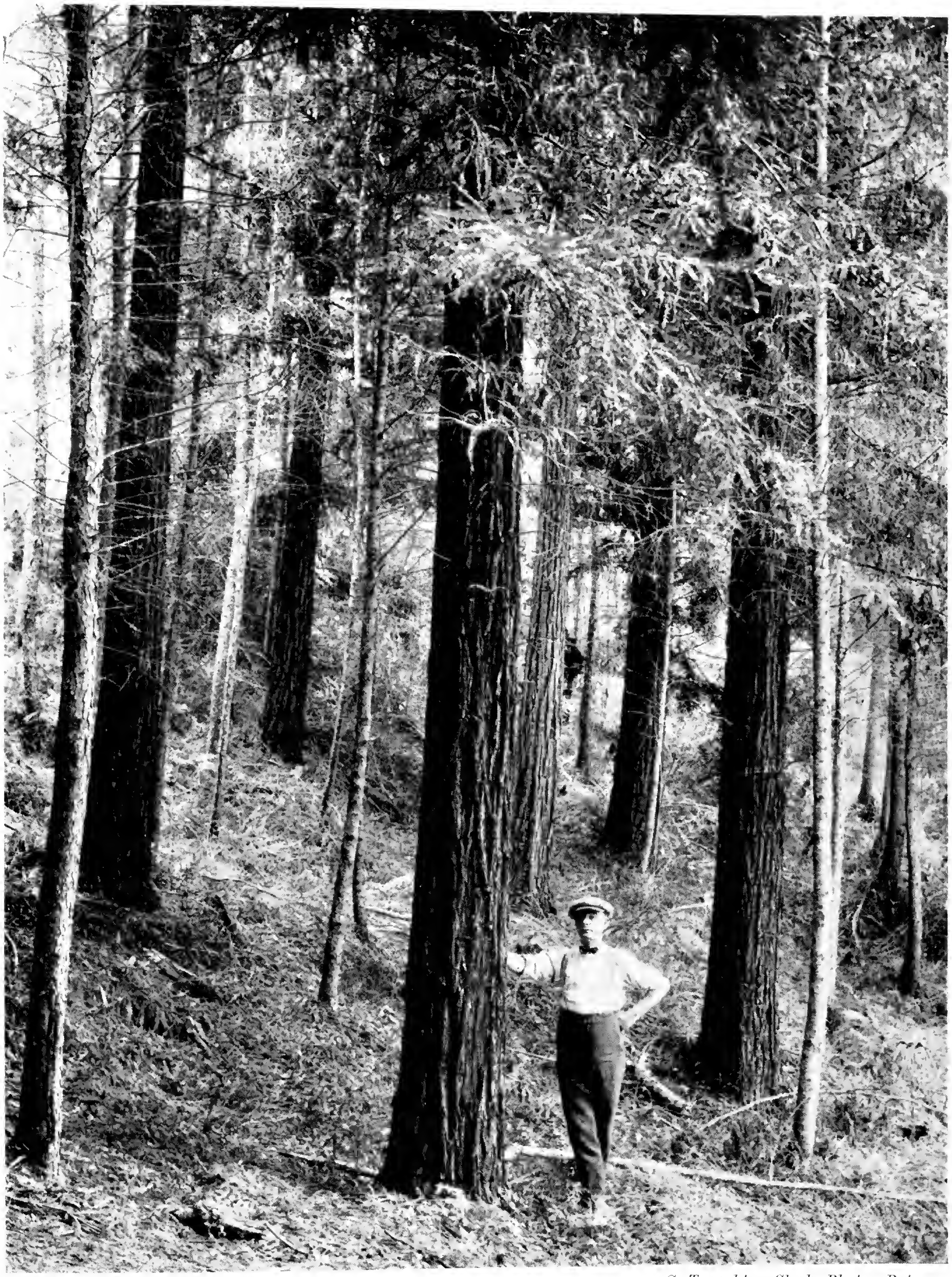
EUC. REGNANS.

Age of specimens in picture, under 30 years.

SANATORIUM GROUNDS, WAITATI, OTAGO.

Man's part in establishing this wonderful little *E. regnans* forest was to plant a few parent trees 50 or 60 years ago. NATURE has done the rest. The same NATURE waits on the forester everywhere to assist him in covering waste spaces quickly and at little cost. In its natural home, Victoria, *E. regnans* is in the first rank for volume of its crop and general utility of its timber.

LARCH AS A NURSE TREE.



C. Troughton Clark, Photo., Rotorua.

SEQUOIA SEMPERVIRENS.
REDWOOD.
STATE FORESTS, ROTORUA REGION.

Twenty-five years ago, under the direction of Mr. H. A. Goudie, larch and redwood were planted together at Whakarewarewa. The hardy deciduous larch nursed the young redwoods through their less vigorous period of life. Later, the redwoods dominated the larch, and now are large forest trees rapidly advancing towards profitable maturity. Eucalypts are less able to bear shade than young redwoods; but the larch could be widely spaced to suit their requirements.

SECTION V.

HARVESTING OF THE TIMBER CROP.

SIZE AND MATURITY OF EUCALYPTUS TREES IN ECONOMIC FORESTRY.

The heights and girths of *Eucalyptus* trees mentioned in books and catalogues usually refer to indigenous specimens favourably situated and probably centuries old. The statements, so far as they are correct, are very interesting from a purely scientific point of view; but to the practical tree planter they are of little value and may be misleading. The man who is planting for utility cannot always choose for his purpose deep sheltered valleys, nor can he anticipate the growth of centuries. He is looking for profit in his own lifetime, or at most within that of his children. He probably has to face average conditions of soil and situation, and he wishes to know what size his trees may be expected to reach in those conditions within twenty to thirty or forty years.

For economic purposes very big trees are really not desirable. If a tree is excessively tall and slender in stem diameter, it is liable to break in falling. If the diameter is very large, the logs will be too heavy for handling and beyond the capacity of any ordinary saw. A larger number per acre of smaller trees will usually, therefore, be a more profitable crop than a smaller number of very large ones. Diameters of stem measuring two to three feet and total heights of one hundred to one hundred and fifty feet will be found about the maximum for convenient conversion to use. With the most rapid-growing species favourably situated these dimensions may be reached within thirty to fifty years. For many purposes, if the tree is *mature,* a less diameter will be ample.

On the question of maturity there is no fixed standard; but it may be said in a general way that a *Eucalyptus* tree is mature when 75 to 80 per cent. of its bole has changed into mature wood. When a tree has matured and reached its best it should be felled and utilized. To keep it standing longer means only loss. There will be loss not only of interest on the timber value of the tree, but probably also deterioration of the tree itself. In all living nature maturity is sooner or later followed by decay. Mature wood (heartwood or duramen), as we have seen, has, like the external sapless bark, ceased to be a living part of the tree. It may persist for a long period in an almost unchanged condition, or it may soon deteriorate, the time and rate of decay being determined by the genus and species to which the tree belongs and by the soil upon which it is growing. New Zealand bushmen are familiar with what is called honeycomb in the centre of very old totara trees; and timber men generally are well aware that some form of heart deterioration is one of the things against which they have to be on their guard in purchasing any over mature trees. The central heartwood of over mature *Eucalyptus* trees first becomes brittle, then soft, and ultimately powdery. This is not identical with the decay that takes place when the timber is exposed to the open air or placed in contact with the ground. It is the decay of a dead part in the living tree. If the tree had been felled in due time, the central heart might have proved exceedingly durable in the most trying situation.

In the natural forests of Australia, where there are many over mature *Eucalyptus* trees, it is the common practice of sawmillers to reject both the sapwood and the central heart. Many of the very ancient forest giants are really only hollow cylinders of comparatively little value. In New Zealand most of our eucalypts are still so young that the question of heart decay does not yet concern us very much; but even here a good many trees have been felled in which the central heart had deteriorated to the brittle stage. Some species are much more liable to heart decay than others and suffer from it at earlier ages. Experience will gradually teach us the age of maturity for each species. Then, when that has been learned, it will become a question in each case whether the annual increment of new timber at the circumference of the tree more than equals the loss at its centre. Generally, prompt felling of our trees as soon as they have really reached maturity will be the policy that will pay best.

Where species and genera are mixed, great care must be used to ensure that the trees shall all ripen together and may be reaped in one process of clear felling.

CONVERSION OF MATURE TREES TO USE.

FELLING.

The correct time for felling timber trees is when their vital forces are least active, or, as the foresters put it, when the sap is down. In the case of deciduous trees a long dormant period follows the falling of the leaves, and the trees may be felled at any time during that period. The case of evergreens is different. Leaf function with them may be checked by drought or by low temperature, but it does not entirely cease for a definite period. The eucalypts are evergreens with a particularly persistent vitality; and generally in this country they may be found making new leaves in almost any month of the year. The seasons when their sap is least active may perhaps be set down as late summer (January and February) and middle to late winter (June, July, and early August). Either season may be chosen for felling; but, if it is desired that the stumps shall sprout again, middle to late winter will be preferable.

SPLITTING.

Every owner of trees cannot possess a sawmill, but he can easily provide himself with the ordinary appliances of the practical bushman—crosscut saw, axes, mauls, and a full set of good iron wedges. If some of his logs are large and tough, he will further need a supply of explosive and fuse, a large-sized auger, and a hardwood rod for tamping. The explosive should be blasting powder, a sufficient charge of which centrally placed and firmly plugged with dry clay, so as equally to divide the resistance, will rend the log into two parts with a clean rift. Other explosives are liable to shatter the log and waste the timber. The value of mature trees depends in part upon the quality of their content, but also largely upon the facility with which they can be converted to use. Good tools and a little skill will lay them all, whether fissile or tough, under tribute for the uses of the farm and homestead. Bad tools make hard work and needlessly raise cost.

SAWING. SEASONING.

SAWING.

Where powerful sawing machinery is available it is better for all timbers and for nearly all purposes than the comparatively primitive process of splitting and adzing. But an occasional hardwood log will not be welcome at a mill that is usually engaged in cutting up softwoods. The hardwood requires a different set of the saws and much greater care to prevent warping and cracking of the sawn product. The question is one of demand and adaptation. In Australia and Tasmania together there are hundreds of mills engaged almost exclusively in cutting up eucalypts into the various sizes and shapes required for building and the technical arts. Experience has developed the appliances and the skill necessary for overcoming the difficulties that these trees undoubtedly present when we put them under the saw. A full account of the methods employed would occupy too much space in this book; but one example may be given by way of illustration. If a sappy hardwood log is sawn down the middle, each half may spring into a curve. An expert at the bench will avoid this by first taking flitches off his log and then dealing with the squared baulk.

SEASONING.

We shall the more intelligently handle our timber if we try to understand the life and structure of the trees from which it has been derived. A living and growing timber tree is an exceedingly complex organism continuously charged with water. The water, which holds nutrient salts in solution, is absorbed from the soil by the rootlets. Thence, by a force remotely like that which moves the blood in an animal, it passes up through the larger roots, through the stem, and through the branches to the leaves. The green leaves that we so much admire fulfil for the tree functions analogous to those of lungs and stomach in the animal. They exhale in invisible vapour the excess of their water; they inhale carbonic acid (carbon dioxide); they transmute selected elements into tissue food for feeding and building the tree. Hydrogen, oxygen, and nitrogen are supplied by the rising sap. Carbon in ample abundance is derived from the atmosphere. The prepared tissue food flows upward to the growing tips and downward under the bark to the smallest roots. It is the food of the cambium tissue, which annually forms new wood in addition to that of the previous year, new material for changing alburnum into duramen, and new bark to make good the expansion and waste at the surface of the tree. The countless cells and tubes and fibres of the wood are fashioned and built together with special adaptation to these two purposes: (*a*) The free passage of water from the rootlets to the leaves: (*b*) Resistance to the force of the wind. The bark provides a channel for conveying the prepared tissue food in the reverse direction, and further serves as a shield to protect the tender cambium. The medullary rays convey to the heartwood the materials necessary for completing its density.

For the timber worker the truth of paramount importance here is that wood by its natural structure is freely pervious to water with the grain; but not so freely pervious across the grain. We have proof and illustration of this truth when we see a freshly felled sapling "bleeding" from the stump and perhaps from the severed part as well, or when we see a green log on a hot fire giving out its sap in froth and steam at the two ends. It is the great facility with which moisture escapes along the grain of the wood that causes the unequal shrinkage and troublesome cracks that occur at the ends of logs and planks in the bush and in the timber yards.

In this connection, however, we must remember that the timber supplies of the world are derived from two great and widely diverse groups of trees. The *first* group comprises the *Coniferae,* of which there are said to be 44 genera and 480 species. The constituent cells in the wood of this group have thin walls, and the wood as a whole is consequently capable of readily dispersing its natural sap by evaporation. Abundant resin may make the heartwood or duramen dense and even heavy; but it does not greatly interfere with the radiation of moisture from the log or from the sawn product. The seasoning of such wood presents no serious difficulty. All conifer timbers are called softwoods; but consistently with this a sub-distinction is now made between the harder and softer species of *Pinus.*

The *second* great group of timber-yielders also includes many genera and species. Eminent amongst them are the *Oaks,* the *Walnuts* and *Hickories,* the *Ashes* and *Maples,* the *Planes,* the *Acacias,* and the *Eucalypts* with their close kindred the *Tristanias,* the *Syncarpias,* and the *Angophoras.* These all yield woods that are dense and heavy; and the laboratory explains why the wood as a whole is of this character by showing that the constituent cells, and tubes, and fibres are thick-walled with cavities often wholly closed where the wood is mature. Such woods yield their moisture slowly, and are liable to serious deterioration if badly handled between the stump and the workshop. The eucalypts especially require great care and skill; and their value merits all we can bestow.

When we make leather out of the skin of an animal we kill the animal and alter the condition of the skin by tanning. When we make timber out of a living tree we kill the tree and change the condition of the wood by sawing and seasoning. Merely drying the water out of a log or plank is not seasoning it. The water has to be evaporated without injuriously altering the structure and form of the wood. We season wood when we so dry it and harden it that it does not crack, or warp, or shrink irregularly, or become brittle. Evaporation must be facilitated and equalized and regulated for as many weeks or months or years as may be required to complete the desired changes. Beginning with the bole of the tree as soon as it falls, we must strip the bark off to encourage radiation of moisture all over the surface and check it at the ends of the logs as they are sawn off. Temporary covering of the ends of the logs with sawdust or soil may also be desirable; but experts warn us against keeping them covered very long lest decay should set in.

Where *Eucalyptus* logs are from mature trees and consist almost entirely of heartwood they may be allowed to lie for some time before they are sawn up; but when the milling is in progress there must be no delay in disposing of the sawn product in some way that will protect it from cracking and warping. Prompt stacking in some approved method is always necessary with sawn *Eucalyptus* timber. Where large sheds and artificial heat are not available the old method of sorting the boards and scantling into nearly horizontal stacks with narrow battens between is perhaps still the best. The timbers are placed even and very carefully battened at the slightly higher end. Such a stack can be built up to a great height so as to economize yard space and at the same time to put heavy pressure upon timbers that would otherwise be liable to warp and twist. Builders often dry their boards by placing them obliquely and alternately on edge against a cross bar; but this method takes up a great deal of space and is not so suitable for the timber yard. Where the ground is exceptionally dry or where there is overhead cover, good results may be obtained by placing the timbers on end in a nearly perpendicular position.

Kiln drying hastens the seasoning process and gives more uniform results than any natural temperature method. The kiln usually consists of a specially built long shed furnished with hot-water pipes for supplying heat and vapour and with rails for carrying trucks. The timber carefully stacked on the trucks with battens between the layers of planks, is passed in at one end of the shed and carried on in stages to the other end. It is then passed out to be further seasoned by the air at a natural temperature, either in the yard or in another shed. Kilns have been designed in various ways; but they all provide for heat to evaporate water from the wood, vapour to prevent too rapid drying of the wood at the surface, and circulation of the air to ensure equal treatment for all the timber. Successful experiments have been made with electricity as a seasoning agent. A powerful current is passed through a stack of green timber so as to heat the moisture within the wood and drive it to the surface. R. T. Baker in *The Hardwoods of Australia and Their Economics* describes all these and other methods of dealing with hardwood timbers and gives the names of Australian firms that are employing them. The reader is referred to that work for full information.

PRESERVATIVE TREATMENT OF WOOD.

Next in importance to the production of wood is its longer preservation in use. If we could double or treble the durability of all our wooden structures, our plantations and forests would correspondingly rise in value. Many experts believe that this can be done. The perishing of wood is due in part to purely chemical and physical reactions; but mainly and generally it is a complex process in which vegetable and animal organisms are concerned as destructive agents.

The *vegetable enemies* of wood are either bacteria similar to those that produce ordinary fermentation or plants included in the great family of the fungi. They are all reproduced by spores, which are exceedingly minute, countlessly numerous, and endowed with very persistent vitality. Whenever and wherever conditions favour them, these bacterial and fungal organisms rapidly develop, penetrate the wood, appropriate its albumen as nutrition, and disintegrate its tissues. The *animal enemies* of wood are what we call borers. They destroy the wood by burrowing into it. There are two main and widely remote orders of them as follows:—(*a*) *Terrestrial borers.* These attack living or dead wood on land only. They are insects. Some of them burrow into the wood while they are in the larval or grub stage and pass the gnawed material through their bodies as food. Examples in New Zealand are *Anobium domesticum,* the furniture beetle; and *Lyctus brunneus,* the powder post beetle. In Europe *Xestobium tessellatum,* the death watch beetle, is the ally of *Anobium domesticum.* Other insects burrow both while immature and when adult, as the white ants whose paramount object appears to be the formation of passages and galleries in which the species may breed and multiply. White ants attack living trees as well as dead timber. (*b*) *Aquatic borers.* These live only in salt or fresh water. They are molluscs kindred to the animals popularly but erroneously called shellfish. There are many of them, of which *Teredo navalis* may be cited as the most widely known representative. For ages these soft-bodied innocent-looking creatures have levied heavy toll upon all seafaring peoples. The building of our ships with steel and of our wharves with concrete has greatly restricted their ravages. But steel ships must not touch concrete wharves. Everywhere there must come between them a shield or fender of wooden piling. To this extent the aquatic borer still has his opportunity to hasten destruction and decay. Apparently the only remedy generally available is periodical renewal of the woodwork; and this means that suitable trees must be grown somewhere to keep up the supply.

The preservative treatment of wood is directed almost exclusively against the vegetable and animal enemies that attack our wooden structures on land—bacteria, fungi, and boring insects. These require for their most active development moisture, warmth, and exclusion of strong sunlight. Bacteria and fungi can flourish at temperatures below 60° F. Insects become most active above 60° F. Generally sapwood offers the enemy easy penetration and abundant albumen. Heartwood is more resistant and less palatable. But certain micro-organisms when present and favoured by moisture can make cellulose available as food for the animal borers. Even heartwood, therefore, is never safe unless perfectly dry or in some other way protected.

A perfect preservative against these enemies would kill all spores, germs, and organisms in or upon the wood at the time of application and thereafter render the tissues permanently immune from attack. Many preservative agents have proved partially successful; but the verdict of long experience gives preference to the tars and oils extracted from wood and coal as coming nearest to the ideal. Tar and pitch have long been used for preserving the standing rigging of ships and for treating the joints and seams in their decking. Creosote is a distillate from tar. It contains the oils that are most adapted for both penetrating wood and permanently combining with its tissues. Whether tar alone or creosote alone or both combined shall be used in any given case is a question to be decided by circumstances. Preparations derived from creosote and claiming to have advantages over the cruder material must be judged on their merits as tested by experiment.

When we have selected our preservative we have still to consider how it can be applied economically as well as effectively. Any treatment will add to the cost of the wood; and if the addition of cost is very great, it may become prohibitive. Here, as everywhere else in industry, we must take full advantage of natural law. Wood lasts longest when it is thoroughly and continuously dry, and perishes most quickly when it is damp or alternately wet and dry. The reason is that its enemies require moisture for their destructive activity, and must either remain dormant or perish when moisture is not available. Wood is considered quite dry when it contains less than 10 per cent. of water. The difficulty in keeping it in such condition is that it absorbs moisture from the air, which contains water in varying amounts. In buildings and in furniture the problem to be solved is to prevent this absorption of water from the air. Painting and varnishing are preservative processes; but we apply them only to the exposed surfaces, the concealed surfaces being unprotected and very often without ventilation. If concealed as well as exposed surfaces were thoroughly brushed with preservative, and fresh, clean air admitted to them, decay would be either wholly prevented or indefinitely retarded.

Anyone who has watched the demolition of old wooden buildings will know that the parts where decay has made most progress are floors that have been placed too near the ground and badly ventilated, outside walls where defects in the weatherboarding have admitted driving rain, and inside linings that have consisted mainly of sapwood. Rafters, if of inferior wood, have also sometimes perished. The conclusion one comes to is that dampness and stagnant air have been responsible for most of the mischief. The assumption that the use of preservatives would remedy all this is fallacious and misleading. The function of preservatives is not to make good the defects in building construction, but to anticipate and supplement the skill and good judgment of builder and joiner. There is really no such thing as "dry rot", that which is so called being due to fungi that derive their moisture partly from the wood and partly from stagnant air. *Merulius lachrymans,* or weeping *Merulius,* is mentioned as the most malignant member of the evil group.

Fence posts and electric wire poles present another aspect of the wood decay problem. They are subject to the disadvantage of being inserted in the ground for part of their length, but against this is the compensating advantage of standing erect. In most kinds of soil the extreme bottom of a post or pole is beyond the reach of bacteria or fungi. The extreme top catches moisture and is liable to slow decay, but may be easily protected by a dressing of paint or bitumen. The seriously vulnerable part is the neck from a foot or more below the surface of the ground to six inches above. In Europe and America necessity has long compelled the use of softwoods and inferior hardwoods for these purposes and also for railway sleepers. Defect in natural durability has there been met to an increasing extent by treatment with preservatives, tar oils entering most largely into the remedies. Even such perishable timbers as poplar and willow are made available for fence posts by being saturated with creosote.

In New Zealand the situation has so far been widely different. For a long time we had our totara and puriri; and when these began to fail we were able to turn to Australia for suppiies of highly durable hardwood. All over this Dominion electric wires are now being carried by these wonderful poles from Australia. The experience of fifty to sixty years has proved, moreover, that we can abundantly produce *Eucalyptus* poles of medium natural durability in our own country. Preservative treatment of softwoods will become increasingly important as the years pass; but the most urgent need just now in New Zealand is a reasonably cheap and effective method for obtaining maximum durability from the eucalypts. Over a wide range in Australia and Tasmania there are in progress experiments that may be expected ere long to give us a workable formula for solving this problem.

Meantime it seems safe and desirable to offer a few suggestions. Eucalypts intended for poles should never be felled until sufficiently mature; but, on the other hand, should never be allowed to stand until they become subject to heart decay. All other things being equal, stout posts or poles will last longer than slender ones. To immerse *Eucalyptus* fence posts in a bath of creosote would be possible; but it would be wasteful of preservative and far too costly for general practice. To immerse long, heavy poles in a bath of creosote is obviously impracticable. With *Eucalyptus* posts and poles, therefore, preservative treatment must be applied to the vulnerable parts, and must aim chiefly at protection of the surface. Sapwood, unless it can be converted into a protective jacket by thorough saturation with creosote, should be stripped off, and the preservative applied direct to the mature wood. The neck of a pole, having been prepared by clean stripping, and being quite dry, should receive two dressings of creosote before insertion in the ground. After insertion in the ground and partial ramming, the soil as it is further filled in and rammed round the neck may be saturated with tar and creosote. Or, a narrow cylinder may be left round the neck and filled in with tar and cement or with tar and ground carbonate of lime. In either case the work must be finished just above the surface of the ground with a waterproof collar of bitumen or cement. The treatment of fence posts should be similar to that of wire poles, but for obvious reasons it must be less costly.

Where timbers are subjected to extremely trying conditions throughout their length, as is the case with railway sleepers, it becomes desirable to impregnate their tissues in every part with a preservative agent. Two principal methods are in use in Europe and America for achieving this object. The more costly but more effective method first extracts all moisture from the wood by suction in a vacuum and then forces the preservative into the tissues by powerful pressure. In the other method the wood is simply placed in a bath of creosote heated up to, but not beyond, 200° Fah., for a sufficient time to ensure saturation, and then taken out and drained on a stage. For a full account of all preservatives in use and all methods for their application, readers are referred to books that will be found in any well stocked engineering library and to bulletins that will from time to time be issued by the State Forest Service.

X Erroneous: It is the sapwood which is non-durable, easily penetrated by antiseptics, and should be treated. If the heartwood is durable it does not require treatment, if it is not durable, [illegible] antiseptic treatment [illegible] is lost on the sound timber. Heartwood is resistant to penetration [illegible] necessary. The author appears to have little knowledge of antiseptic treatment.
[illegible]

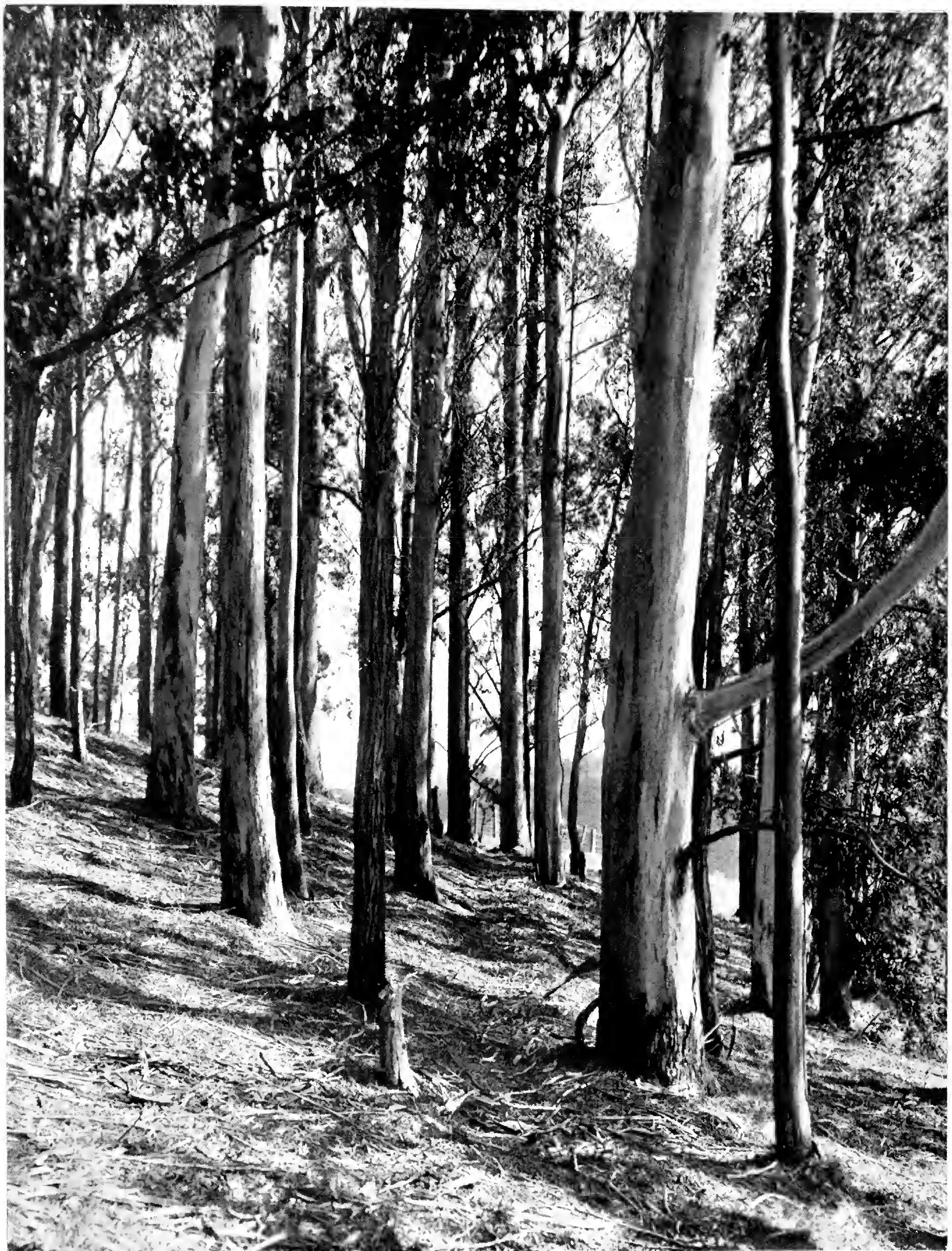
SAWMILLING IN TASMANIA.

Beattie, Photo., Hobart.

SCENE AT THE GEEVESTON SAWMILL, SOUTH TASMANIA.

Great *Eucalyptus* logs waiting their turn to be drawn into the mill, there to be converted by powerful band-saws and bench-saws into commercial timber. The logs are being stripped of bark and cleaned before being sent in to the saws.

The Geeveston sawmill is in the region lying along the navigable waters of the Huon River and its outlet to the sea. A map in the State bulletin, *Tasmanian Forestry* (1910), shows that there were not very long ago as many as forty other mills in this region. So immensely rich was the original forest.



Lovell-Smith, Photo., Hastings.

EUC. AMYGDALINA and EUC. RISDONI.

Age about 40 years.

"TUNANUI," HASTINGS (SIR ANDREW RUSSELL).

The trees here depicted represent a large number of specimens that would make long-lasting poles, but will yield a much better return to the country if carefully conserved as sources of seed for future plantings.

Steffano Webb, Photo., Christchurch.

EUC. VIMINALIS.

A vigorous and beautiful plantation in large pole stage. North Canterbury.

Steffano Webb, Photo., Christchurch.

EUC. GIGANTEA

In early sapling stage with large drooping leaves.

Forest Service Photo.

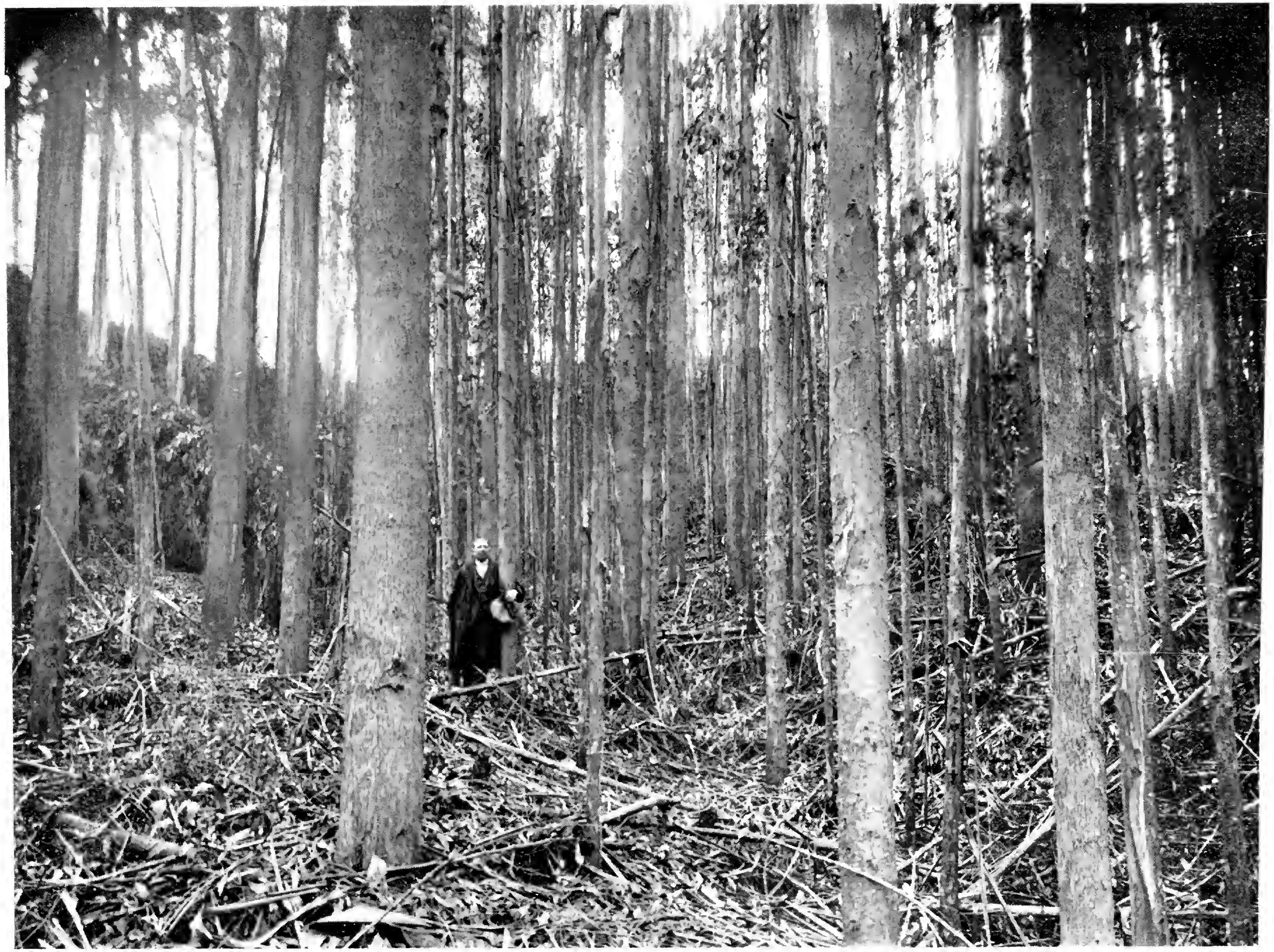
EUC. EUGENIOIDES.

With some other Eucalypts. Age 33 years.

"OKUTI," LITTLE RIVER (DUDLEY RICHARDS).

The Eucalypts at "Okuti" cover many acres. Several species are represented. The area shown in this picture is occupied mainly by *E. eugenioides.* A few trees on the outskirts of the plantation are heavily branched; those within have clean shaft-like boles of great length.

AN EXAMPLE OF NATURE'S FOREST MAKING.



H. C. Gore, Photo., Dunedin.

EUC. REGNANS.

Age of specimens in picture, under 30 years.

SANATORIUM GROUNDS, WAITATI, OTAGO.

As a timber yielder *E. regnans* holds an intermediate place between the denser hardwoods and the softwoods. Such a tree will always have a wide utility. A striking testimony to the quality of a local grown specimen comes from Mr. Orton Bradley, of Charteris Bay, in a letter dated 5/8/27. He says: "We have milled a 2ft. 6in. diameter *E. regnans.* There is no doubt that it is a beautiful timber for construction purposes; also for turning. It hardly warps at all, and is very light."

SECTION VI.

MISCELLANEOUS TOPICS.

NOMENCLATURE.

The eucalypts have two sets of names. We call the one set common or vernacular names, the other set botanical or scientific names. In most cases the common names were given by people who were neither scientific in observation nor gifted in description. The botanical names were given by people who had been trained to discriminate between natural objects and accurately to record the results of their research. In the common nomenclature it often happens that the same name is given to trees that belong to several quite distinct species. The reverse practice also exists of bestowing more than one name upon a single species. In the botanical nomenclature no specific name can be given to more than one species, and no species can ultimately claim more than one specific name. The common names have not been registered in any way that has fixed their meaning and application. The botanical names with their attached specific descriptions have all been published in journals or books that are preserved for future reference. Such names and descriptions, moreover, are maintained under a code of honour long established amongst the scientific men of all nations. Usage is largely on the side of the common names; accuracy all on the side of the botanical names. In the interests of both science and trade the common names should be everywhere discouraged and the botanical names brought more fully into use. A quite fair statement will require us to consider the two sets of names separately as well as in their relation to each other.

THE COMMON OR VERNACULAR NAMES.

Common names are applied to the eucalypts in two quite distinct ways. In the one case they denote groups of species; in the other case individual or single species. The one practice is useful or at least harmless; the other has everywhere led to confusion. The distinction must be made clear.

(*a*) COMMON NAMES USED TO DENOTE GROUPS.

If we speak or write in the *plural* about bloodwoods or mahoganies or boxes or ironbarks or stringybarks or peppermints, it is well understood that we are applying the names to groups, not to individual species. The grouping is founded mainly upon similarity in bark or in wood or in both. Botanists admit the validity of the grouping in certain cases, but always subject to the proviso that every constituent unit or species in each group shall have a scientific description and a registered name that cannot be appropriated by any other species. Thus restricted and safeguarded, the arrangement in groups is convenient and helpful to both the practical forester and the scientific student.

INCORRECT USE OF COMMON NAMES.

(*b*) COMMON NAMES USED TO DENOTE SINGLE OR INDIVIDUAL SPECIES.

When people speak and write in the *singular* about "bangalay" or "jarrah" or "tuart" or "tallow-wood" or "mountain ash" or "yellow box" or "brown stringybark" we understand that they are applying the terms to particular trees or species not to groups. Used in this specific sense, some of the common names may have an interest and appropriateness in limited forest areas in Australia. A few are identical with names that were applied to the trees by the aboriginal inhabitants, and may serve, like some place names, to remind the white man that he was preceded in the occupation of his country by a race that is passing forever away. A few may recall events and experiences in early Colonial history. A few others are interesting as indicating the role of the simple woodman in naming the objects with which he had to deal in his new sphere of labour.

But when we take the whole range of the Australian States into view we find in the use of these common or bushmen's names a most embarrassing amount of inconsistency and confusion. It is not suggested here that this state of things could have been prevented. The good and brave people who first made homes in the vast new land of Australia were equipped for practical work, not for the naming of trees. There were thousands of strange trees to be named, and in the average man's language not enough names to go round. The purpose of this article is to show that, so far as New Zealand is concerned, the confusion inherited from an earlier generation need not be and must not be perpetuated. The common nomenclature has woven around the eucalypts a network of false notions and prejudices. This must be removed if these wonderful and beautiful trees are ever to take their due place in the world's forestry.

A few examples will show how utterly hopeless the common nomenclature is as a scheme for discriminating between the numerous individual species of the genus. We find in the vernacular listing of the trees four or five "blue gums", an indefinite number of "red gums", two or three "grey gums", and several "white gums"; sixteen to twenty "stringybarks", five or six "peppermints", about twenty "boxes", eleven "ironbarks", ten or eleven "mahoganies", and eight "bloodwoods"; three or four "cabbage gums" and about as many "apples"; five "blackbutts" whose butts are often not black; one or two "swamp gums" that do not grow in swamps; a "manna gum" that is not the only manna yielder; a "sugar gum" from which it would be no easy matter to extract sugar; a "cider gum" so called because somebody imagined that its sap tasted a little like cider; two or three "messmates" that do not always "mess" (grow) with the same "mates" (species); and, lastly, a "bastard mahogany" that is as well and nobly born as any aristocrat of the good old times.

There are no true ironbarks and no red gums in Tasmania, yet both names have been applied to trees in that Island. Of the true mainland ironbarks two species are called "narrow-leaved" and two "broad-leaved", while one has the awkward distinction of having been called "white", "black", "grey", and "red" in a single locality. (Baker *Hardwoods* pp. 502 and 503; Maiden *Crit. Revis.* ii. 105).

SPECIFIC USE OF COMMON NAMES CONDEMNED.

The application of European timber names to Australian hardwoods has perhaps gone too far for recall; but surely New Zealand furniture dealers should know when they sell beautiful suites of furniture as "Australian oak" that the wood is not oak at all, but the product of *Eucalyptus* trees.

Maiden records the vernacular names as a matter of historic information, but without either commending or condemning their use in forestry and trade. Baker admits them into his *Hardwoods of Australia,* but near the end of the volume expresses regret for having done so. After discussing the prevalent confusion due to use of the common names, and the advantage gained by the essential oil industry through exclusive use of the scientific names, he states his well considered judgment in the two sentences here following:—"Why then cannot the whole trade follow suit and thus for all time remove the present lamentable chaotic confusion surrounding our timber nomenclature". "I regret that the colour plates had been printed before this article was written, otherwise every common name would have been deleted from this work". (*Hardwoods* 388). It is obvious that Mr. Baker regards the reform of the common nomenclature as impossible; and where he with his intimate knowledge of the trees and their timbers can see no hope in any process of patching and mending we may take it as certain that nobody will succeed.

In New Zealand, foresters and amateur tree planters are learning the botanical names very fast, and coming more and more to appreciate the accuracy and certainty with which, by means of them, they may understand what tree or what timber is meant when a name is mentioned. Many of the most successful growers do not know the common names and would not on any account be bothered with them.

Timber dealers are the most hesitant about using the botanical names; and yet it is just they who most need protection against the tangle of the common nomenclature. It is well known that orders for Australian hardwoods going forward under common names can have no certainty of specific fulfilment. Dealers who wish to obtain one particular timber may find themselves supplied with another without any possible hope of redress. They are using a nomenclature that has no exact descriptions and no effective means for preventing half a dozen timbers being called by the same name. They must accept what comes and make the best of it. If, instead of going on in this hopeless way, dealers would persistently use the botanical names, samples of the timber received could be sent to a laboratory or technological museum and tested by comparison with certified specimens of the species named. Substitution of one timber for another would be branded as wrong, and would soon become very much less frequent. The aim of both science and trade should be to use language and maintain practices that will permit neither misunderstanding nor evasion.

The day should be past for importing into New Zealand *Eucalyptus* hardwoods under such names as "jarrah", "karri", "spotted-gum", "white-mahogany", or "black-butt". The names should be *Euc. marginata, Euc. diversicolor, Euc. maculata, Euc. acmenioides,* and *Euc. pilularis* (if the N.S.W. tree is meant). Ironbark, as we have seen, is a group name, and should never be used in trade at all unless limited by the botanical name of the particular species under sale or use—*Euc. paniculata, Euc. crebra, Euc. siderophloia,* or *Euc. sideroxylon,* as the case may be. Stringybark and all other group names must be similarly limited by specific botanical names. Either by law or by trade honour, shippers should be compelled to declare the botanical names of all timbers shipped; and importers should take pains to see that they get what is on the manifest.

Two Australian hardwoods may be closely similar in appearance, but widely different in value and durability. Placed in the ground, one may perish in seven years while the other will easily last three or four times seven years. In the absence of certified botanical names, the bad species discredits the good, and the whole trade suffers. Where the natural specific distinctions are unknown or are ignored, no stamps or brands on the baulks or logs can more than vaguely guarantee quality. The problem is difficult, but Australia has many able botanists and foresters to solve it. If the Forest Services of all the States would resolutely combine to cut out the common names, timber getters, builders, engineers, shippers, and importers would all soon fall into line.

The tacking of common names to the botanical names in catalogues of seeds, plants, and timbers appears to assume that the vernaculars will be known where the scientific names are not known, and that the one set of names will serve to interpret the other. If both sets were on an equal footing of reliability, the assumption might stand; but, as we have seen, the scientific names are alone trustworthy. The *Eucalyptus* common names as applied to individual species have a place in Australian history. It is an interesting and curious place. Taken over the whole range of the States, the theme might be even worthy of a historical monograph. But in this age of careful research and explicit definition names hastily bestowed upon particular trees by settlers and bushmen are out of date and unfitting. Only as group names are the vernaculars safe and valid. Used as specific names they at once throw us into uncertainty, waste our time, and imperil our cash.

BOTANICAL NAMES.

The great genus *Eucalyptus* with its 400 species needs a nomenclature that will be the same in all countries and in all trades. Botanists have provided such a nomenclature. Their method has been simple and uniform. The resultant specific names are such as a child may easily learn and remember. In a country where everybody goes to school there can be no excuse for not learning them.

Botanical names are either pure Latin words or Latinized words from Greek or from some modern language. A good many of them are Latinized personal names or place names. Grammatically, the name of a genus may be masculine, feminine, or neuter. The specific names are usually adjectives made to agree with the name of the genus; but sometimes they are nouns in the genitive case singular. The generic word *Eucalyptus,* which has already been explained, is treated as a feminine noun of the Latin second declension. Most of the specific names are adjectives made to agree with it, the principal endings being -a, -ana, -ans, -ens, -is, -ensis; and the words calyx (seed-cup), carpa (fruit), corys (helmet, lid of bud), oides (Gk. eidos, form or likeness), phloia (bark), xylon (wood).

BOTANICAL NAMES.

Personal and place names may give us adjectives in -ana or -ensis. Examples are ***Bosistoana*** from the name of Joseph Bosisto, one of the pioneers in ***Eucalyptus*** oil extraction; ***Delegatensis*** from Mount Delegate in New South Wales, where the species so named was found growing. But when the Latinized nominative so requires or suggests, the specific name takes the form of the genitive singular. Thus from Risdon, a place in Tasmania, we assume Risdonus or Risdonum (nom.) and ***Risdoni*** (gen.), and then make ***Eucalyptus Risdoni,*** which means the eucalypt of Risdon. From Gunn, the name of a botanist, we assume Gunnius (nom.) and Gunnii (gen.), and then make ***Eucalyptus Gunnii,*** which means Gunn's eucalypt or the eucalypt named in honour of R. C. Gunn. From the personal name Mueller we have both ***Muelleriana*** and ***Muelleri.*** In the best English tradition specific names derived from names of persons or of places (proper nouns) are always commenced with capital letters. Other specific names commence with small letters.

The student *must* learn and remember the botanical names of the species; and while he is learning the mere words it will be an advantage also to learn their meanings or personal references. We cannot claim that botanists have in all cases chosen the best possible specific names for the eucalypts; but the student will find that he has usually something to gain and nothing to lose by going back in each case to the point of view of the naming botanist. The name expressed something that appeared at the time important and interesting; and what impressed the botanist when he named the species, it will usually be worth while for us to note when we study that species for ourselves. Descriptive names, especially, have an important educational value. Personal names are less easily traced and will not always so well repay research.

The only difficulty about scientific names pertains to pronunciation. Some botanists still adhere to the English sounds of the letters; but the reformed or (more correctly) restored classical pronunciation seems now destined to be universally adopted. Thus *a* will be sounded long as in *father* or short as in *ant; e* will be sounded long as *ei* in *freight* or short as in *set; i* long as in *machine* or short as in *pin; o* as in *note; u* as *oo; c* as *k; g* always hard; *v* as *w*. The schools have very generally adopted these sounds in teaching Latin; and any student, even if not following a Latin course, can easily put himself right.

THE EUCALYPTS AND THEIR INSECT ENEMIES.

The preying of insects upon plants is nothing new. It has been going on for ages over all the habitable land surfaces of the earth. Under ordinary conditions the process does not attract our attention. Our plants and trees are sufficiently vigorous to support easily the animals that live upon them as parasites or visit them adventitiously in search of food. A kind of balance or equilibrium is maintained between the vital resources of the plant and the animal demands made upon them. But the equilibrium may be disturbed or even permanently unsettled. The soil may after a time prove deficient in some of the mineral salts required by the plant. The roots of the plant may reach a stratum of dry shingle, or limestone, or hard rock. Temperature may rise too high or fall too low. The sky may fail of its wonted showers or pour down successive torrents and too heavily saturate the ground. The plant then declines in vitality. Parasites and visiting enemies multiply. Leaves and twigs die back; and then, if no relief be given, death invades the stem and roots. The introduction of other insects to prey upon those that have been preying upon our plants may greatly help. It may even restore the balance of forces. But for general and permanent remedy we must go deeper.

Animals as well as plants become subject to an increasing burden of alien life whenever and wherever they fall below normal vitality. The enfeebled colony of bees develops disease or is robbed by stronger colonies. Lice multiply upon debilitated cows and horses, and ticks upon underfed sheep. There is thus some general law or sequence of cause and effect whereby poverty of sap in the plant or of blood in the animal is surely followed by heavier toll to the ever lurking enemy. Nature apparently decrees the destruction of the unadapted; and parasites, whether vegetable or animal, fill the role of agents in the destructive process. Gardeners, farmers, and tree planters should know their insect enemies and their insect friends. Every ally that will slay and clear away blights and pests should be encouraged. But our reliance everywhere must be first and mainly upon vigorous and well-sustained vitality. Animals must be well and suitably fed; trees must be planted where soil, rainfall, and temperature will combine to promote exuberant and resistant life.

We are concerned here with the bearing of this truth upon the eucalypts. These trees as we see them in their native Tasmania and Australia are the hosts of countless *Insecta* and *Arachnida* and of some vegetable parasites. Some of the insects are enemies; some friends. Some of the enemies are at their worst in the larval or grub stage; others in the mature or adult stage. Some are leaf-eaters; others sap suckers. Generally the vital forces are balanced. In favourable situations the trees flourish, grow to normal dimensions, and persist to their due term of life. Enemies are there, but the well-nourished life of the trees aided by the warfare of the friendly insects keeps them effectually under control. In hard conditions a species will sometimes develop resistance by taking on a dwarf form and by thickening its leaves; but this is a slow process and requires a good many years for its completion. In some parts of Australia certain of the eucalypts are liable to be infested with vegetable parasites as well as animal enemies. These vegetable parasites are sap suckers belonging to the mistletoe family (Loranthaceae). And here, again, it is the rapid-growing and vigorous individual trees that suffer least, and those with less resistant vitality that suffer most. J. H. Maiden in his "Forest Flora" has given much information about the enemies of the eucalypts as observed and recorded by scientific men in Australia.

As immigrants into New Zealand the eucalypts are subject to a warfare against insect enemies similar to that which they have successfully maintained in their native Australia. Here as yonder there are leaf eaters and sap suckers. Here as yonder there is need for healthy sap and strongly resistant vitality. Here as yonder there is a place and a function for insect allies. The reader will better understand our position in New Zealand in respect to insect enemies and friends if I quote here a statement kindly contributed by Mr. David Miller, B.Sc., Entomologist at the Biological Laboratory, Wellington. The statement is as follows:—

"LIST OF INSECTS INFECTING GROWING EUCALYPTUS SPP. IN N.Z.

The Gum tree Scale (*Eriococcus coriaceus* Maskell).
The Eucalyptus Mussel Scale (*Lepidosaphes eucalypti* Froggatt).
The Bronze Beetle (*Eucolaspis brunneus* Fabricius).
The Eucalyptus leaf weevil (*Gonipterus scutellatus* Bois-Duval),
The Eucalyptus Tortoise Beetle (*Paropsis dilatata* Erhorn).
The Green Chafer (*Pyronota festiva* Fabricius).
The Elusive Tortrix (*Tortrix excessana* Walker).
The Blue-gum Leaf-tyer (*Eucosma plebeiana* Zeller).
The Eucalyptus leaf-roller (*Spilonota macropetana* Meyrick).
The Blue gum Gall chalcid (*Rhicnopeltella eucalypti* Gahan).
The Eucalyptus Psyllid (*Rhinocola eucalypti* Maskell).

With the exception of the Bronze beetle, the Elusive tortrix, and the Green chafer, which are native to New Zealand, all the above named insects are importations from Australia. Only three species can be considered as major pests; these are the gum-tree scale, the leaf weevil, and the gall chalcid, the scale and the chalcid being most destructive. The scale does not confine its attention to any one species of *Eucalyptus* though its attacks are most severe upon *E. globulus*, while such species as *regnans, obliqua* and *viminalis,* for example, are better able to withstand infestation. The scale is controlled by the ladybird (*Rhizobius ventralis*) which has been distributed in the infested areas. This beetle, however, is often unable to cope with the pest quickly enough to prevent a considerable amount of damage being done. The gall chalcid is confined solely to *E. globulus*, and there is no means for control available at present."

It should encourage planters to know that the worst of the insect enemies in this rather long list are importations from Australia where the eucalypts have survived and flourished for thousands of years. Enemies that have failed to kill these trees in their native home may surely be assumed to be incapable of killing them in any other country where the trees can be given equal advantages of soil and climate. But what nature has accomplished in Australia in establishing and maintaining a balance of vital activities we must achieve in New Zealand by our own practical wisdom. People who do not know the eucalypts well enough to distinguish the species are very liable to conclude that, because one species is diseased, all are diseased or soon will be. Much that has been written on this subject within the last few years has consequently been very misleading. The truth is that our losses so far have been relatively small. Some of the most valuable of our species have been scarcely touched; others have suffered less or more severely; only one species, the familiar *Eucalyptus globulus,* has been seriously injured over extended areas. The first step towards effectual adjustment and remedy must be a study of the causes that have operated in aggravating the attacks of the enemy in these exceptional cases. The difference between the several species in liability to attack is due, of course, to difference in palatableness of their sap and tissues to the preying insects. This we cannot alter. All we can do is to observe and record results for guidance in our future planting, always remembering that insects as well as birds and mammals may gradually change their tastes and habits. The causes I propose now to discuss are those over which we may exercise control.

We will consider first the case of *Euc. globulus.* The natural optimum of this species is on good lowland country in south-eastern Tasmania in about the latitude of Christchurch. There it formed a hundred years ago some of the noblest forests to be found in any country. It is one of a few species that have maintained approximate identity on both sides of the strait since Tasmania was ages ago rifted from the mainland. By the law of compensation between latitude and altitude *E. globulus* is a lowland tree in Tasmania and a mountain tree in Victoria. It is thus a cool country tree; and, as already intimated, it requires for its optimum good land and abundant moisture. In New Zealand we have planted this tree in a wide range of localities and usually without any regard to its requirements in respect to either climate or soil. We have planted it on warm lowlands where the winters are too mild; we have planted it on gravel beds and poor hillsides where the substratum is too dry. Thus wrongly planted, it may have flourished and grown rapidly for some years; but when the day of reckoning has come with insect enemies it has failed in resistance and died back. Where, on the other hand, it has been planted on deep subsoil, rich in alumina, well watered, and subject to cold winters, it has resisted or endured the attacks of its enemies and well maintained its vigour and beauty. In Canterbury and Otago the contrast between *E. globulus* wrongly planted and the same species rightly planted is very impressive, and may be noted by anybody travelling in those provinces. Insect allies will help this species everywhere, and all efforts should be made to encourage the scale-eating ladybird already introduced and to find the natural destroyer of the deadly gall chalcid; but our first and chief concern must be to give the species conditions of climate and soil similar to those of its native habitat in Tasmania. Where this cannot be done *Euc. globulus* should be cut right out and something else planted in its place. For all North Island lowlands there can be found species that will yield equally valuable timber and will prove far less palatable to either leaf eating or sap sucking insect enemies.

Another example showing how resistance to enemies depends upon vitality and vitality upon congenial conditions of soil and climate is found in the case of the almost equally familiar *E. viminalis.* Like *E. globulus* this tree requires for its best development good land, abundant moisture, and a cold winter. Near the sea it also requires protection against saline winds. There are many valuable stands of this species in Canterbury; but as one travels through the district great difference is noted in the aspect and vigour of the trees. The difference is primarily due to diversity in the sub-strata over which the trees have been planted. On dry parts of the plains the foliage is liable to be eaten away by insects faster than the vital resources available can replace it. On good aluminous land with adequate rainfall or abundant soil moisture, the trees suffer less loss of foliage and can easily replace by new growth that which has been lost. Insect allies will help the debilitated trees even when they are unsuitably located on dry land; but the wise forester will in future plant his *E. viminalis* only where the conditions will ensure for it persistent and strongly resistant vitality.

A third example will be fittingly supplied by the greatly valued *E. rostrata.* This species grows naturally in all the Australian States except Tasmania. Its habitat is usually on low country in the vicinity of streams and rivers; and where it spreads on to dry uplands it declines in vigour and becomes liable to severe injury by insects. A belt of low-lying and sometimes flooded land along the River Murray in New South Wales and Victoria provides the conditions for its optimum or best development. Its dense red heartwood has a reputation for durability in the ground equal to that of our own best totara. Planters in New Zealand early included it amongst their selected species. Unfortunately while they looked forward in the hope of reaping crops of this precious timber they did not know or did not remember that the species could be successfully cultivated only on good alluvial land where the winters were mild. Of the many thousands of plants that were propagated and distributed, only a few were so fortunate as to be favoured with quite congenial conditions. Some were planted over dry shingle beds; some too high above sea level; some too far south. The foliage of this species is very palatable to the leaf-eating weevil, and the trees have been generally attacked by this insect. Specimens fortunately placed have been able to resist or endure the enemy and maintain their vigour while those planted where nature had predetermined that they should not flourish have been depressed and dwarfed.

The conclusion to which this research leads is obvious. The several species of *Eucalyptus* under cultivation in New Zealand differ greatly in their palatableness to insect enemies. Some are attacked only very slightly; others more severely; a few seriously. Resistance to the attacks depends first and mainly upon healthy sap and abounding vitality in the trees, and vitality depends upon congenial conditions of climate and soil. But here as in Australia the counter attacks of friendly insects are necessary to maintain the balance of vital forces. Each species must first be given its appropriate location; and then, when the planter has done his best the entomologist must stand by to bring in and distribute those friendly insects that are known to prey upon the enemies of our trees. The owner of plantations must have courage, so that, when he finds any of his trees wrongly chosen and unadapted to his locality, he may resolutely cut them out and plant others.

Students who wish to take up research on the forest insects of Australia and New Zealand should obtain the writings of Walter W. Froggatt, F.L.S., late Government Entomologist, New South Wales, the Bulletin by David Miller, B.Sc., F.E.S., issued under the authority of our own Forest Service in 1925, and *The Insects of Australia and New Zealand* by Dr. R. J. Tillyard, M.A., ScD., Director of the Cawthron Institute, Nelson.

MAXIMUM DIMENSIONS IN NATURAL FORESTS.

Some of the species of *Eucalyptus* when they can enjoy good roothold, shelter from violent winds, abundant moisture, and a long period of life, attain dimensions in both height and girth that place them high up amongst the world's tree giants. The tallest grower is *Euc. regnans.* This name is expressive of royalty and preeminence, and anyone who has seen the *E. regnans* forests will admit that it is worthily borne. Botanists, surveyors, woodmen, and visitors from over the seas have all been roused to enthusiasm by this tallest of the eucalypts. Special trees have from time to time been selected for notice and report; and where the truth was so wonderful we ought not to be surprised if we sometimes find reason to suspect exaggeration in the records.

E. regnans reached its optimum in Gippsland, Victoria. It was in Victoria that the reports about phenomenally tall trees originated. Very generally the tallest trees were densely surrounded with other trees. Often they were in deep gullies flanked by steep hills. To measure the height of a tall standing tree is possible only by triangulation. The apex of the tree must be sighted from a position whence a base line can be measured to the bottom of the stem. In an open situation this is easy; in a dense forest with uneven ground, extremely difficult. The apex of the tree may be clearly visible half a mile or more away but wholly obscured from all near points. The most skilful engineer with his instruments may under such circumstances find himself baffled. The best he can do is to form an estimate of the tree's height from such observations as are possible. The measurement of even a fallen tree in a tangled forest is by no means an easy task for a single person. And the people who felled trees in the early days were not interested in total heights. They were after the logs for splitting or sawing.

In these conditions there was constant temptation to make guesses and estimates, and to publish them as if they had been verified. It is unfortunate that the distinguished name of Baron von Mueller is associated with some of the reports; but we must remember that the Baron was a very busy man, and that he did not claim to have measured the trees himself. He accepted and trusted the statements of others.

In the matter of these tall tree measurements we do not find firm ground until we come to 1888. That was the year in which was held the Centennial International Exhibition in Melbourne. An intense and wide-spread interest had been awakened in the natural products of all Australia and of Victoria in particular. The current reports about surpassingly tall trees had come under suspicion and mistrust. A number of gentlemen in Melbourne determined to have the forests searched and the whole question put on a better footing. Expenses were guaranteed to the amount of £600. A skilled civil engineer who was also a good photographer, and an experienced surveyor, were engaged to undertake the task. All the localities with any especial reputation for tall trees were visited. The trees selected for measurement were carefully located and photographed, so that results might be verified by other observers. Measurements were obtained of total heights and of girths six feet above the level of the ground. The report of the experts was presented to a committee in Melbourne, printed in atlas form, and placed amongst the exhibits at the Exhibition. Full particulars were given about seven trees and mention made of an eighth. The greatest height recorded was 326ft. 1in.; the greatest girth 55ft. 7in.; results being from separate trees.

J. H. Maiden in his *Forest Flora,* Vol. ii. pp. 161-165, discusses all these reports about tall trees. His article is strictly judicial in tone, but clearly discredits most of the statements made prior to 1888. Seven years later in a paper on *Australian Vegetation* issued in connection with the visit of the British Association for the Advancement of Science we find him expressing himself as follows:—

"The official size of the tallest Gippsland tree is given as—height, 326ft. 1in.; girth, 25ft. 7in., measured 6 feet from ground; locality, spur of Mt. Baw Baw, 91 miles from Melbourne. This is enormous, but different from the alleged heights of from 400 to 525 feet foisted on Mueller, and which will probably not be eradicated from the newspapers for another generation.

"As regards the Californian trees brought into comparison, Prof. Sargent, an eminent authority, may be quoted, and in view of the actual measurements that he presents, viz., 340 feet in height for a Redwood and a girth round the trunk of 107 feet for its congener the "Big Tree", an opinion may be expressed that, so far as is known at present, California is the home both of the tallest and of the broadest trees in the world. The difference (under 14 feet) against the Gippsland tree is not large, and it would not be surprising if additional investigations should cause this friendly competition between Australia and the United States to end differently."

A. D. Hardy of the Victorian Forests Commission has ably discussed and summarized the whole question of tall trees in papers read before several scientific associations. Professor A. J. Ewart of the Melbourne University, has dealt with it in his *Handbook of Forest Trees for Victorian Foresters.* These two highly competent authorities, like Maiden, regard the early reports about tall trees as lacking verification and without even the support of probability. They are both disinclined to believe that trees now exist anywhere in Australia over 300ft. in height.

Other tall-growing species of *Eucalyptus* are *E. globulus, E. obliqua, E. diversicolor, E. pilularis* and *E. microcorys;* but records of their maximum heights are not available. The truth on the whole, then, seems to be somewhat as follows:—(1) There is no unquestioned evidence to show that there ever were in any country trees 500 feet high. (2) The existence formerly in Australia of trees 400 feet high is insufficiently attested, but cannot be denied. (3) The discovery in the *E. regnans* forests of trees considerably over 300 feet high may be regarded as having been proved. (4) Reports crediting other species with heights of 300 feet need confirmation. (5) Many valuable species have probably never reached a height of 250 feet, while many have never reached even 200 feet. The tallest eucalypts known to the writer as growing in New Zealand are all still under 200 feet in height.

The question of girths is less difficult and less important. The large-growing *Eucalyptus* trees begin their life with strong taproots that penetrate far into the sub-soil. As the trees gain age and maturity the taproots die and decay. Each tree then becomes increasingly dependent upon its lateral roots and buttresses, which increase in size and strength according to the demand made upon them. The oldest and tallest trees of all large-growing species usually exhibit a very wide spread of buttresses, and often their huge roots will be found quite near the surface of the ground. A great contrast appears between the girth round the buttresses and the girth round the bole clear above them. The one may measure 40ft. to 60ft., while the latter measures only 12ft. to 15ft. With these wide-based trees the common practice of bushmen is to build a light stage upon which to stand and fell the tree so as to leave the whole of the buttressed part in the stump.

It is impossible to say how the eucalypts of Gippsland and the sequoias of California would have compared two or three hundred years ago. At the present time *Sequoia sempervirens* appears to carry the palm for height and *Sequoia gigantea* for girth. *Eucalyptus regnans* comes second on both counts.

The largest of the eucalypts are almost certainly very much younger trees than the largest of the sequoias. Annual growth rings are usually much less easily counted in hardwoods than softwoods.

The giants of the Australian forests probably range in age from 200 to 300 years. In the economic forestry of the future very big trees will rarely if ever be possible. The regenerated forest and the planted forest will in nearly all cases be reaped within the first century. State forest departments and private planters will alike be looking for an early return for their expenditure. Some conifers may be left a little longer; but *Eucalyptus* trees will be planted to be reaped within 25 years to 75 years, according to the species cultivated and the uses to which their timber is to be applied. We look with regret upon vanishing giants; but apparently it is part of the scheme of the world that they shall gradually disappear.

EUCALYPTS AS HONEY YIELDERS.

Of the numerous species of *Eucalyptus* some flower in spring and early summer, some in autumn, others in late winter. The same species may flower at different seasons. In the Australian bush there is probably no month of the year when *Eucalyptus* flowers could not be found. Many of the species bear flowers in great profusion. During the whole time of the flowering the trees are freely visited by bees and birds. The chief attraction is the honey that is secreted in the depression at the base of the style; but in many cases bees also collect the pollen. The quantity of honey yielded by some species in favourable seasons is very great. The quality varies with the species and with the season. Bee keepers in Australia have been systematically producing honey from eucalypts for over half a century. Scientific men have aided them with careful research. Much has been written about the relative merits of the species in this connection. But there has not yet been a sufficient amount of exact observation to form a basis for complete grading of the species as honey yielders. Some species are known to be of very high merit; others are still regarded with diversity of opinion. A few species valued in Australia will be excluded by our climate.

Looking to the economic conditions that may be expected to prevail in New Zealand in the not distant future, we may lay it down as generally imperative that trees planted for honey production shall also be timber yielders. Pursuant to the climatic grouping in Section iii. of this book, the following list will perhaps be the best that can be suggested to apiarists in this country in the present state of our knowledge:—

Group i.

E. cornuta, E. gomphocephala, E. maculata, and *E. propinqua.*

Group ii.

E. cladocalyx, E. microcorys, E. paniculata, and *E. pilularis.*

Group iii.

E. leucoxylon, E. longifolia, E. melliodora, E. piperita, E. rostrata, E. saligna, E. sideroxylon, and *E. Smithii.*

Group iv.

E. fastigata, E. Macarthuri, E. obliqua, and *E. Sieberiana.*

Group v.

E. amygdalina, E. radiata, E. Risdoni, and *E. viminalis.*

Group vi.

E. Gunnii and *E. urnigera.*

Other Australian trees suitable for production of both honey and timber in milder parts of this country are the Kindred of the eucalypts mentioned in this Section and the early-flowering acacias.

For very much fuller information on the value of eucalypts and other Australian trees as honey yielders the reader is referred to the *Handbook of Forest Trees for Victorian Foresters* by Professor A. J. Ewart, of the University of Melbourne.

KINDRED OF THE EUCALYPTS.

There are a few genera so near of kin to the eucalypts as to have been occasionally confused with them by earlier botanists. Such are *Angophora, Tristania, Syncarpia,* and *Melaleuca.* The eucalypts have flowers without petals. These kindred genera all have flowers with petals. The need for brevity will permit description of only one species in each genus.

ANGOPHORA LANCEOLATA Cavanilles.

NATURAL HABITAT, DESCRIPTION, AND USES.

The species is widely distributed in New South Wales from the seaboard over the mountains and in south-eastern Queensland. Tree of medium size, often found growing among rocks where there is little soil. Dead bark deciduous from branches and stem; newly exposed living bark white or grey, much stained with exudations of kino. Leaves stalked, lance-shaped, featherveined, 3in. to 5in. long, ⅝in. wide. Flowers in compound clusters, stalks various, stalklets about ¼in. Each flower with 4 or 5 petals and as many sepals; anthers with longitudinal and parallel openings. Ripe seed-cup bell-shaped, a little over ½in. deep and about the same in width, strikingly ribbed or angled with 4 or more of the ribs projecting above the rim and thus giving the rim a toothed appearance, 3- or 4-celled, valves small. Mature wood pale, rather coarse in grain, but strong and tough, used by wheelwrights, good fuel.

Other species of *Angophora* are *A. intermedia* and *A. subvelutina.* They are distinguished from *A. lanceolata* by retaining their dead bark on stem and branches. In all species of *Angophora* the leaves are usually opposite in pairs. In *A. subvelutina* and one or two other species they are also sessile.

CULTIVATION IN NEW ZEALAND.

A few specimens of *Angophora* have been noted by the writer near Auckland and on the East Coast. They are healthy and vigorous. All the species mentioned make very handsome single trees and might be given experimental place in our parks and arboreta. *A. lanceolata* might find a useful place on rocky areas where most other trees refuse to grow.

Angophora is a Greek compound meaning "vessel-bearing", and was suggested by the striking appearance of the seed-cups.

TRISTANIA CONFERTA Robert Brown.

NATURAL HABITAT, DESCRIPTION, AND USES.

The native home of the species is in northern New South Wales and southern Queensland, from the seaboard to the eastern slopes of the ranges. The tree grows to various heights up to 50ft., 100ft., or even 150ft., with corresponding diameter of stem; dead bark sub-fibrous, deciduous. Leaves wavy, and in size and general appearance like those of a very large-leaved *Pittosporum;* often crowded at the ends of the twigs. Flowers in umbel-like clusters with stalk and stalklets, the clusters being grouped beneath the crowded terminal leaves. Each flower with 5 petals and above each petal a plume-like spray of stamens; anthers with parallel and longitudinal openings. Ripe seed-cup nearly ½in. wide by 5/16in. deep, shaped like a bell with broad mouth, 3-celled, with open valves about even with rim. Mature wood tough, strong, durable, likely to be of great value for technical purposes.

T. conferta makes very beautiful single specimens, and is much used in New South Wales for planting in streets and parks.

CULTIVATION IN NEW ZEALAND.

A few young trees have been noted about Auckland and in Hawke's Bay. Further plantings should be made in all warm districts so as thoroughly to test the suitability of this beautiful and valuable tree for cultivation in this country.

The generic name *Tristania* was given in honour of a French botanist named Tristan; *conferta* refers to the crowding of the leaves at the ends of the twigs. The species has several bushmen's names, of which the one most frequently used is perhaps "brush box". Our policy in this and in every other case should be to use and to teach the botanical name as constantly and as exclusively as possible.

SYNCARPIA LAURIFOLIA Tenore.

NATURAL HABITAT, DESCRIPTION, AND USES.

The species is widely distributed in north-eastern New South Wales and southern Queensland, and appears to be at its optimum in deep gullies containing good soil. Maiden in *Forest Flora* (Vol. i. 27) states that "from 120 to 180 feet is no uncommon height for this tree to attain." Girths are large in proportion, and the boles are said to be often clear of branches up to 80ft. or 90 ft. The dead bark is flaky, fibrous, persistent, and ultimately thick. The leaves are stalked, about 3in. long by 1in. or more wide, and somewhat wavy. The flowers are on peduncles in rounded heads with their calyces or seed-vessels firmly grown together, the number in each head being five to seven or more. Each individual flower has four or rarely five petals and a corresponding number of lobes or sepals. The stamens are numerous and radiating; anthers with parallel and longitudinal openings. The ripe seed-cups appear as if firmly set in wax or cement with upper part and lobed rims projecting away from the common centre. The generic name *Syncarpia* is formed from the Greek *sun* together and *karpos* a fruit, and was suggested by this remarkable union of the calyces in the flower head. The specific name of course means laurel-leaved.

The mature wood is red to dark red or dark brown, according to the age and degree of maturity of the trees. At the best red stage it is tough and very durable either in the ground or in water. It has long been in favour for wharf piling, the piles being usually driven with the bark on as an extra resistant to the marine borers. On the resistant value of the bark there is diversity of opinion. The question is one for marine engineers.

CULTIVATION IN NEW ZEALAND.

A few specimens were doing well in the Mount Albert Railway Reserve when the plantation there was cut down some years ago. One or two others have been noted about Mount Eden. But no competent and systematic effort has yet been made to acclimatize the species in this country. We have imported large numbers of the poles and used them for our wharves, but have made no attempt to produce a future supply for ourselves. Well grown specimens of *S. laurifolia* are stately and beautiful, and in many localities would form a much valued addition to the flora of our parks and arboreta. The Forest Service of New South Wales could supply seed from best trees in cool parts of the natural habitat. In this way, at little cost, the species might be tested for cultivation on a larger scale.

S. laurifolia is one of the many Australian trees that have been unfortunate in the names bestowed upon them by timber-getters. It is called "Turpentine-tree" and the timber for brevity "turpentine". The tree exudes an oleo-resin which is quite different from the kino of the eucalypts; but it is not a turpentine yielder. The botanical name is appropriate and descriptive, and should everywhere be preferred.

MELALEUCA LEUCADENDRON Linnaeus.

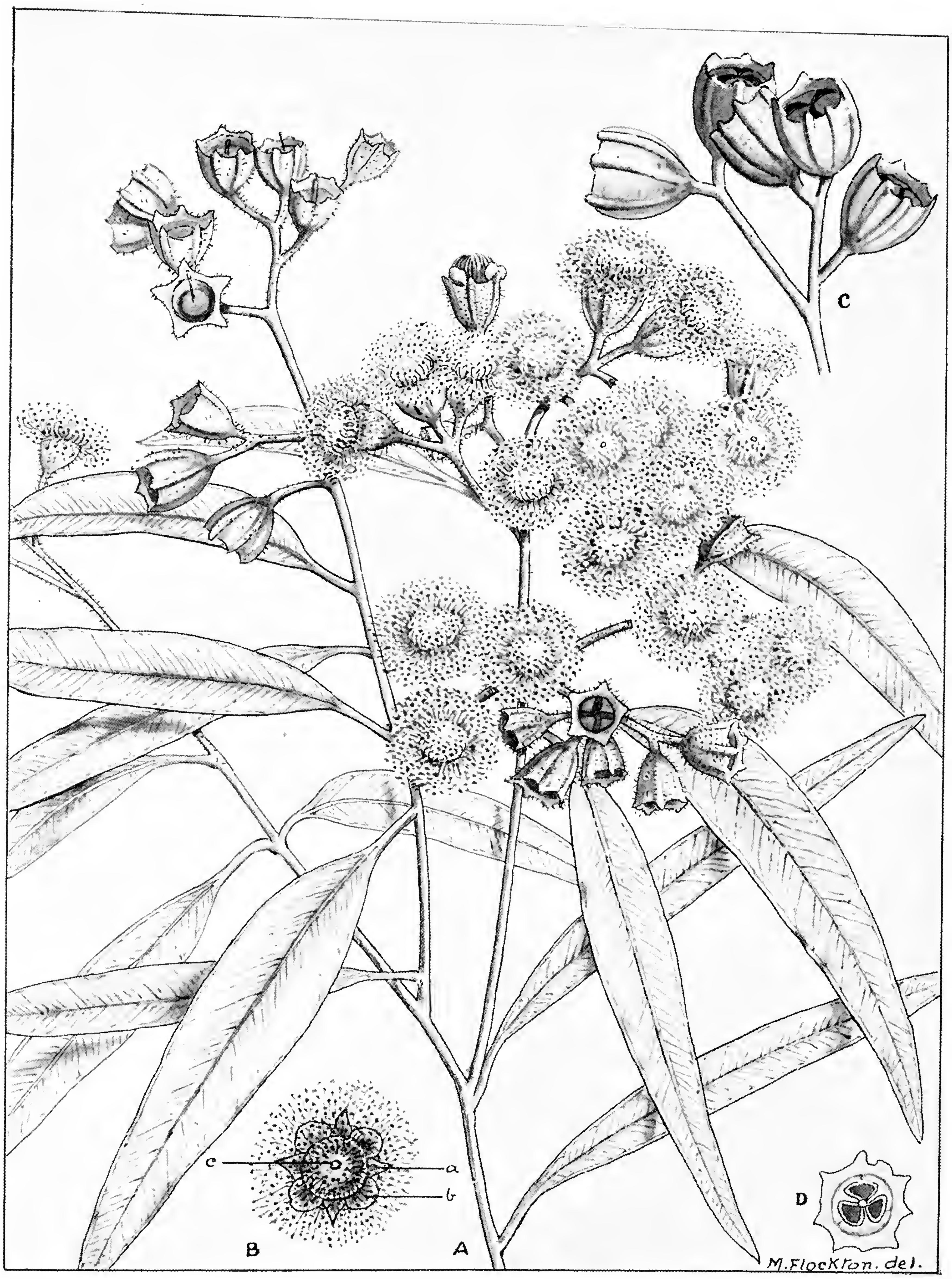
NATURAL HABITAT, DESCRIPTION, AND USES.

Maiden in *Forest Flora,* Vol. i. at p. 96, states the habitat of this plant as follows:—"From the Shoalhaven River, New South Wales (I do not know the furthest southern locality), north right along the coast, in moist sandy localities, to Northern Queensland and the Northern Territory. Found also in Western Australia (its precise range I do not know), in New Caledonia, the whole Malayan Archipelago, and Burmah". The genus as a whole extends still farther; and in the great range here given for *M. leucadendron* there are several varieties, in respect to which the tendency appears to be towards giving them the rank of distinct species.

M. leucadendron, as understood by Maiden, attains its Australian optimum in sheltered bays and along the banks of saltwater creeks where the climate is sub-tropical to tropical. It there becomes a tree 40ft. to 50ft. high and up to 1ft. 6in. or 2ft. in diameter. In the mass and as single specimens the trees are often very beautiful. The dead bark is sub-fibrous and flaky and persists far up the tree. Leaves stalked, up to 3in. long by ½in. wide, with three to five very distinct longitudinal veins. Flowers separate but usually crowded near together along slender young twigs. Anthers with longitudinal and nearly parallel openings. Ripe seed-cups nearly ¼in. in diameter, sessile, and closely packed along the stalk of the twig. MATURE WOOD cross-grained, hard, very lasting in wet ground, useful in boatbuilding. The "Cajeput oil" of commerce is derived from a species of *Melaleuca.* The essential oil of *M. leucadendron* is similar to but not identical with "Cajeput".

CULTIVATION IN NEW ZEALAND.

Our intricate northern waterways present many sheltered shore-lines where *M. leucadendron* should find congenial conditions. Associated there with our native pohutukawa it would beautify the landscape and furnish valuable wood for local fences, as well as for use in the yards of boat-builders.



ANGOPHORA LANCEOLATA.

EXPLANATION OF PLATE.

A. Twig bearing flowers, young fruits, and adult leaves. B. Flower showing (*a*) sepals, (*b*) petals, and (*c*) stigma, all details being slightly enlarged. C. Ripe seed-cups. D. Transverse section through seed-cup, showing the usual three cells.

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TRISTANIA CONFERTA.

EXPLANATION OF PLATE.

A. Twig bearing flowers, ripe seed-cups, and leaves in usual adult form. B. Young flower showing sepals and petals in imbricate arrangement. C. Scars where whorl of leaves has fallen away.

SYNCARPIA LAURIFOLIA.

EXPLANATION OF PLATE.

A. Twig bearing flowers and adult leaves, natural size. B. Flower with stamens removed. C. Seed-cups; note that they are connate to about the middle. D. Vertical section of a head of fruits.

NOTE.—Details in B., C. and D. are enlarged.

MELALEUCA LEUCADENDRON.

EXPLANATION OF PLATE.

A. Twig with buds, flowers, and adult leaves, natural size. B. and C. Front and back view of flower opened out. D. Petal with portion of stamens, showing attachment at base. E. Fruiting spike.

NOTE.—B. and C. are enlarged; D. still more enlarged.

MEASUREMENT OF TREES AND LOGS.

HEIGHT OF A TREE.

The height of a tall standing tree can be known only by some method based on science. Essential appliances are an instrument for accurately registering angles and a tape for measuring a base or ground-line. The angle most convenient for ordinary use is 45°. With instrument set to this, sight apex of tree. Place mark on ground exactly below instrument. Measure distance along ground between tree and mark. Add height of instrument so as to extend base to point where angle of 45° touches the ground. If tree is large, add also half diameter of stump. Assuming that the ground is level and the tree perpendicular, the base or ground-line will then equal height of tree. By setting instrument level any rise or fall in ground may be detected and allowance made accordingly. Other angles require that the base shall be multiplied or divided. These three are convenient:—60° with base multiplied by 1.732; 63½° with base multiplied by 2; 26½° with base divided by 2. A surveyor with theodolite can use any angle. The amateur is restricted. An Abney Level is a very convenient instrument for general use.

CONTENTS OF A LOG.

It is usual in New Zealand to express contents of a log in terms of the superficial foot, which means a piece of board one foot square and an inch in thickness. Girth of a log is taken midway between the ends, after chipping off a ring of bark. Where the girth contains even feet or extra inches easily convertible into decimals of the foot, as 3, 6, and 9, proceed as follows:—Multiply girth into itself; multiply product by 3; divide product by 4; multiply quotient by length of log in feet.

(a) Log 8′ x 16′ (girth and length).	(b) Log 9′ 6″ x 20′
8	9.5
8	9.5
64	475
3	855
4)192	90.25
48	3
16	4)270.75
288	67.6875
48	20
768 super. ft.	1353.7500

Read as 1354 super. ft.

CONTENTS OF A LOG.

Where extra inches are not readily convertible into decimals of the foot, use the Hoppus method as follows:—Reduce girth to inches; divide by 4; multiply quotient into itself; multiply by length of log in feet; divide by 12.

```
(c) Log 7′ 4″ x 25′
   7′ 4″
   12
  ─────
4)88
  ─────
   22
   22
  ─────
   44
  44
  ─────
  484
   25
  ─────
 2420
 968
 ──────
12)12100
 ──────
  1008 super ft. (fraction omitted).
```

```
(d) Log 10′ 7″ x 30′
   10′ 7″
   12
  ─────
4)127
  ─────
   31.75
   31.75
  ───────
   15875
  22225
  3175
 9525
 ──────────
 1008.0625
        30
 ──────────
12)30241.8750
 ──────────
   2520.1562
     Read as 2520 super. ft.
```

NOTES.

(*a*) It is often necessary to report quickly on the contents of standing trees. Total length of bole and medial girth are carefully estimated for each tree and the contents worked out in the ordinary way.

(*b*) In the timber trade boards less than one inch in thickness are charged at superficial rates.

(*c*) Ready reckoners for round and sawn timber may be obtained from the booksellers.

(*d*) In milling a log into boards, about 20% of its absolute contents are lost in saw-cuts and waste. The two formulae here explained allow for this, and show approximately the amount of sawn product that will be available for use. It will be found that the results closely coincide with those given in the Ready Reckoner for Round Timber by Haakon Dahl.

(*e*) A fraction in the contents of a log, if only six inches or less than six inches, is disregarded; if more than six inches, it is counted as a foot.

(*f*) The scientific forester will ascertain the absolute contents of the log and deduct therefrom the estimated loss in milling. His results will be practically the same as those obtained by the formulae given above.

SECTION VII.

ALPHABETICAL LIST OF ALL KNOWN SPECIES OF EUCALYPTUS.

ABBREVIATIONS.

C.R. = Maiden's *Critical Revision of the Genus Eucalyptus,* where each species is described and figured.

T. = Tasmania; V. = Victoria; S.A. = South Australia; N.S.W. = New South Wales; Q. = Queensland; S.Q. = Southern Queensland; N.Q. = Northern Queensland; W.A. = Western Australia; N.W.W.A. = North-West Western Australia; N.T. = Northern Territory; N.A. = North Australia. X before the name denotes hybrid; thus—x **E. Algeriensis;** mm. = Millimetres; cm. = Centimetres; in. = Inches.

SCALE FOR MEASURING DIAMETERS OF SEED-CUPS.

Size Expressed in Words.	In Fractions of the Metre.	In Nearest Foot Rule Equivalents.
Extremely Small	3 to 4 mm.	⅛ to 3/16 in.
Very Small	4 to 6 mm.	3/16 to ¼ in.
Small	6 to 9 mm.	¼ to ⅜ in.
Medium	9 to 12 mm.	⅜ to ½in.
Large	12 to 25 mm.	½ to 1 in.
Very Large	25 mm. to 5 cm.	1 in. to 2 in.
Extremely Large	5 cm. to 9 cm.	2 in. to 3½ in.

In using this scale the student will need a pair of sharp-pointed callipers and a suitably divided rule. When the seed-cup gradually tapers into the pedicel, there will sometimes be room for difference of judgment as to where the one ends and the other begins. Measurements of depth by two people may thus not always agree. Width, on the other hand, will be taken at the widest part, and will be easily determined. When strictly measured many **Eucalyptus** seed-cups will be found to have a width greater than their depth. The student must not forget that sizes vary within the species and even on the same tree.

buds small, stellate; seed-cups small, nearly spherical (5-8 mm.). Timber pale brown, fissile, durable. Mountain ranges, N.S.W., V.

E. aggregata: Deane & Maiden. C.R. Pt. xxv. 85; Vol. iii. 85; Pt. lvii. 354; Vol. vi. 354; Pt. lxix. 427; Vol. vii. 427.

A small tree 20-40 feet high; bark rough, curly-flaky; juvenile leaves oval to oblong; buds and seed-cups very small, (4 x 5 mm.). Timber white, tough, not durable. A swamp loving species. N.S.W., T. (See Group iv. 45.)

E. alba: Reinwardt. C.R. Pt. xxv. 90; Vol. iii. 90.

A medium-sized tree, with a smooth bark; juvenile leaves broad, ovate; buds and seed-cups medium, (8 x 7 mm.). Timber reddish-brown, coarse-fibred. A tropical species. Timor, Papua, Java, N.W.W.A., N.T., N.Q.

E. albens: Miquel. C.R. Pt. lviii. 440; Vol. vi. 440.

A medium-sized tree, with a close, usually white Box bark on trunk; branches smooth or ribbony. Leaves glaucous; juvenile leaves large, orbicular. Buds very angular; seed-cups medium (9-12 x 8-10 mm.), cylindrical to pyriform, nearly sessile. Timber pale, very hard, and very durable. V., S.A., N.S.W.

E. albida: Maiden & Blakely. C.R. Pt. lxviii. 380; Vol. vii. 380.

A Mallee, 2-6 feet high; juvenile leaves thin, glaucous, sessile; adult leaves thin, narrow-lanceolate; buds clavate, including the pedicels 8-10 mm. long; seed-cups campanulate (bell-shaped), (3-4 mm. long). In sandy or gravelly soil. W.A.

x E. Algeriensis: Trabut. C.R. Pt. lii. 72; Vol. vi. 72.

A hybrid; reputed parents, **E. rudis,** and **E. rostrata.** A lofty tree; bark almost smooth; leaves somewhat glaucous, narrow-lanceolate, buds ovoid-clavate, on long pedicels; seed-cups small, hemispherical. Algiers.

E. alpina: Lindley. C.R. Pt. ix. 259; Vol. i. 259.

A dwarf alpine Stringybark, with gnarled, spreading branches; leaves thick, leathery, shining; buds and seed-cups large, warty (12-16 x 16-22 mm.). Confined to the higher parts of the Victorian Alps.

E. altior: Maiden. C.R. Pt. lvi. 272; Vol. vi. 272.

Syn. **E. oreades.** Baker. C.R. Vol. iv. 290.

A tall, shaft-like tree, with a smooth glaucous bark, except at extreme base; leaves lanceolate, falcate; buds angular; seed-cups medium, (6-8 x 8-10 mm.). Timber pale, soft, fissile, splendid for cabinet work. Blue Mountains, N.S.W. (See Group iv. 53.)

E. amplifolia: Naudin. C.R. Pt. xxxi. 19; Vol. iv. 19.

A medium-sized to large tree, with smooth blotched bark; juvenile leaves very broad, orbicular; adult leaves lanceolate; buds stellate; seed-cups small (4-6 x 5-7 mm.). Timber reddish, inferior. N.S.W.

E. amygdalina: Labillardiere. C.R. Pt. vi. 149; Vol. i. 149; Pt. xxxviii. 227; Vol. iv. 227.

A small to medium-sized tree; bark more or less sub-fibrous on trunk, branches smooth; juvenile leaves narrow-lanceolate, sometimes sessile; adult leaves narrow to medium; buds small, clavate, seed-cups small, hemispherical (6 x 5 mm.). T. (See Group v. 57.)

E. Andrewsi: Maiden. C.R. Pt. vii. 194; Vol. i. 194; Pt. xlvi. 171; Vol. v. 171.

A large tree 150-180 feet high; diameter 4-8 feet; bark rough and persistent at butt; branches smooth; juvenile leaves very broad, sometimes glaucous; adult leaves lanceolate-falcate; buds small, clavate; seed-cups small, sub-globose, truncate. Timber pale, fissile. Northern N.S.W., S.Q., at high elevations. (See Group iv. 46.)

E. angophoroides: Baker. C.R. Pt. xlvi. 175; Vol. v. 175.

A medium-sized tree, with a white Box bark, persistent for some distance on trunk; juvenile leaves, ovate to cordate; buds small, ovoid; seed-cups small to very small, hemispherical, (4 x 5 mm.). Timber pale, soft and light; Southern coastal districts, N.S.W., V.

E. angulosa: Schauer. C.R. Pt. lvi. 277; Vol. vi. 277.

A Mallee, 15-20 feet high, with dense foliage. Stems more or less smooth and white. Leaves coarse. Buds and seed-cups large, ribbed, (cups 10-22 x 10-20 mm.). V., S.A., W.A.

E. ABERGIANA TO E. AGGLOMERATA.

In the following notes bark is described as it appears to the eye, but always subject to the distinction between living bark and dead bark as explained in Section I. of this book.

In preparing the following list the author has had the indispensable help of Mr. W. F. Blakely, Botanist and Eucalyptologist at the Botanic Gardens, Sydney. The list is based on Maiden's *Critical Revision.* As here presented, it does not quite reach the 400 mark; but several species believed to be new await determination and inclusion. Mr. Blakely makes a present total count for the genus of 405 species and hybrids, and anticipates further discoveries.

When Mr. Maiden was called away from his great work amongst the trees and plants the *Critical Revision* was still unfinished. The Parts necessary for completing Vols vii. and viii. were in manuscript, but not yet printed. To R. H. Cambage, one of Maiden's most trusted botanical friends, and to W. F. Blakely fell the task of revising these Parts and seeing them through the Press. Their work is progressing as fast as circumstances will permit. Where the Parts have not yet been printed, page numbers are unavoidably omitted from the references.

Group numbers at foot of notes on certain species refer to descriptions in Section iii. of this book.

NAMES AND BRIEF DESCRIPTIONS OF THE KNOWN EUCALYPTS.

Eucalyptus Abergiana: F. v. Mueller. C.R. Pt. xli. 9; Vol. v. 9.

A medium-sized Bloodwood, with coarse leaves, large, club-shaped buds, and large urn-shaped seed-cups (28 x 25 mm.). N.T., W.A.

E. acaciaeformis: Deane & Maiden. C.R. Pt. xxii. 26; Vol. iii. 26.

A medium-sized tree; bark dark, fibrous, rough, furrowed, like an Ironbark; juvenile leaves small, oblong; adult leaves lanceolate; buds and seed-cups very small (4 x 4 mm.). Timber reddish, fissile. N.S.W.

E. acacioides: A. Cunningham. C.R. Pt. xi. 45; Vol. ii. 45; Pt. lxi. 12; Vol. vii. 12.

A small, green Mallee, or small tree; juvenile leaves linear; adult leaves narrow; buds clavate to obovate, acute; seed-cups small, pyriform to hemispherical, (6 x 5 mm.). Dry parts, V., N.S.W.

E. accedens: W. V. Fitzgerald. C.R. Pt. xxxiv. 99; Vol. iv. 99.

A sturdy White Gum, 40-60 feet high, bark greyish or white; contains 40-50 per cent. of tannic principle; leaves thick, glaucous; buds blunt of medium size; seed-cups pear-shaped, (7-10 x 5-8 mm.). Timber reddish-brown, hard, interlocked. W.A.

E. acmenioides: Schauer. C.R. Pt. ix. 263; Vol. i. 263.

A tall, erect tree; bark fibrous, persistent; juvenile leaves large, opposite, sessile; buds small, pointed; seed-cups small, sub-globose, truncate to pear-shaped (6-9 x 6-9 mm.). Timber pale, useful for many purposes. Coast districts of N.S.W. and Q. (See Group ii. 11.)

E. adjuncta; Maiden. C.R. Pt. l. 297; Vol. v. 297.

A tree 40-80 feet high; bark smooth, blotched somewhat similar to a Grey Gum; buds large, drooping; seed-cups medium, (10 x 11 mm.). Timber red. Rare. N.S.W.

E. affinis: Deane & Maiden. C.R. Pt. xiii. 101; Vol. ii. 101.

A medium-sized tree 60-80 feet high, bark half Ironbark and half Box; juvenile leaves glaucous, elliptical; buds elongated, acute; seed-cups medium (8-11 x 7-10 mm.), pedicels long, slender. Timber brown, interlocked. N.S.W.

E. agglomerata: Maiden. C.R. Pt. lvii. 341; Vol. vi. 341; Pt. lxvi. 308; Vol. vii. 308.

An erect tree 50-100 feet high; bark fibrous, persistent; juvenile leaves elliptical to lanceolate, hispid-stellate; adult leaves lanceolate;

E. ANGUSTA TO E. BAKERI.

E. angusta: Syn. E. rigidula. Maiden. C.R. Pt. lvi. 265; Vol. vi. 265; Pt. lxix. 403; Vol. vii. 403.

A tall shrub or spindly tree. Leaves narrow, lanceolate, rigid; buds and seed-cups medium (10 x 9 mm.). W.A.

E. angustissima: F. von Mueller. C.R. Pt. xix. 285; Vol. ii. 285.

A small bushy shrub, 5-6 feet high or more; leaves very narrow, yellowish-green; buds and seed-cups very small, (cups 4 x 4 to 5 x 6 mm.). W.A.

E. annulata: Bentham. C.R. Pt. xxxv. 116; Vol. iv. 116.

A tall shrub 12-30 feet high, with a smooth ash-coloured bark; leaves narrow; buds large, cylindrical, obtuse; seed-cups medium, top-shaped, valves protruding, (7 x 12 mm.). W.A.

x E. Antipolitensis: Trabut. C.R. Pt. lii. 74; Vol. vi. 74.

A hybrid; reputed parents, **E. globulus** and **E. viminalis.** A tall tree, bark fissured; juvenile leaves sessile, lanceolate; adult leaves long, narrow, lanceolate; buds and seed-cups in threes, rather large. Southern France.

E. apiculata: Baker & Smith. C.R. Pt. ix. 285; Vol. i. 285; Pt. lxi. 9; Vol. vii. 9.

A dark green shrub 6-10 feet. Leaves narrow, dark green, and shining; buds small, acute; seed-cups urn-shaped to pilular, (8 x 7 mm.). Southern tablelands, N.S.W.

E. approximans: Maiden. C.R. Pt. xliii. 96; Vol. v. 96.

A Mallee-like plant 4-10 feet high, with whip-stick like stems, and dark green, narrow, shining leaves; seed-cups slightly bell-shaped, small, (7 x 6 mm.). N.S.W.

E. Archeri: Maiden & Blakely. C.R. Pt. lxxi.; Vol. viii.

A small shrubby alpine species with white stems, pale yellowish-green leaves, and small rough buds and seed-cups. T.

E. argillacea: W. V. Fitzgerald. C.R. Pt. xxxv. 132; Vol. iv. 132.

A tree 25-40 feet, 9-12 inches diameter, bark dark grey, persistent on trunk and branches, semi-fibrous; leaves very glaucous, ovate to lanceolate; buds clavate; seed-cups bell-shaped, small (9 x 6 mm.). W.A.

E. aspera: F. von Mueller. C.R. Pt. xxxvii. 185; Vol. iv. 185.

A small tree; bark smooth, greyish-white; leaves small, sessile, hispid; buds clavate; seed-cups ovoid-truncate, rim sharp. N.T.

E. astringens: Maiden. C.R. Pt. lxii. 55; Vol. vii. 55.

A smooth-barked tree, 40-60 feet high; juvenile leaves very broad; adult leaves narrow-lanceolate; buds elongated; lid more than twice the length of the calyx-tube; seed-cups small, bell-shaped to ovoid, valves protruding, (7 x 5 mm.). Resembles **E. salubris** in general appearance. Bark used commercially. W.A.

x E. Auburnensis: Maiden. C.R. Pt. liii. 116; Vol. vi. 116.

A supposed natural hybrid. A small Ironbark, with broad, glaucous juvenile leaves, and very small buds and seed-cups. Rare. N.S.W.

E. Badjensis: de Beuzeville & Welch. C.R. Pt. lxviii. 376; Vol. vii. 376.

A large forest tree, 50-100 feet high; bark persistent about half-way up the trunk, smooth above; juvenile leaves opposite, narrow-lanceolate, sessile; adult leaves falcate-lanceolate; buds and seed-cups in threes, sessile, very small, (5 x 5 mm.). Timber pale reddish, hard, not very durable. Main Southern Dividing Range, at about 4,000 feet elevation. N.S.W.

E. Baeuerleni: F. von Mueller. C.R. Pt. xxix. 183; Vol. iii. 183.

A stunted or tall tree, sometimes forming a Mallee-like growth, especially in exposed situations; bark smooth, brownish to greenish-white; buds with acute points; seed-cups top-shaped, medium, (7-10 x 8-7 mm.). Timber pale-coloured, hard. N.S.W., at high elevations.

E. Baileyana: F. von Mueller. C.R. Pt. xliv. 113; Vol. v. 113.

A medium-sized tree; bark rough, fibrous; juvenile leaves broadly elliptical, hoary, and softly tomentose beneath, glossy above; adult leaves narrow-lanceolate; buds clavate to pyriform; seed-cups large, globular-urceolate, (15 x 15 mm.). Timber light coloured, hard, interlocked, and very tough. Northern N.S.W. and Q.

E. Bakeri: Maiden. C.R. Pt. xliv. 123; Vol. v. 123.

A small pendulous, willow-like tree, 30-50 feet high; bark Box-like on trunk only; leaves linear; buds bullet-shaped, small; seed-cups small (5 x 6 mm.), valves protruding, needle-pointed. Timber deep red, hard, heavy. Dry parts of N.S.W., Q.

E. Bancrofti: Maiden. C.R. Pt. xxxi. 14; Vol. iv. 14.

A large tree, bark usually smooth, blotched, falling away in irregular patches, foliage often coarse; buds bullet-shaped; seed-cups top-shaped, small to medium, valves protruding, (6-9 x 9-11 mm.). Timber soft and somewhat brittle. North Coast districts of N.S.W., S.Q.

E. Banksii: Maiden. C.R. Pt. xxiv. 74; Vol. iii. 74.

A large tree up to 100 feet; bark fuzzy at base, persistent; juvenile leaves sessile, orbicular to cordate; adult leaves lanceolate; seed-cups small, sessile, (5 x 6 mm.). Timber pale, hard, durable. N.S.W., Q.

x E. Barmedmanensis: Maiden. C.R. Pt. liii. 108; Vol. vi. 108.

"A supposed natural hybrid," allied to **E. sideroxylon** and **E. melliodora.** Buds with conical lids; seed-cups urn-shaped, (6 x 7 mm.). Rare. Barmedman, N.S.W.

E. Baueriana: Schauer. C.R. Pt. xiii. 120; Vol. ii. 120; Pt. xlii. 62; Vol. v. 62; Pt. lxi. 16; Vol. vii. 16.

A medium-sized tree, with a rounded head of dense foliage. Rough greyish or dark soft bark on trunk and ultimate branchlets. Juvenile leaves orbicular to broadly lanceolate; adult leaves ovate; buds small, clavate; seed-cups conoid, (8 x 7 mm.). Timber reddish, hard, durable. V., N.S.W., Q.

E. Baxteri: (Bentham) Maiden & Blakely. C.R. Pt. lxx. Vol. vii. .

A small to medium-sized Stringybark; juvenile leaves broadly elliptical; adult leaves usually broadly and obliquely lanceolate; buds clavate, rough; seed-cups rather large, hemispherical to sub-globose, (12-15 x 10-12 mm.). Timber pale, durable. V., S.A.

E. Behriana: F. von Mueller. C.R. Pt. x. 335; Vol. i. 335.

A tall shrub or small tree up to 20-30 feet and more, with one or two dozen stems of 3 to 4 inches in diameter springing from one root. Bark always smooth and of a dark oily-looking green. Leaves broad; buds small, sessile; seed-cups small, (5-7 x 5-4 mm.). Dry parts of V., N.S.W.

E. Benthami: Maiden & Cambage. C.R. Pt. xxix. 188; Vol. iii. 188.

A large White Gum, 60-100 feet high, diameter up to 6 feet with more or less flaky bark at butt; juvenile leaves slightly glaucous, ovate-lanceolate; adult leaves lanceolate; buds glaucous, slightly urn-shaped; seed-cups very small, urceolate to nearly bell-shaped, (5 x 5 mm.). Timber pale, fissile, fairly hard. Nepean Valley, N.S.W.

E. Beyeri: R. T. Baker. C.R. Pt. xlviii. 235; Vol. v. 235.

A typical Ironbark, up to 100 feet high, with deeply furrowed, very hard, lead-coloured bark, permeated with kino (gum). Leaves narrow, glaucous; seed-cups usually larger than in **E. crebra** (6 x 5 mm.). Timber brown to reddish-brown, very durable. Rare. N.S.W.

E. biangularis: Simmonds. C.R. Pt. lxviii. 382; Vol. vii. 382.

A supposed natural hybrid; reputed parents, **E. globulus** and **E. urnigera.** A tree 40-100 feet high, with the botanical characters of the above species; cultivated in New Zealand; probably of Tasmanian origin. Buds in threes; seed-cups medium, strongly biangular, orifice crater-like.

E. bicolor: A. Cunningham. C.R. Pt. xi. 6; Vol. ii. 6; Pt. xlvii. 209; Vol. v. 209.

A moderately large tree, with pendulous, more or less smooth branches, and dark rough, persistent bark on trunk; leaves narrow lanceolate, somewhat glaucous; buds and seed-cups very small; cups pear-shaped, (4-5 x 3-4 mm.). Timber red, hard, durable. Dry parts of V., S.A., N.S.W., Q.

E. bicostata: Maiden, Blakely and Simmonds. C.R. Pt. lxxi. ; Vol. viii. .

A Blue Gum, 40-150 feet high, bark smooth bluish, decorticating in strips or flakes; juvenile leaves large, very glaucous, opposite, sessile, ovate-cordate to broad-lanceolate; adult leaves deep green, falcate-lanceolate, often very long; buds sessile, usually in threes, warty, bicostate, when young subtended by broad, thin, connate deciduous bracts; seed-cups turbinate to nearly globular, with a conspicuous disc, moderately smooth, two-ribbed, (12-17 x 14-20 mm.). Timber pale, close grained, hard, durable. N.S.W., V., in rich soil, frequently on limestone ridges surrounded by high hills.

E. BLACKBURNIANA TO E. BUCKNELLI.

x E. Blackburniana: Maiden. C.R. Pt. liii. 120; Vol. vi. 120.

A supposed natural hybrid. A medium-sized Ironbark Box, with linear juvenile leaves, and small buds and seed-cups. Allied to **E. odorata.** Timber brownish, interlocked. Rare. V.

E. Blakelyi: Maiden. C.R. Pt. xxxii. 43; Vol. iv. 43.

An erect tree of medium size with smooth more or less blotted bark; branches sometimes pendulous; juvenile leaves thick, ovate to elliptical; buds conical to rostrate; seed-cups on long pedicels, ovate; valves prominent, (6 x 6 mm.). Timber red, soft. N.S.W., Q.

E. Blaxlandi: Maiden & Cambage. C.R. Pt. xlv. 150; Vol. v. 150.

A medium-sized Stringybark, with reddish fibrous, often deeply furrowed bark on trunk; branches smooth, juvenile leaves ovate to elliptical, slightly stellate-hispid; adult leaves lanceolate; buds rounded-clavate, small; seed-cups medium, closely sessile, valves protruding, (9-10 x 8-9 mm.). Timber pale, of excellent quality. Western and southern mountain ranges of N.S.W. (See Group iii. under 27).

E. Bloxsomei: Maiden. C.R. Pt. lxvii. 315; Vol. vii. 315.

A medium-sized Yellow Bloodwood; bark yellow-flaky; juvenile leaves ovate, slightly peltate; adult leaves narrow-lanceolate; buds glaucous, small, shining; seed-cups small to large, urn-shaped. Timber pale brown. Dry parts of S. and W.Q.

E. Boormani: Deane & Maiden. C.R. Pt. x. 330; Vol. i. 330.

A large tree, with a dark-coloured, hard, scaly bark extending to the smaller branches. Juvenile leaves broad; buds conical; seed-cups semi-ovate, (10 x 8 mm.). Timber pale reddish-brown, hard, durable. N.S.W. Rare.

E. Bosistoana: F. von Mueller. C.R. Pt. xi. 1; Vol. ii. 1; Pt. lvi. 270; Vol. vi. 270.

An upright-growing tree, with a flaky, sub-fibrous bark on trunk; branches smooth; juvenile leaves broad; buds ovoid, pedicellate; seed-cups hemispherical to nearly ovoid, (8 x 7 mm.). Timber reddish-yellow, hard, durable. V., N.S.W. (See Group iii. 25).

E. botryoides: Smith. C.R. Pt. xxiii. 50; Vol. iii. 50.

A medium to large tree with a persistent rough, sub-fibrous bark on trunk and main branches; leaves moderately large, finely veined; buds and seed-cups medium to small, somewhat angular, closely sessile. (9 x 7 mm.). Timber red, durable. Coastal districts of V., N.S.W., Q. (See Group iii. 26).

E. Bottii: Blakely. C.R. Pt. lxxi. ; Vol. viii. .

A straight, somewhat massive tree, 50-100 feet high; bark on trunk peppermint-like, but usually more deeply furrowed and rougher, branches smooth and ribbony; juvenile leaves large, slightly glaucous, somewhat similar to those of E. Sieberiana; adult leaves falcate-lanceolate, undulate; buds rather numerous, small, lid pointed; seed-cups ovoid to globular, (9 x 9 mm.). In moderately wet, low-lying soil on top of porous clay. N.S.W.

x E. Bourlieri: Trabut. C.R. Pt. lii. 75; Vol. vi. 75.

A French hybrid; reputed parents, **E. globulus** and (?). Buds and seed-cups in threes, smaller than those of **E. globulus.**

E. Bowmani: F. von Mueller. C.R. Pt. x. 344; Vol. i. 344.

An imperfectly known Queensland species, allied to **E. hemiphloia;** seed-cups pear-shaped, (9 x 5 mm.).

E. brachyandra: F. von Mueller. C.R. Pt. xxx. 219; Vol. iii. 219.

A crooked tree, 25-30 feet high; bark grey, rough; leaves ovate, inflorescence paniculate; buds and seed-cups extremely small; seed-cups goblet-shaped, (3 x 4 mm.). Rare. N.T., W.A.

E. Brownii: Maiden & Cambage. C.R. Pt. xlvii. 194; Vol. v. 194.

A medium-sized tree, about 40 feet high; bark Box-like on trunk and large branches; leaves narrow-lanceolate; buds small, clavate; seed-cups small, conoid, (5 x 4 mm.). Timber red. N.Q.

E. Bucknelli: Cambage. C.R. Pt. lxxi. ; Vol. viii. .

A tree, 30-40 feet high; bark shortly fibrous to slightly furrowed like an Ironbark, mature leaves lanceolate, greyish green, buds pedicellate, clavate, 3-4 mm. long; seed-cups ovoid to pyriform, truncate, valves exsert, (4-5 x 3-6 mm.). Timber reddish-brown, very hard, heavy and interlocked. N.S.W. and Q.

E. buprestium: F. von Mueller. C.R. Pt. viii. 243; Vol. i. 243; Pt. lvi. 268; Vol. vi. 268.

A tall shrub up to 15 or 20 feet with a Mallee habit and smooth stems; buds small, clavate; seed-cups very large, globose, (22 x 25 mm. or larger). W.A.

E. Burracoppinensis: Maiden & Blakely. C.R. Pt. lxviii. 367; Vol. vii. 367.

A small tree or shrub, 8-15 feet high; bark rough on trunk, smooth on branches; leaves thick, shining, narrow to broad lanceolate, buds pyriform; lid rostrate or beaked, ribbed; seed-cups turbinate, thick, large (3 cm. x 2 cm.). Sand plains, W.A.

E. caesia: Bentham. C.R. Pt. xxii. 31; Vol. iii. 31.

A glaucous Mallee, about 12 feet high, bark smooth, tough, shedding in long lengths; leaves glaucous; buds oval, rostrate or beaked, large; seed-cups large, broadly campanulate or bell-shaped, (19 x 20 mm.). W.A.

E. Caleyi: Maiden. C.R. Pt. xii. 95; Vol. ii. 95; Pt. lxi. 14; Vol. vii. 14.

A tall tree, often glaucous, with very hard, deeply furrowed bark like **E. sideroxylon;** leaves broad, glaucous; seed-cups pear-shaped, medium, (10 x 9 mm.). Timber red or reddish-brown, of good quality. N.S.W., Q.

E. Callanii: Blakely. C.R. Pt. lxxi. ; Vol. viii. . Plate 289.

A slender Stringybark 20-50 feet high; juvenile leaves broad, smooth, obliquely ovate, shortly petiolate; adult leaves glossy, narrow to broad lanceolate, prominently veined; buds clavate to conical, seed-cups mallet-shaped, (5-7 mm.). Timber pale, fissile. N.S.W.

E. calophylla: R. Brown. C.R. Pt. xliii. 73; Vol. v. 73.

A small to large tree, bark rough, persistent; juvenile leaves large, often peltate, broadly lanceolate; adult leaves narrow to broad lanceolate; inflorescence terminal; buds large, clavate; filaments white, rarely pink in the typical form; but there are numerous garden hybrids of this species. Seed-cups urceolate or urn-shaped, very large, (35 x 30 mm.). Seeds large, black, not winged. W.A. (See Group i. 1.)

E. calycogona: Turczaninow. C.R. Pt. iii. 77; Vol. i. 77.

A Mallee, up to 25 or 30 feet, with a smooth bark, leaves oblong-lanceolate; buds angular; seed-cups quadrangular, small to medium (6-10 x 5-8 mm.). V., S.A., W.A.

E. Cambageana: Maiden. C.R. Pt. xlvii. 196; Vol. v. 196.

A medium-sized tree 50-80 feet high; bark scaly on lower part of trunk; juvenile leaves rhomboid-ovate to broadly lanceolate with irregular margins; adult leaves falcate-lanceolate; buds small, clavate; seed-cups small, conical, (6 x 5 mm.). Timber reddish-brown, hard, heavy. Q.

E. Camfieldi: Maiden. C.R. Pt. xlv. 148; Vol. v. 148.

A Mallee 4-12 feet high, forming dense thickets on poor sandstone soil in the Port Jackson and Hawkesbury River districts. Buds densely clustered; seed-cups sessile, basin-shaped, small, (6 x 6 mm.). N.S.W.

E. Campaspe: S. le M. Moore. C.R. Pt. xvi. 203; Vol. ii. 203; Pt. lxvii. 362; Vol. vii. 362.

A Mallee-like plant up to 40 feet high, with drooping branches, and smooth bark; leaves glaucous, thick; seed-cups glaucous, sessile, medium, (7 x 10 mm. or larger). Timber pale, hard, durable. Dry parts of W.A.

E. canaliculata: Maiden. C.R. Pt. xlvii. 220; Vol. v. 220.

A Grey Gum, over 100 feet high; bark blotched, falling away in thick flakes; juvenile leaves broadly lanceolate; adult leaves narrow-lanceolate; buds thick, clavate; seed-cups large, conoid-hemispherical, very angular, (14 x 15 mm.). Timber pale, coarse-fibred, interlocked. Rare. N.S.W.

E. capitellata: Smith. C.R. Pt. viii. 211; Vol. i. 211; Pt. xlv. 146; Vol. v. 146; Pt. lxvi. 307, 314; Vol. vii. 307, 314.

A small to medium-sized tree; bark reddish, fibrous, persistent throughout; juvenile leaves large, orbicular, to ovate, or obliquely and broadly lanceolate; buds angular; seed-cups compressed, sessile, medium, (7 x 10 mm.). Timber pale brown, durable. Port Jackson district, N.S.W. (See Group iii. 27.)

E. CELASTROIDES TO E. COMETAE-VALLIS.

E. celastroides: Turczaninow. C.R. Pt. xxxix. 259; Vol. iv. 259.

A medium-sized tree, with a little rough bark at butt; leaves oblong, lanceolate; buds clavate; seed-cups slightly glaucous, somewhat urceolate or urn-shaped, small, (5-7 x 4-5 mm.). W.A.

x E. Chisholmi: Maiden & Blakely. C.R. Pt. lxii. 61; Vol. vii. 61.

A supposed natural hybrid, between **E. piperita** and **E. micrantha.** Rare. N.S.W.

E. cinerea: F. von Mueller. C.R. Pt. xxi. 1; Vol. iii. 1.

A small to medium-sized tree, with a matted, persistent bark, ragged, fibrous, reddish-brown on trunk and larger branches, decorticating in small strips from smaller branches, leaving them creamy-white; juvenile leaves short and broad, sessile; adult leaves sessile or stalked; seed-cups small to medium; usually in threes, (5-7 x 7-10 mm.). Timber reddish, inferior. In poor soil. V., N.S.W. (See Group vi. under **E. cordata** 66).

E. citriodora: Hooker. C. R. Pt. lviii. 433; Vol. vi. 433.

A tall stately tree; bark smooth, mottled. Juvenile leaves narrow to broad lanceolate, often peltate; adult leaves usually narrow-lanceolate; in both stages very rich in lemon-scented essential oil. Inflorescence terminal; buds and seed-cups similar to those of **E. maculata,** but usually smaller. Timber pale, durable. Q. (See Group i. 2).

E. cladocalyx: F. von Mueller. C.R. Pt. xxxvi. 161; Vol. iv. 161:

An umbrageous tree; juvenile leaves large, orbicular; buds claviform; seed-cups urceolate-ovate, costate or ribbed, (12 x 8 mm.). Timber pale-brown. A useful shade and ornamental tree in dry localities; cultivated for its timber in Victoria. S.A., V. (See Group ii. 12.)

E. clavigera: A. Cunningham. C.R. Pt. xxxvii 179; Vol. iv. 179.

An erect tree, 20-35 feet; bark grey, flaky at base, smooth above. Leaves large, rough or scabrous; buds small, clavate; seed-cups cylindrical to urceolate or urn-shaped, medium, (12 x 9 mm.). A Bloodwood. Timber dark-brown, durable. W.A., N.T., Q.

E. Clelandi: Maiden. C.R. Pt. xvi. 189; Vol. ii. 189.

A medium-sized tree, bark hard, flaky, and blackish at butt; branchlets and leaves glaucous; buds clavate, ribbed; seed-cups small, smooth, sub-cylindrical, (6 x 5 mm.). Timber cigar-brown. Dry interior. W.A.

E. Cliftoniana: W. V. Fitzgerald. C.R. Pt. xxxviii. 209; Vol. iv. 209.

A Bloodwood, 30-40 feet high; bark rough, persistent; leaves narrow; seed-cups large, globular, (15 x 20 mm.). Rare. W.A.

E. Cloeziana: F. von Mueller. C.R. Pt. xiv. 156; Vol. ii. 156.

A medium-sized tree; bark dark, flaky-fibrous throughout; juvenile leaves oval; adult leaves narrow-lanceolate; inflorescence in large, terminal panicles or clusters; seed-cups medium, depressed, globular, (9 x 10 mm.). Timber pale, inferior. Dry parts of Q.

E. cneorifolia: De Candolle. C.R. Pt. xiii. 127; Vol. ii. 127.

A Mallee, confined to Kangaroo Island, South Australia, where it forms an impenetrable scrub. Buds and seed-cups small, sessile. Yields a valuable oil.

E. coccifera: Hooker, f. (The f—Lat. *filius*—is to distinguish the younger Hooker from his father.) C.R. Pt. v. 142; Vol. i. 142.

A small tree, 12-20 feet high, with a smooth, white bark. An alpine species, confined to Tasmania; juvenile leaves ovate to elliptical; adult leaves lanceolate, short, rigid; buds clavate; seed-cups very broad at top, narrow at base, (7-13 x 6-10 mm.). (See Group vi. 65).

E. collina: W. V. Fitzgerald. C.R. Pt. lviii. 419; Vol. vi. 419.

A Bloodwood, 40-60 feet high, with smooth mottled bark; juvenile leaves broad, hairy or setose; adult leaves narrow-lanceolate; buds large, clavate; seed-cups oblong to urn-shaped, very large, (38 x 22 mm.). Timber dark brown, hard and tough. N.W., W.A.

E. Cometae-Vallis: Maiden. C.R. Pt. lviii. 431; Vol. vi. 431.

A tall shrub or small tree, with thick, yellowish-green, narrow leaves; seed-cups cylindrical to bell-shaped, small, (9 x 7 mm.). Dry parts of W.A.

E. CONCOLOR TO E. CORYMBOSA.

E. concolor: Schauer. C.R. Pt. xiv. 153; Vol. ii. 153; Pt. xlii. 66; Vol. v. 66.

A small erect shrub or tree, often forming dense thickets on limestone formation; leaves thick, falcate-lanceolate; buds numerous, rostrate or beaked; seed-cups small, oval to globular (5-7 x 6-8 mm.). W.A.

E. confluens: (W. V. Fitzgerald) Maiden. C.R. Pt. xxxvi. 174; Vol. iv. 174.

A small tree, up to 30 feet high, with a diameter up to 1 foot; bark persistent, white and smooth; leaves narrow; seed-cups very small, (5 x 6 mm.). Timber reddish-brown, hard and tough. W.A.

E. conglobata: (R. Brown) Maiden. C.R. Pt. lvi. 273; Vol. vi. 273.

A dwarf spreading Mallee; juvenile leaves broad, slightly glaucous; buds and seed-cups small, closely sessile, (5-8 mm.). Sea-coast, S.A., W.A.

E. conglomerata: Maiden & Blakely. C.R. Pt. lxxi. ; Vol. viii. ; Plate 288.

A small Stringybark; bark rough, slightly furrowed, juvenile leaves narrow-lanceolate, slightly hairy; adult leaves narrow to broad lanceolate; buds numerous, congested in dense heads, slender, acute; seed-cups urceolate to globose, closely sessile in a small ball-like mass. Timber white. N.S.W., Q.

E. conica: Deane & Maiden. C.R. Pt. xlii. 64; Vol. v. 64.

A tree 40-60 feet high, with a fuzzy bark on trunk and branches; juvenile leaves broadly ovate to elliptical; adult leaves narrow-lanceolate; inflorescence paniculate; buds small, clavate; seed-cups narrow, funnel-shaped, (7 x 5 mm. or smaller). Timber brown, or reddish-brown, hard, tough, and durable. N.S.W., Q.

E. Consideniana: Maiden. C.R. Pt. x. 312; Vol. i. 312.

A medium-sized tree with grey tough sub-fibrous bark, leaves heavy, thick, falcate-lanceolate, more or less glaucous; buds clavate, pointed; seed-cups pear-shaped, medium, (9-10 x 7-8 mm.). Timber pale, soft, inferior to **E. Sieberiana,** to which it is closely allied. Mountain ranges, V., N.S.W.

E. Cooperiana: F. von Mueller. C.R. Pt. xxxvi. 166; Vol. iv. 166.

An imperfectly known species as regards habit and bark. It is closely allied to **E. cladocalyx** in the shape of the buds; leaves broadish; buds clavate, numerous. Rare. W.A.

E. cordata: Labillardière. C.R. Pt. xix. 282; Vol. ii. 282.

A small to large tree with glaucous foliage; bark smooth; timber light yellow in colour; juvenile and adult leaves somewhat similar, broad, glaucous, sessile; seed-cups in threes, medium, (12 x 11 mm. or smaller). T. (See Group vi. 66.)

x E. Cordieri: Trabut. C.R. Pt. lii. 76; Vol. vi. 76.

A hybrid, reputed parents **E. globulus** and **E. goniocalyx.** A tree similar to **E. globulus;** juvenile leaves rounded, cordate, sessile, glaucous; adult leaves narrow-lanceolate; buds and seed-cups somewhat angular, smaller than those of **E. globulus.** France.

E. coriacea: A. Cunningham. C.R. Pt. v. 133; Vol. i. 133.

A small tree, often growing in dense colonies and at an elevation of 5,000 to 6,500 feet; juvenile leaves very broad; adult leaves thick, coriaceous, very acutely veined; buds clavate; seed-cups medium, pear-shaped to sub-globose. T., S.A., V., N.S.W. (See Group v. 58.)

E. cornuta: Labillardière. C.R. Pt. xxxiv. 103; Vol. iv. 103.

A medium-sized tree, sometimes forming Marlock thickets, with rough, dark, fibrous, persistent bark on trunk; juvenile leaves ovate to orbicular; adult leaves narrow-lanceolate; buds horn-shaped; seed-cups medium, short-stalked, (10 x 8 mm.). An ornamental species, often with greenish flowers. Timber the strongest of all the W. Australian species. (See Group i. 3.)

E. corrugata: Luehmann. C.R. Pt. xvi. 198; Vol. ii. 198.

A tree attaining about 30 feet in height, with a smooth, ashy-grey bark; leaves glaucous; buds shortly clavate, corrugated; seed-cups hemispherical, corrugated, (10 x 12 mm.). W.A.

E. corymbosa: Smith. C.R. Pt. xxxix. 242; Vol. iv. 242.

One of the Bloodwoods. A medium-sized to large tree; bark rough, scaly, persistent; juvenile leaves broadly oval, slightly bristly; adult leaves lanceolate; venation very fine; inflorescence a large compound terminal cluster or corymb; buds large, with smooth dome-like lids; seed-cups large, urn-shaped, (12-20 x 10-18 mm.). Timber reddish, durable under ground. Coast districts of V., N.S.W., Q. (See Group i. 4.)

E. cosmophylla: F. von Mueller. C.R. Pt. xxi. 16; Vol. iii. 16.

A smooth barked tree of medium size; the bark usually falling off in irregular patches; juvenile leaves broad; adult leaves lanceolate-falcate, to broad lanceolate; seed-cups bell-shaped, large, (10-15 x 12-20 mm.). Timber red, unimportant. S.A.

E. crebra: F. von Mueller. C.R. Pt. xii. 63; Vol. ii.. 63.

A tall tree with drooping branches. Bark very deeply furrowed, hard and persistent; juvenile leaves very narrow, slightly glaucous; seed-cups very small, (5-6 x 4-5 mm.). Timber red, hard and interlocked. One of the best; prefers a heavy soil. Q., N.S.W. (See Group ii. 13.)

E. crucis: Maiden. C.R. Pt. lix. 514; Vol. vi. 514; Pt. lxix. 403; Vol. vii. 403.

A slender glaucous, small tree or sometimes forming Mallee-like clump. Bark deciduous in thin flakes, leaving the stem smooth; juvenile leaves glaucous, cordate to elliptical, remaining in the opposite stage for two or three years or more; seed-cups basin-shaped with convex rim, valves prominent, medium, (10 x 12 mm.). Sand plains, W.A.

E. Culleni: R. H. Cambage. C.R. Pt. xlviii. 233; Vol. v. 233.

A medium-sized tree, with a hard deeply furrowed bark (a typical Ironbark). Leaves narrow-lanceolate; seed-cups small, rounded-clavate, pedicels long. Timber red, hard and durable. N.Q.

E. cylindriflora: Maiden & Blakely. C.R. Pt. lxix. 411; Vol. vii. 411.

A white Mallee; near **E. erythronema.** Juvenile leaves spathulate; adult leaves narrow-lanceolate; buds cylindrical, 1.5 cm. long; filaments or stamens yellowish; seed-cups tube-like, 1 cm. long. On loam flats. W.A.

E. Dalrympleana: Maiden. C.R. Pt. xlix. 268; Vol. v. 268.

A massive White Gum, with blotched, more or less short, scaly bark on trunk; juvenile leaves sessile, broad, ovate to orbicular; adult leaves long, lanceolate, undulate; buds in threes, somewhat similar to those of **E. viminalis.** Seed-cups small, with protruding valves, (7 x 8 mm.). Timber pale, light, durable. Mountain Ranges, V., N.S.W., T. (See Group v. 59.)

E. Dawsoni: R. T. Baker. C.R. Pt. xlii. 56; Vol. v. 56.

A medium-sized tree with moderately smooth bark which falls away in thin lenticular flakes; seed-cups cone-shaped, very small, (6 x 5 mm.); somewhat similar to **E. polyanthemos** in all botanical characters. Rare. N.S.W.

E. dealbata: A. Cunningham. C.R. Pt. xxxii. 47; Vol. iv. 47.

A somewhat scraggy, small tree with rough bark on trunk, smooth on branches or falling away in small flakes or short ribbons; leaves glaucous; seed-cups glaucous, hemispherical, very small, valves prominent, (5 x 6 mm.). Timber red, brittle. N.S.W., Q.

E. Deanei: Maiden. C.R. Pt. xxiv. 63; Vol. iii. 63.

A large forest tree up to 200 feet; bark usually smooth except on lower part of trunk. It is closely allied to **E. saligna,** but may be distinguished from it by the orbicular juvenile leaves; seed-cups very small, bell-shaped, (5 x 5 mm.). Timber red, durable. Mountain ranges, N.S.W., Q. (See Group ii. 14.)

E. de Beuzevillei: Maiden. C.R. Pt. xlvii. 190; Vol. v. 190.

A large White Gum; bark smooth or somewhat flaky at butt; juvenile leaves glaucous, large, orbicular to cordate; adult leaves lanceolate; buds compressed-angular, sessile; seed-cups medium, angular, sub-globose, (10 x 12 mm.). Timber pale. An alpine species, growing at an elevation of 5,400 feet. N.S.W.

E. decipiens: Endlicher. C.R. Pt. xiv. 149; Vol. ii. 149; Pt. xlvi. 182; Vol. v. 182.

A small spreading tree, 30-50 feet high, with Box-like, persistent bark; juvenile leaves orbicular, emarginate; adult leaves narrow-lanceolate; buds sessile, rostrate; seed-cups sessile, globular, valves protruding, (5 x 9 mm.). Timber red, soft. Limestone formation, near Fremantle, W.A.

E. DECORTICANS TO E. DRUMMONDII.

E. decorticans: Maiden. C.R. Pt. xlviii. 231; Vol. v. 231.

Bark on butt very hard, with broad flat ridges, deciduous from branches. Leaves narrow-lanceolate; buds in terminal umbels, conical; seed-cups oval to pear-shaped, (7-9 mm. long.). Timber red, inferior. Q.

E. decurva: F. von. Mueller. C.R. Pt. xvi. 191; Vol. ii. 191.

A spindly, glaucous Mallee of 10-15 feet; juvenile leaves sessile, broad; seed-cups club-shaped to oval, on long pedicels, nodding or deflexed, medium, (10 x 9 mm.). Dry parts of W.A.

E. Desmondensis: Maiden & Blakely. C.R. Pt. lxix. 425; Vol. vii. 425.

A slender, glaucous, drooping shrub, 10-15 feet high; leaves thick, glaucous; buds sessile, cylindrical; calyx-tube funnel-shaped; ripe seed-cups not received. Southern W.A.

E. dichromophloia: F. von Mueller. C.R. Pt. xl. 313; Vol. iv. 313; Pt. xlix. 270; Vol. v. 270.

A medium-sized tree; bark scaly, pale red, or reddish-brown; juvenile leaves elliptical, bristly; adult leaves narrow-lanceolate, finely veined; buds small; seed-cups urn-shaped, large (14-18 x 12-15 mm.). Timber reddish, durable under ground. Q., N.T., W.A.

E. Dielsii: Gardner. C.R. Pt. lxxi. ; Vol. viii. .

A small Mallee, with narrow glossy leaves, cylindrical buds about ½ inch long, and sub-globose seed-cups on long deflexed pedicels; an ornamental species. W.A.

E. diptera: Andrews. C.R. Pt. xvi. 206; Vol. ii. 206; Pt. lxix. 419; Vol. vii. 419.

A slender tree, 10-20 feet high. Leaves narrow lanceolate, green; buds compressed, two-winged; seed-cups two-winged, sessile, small. Rare. South coast of W.A.

E. diversicolor: F. von Mueller. C.R. Pt. xx. 298; Vol. ii. 298.

A very large tree; bark smooth except at butt; juvenile leaves stalked, short, broad; adult leaves lanceolate; buds clavate or club-shaped; seed-cups pyriform, medium, (10 x 12 mm.). Timber red, heavy, dense, tough, durable. W.A. (See Group ii. 15).

E. diversifolia: Bonpland. C.R. Pt. vii. 197; Vol. i. 197.

A small Mallee-like shrub or small tree, with smooth bark; leaves oblong or lanceolate; buds rather large; seed-cups large, nearly globular, rather thick, (10-15 x 10-12 mm.). V., S.A., W.A.

E. dives: Schauer. C.R. Pt. vii. 190; Vol. i. 190.

A medium-sized spreading tree, with short bole, and Peppermint bark on trunk. Juvenile leaves glaucous, sessile, ovate to broadly elliptical, very aromatic; buds numerous, small; seed-cups small, (6-8 x 5-7 mm.). Timber pale, inferior. Cold parts of V., N.S.W. Usually on very poor soil.

E. Dixsoni: Wakefield. C.R. Pt. lxxi. ; Vol. viii. . Plate 291.

Usually a small tree, rarely exceeding 50 feet in height; bark persistent, fibrous, of the Peppermint type; juvenile leaves opposite, sessile, ovate, pale green to glaucous; adult leaves lanceolate-falcate, buds slender, clavate; lid obtuse; seed-cups goblet-shaped, (7-6 mm.). Timber unknown, probably of third-class quality. N.S.W.

E. Dongarraensis: Maiden & Blakely. C.R. Pt. lxviii. 371; Vol. vii. 371.

A slender White Gum, 20-25 feet high. Juvenile leaves broad, glaucous; adult leaves thick, broad-lanceolate; buds glaucous, clavate, 11 mm. long; seed-cups pyriform, 10 mm. long. W.A.

E. doratoxylon: F. von Mueller. C.R. Pt. xvi. 195; Vol. ii. 195.

A shrub or small tree, with narrow opposite dark green leaves; buds cylindrical rostrate or beaked; seed-cups clavate (6 x 5 mm.). Wood pale, used for spears. Rare. W.A.

E. drepanophylla: F. von Mueller. C.R. Pt. xlix. 261; Vol. v. 261.

A typical Ironbark, somewhat similar to **E. siderophloia** in size, habit, and bark. Leaves long, lanceolate; buds with conical lids; seed-cups somewhat pear-shaped, small, (5-6 x 4-6 mm.). Timber red. Q.

E. Drummondii: Bentham. C.R. Pt. xvii. 223; Vol. ii. 223; Pt. xli. 22; Vol. v. 22.

A small tree, with smooth white bark; leaves from ovate to oblong; buds clavate, rather large; seed-cups medium globular, valves protruding, (9 x 9 mm.). W.A.

E. DUMOSA TO E. EXIMIA.

E. dumosa: A. Cunningham. C.R. Pt. xxxviii. 220; Vol. iv. 220.

A large shrub or small tree, 20-40 feet high; leaves thick, slightly glaucous, narrow to broad lanceolate; buds small, lid streaked; seed-cups small to medium, (7-10 x 5-7 mm.). Timber brown, hard, durable. The roots of this species have been found in artesian water at a depth of 60 feet. V., S.A., N.S.W., W.A.

E. Dundasi: Maiden. C.R. Pt. xxxiii. 82; Vol. iv. 82; Pt. lxix. 417; Vol. vii. 417.

A small tree; bark rough at base; leaves narrow-lanceolate; buds cylindroid, lid pointed; seed-cups cylindrical to bell-shaped, small. Rare. Dundas, W.A.

E. Dunnii: Maiden. C.R. Pt. xxiv. 65; Vol. iii. 65.

An erect species, attaining a very great size. A White Gum with more or less fibrous-flaky bark at butt. Resembling **E. saligna** in habit a good deal. Juvenile leaves broad; adult leaves long; seed-cups very small, (5 x 6 mm.). Timber pale, fissile, durable. Northern parts of Dividing Range, N.S.W., Q.

E. Dwyeri: Maiden & Blakely. C.R. Pt. lxviii. 363; Vol. vii. 363.

A smooth barked Mallee or small tree; juvenile leaves narrow-lanceolate; adult leaves moderately thick, narrow-lanceolate; buds shining, lid conical; seed-cups urn-shaped to bell-shaped, up to 9 mm. in diameter. Timber red. Moderately dry areas, N.S.W.

E. Ebbanoensis: Maiden. C.R. Pt. xlvi. 169; Vol. v. 169.

A small tree, about 30 feet high, with a diameter of 9 inches or more; bark smooth; leaves narrow-lanceolate; seed-cups in threes, bell-shaped, medium, (10 x 10 mm.). W.A.

E. elaeophora: F. von Mueller. C.R. Pt. xix. 275; Vol. ii. 275.

A medium to large tree, with Box bark, rough, persistent on trunk and branches; juvenile leaves large, glaucous, sessile; buds oval, blunt-pointed; seed-cups sessile, medium, (5-10 x 6-10 mm.). Timber pale, inferior. N.S.W., V.

E. eremophila: Maiden. C.R. Pt. xliv. 128; Vol. v. 128; Pt. lxi. 22; Vol. vii. 22.

A shrub or medium-sized tree, with smooth, scaly bark; leaves narrow-lanceolate; buds with horn-shaped lids, 10 mm. long; seed-cups cylindrical to nearly round, flat-topped, medium, (9-10 x 7-11 mm.). Dry sand plains, W.A.

E. erythrocorys: F. von Mueller. C.R. Pt. xlv. 133; Vol. v. 133.

A medium-sized tree, with a smooth, partly flaky bark; dark green, pendulous, mostly opposite leaves; buds large, fleshy, ribbed; flowers large, handsome, greenish; seed-cups ribbed, domed, very large, (4-6 cm. in diameter). Suitable for tropical gardens. N.W.W.A.

E. erythronema: Turczaninow. C.R. Pt. xxii. 23; Vol. iii. 23.

A Mallee or small crooked tree, 20-30 feet high, with a very light grey, smooth bark; leaves narrow; buds large, conical; filaments scarlet; seed-cups on long pedicels, medium. An ornamental species; dry regions, W.A.

E. eudesmioides: F. von Mueller. C.R. Pt. xlvi. 165; Vol. v. 165.

A small Mallee or medium-sized tree, with a smooth white bark; leaves small, lanceolate, opposite; seed-cups in threes, urn-shaped to bell-shaped, (14 x 10 mm.). W.A., S.A., N.T.

E. eugenioides: Sieber. C.R. Pt. viii. 232; Vol. i. 232.

A medium-sized Stringybark; juvenile leaves very hispid or rough, with margins undulate; buds small, somewhat stellate; seed-cups small, globose, truncate or flat-topped, with valves usually protruding, (5 x 7 mm. or larger). Timber brown to reddish-brown, durable. V., N.S.W., Q. (See Group iii. 28.)

E. Ewartiana: Maiden. C.R. Pt. xliv. 120; Vol. v. 120.

A Mallee, with slender stems 10-15 feet high, and 2-3 inches in diameter; juvenile leaves broad; adult leaves narrow; buds with blunt lids; seed-cups medium, thick, valves protruding and strong (10 x 12 mm.). Dry regions, W.A.

E. eximia: Schauer. C.R. Pt. xlii. 27; Vol. v. 27.

A medium-sized tree, with yellow, rough-flaky, persistent bark; juvenile leaves large, peltate; adult leaves thick, falcate, lanceolate; flowers in large terminal panicles; buds large, club-shaped; seed-cups large, sessile, urn-shaped, (13-16 x 14-15 mm.). Timber pale, hard, durable. Sandstone ridges, N.S.W.

E. EXSERTA TO E. FRAXINOIDES.

E. exserta: F. von Mueller. C.R. Pt. xxxii. 33; Vol. iv. 33.

A medium-sized tree, with rough bark of a Peppermint nature; leaves narrow-lanceolate; buds with conical lids; seed-cups top-shaped, medium, thick, rim and valves very prominent, (5-10 x 6-9 mm.). Timber brownish, soft. N.Q.

E. falcata: Turczaninow. C.R. Pt. xv. 179; Vol. ii. 179; Pt. lxi. 17; Vol. vii. 17.

A drooping Mallee, with very slender stems; leaves glaucous; buds with long rostrate lids; seed-cups roundish, valves prominent and slender, (9 x 10 mm.). Limestone Hills, near Fremantle, W.A.

E. fasciculosa: F. von Mueller. C.R. Pt. xiv. 140; Vol. ii. 140.

A White Gum of medium size; bark somewhat flaky at butt; juvenile leaves broad, ovate; buds clavate; seed-cups clavate to pyriform, (7 x 5 mm.). Timber red or reddish-brown. Dry interior, S.A.

E. fastigata: Deane & Maiden. C.R. Pt. vii. 185; Vol. i. 185; Pt. lxi. 1; Vol. vii. 1.

A tall shaft-like tree, 80 to over 200 feet high, with a diameter of 6-8 feet; bark stringy up to large branches; juvenile leaves ovate-lanceolate, slightly hispid or rough; adult leaves falcate-lanceolate, strongly veined; umbels usually in pairs; buds low-pointed; seed-cups pear-shaped, domed, valves protruding, (10 x 9 mm. or less). Timber pale, fissile. Mountain ranges, N.S.W., V. (See Group iv. 47.)

E. ferruginea: Schauer. C.R. Pt. xxxviii. 214; Vol. iv. 214.

A medium-sized scrubby Bloodwood; bark rough, ash-coloured, persistent on lower part of trunk. Leaves large, sessile, hispid; inflorescence terminal as in all the Bloodwoods; buds thick, club-shaped; seed-cups large, urn-shaped, (24 x 18 mm.). W.A., N.T.

E. ficifolia: F. von Mueller. C.R. Pt. xliii. 71; Vol. v. 71.

A small tree, with rough, persistent bark; juvenile leaves broad, lanceolate, sometimes peltate; adult leaves medium to broad lanceolate, finely veined; inflorescence terminal; buds large, with smooth, dome-like lids; filaments flame-red; seed-cups very large, urn-shaped, (35 x 30 mm.). A decorative species of which there are numerous garden varieties. W.A. (See Group ii. 16.)

E. Flocktoniae: Maiden. C.R. Pt. xxxix. 281; Vol. iv. 281; Pt. lviii. 421; Vol. vi. 421; Pt. lix. 515; Vol. vi. 515.

An erect, many-stemmed or Mallee-like shrub or small tree, up to 40 feet high; bark almost smooth; stripped for tanning purposes; juvenile leaves opposite, decurrent, broadly lanceolate; adult leaves lanceolate; buds with raised ridges; seed-cups medium, urn-shaped, costate or ribbed. (10 x 9 mm.). Timber red, dense, durable. W.A., S.A.

E. foecunda: Schauer. C.R. Pt. iv. 112; Vol. i. 112.

A medium-sized tree, or sometimes Mallee-like in habit; bark rough on trunk; leaves narrow oblong to lanceolate; buds small, clavate; seed-cups small, clavate to campanulate or bell-shaped, (7-10 x 5-8 mm.). On limestone hills, W.A.

E. Foelschiana: F. von Mueller. C.R. Pt. xli. 4; Vol. v. 4.

A dwarf tree, sometimes of shrubby growth; bark hard, scaly, deciduous; leaves ovate to orbicular, sometimes very large; seed-cups large, urn-shaped, (20-30 x 18-25 mm.). N.T.

E. Forrestiana: Diels. C.R. Pt. xxii. 35; Vol. iii. 35; Pt. lxix. 429; Vol. vii. 429.

A very slender Mallee, 5-10 feet high; leaves broadish; buds and seed-cups large, quadrangular, (cups 30 x 35 mm.). W.A.

x E. Forsythii: Maiden. C.R. Pt. liii. 115; Vol. vi. 115.

A supposed natural hybrid. Ironbark, closely allied to **E. melliodora** and **E. crebra.** Seed-cups goblet-shaped (7 x 7 mm.). Rare. N.S.W.

E. fraxinoides: Deane & Maiden. C.R. Pt. xxxix. 298; Vol. iv. 298.

A tall, straight, smooth-barked tree, somewhat resembling **E. maculata,** as regards the nature of the bark; leaves lanceolate; buds ovoid; seed-cups medium, globular to urn-shaped, (10-12 x 12-10 mm.). Timber pale, fissile, inflammable when green. Southern mountain ranges, N.S.W.

E. FRUTICETORUM TO E. GONIOCALYX.

E. fruticetorum: F. von Mueller. C.R. Pt. xi. 40; Vol. ii. 40.

A glaucous Mallee, with quadrangular branchlets and willowy, light-coloured stems; juvenile leaves broad; adult leaves narrow; buds small, sessile; seed-cups ovate, short-stalked, very small, (4 x 5 mm.). Dry parts of S.A., V., N.S.W. The species yields a valuable oil.

E. gamophylla: F. von Mueller. C.R. Pt. xxxv. 128; Vol. iv. 128.

A very glaucous shrub or small tree, with opposite perfoliate connate leaves; buds clavate; seed-cups pear-shaped to bell-shaped, small to medium. Dry parts of S.A., N.T., W.A.

E. Gardneri: Maiden. C.R. Pt. lxii 53; Vol. vii. 53.

A slender tree 20-30 feet high, foliage throughout of a bluish cast; juvenile leaves ovate; adult leaves narrow-lanceolate; buds elongated, 2 cm. long, tapering to a sharp point; seed-cups pear-shaped, 12 mm. long by 6 mm. in diameter. Timber light-coloured, dense. W.A.

E. gigantea: Hooker, f. C.R. Pt. xx. 291; Vol. ii. 291.

A tall tree, with a straight tapering trunk; bark on lower half thick and woolly, like a Stringybark; juvenile leaves very broad; adult leaves medium to broad lanceolate; buds medium, clavate; seed-cups medium, pyriform, (12-10 mm.). Timber pale, fissile. Cold mountain ranges of N.S.W., V., T. (See Group v. 60.)

E. Gilleni: Ewart & Kerr. C.R. Pt. lxxi. ; Vol. viii. .

A low densely branched shrub, 6-8 feet high; leaves broadish; seed-cups in threes, (5 x 6 mm.). Mt. Gillen, N.T.

E. Gillii: Maiden. C.R. Pt. xv. 177; Vol. ii. 177.

A glaucous Mallee attaining a height of 20 feet, the stems and branches rather crooked; leaves glaucous, usually sessile, cordate to elliptical; buds ovoid, rostrate or beaked; seed-cups club-shaped to nearly round, (5-8 x 5-8 mm.). Dry interior of N.S.W.

E. glaucescens: Maiden & Blakely. C.R. Pt. lxxi. ; Vol. viii. .

A glaucous Mallee or small tree; live bark smooth, whitish; dead bark short-flaky; juvenile leaves sessile, ovate to orbicular; adult leaves glaucous, lanceolate, thick, leathery; buds in threes, sessile; seed-cups barrel-shaped, sessile, (9 x 8 mm.). Alpine regions, N.S.W., V.

E. globulus: Labillardière. C.R. Pt. xviii. 249; Vol. ii. 249; Pt. xlviii. 240; Vol. v. 240; Pt. lxxi. ; Vol. viii. .

In strict propriety, only those eucalypts that shed their dead bark are "Gums," and only those "Gums" whose juvenile foliage and young stems are glaucous or blue-green in colour are "Blue-gums." **E. globulus** is a "blue-gum" and the best-known member of its group. Bark irregularly deciduous; juvenile leaves large, coarse, sessile; adult leaves stalked, long, deep-green; buds warty with low cap-like lids; seed-cups solitary, sessile, rough, often with very full disc or rim (10-15 x 15-25-30 mm.). Timber pale interlocked, hard, of first quality for technical work. T., V. (See Group iv. 48.)

E. gomphocephala: A. P. de Candolle. C.R. Pt. xxi. 19; Vol. iii. 19.

A medium-sized tree, with a sub-fibrous matted bark on trunk, branches smooth, ribbony; juvenile leaves broadish lanceolate; buds with round large heads; seed-cups bell-shaped, large, (13-20 x 11-15 mm.). Timber pale, yellowish, hard and durable. W.A. (See Group i. 5.)

x E. gomphocornuta: Trabut. C.R. Pt. lii. 76; Vol. vi. 76.

A hybrid; reputed parents, **E. gomphocephala** and **E. cornuta.** A pyramidal-shaped tree with dark-green foliage, and persistent, finely fissured bark; buds large, cylindro-conic; seed-cups large, cylindrical to campanulate or bell-shaped. France.

E. goniantha: Turczaninow. C.R. Pt. xvi. 200; Vol. ii. 200. Pt. iv. 103; Vol. i. 103.

A small shrub or small tree, with glaucous, almost closely sessile cordate leaves; buds very angular or corrugated. Rare. W.A.

E. goniocalyx: F. von Mueller. C.R. Pt. xix. 267; Vol. ii. 267.

A tall tree, bark smoothish, but with ribbons and more or less roughish and even flaky at butt; juvenile leaves sessile, broad, glaucous; buds medium, more or less angular; seed-cups small to medium, slightly angular, (6-10 x 5-6 mm.). Timber pale, fissile. V., N.S.W. (See Group iv. 49.)

E. GRACILIS TO E. HILLII.

E. gracilis: F. von Mueller. C.R. Pt. xxxix. 262; Vol. iv. 262.

Tree, up to 60 feet high. It grows in clumps, but not Mallee-like. Often it is dwarf and crooked, and with hard, dark-coloured bark on the short trunk as on a Mallee of this size; leaves narrow, shining; seed-cups very small. (5-6 x 3-4 mm.). Timber cigar-brown. S.A., V., N.S.W., W.A.

E. grandifolia: R. Brown. C.R. Pt. xxxvii. 187; Vol. iv. 187.

A medium-sized tree; bark rough at base, only; juvenile leaves large and broad; adult leaves narrow to broad, lanceolate, 6-12 inches long; seed-cups on very long pedicels, urn-shaped, (13-20 x 9-15 mm.). Timber inferior, except for fuel. W.A., N.T., Q.

E. grandis: (Hill) Maiden. C.R. Pt. xxiii. 58; Vol. iii. 58; Pt. xl. 338; Vol. iv. 338.

A tall, straight tree, 50-140 feet high, with smooth, glaucous bark; leaves broad, lanceolate, finely veined; buds glaucous, blunt-pointed; seed-cups glaucous, 4-6 celled, small, (7-6 x 6-5 mm.). Timber red, in high repute for strength, lightness and durability. North coast districts of N.S.W. and S.Q. (See Group ii. 17).

E. Griffithsii: Maiden. C.R. Pt. xvi. 208; Vol. ii. 208.

A White Gum, up to 60 feet high and 2ft. 6in. in diameter. Bark somewhat ribbony, box-scaly at butt; leaves narrow, lanceolate; buds flat-topped, corrugated, or winged; seed-cups medium, campanulate, corrugated, (13 x 10 mm.). Kalgoorlie, W.A.

E. grossa: F. von Mueller. C.R. Pt. xvi. 210; Vol. ii. 210.

A straggling or spreading Mallee-like shrub 3-9 feet high; leaves broad, lanceolate, thick; buds cylindrical, ovoid, smooth; seed-cups large, bell-shaped, (20 x 10 mm.). Rare. W.A.

E. Guilfoylei: Maiden. C.R. Pt. xx. 301; Vol. ii. 301.

A tall tree, with fibrous or stringy bark on stem; juvenile leaves large; buds oblong to oval, with blunt lids; seed-cups medium, pear-shaped, (11 x 10 mm.). Timber yellowish, fissile, durable. W.A.

E. Gunnii: Hooker, f. C.R. Pt. xxvi. 106; Vol. iii. 106; Pt. lix. 500; Vol. vi. 500.

A shrub to large tree; bark deciduous in patches; juvenile leaves glaucous, smallish, ovate to broadly elliptical; adult leaves narrow-lanceolate; seed-cups in threes, glaucous, small, (8 x 7 mm. or larger). An alpine species. T. (See Group vi. 67.)

E. haemastoma: Smith. C.R. Pt. x. 317; Vol. i. 317; Pt. lix. 505; Vol. vi. 505.

A small to medium-sized tree, with smooth blotched bark; leaves thick, rather large; seed-cups small to medium, pear-shaped, (8-9 x 9-10 mm.). Timber reddish, brittle. Sandstone formation, N.S.W., Q. (See Group iii. 29.)

E. haematoxylon: Maiden. C.R. Pt. xliii. 82; Vol. v. 82.

A small tree, somewhat similar to **E. calophylla** in general appearance and also in its botanical characters, but with smaller seed-cups, (22 x 20 mm.). Timber red, soft. W.A.

E. hemiphloia: F. von Mueller. C.R. Pt. xi. 14; Vol. ii. 14. Pt. lviii. 435; Vol. vi. 435.

Erect in habit, the trunk with a grey, sub-fibrous, compact Box bark, branches smooth, or with short ribbons; juvenile leaves broad, green; buds slightly angular; seed-cups cylindrical-pyriform, small, (8 x 5 mm.). Timber pale, very hard and durable. N.S.W., Q. (See Group iii. 30.)

E. Herbertiana: Maiden. C.R. Pt. lviii. 429; Vol. vi. 429.

A Mallee-like species, 15-20 feet high; adult leaves long, narrow-lanceolate; buds small, sessile; seed-cups very small, valves prominent, (6 x 6 mm.). W.A.

E. Hillii: Maiden. C.R. Pt. xlix. 271; Vol. v. 271.

A medium-sized tree with a soft, scaly bark and smooth branches; juvenile leaves very broad; adult leaves long-stalked, broadly-lanceolate; buds large, club-shaped; ripe seed-cups not seen. Bathurst Island, N.A.

E. HOUSEANA TO E. JUGALIS.

E. Houseana: (W. V. Fitzgerald) Maiden. C.R. Pt. l. 291; Vol. v. 291.

Tree up to 70 feet high; bark persistent, white to greyish-white; juvenile leaves sessile, broad; buds ovoid, small, sessile; seed-cups very small, goblet-shaped, (5 x 6 mm.). Timber reddish. One of the largest species in tropical W.A.

E. Howittiana: F. von Mueller. C.R. Pt. xxxii. 59; Vol. iv. 59.

A tree, attaining a height of 100 feet, bark rough, Box-like to sub-fibrous; leaves narrowish; inflorescence paniculate; seed-cups extremely small, (4 x 4 mm.). Timber pale, fissile. N.Q.

x **E. hybrida:** Maiden. C.R. Pt. xlii. 48; Vol. v. 48.

A supposed natural hybrid. Ironbark Box. An erect tree, bark hard, corrugated. Seed-cups bell-shaped, small, (9 x 6 mm.). Timber hard, interlocked. Rare. Port Jackson district, N.S.W.

E. incrassata: Labillardière. C.R. Pt. vi. 93; Vol. i. 93.

A medium-sized Mallee, with more or less clean stems; juvenile leaves broad; adult leaves lanceolate, falcate; buds cylindrical; seed-cups barrel-shaped, medium (12 x 9 mm.). W.A.

x **E. Insizwaensis:** Maiden. C.R. Pt. lii. 82; Vol. vi. 82.

A South African hybrid; reputed parents **E. robusta** and (?). A medium-sized tree, with a smooth bark; juvenile leaves broadly lanceolate; adult leaves narrow to broad-lanceolate; buds in threes, sessile, glaucous, ribbed; seed-cups sessile, bell-shaped, ribbed, about ½in. in depth and width. Insizwa Plantation, Cape Province.

E. intermedia: R. T. Baker. C.R. Pt. xxxix. 252; Vol. iv. 252; Pt. lxii. 66; Vol. vii. 66.

A medium-sized Bloodwood; bark rough, scaly; inflorescence, buds, and seed-cups the same as in **E. corymbosa.** Timber pale pink, fissile. Rare. N.S.W., Q.

E. intertexta: R. T. Baker. C.R. Pt. xxxvi. 169; Vol. iv. 169.

A large tree, up to 80 feet and 3 feet in diameter, sometimes called White Gum. Bark blotched and usually rough for about 20 feet from the ground; upper part of trunk and branches smooth; leaves narrow to broad lanceolate; seed-cups small, ovoid, (8 x 6 mm.). Timber red, hard, durable. N.S.W., S.A., N.T., W.A., Q.

E. Irbyi: Baker & Smith. C.R. Pt. li. 15; Vol. vi. 15.

A small tree, with a smooth, pale or ashy-coloured bark; juvenile leaves sessile, broad, ovate; adult leaves narrow to broadly lanceolate; buds small, ovoid, acute; seed-cups small, hemispherical, valves slightly protruding, (7 x 8 mm.). Timber not known. Rare. T.

E. Isingiana: Maiden. C.R. Pt. lvii. 353; Vol. vi. 353.

A small shrubby Mallee 4-6 feet high; seed-cups large, long-stalked, bell-shaped to barrel-shaped, (18 x 15 mm.). S.A.

E. Jacksoni: Maiden. C.R. Pt. xliv. 126; Vol. v. 126.

A large tree, up to 200 feet high; bark fibrous, reddish; juvenile leaves broad, ovate; adult leaves lanceolate, finely veined; seed-cups spherical, medium, (9 x 10 mm.). Timber reddish. Southern districts of W.A. (See under **E. marginata**, Group i. 7.)

E. Jenseni: Maiden. C.R. Pt. lvi. 255; Vol. vi. 255.

A tree 30-40 feet high; bark rough on trunk and branches; leaves more or less glaucous; seed-cups very small, (5 x 5 mm.). Timber red. N.T.

E. Johnstoni: Maiden. C.R. Pt. lvi. 280; Vol. vi. 280; also Pt. xxviii. 160; Vol. iii. 160 (E. Muelleri).

A tall erect tree up to 200 feet high; bark smooth, blotched, brown, scaly at base; juvenile leaves thick, sessile, orbicular; adult leaves lanceolate; buds sessile, in threes, rounded slightly ribbed; seed-cups turbinate to hemispherical, valves protruding, medium (9 x 10 mm.). Timber light red, hard, heavy. T.

(See under **E. Muelleri,** Group vi. 68.)

x **E. jugalis:** Naudin. C.R. Pt. lii. 77; Vol. vi. 77.

A French hybrid; reputed parents **E. melanoxylon** and (?)

E. JUTSONI TO E. LATIFOLIA.

E. Jutsoni: Maiden. C.R. Pt. l. 295; Vol. v. 295.

A small, slender Mallee-like Gum, 6-8 feet high, with narrow, rigid leaves, and smallish buds tapering at both ends. W.A.

x **E. Kalangadooensis:** Maiden and Blakely. C.R. Pt. lxviii. 378; Vol. vii. 378.

A supposed natural hybrid. A tall tree; bark smooth or nearly so; juvenile leaves broadly lanceolate; adult leaves narrow to broad lanceolate; buds turbinate, (10-12 mm. long); seed-cups turbinate to semi-ovate, (10 mm. long). Timber pale. S.A.

E. Kalganensis: Maiden. C.R. Pt. lvii. 349; Vol. vi. 349.

A slender Mallee, 6-10 feet high, with thick, broadish leaves and large, showy, yellowish-green flowers; seed-cups basin-shaped (15 x 15 mm.). W.A.

E. Kesselli: Maiden & Blakely. C.R. Pt. lxix. 423; Vol. vii. 423.

A small Mallee. Leaves thick, broadish; buds rather large; filaments cream-coloured; seed-cups thick, turbinate, corrugated, (15-18 mm. long). Sand plains, W.A.

E. Kingsmilli: Maiden & Blakely. C.R. Pt. lxxi. ; Vol. viii. .

A shrub or small tree attaining a height of about 20 feet, with narrow leaves and moderately large crimson fluted buds and seed-cups. A showy variety, suitable for semi-tropical districts. W.A.

E. Kirtoniana: F. von Mueller. C.R. Pt. xxix. 200; Vol. iii. 200.

A medium-sized tree, with furrowed, fibrous bark somewhat resembling that of **E. resinifera.** Seed-cups bell-shaped with prominent valves, (10 x 11 mm.). Found associated with **E. botryoides,** along the coast from Port Jackson, N.S.W., to Fraser Island, Q. Very hardy under cultivation in India.

E. Kitsoniana: Maiden. C.R. Pt. xxviii. 164; Vol. iii. 164.

A dwarf tree; bark smooth, ashy-grey; juvenile leaves large, broadly ovate; adult leaves narrow to broad lanceolate; buds small, sessile; seed-cups small, sessile, basin-shaped (7 x 8 mm.). In wet land. V.

E. Kondininensis: Maiden & Blakely. C.R. Pt. lxix. 404; Vol. vii. 404.

A tree 40-60 feet; juvenile leaves slightly glaucous, oblong, obtuse; adult leaves narrow-lanceolate; seed-cups small, bell-shaped. Timber light to dark brown, dense, strong. W.A.

E. Kruseana: F. von Mueller. C.R. Pt. xlii. 51; Vol. v. 51.

A straggling, somewhat dense shrub, 4-8 feet high, with slender stems and small, glaucous, sessile leaves somewhat like those of **E. cordata;** seed-cups ovoid to pear-shaped (7 x 5 mm.). Dry parts of W.A.

E. Kybeanensis: Maiden & Cambage. C.R. Pt. xlvi. 178; Vol. v. 178.

A Mallee, 6-10 feet high, with smooth, greenish stems 1½ inches in diameter; leaves narrow; seed-cups small, globular to top-shaped, sessile (7 x 8 mm.). N.S.W., 4,000 feet above sea-level.

E. laevopinea: Baker. C.R. Pt. xl. 327; Vol. iv. 327.

A medium-sized Stringybark; leaves glaucous when young; seed-cups medium, globose, short-stalked, (10 x 11 mm.). Timber pale, fissile. N.S.W. (See Group iii. 31.)

E. Lane-Poolei: Maiden. C.R. Pt. xliv. 117; Vol. v. 117.

A White Gum, 40-50 feet high; juvenile leaves broad, lanceolate; adult leaves narrow-lanceolate; seed-cups medium, (10 x 10 mm.). Timber reddish-brown, hard, interlocked. W.A.

x **E. Langii:** Maiden & Blakely. C.R. Pt. lxxi. ; Vol. viii. .

A natural hybrid. A beautifully shaped tree, with slender pendent branchlets, long, narrow glossy leaves, and cylindroid-urceolate seed-cups. V.

E. Laseroni: Baker, C.R. Pt. xlvii. 187; Vol. v. 187.

A small Stringybark; leaves ovate to lanceolate, strongly veined; seed-cups hemispherical, (6 x 8 mm.). Rare. N.S.W.

E. latifolia: F. von Mueller. C.R. Pt. xli. 1; Vol. v. 1.

A smooth-barked Bloodwood, 30-40 feet high; leaves ovate to broadly lanceolate; flowers in large terminal panicles or clusters; seed-cups medium to large, oval to urn-shaped, (11-16 x 10-15 mm.). Timber pink, dense, rather hard. W.A., N.T.

E. Lehmanni: Preiss. C.R. Pt. xxxv. 111; Vol. iv. 111.

A small shrub or tree, up to 30 feet high, forming a Mallee-like growth; leaves small; buds with long horn-like lids; seed-cups fused into a large conglomerate mass, (5 x 8 cm. or larger). An ornamental species with green filaments. W.A. (See Group i. under **E. Cornuta** 3.)

E. leptophleba: F. von Mueller. C.R. Pt. x. 332; Vol. i. 332; Pt. xlix. 264; Vol. v. 264.

A large tree; bark rough, fissured, persistent; juvenile leaves coarse; adult leaves long, undulate; buds clavate, pointed; seed-cups small to medium, oval to bell-shaped, (9 x 8 mm.). Timber reddish-brown. N.Q.

E. leptophylla: F. von Mueller. C.R. Pt. lvi. 259; Vol. vi. 259.

A very slender, many-stemmed Mallee; juvenile and adult leaves narrow, dark green, lanceolate; seed-cups club-shaped, very small (5 x 5 mm.). A species adapted to regions with low rainfall. N.S.W., V., S.A., W.A.

E. leptopoda: Bentham. C.R. Pt. xvii. 219; Vol. ii. 219.

A small Mallee-like shrub or small spindly tree, with several stems together; leaves narrow; buds ovoid, on long slender pedicels; seed-cups stalked, depressed, globular, valves protruding (6 x 7 mm.). W.A.

E. le Souefii: Maiden. C.R. Pt. xvi. 187; Vol. ii. 187.

A tree of medium size, bark flaky at butt, the greater portion of the trunk and the whole of the branches smooth; leaves glaucous, ovate to lanceolate; buds elliptical, strongly ribbed; seed-cups small to medium, deeply ribbed (8 x 9 mm.). W.A.

E. leucoxylon: F. von Mueller. C.R. Pt. xii. 88; Vol. ii. 88.

A medium-sized to large tree, bark smooth, but more or less flaky and deciduous; juvenile leaves short and broad, sessile; adult leaves lanceolate; buds large, rostrate or beaked; filaments white or pink to crimson; seed-cups medium to large, pyriform to goblet-shaped, (10 x 11 mm.). Timber pale, reputed durable. S.A., V., N.S.W. (See Group iii. 32.)

E. ligustrina: De Candolle. C.R. Pt. xl. 332; Vol. iv. 332.

A small species, often forming Mallee-like thickets, up to 12 feet high, but sometimes growing as a single tree, up to 30 feet high; bark stringy; seed-cups very small, (5 x 6 mm.). Confined mostly to the higher parts of the Blue Mountains, N.S.W.

E. linearis: Dehnhardt. C.R. Pt. vi. 168; Vol. i. 168.

Small to medium-sized tree; leaves very narrow; buds small, club-shaped; seed-cups very small (5 x 4 mm.). Timber pale, moderately fissile. Confined to T. (See Group v. under 57.)

E. lirata: (W. V. Fitzgerald) Maiden. C.R. Pt. xliv. 111; Vol. v. 111.

A tree 30-40 feet high; bark greyish, rough; leaves narrow; seed-cups medium, urn-shaped, (10 x 9 mm.). Timber brownish, fissile. Rare. N.W.W.A.

E. longicornis: F. von Mueller. C.R. Pt. xxxix. 272; Vol. iv. 272; Pt. lix. 502; Vol. vi. 502.

A magnificent tree, which, unlike the other allies of **E. oleosa,** carries its rough bark right up to the base of the crown; leaves narrow; buds elongated, rostrate, ½ inch long; seed-cups slightly urn-shaped, small; valves protruding and acute, (8-7 x 7-9 mm.). Timber red and exceptionally tough. W.A.

E. longifolia: Link & Otto. C.R. Pt. xx. 295; Vol. ii. 295.

A handsome, large tree. Bark grey, deciduous in irregular flakes from the branches, persistent and thick, fibrous on the stem; juvenile leaves broad; sapling leaves long; adult leaves falcate-lanceolate; buds egg-shaped, sometimes pointed; seed-cups usually in threes, large, pendulous, bell-shaped, (11-15 x 10-14 mm.). Timber deep red, durable. V., N.S.W. (See Group iii. 33.)

E. Macarthuri: Deane & Maiden. C.R. Pt. xxv. 81; Vol. iii. 81.

A tall tree of beautiful form, with a rounded head. Bark rough, somewhat Box-like, but spongy; upper branches smooth and white; juvenile leaves lanceolate to cordate, sessile, stem-clasping; adult leaves narrow-lanceolate; seed-cups very small (5 x 6 mm.). Timber pale, coarse in grain, moderately durable. N.S.W. (See Group iv. 50.)

E. McCLATCHEI TO E. MELLIODORA.

x E. McClatchei: Kinney. C. R. Pt. lxxi. ; Vol. viii. . Plate 200.

A supposed hybrid; reputed parents **E. Globulus** and (?) Leaves like those of **E. Globulus**; buds and seed-cups in threes, pedicellate. Los Angeles, California.

x E. McIntyrensis: Maiden. C.R. Pt. liv. 166; Vol. vi. 166.

A supposed natural hybrid. A medium-sized scrambling Gum-tree, with more or less flaky bark on the butt; seed-cups mallet-shaped, (7 x 9 mm.). Timber red. S.A.

E. macrandra: F. von Mueller. C.R. Pt. xxxvi. 153; Vol. iv. 153.

A shrub or small tree with a smooth bark; leaves broad; buds sub-cylindrical, sometimes more than an inch long; seed-cups small, semi-ovoid to nearly bell-shaped, valves not protruding (7-8 x 5-7 mm.). Sand plains, W.A.

E. macrocarpa: Hooker. C.R. Pt. xviii. 239; Vol. ii. 239.

A very straggling, glaucous shrub, up to 14 feet high, forming dense thickets; leaves very glaucous, opposite, sessile; buds large, globular; filaments or stamens pink; seed-cups very large, broadly top-shaped (5 x 9 cm.) An ornamental species. Sand plains, W.A.

E. macrorrhyncha: F. von Mueller. C.R. Pt. viii. 225; Vol. i. 225.

A medium-sized tree; bark fibrous on trunk and main branches; juvenile leaves broad, slightly hispid or rough; buds with blunt points; seed-cups medium, three-celled, (5-10 x 10-11 mm.). Timber whitish to pale brown, durable. V., S.A., N.S.W., Q. (See Group iii. 34.)

E. maculata: Hooker. C.R. Pt. xliii. 84; Vol. v. 84.

A tall tree; bark deciduous in patches; juvenile leaves large, broadly lanceolate, peltate, hispid or rough; adult leaves large, lanceolate; flowers terminal in clusters; buds large, clavate; lid domed; seed-cups medium to large, urceolate, (14-18 x 10-15 mm.). Timber pale, of good quality. V., N.S.W., Q. (See Group i. 6.)

E. maculosa: R. T. Baker. C.R. Pt. xxvii. 125; Vol. iii. 125; Pt. lxviii. 373; Vol. vii. 373.

A medium-sized tree, with a smooth, blotched bark; juvenile leaves usually more or less oblong; adult leaves narrow, lanceolate; seed-cups small (5-7 x 4-6 mm.). Timber red, brittle. N.S.W., V.

E. Maideni: F. von Mueller. C.R. Pt. xviii. 256; Vol. ii. 256.

A tall, smooth-bark Gum, somewhat like **E. globulus**; the juvenile and adult leaves are also similar to those of **E. globulus**; buds narrow, clavate, pointed; seed-cups stalked, top-shaped, smaller than those of **E. globulus**, (about 10 x 12 mm.). Timber pale, hard and durable. Thrives at a much higher altitude than **E. globulus.** V., N.S.W. (See Group iv. 51.)

E. marginata: Smith. C.R. Pt. viii. 241; Vol. i. 241; Pt. li. 13; Vol. vi. 13; Pt. lvi. 267; Vol. vi. 267.

A large forest tree; bark rough, persistent, sub-fibrous; juvenile leaves broad; buds large, with long conical lids; seed-cups large, stalked, globular, (16 x 15 mm.). Timber red, of excellent quality. W.A. (See Group i. 7.)

E. megacarpa: F. von Mueller. C.R. Pt. xviii. 246; Vol. ii. 246.

A medium-sized tree; bark smooth; juvenile leaves broad, elliptical; buds large; seed-cups very large, semi-globose, (25 x 30 mm.). Timber brownish, brittle. W.A.

E. melanophloia: F. von Mueller. C.R. Pt. xii. 71; Vol. ii. 71; Pt. lix. 497; Vol. vi. 497.

"Silver-leafed Ironbark." A medium-sized tree with rough, deeply furrowed hard bark; juvenile leaves ovate, sessile; adult leaves elliptical, usually sessile in pairs; buds semi-ovate; seed-cups very small, pilular, (4-5 x 5-4 mm.). Timber red, inferior. N.S.W., Q.

E. melanoxylon: Maiden. C.R. Pt. lvii. 351; Vol. vi. 351.

A tree 40-60 feet high; bark rough and persistent at base only; juvenile leaves glaucous, thick, ovate-lanceolate to lanceolate; adult leaves narrow-lanceolate; buds small, club-shaped; seed-cups small, valves exsert (6 x 5 mm.). Timber very dark, almost black, hard. W.A.

E. melliodora: A. Cunningham. C.R. Pt. xiv. 135; Vol. ii. 135.

A well-shaped medium-sized tree, with pendulous branches; bark sub-fibrous on lower part of trunk; juvenile leaves ovate, somewhat triple-nerved; adult leaves narrow-lanceolate; buds clavate, pedicels slender; seed-cups small, hemispherical, (5-7 x 5-6 mm.). Timber pale, hard, durable. V., N.S.W., Q. (See Group iii. 35.)

E. Merrickae: Maiden & Blakely. C.R. Pt. lxix. 430; Vol. vii. 430.

A small narrow-leaved Mallee; buds in threes, cylindrical, obtuse; seed-cups campanulate or bell-shaped, (7-9 mm. long). Saline flats, Southern W.A.

E. micrantha: De Candolle. C.R. Pt. lix. 508; Vol. vi. 508.

Tree medium-sized; bark smooth, blotched; juvenile leaves narrow-lanceolate; adult leaves narrow; seed-cups small, (4-6 x 5-6 mm.). Timber red, brittle. N.S.W., Q.

E. micranthera: F. von Mueller. C.R. Pt. xx. 308; Vol. ii. 308; Pt. xlvii. 217; Vol. v. 217.

A shrub, 6-10 feet high, with a smooth bark; seed-cups small to medium, sessile, (8 x 9 mm.). W.A.

E. microcarpa: Maiden. C.R. Pt. xlvii. 207; Vol. v. 207; Pt. lviii. 438; Vol. vi. 438.

A medium-sized or large tree, rather erect in habit; the bark sub-fibrous, rather close, and greyish or white on the trunk, branches smooth; adult leaves narrow; seed-cups very small (6-4 x 3-4 mm.). Timber very hard, durable. V., N.S.W., S.A.

E. microcorys: F. von Mueller. C.R. Pt. ix. 261; Vol. i. 261.

A large tree; bark fibrous, persistent; juvenile leaves small, ovate to elliptical; adult leaves lanceolate; buds cylindrical-clavate; seed-cups cylindrical to pear-shaped, (10 x 6 mm.). Timber pale, hard, durable, one of the best. North Coast districts of N.S.W., S.Q. (See Group ii. 18.)

E. microneura: Maiden & Blakely. C.R. Pt. lxix. 415; Vol. vii. 415.

A small tree; bark Box-like. Leaves drooping, glaucous; venation fine, almost invisible; buds glaucous, elliptical, acute, (5-6 mm. long); seed-cups turbinate to campanulate or bell-shaped (5-6 mm. long). N.Q.

E. microtheca: F. von Mueller. C.R. Pt. xi. 51; Vol. ii. 51.

A medium-sized tree; bark Box-like on trunk; juvenile leaves broadly oblong to lanceolate, glaucous; adult leaves narrow, somewhat glaucous; seed-cups extremely small, glaucous, (3-4 x 3-5 mm.). Timber red, hard, interlocked. Dry parts of N.S.W., Q., S.A., N.A., W.A.

E. miniata: A. Cunningham. C.R. Pt. xxii. 37; Vol. iii. 37; Pt. xlvii. 198; Vol. v. 198.

A small shrub or tree; bark yellow, scaly, almost papery; leaves very broad to narrowish; buds very angular, sessile; filaments or stamens scarlet; seed-cups very large, ribbed, barrel-shaped, (3-6 x 2-5 cm.). An ornamental species, confined to N.W.A. and N.Q.

E. Mitchelliana: (Syn. E. Mitchelli) Cambage. C.R. Pt. xlvii. 192; Vol. v. 192.

An umbrageous tree up to 50 feet high; bark almost smooth, white; leaves linear-lanceolate; seed-cups small, ovoid, sessile, (6 x 6 mm.). Mount Buffalo, V., at an elevation of 4,400 feet above sea-level.

E. Mooreana: (W. V. Fitzgerald) Maiden. C.R. Pt. xliii. 93; Vol. v. 93.

A small, crooked tree; leaves glaucous; broadly lanceolate, sessile; seed-cups medium, valves prominent, (10 x 8 mm.). Timber reddish, tough. W.A.

E. Moorei: Maiden & Cambage. C.R. Pt. xxxviii. 218; Vol. iv. 218.

An erect shrub or Mallee, 6-20 feet high; juvenile and adult leaves narrow-lanceolate; buds small, pointed; seed-cups small, nearly globular, (7 x 5 mm.). Blue Mountains, N.S.W.

E. Morrisii: Baker. C.R. Pt. xxxii. 56; Vol. iv. 56.

A small tree, 10-30 feet high; leaves narrow-lanceolate; buds ovoid; seed-cups medium, ovate, thick, valves prominent, (8-10 x 8-11 mm.). Dry interior, N.S.W., Q., S.A.

x E. Mortoniana: Kinney. C.R. Pt. lxxi. ; Vol. viii. .

A supposed natural hybrid; reputed parents, **E. Maideni** and **E. globulus**. It has the general appearance of the latter, but the bark is much rougher, leaves broad, buds in threes, pedicellate, also the seed-cups, which are turbinate, (13 x 20 mm.). Los Angeles, California, from Australian seed.

E. MUELLERI TO E. NOVA-ANGLICA.

E. Muelleri: T. B. Moore. See under **E. Johnstoni,** Maiden.

E. Muelleriana: Howitt. C.R. Pt. viii. 219; Vol. i. 219.

A large Stringybark. Inner bark often yellow, dull to bright. Juvenile leaves slightly hispid or rough, broadly-lanceolate; seed-cups medium, pyriform, truncate, (7-9 x 6-10 mm.). Timber pale brown, durable. V., S.A., N.S.W., Q. (See Group iii. 36.)

E. multicaulis: Blakely. C.R. Pt. lxxi. ; Vol. viii. .

A Mallee, with numerous whip-stick or clothes-prop like stems 6-20 feet high; bark rough at base of large plants; juvenile leaves broadly lanceolate, slightly glaucous; adult leaves falcate-lanceolate, rather thick; buds clavate, lid very small, blunt; seed-cups slightly urn-shaped to pyriform, (7-9 x 6-8 mm.). In wet, firm sandy soil, N.S.W.

E. Mundijongensis: Maiden. C.R. Pt. l. 305; Vol. v. 305.

A tall tree, 80-100 feet high; bark more or less hard and flaky; juvenile leaves coarse; adult leaves narrow-lanceolate; buds large, cylindrical; seed-cups large, with depth much greater than width, (15 x 10 mm.). Timber pale. Rare. W.A.

E. Murphyi: Maiden & Blakely. C.R. Pt. lxx. ; Vol. viii. ; Plate 285.

A tree, 40-80 feet high, 2-4 feet in diameter; bark on trunk hard, deeply furrowed like an Ironbark, branches smooth; juvenile leaves narrow-oblong; adult leaves narrow-lanceolate; buds clavate, lid conical; seed-cups pyriform, including the pedicels, (8-10 x 4-5 mm.). Timber pale red, equal to **E. crebra.** N.S.W.

E. Naudiniana: F. von Mueller. C.R. Pt. xii. 79; Vol. ii. 79; Pt. lxi. 13; Vol. vii. 13.

A tall tree, 50-100 feet high; bark smooth, salmon-coloured; juvenile and adult leaves broad, thin; seed-cups very small, globular, (5 x 6 mm.). Timber red. Philippine Islands, New Britain.

E. neglecta: Maiden. C.R. Pt. xxvii. 151; Vol. iii. 151.

A small, compact, leafy tree 12-20 feet high; often forming dense thickets; juvenile leaves broadly ovate, sessile; seed-cups small, closely sessile. Rare. V.

E. Nicholi: Maiden & Blakely. C.R. Pt. lxxi. ; Vol. viii. .

A graceful Willow-like tree, 30-50 feet high, up to 2 feet diameter; bark sub-fibrous of the Peppermint type; juvenile leaves linear to linear-lanceolate; adult leaves narrow-lanceolate; buds pedicellate, elliptical; seed-cups hemispherical to nearly globose, very small, with exsert valves, (4 x 5 mm.). Timber pale reddish, soft, not durable in the ground. N.S.W.

E. nigra: R. T. Baker. C.R. Pt. lxxi. ; Vol. viii. .

A tall tree with a black stringy bark; leaves lanceolate, scarcely falcate; buds 8-12 in a cluster, small, pointed, seed-cups hemispherical to pyriform, (6 x 8 mm.). Timber dark brown, said to be inferior to **E. eugenioides.** N.S.W.

E. nitens: Maiden. C.R. Pt. xix. 272; Vol. ii. 272.

A large tree, 200-300 feet high; bark deciduous, hanging in long strips; juvenile leaves sessile, broadly lanceolate, glaucous; buds cigar-shaped, shining; seed-cups very small, ovate, shining, (5 x 4 mm.). Timber pale, light, not fully tested. Southern mountain ranges of N.S.W., V. (See Group iv. under 49.)

E. nitida: Hooker, f. C.R. Pt. xxxviii. 235; Vol. iv. 235; Pt. lxi. 21; Vol. vii. 21.

A shrub or small tree; juvenile leaves ovate to elliptical; buds clavate; seed-cups small, (6 x 5 mm.). Confined to Tasmania, where it grows in poor sandy soil near the sea.

E. Normantonensis: Maiden & Cambage. C.R. Pt. xlv. 156; Vol. v. 156.

A small tree, 10-30 feet high; bark rough, persistent; leaves narrow; seed-cups very small, bell-shaped, (6 x 5 mm.). N.Q.

E. notabilis: Maiden. C.R. Pt. xlvii. 218; Vol. v. 218.

A medium-sized tree, similar to **E. resinifera;** buds blunt, conoid; seed-cups small, almost hemispherical. Timber pale brown. Rare. N.S.W.

E. Nova-anglica: Deane & Maiden. C.R. Pt. xlviii. 242; Vol. v. 242.

A much-branched tree, of medium size; bark Peppermint-like, rough, fibrous; juvenile leaves sessile, glaucous, orbicular to elliptical; seed-cups very small, glaucous, (5 x 5 mm.). Timber pale pink, soft; inferior. N.S.W., Q.

E. Nowraensis: Maiden. C.R. Pt. lxii. 68; Vol. vii. 68.

Tree 50-60 feet high, with smooth bark; juvenile leaves broadly ovate to elliptical, smooth; adult leaves narrow-lanceolate; buds in terminal panicles, large, clavate; seed-cups urceolate or urn shaped, large, (15 x 12 mm.). Rare. Nowra, N.S.W.

E. nubilis: Maiden & Blakely. C.R. Pt. lxxi. ; Vol. viii. .

A small stunted glaucous Ironbark, with rather broad, thick, juvenile leaves and narrow-lanceolate adult leaves; buds glaucous, cylindrical to conical, rather small; seed-cups small, pyriform, pedicels slender, (7 x 8 mm.). Timber red, inferior. N.S.W., Q.

E. numerosa: Maiden. C.R. Pt. xxxviii. 233; Vol. iv. 233; Pt. lxi. 20; Vol. vii. 20.

A small slender tree; bark rough, Peppermint-like at butt; branches smooth; juvenile leaves narrow-lanceolate, sessile; adult leaves narrow; buds small, very numerous in the umbel; seed-cups small to very small, pedicels slender, (6 x 5 mm.). Timber white, fissile. N.S.W., V. (See Group iii. 37.)

E. nutans: F. von Mueller. C.R. Pt. xxxv. 121; Vol. iv. 121; Pt. lxiii. 82; Vol. vii. 82.

A small Mallee-like shrub forming dense thickets; buds obtuse; filaments crimson or purple; seed-cups medium, bell-shaped, sessile on flat peduncle, (10 x 10 mm.). An ornamental species. W.A.

E. obliqua: L'Héritier. C.R. Pt. ii. 51; Vol. i. 51.

A medium-sized to large umbrageous tree; bark rough, fibrous, persistent on trunk and branches; juvenile leaves large, obliquely lanceolate; adult leaves moderately broad, oblique, lanceolate; buds clavate with pale lids; seed-cups medium, sub-cylindrical to urceolate or urn-shaped, (12 x 10 mm.). Timber pale, of excellent quality. T., V., N.S.W., S.A. (See Group iv. 52.)

E. obtusiflora: De Candolle. C.R. Pt. xxxiv. 295; Vol. iv. 295.

A dwarf Mallee-like shrub, 4-12 feet high; leaves broadish; seed-cups medium, urn-shaped, (8-13 x 9-11 mm.). N.S.W.

E. occidentalis: Endlicher. C.R. Pt. xxxvi. 137; Vol. iv. 137.

A small shrub or large tree, often forming thickets; bark rough, persistent on trunk; juvenile leaves coarse; buds elongated, obtuse; seed-cups medium, campanulate or bell-shaped. Timber brown. W.A.

E. ochrophloia: F. von Mueller. C.R. Pt. xi. 50; Vol. ii. 50.

A small erect tree, 40-50 feet high; bark at butt rough; leaves narrow-lanceolate; buds elongated; seed-cups large, remarkably cylindrical, (15 x 6 mm.). Timber brown, very hard, durable. Dry interior, N.S.W.

E. ochrophylla: Maiden & Blakely. C.R. Pt. lxxi. ; Vol. viii. .

A slender tree or Mallee, 6-20 feet high, with light green very glossy leaves, small clavate, obtuse, striate buds on long pedicels, and pyriform to mallet-shaped seed-cups, (8-10 x 6-10 mm.). Dry interior, W.A., S.A.

E. odontocarpa: F. von Mueller. Pt. xlv. 144; Vol. v. 144.

A shrub of 8-10 feet; a Mallee; leaves long and narrow; buds narrow turbinate, with four small prominent teeth; seed-cups oblong to bell-shaped, toothed, (10 x 7 mm.). N.T., W.A.

E. odorata: Behr & Schlechtendal. C.R. Pt. xi. 26; Vol. ii. 26; Pt. xlvii. 205; Vol. v. 205.

A medium-sized tree, with dark grey, persistent, rough bark on trunk, branches smooth; juvenile leaves narrow; buds slightly angular, small; seed-cups top-shaped or hemispherical, small, (5-8 x 5-6 mm.). Timber pale-coloured, hard, interlocked. V., S.A., N.S.W.

E. Oldfieldii: F. von Mueller. C.R. Pt. xvii. 223; Vol. ii. 223; Pt. xli. 20; Vol. v. 20.

A small Mallee, with thick, ovate-lanceolate leaves; large, round, pointed buds; and large, thick turbinate seed-cups, (11 x 15 mm.). W.A., S.A.

E. oleosa: F. von Mueller. C.R. Pt. xv. 165; Vol. ii. 165; Pt. xxxix. 275; Vol. iv. 275; Pt. lxii. 65; Vol. vii. 65.

A small to medium-sized tree, bark more or less rough at base of trunk; juvenile leaves oblong; adult leaves lanceolate; seed-cups small, valves needle-pointed, (5-9 x 6-9 mm.). Dry parts of V., S.A., N.S.W., W.A.

E. oligantha: Schauer. C.R. Pt. xiv. 160; Vol. ii. 160.

A tropical tree, about 40 feet high; bark greyish, smooth; leaves broad, glaucous; inflorescence paniculate; buds large, ovoid; seed-cups campanulate to urceolate. Timber brown, soft. N.A., W.A.

E. orbifolia: F. von Mueller. C.R. Pt. xvii. 227; Vol. ii. 227.

A shrub of 5 feet, with broad, orbicular, dark-green, shining leaves. An imperfectly known species. W.A.

E. oreades: R. T. Baker. See under **E. altior.**

E. orgadophila: Maiden & Blakely. C.R. Pt. lxx. ; Vol. viii. ; Plate 285.

A medium-sized tree, 30-40 feet high, with Box-like bark at base, upper part of trunk and branches smooth; juvenile leaves broadly ovate to obovate; adult leaves narrow-lanceolate; buds usually terminal, clavate; seed-cups somewhat pear-shaped, slightly ribbed, including the pedicels, (8-13 mm.). Q.

E. ovata: Labillardiere. C.R. Pt. xxvii. 133; Vol. iii. 133.

A large tree, bark more or less rough at butt; ribbony on branches; juvenile leaves broadly ovate; adult leaves broad, undulate; buds acute; seed-cups hemispherical to top-shaped, rim sharp (8 x 7 mm.). Timber pale, tough, liable to warp. T., V., S.A., N.S.W. (See Group iv. 54.)

x E. oviformis: Maiden & Blakely. C.R. Pt. lxxi. ; Vol. viii. .

A supposed natural hybrid between **E. tereticornis** and **E. Maideni.** A moderately large tree somewhat like **E. tereticornis,** but the bark is lighter and marked with reddish patches and dark blotches; adult leaves lanceolate, thick, prominently veined; buds smooth, several in a cluster, including the pedicels nearly 1 inch long; seed-cups ovoid, with a moderately large disc and 3-4 short, exsert valves, (12 x 11 mm.). V.

E. ovularis: Maiden & Blakely. C.R. Pt. lxix. 421; Vol. vii. 421.

A small Mallee-like shrub, 6-12 feet high; leaves narrow-lanceolate; buds urceolate, (5 mm. long); seed-cups ovoid, (4-6 mm. long). W.A.

E. pachycalyx: Maiden & Blakely. C.R. Pt. lxxi. ; Vol. viii. ; Plate 289.

A small tree with a smooth bark like **E. maculata;** adult leaves narrow-lanceolate or falcate-lanceolate; buds pedicellate, cylindrical-clavate, the lid longer than the smooth, thick calyx. N.Q.

E. pachyloma: Bentham. C.R. Pt. vii. 200; Vol. i. 200; Pt. xxxiii. 84; Vol. iv. 84.

A small, spindly, sand-plain shrub, 5-12 feet high, confined to W.A.

E. pachyphylla: F. von Mueller. C.R. Pt. xli. 12; Vol. v. 12.

A shrubby Mallee, with broad, thick lanceolate leaves, and large, deeply corrugated buds and seed-cups; cups broad, top-shaped, (17 x 28 mm.). N.T., Q.

E. pallidifolia: F. von Mueller. C.R. Pt. xxii. 29; Vol. iii. 29.

A small, more or less crooked tree, bark white to the ground and brittle; juvenile leaves orbicular or nearly so; adult leaves oblong to lanceolate; buds egg-like; seed-cups small, oval, nearly sessile, (6 x 5 mm.). Timber reddish, hard, and mottled. N.T., N.Q.

E. paniculata: Smith. C.R. Pt. xiii. 104; Vol. ii. 104; Pt. xlviii. 225; Vol. v. 225.

"Grey Ironbark." An erect tree, 40-80 feet high; bark dark grey, hard, deeply furrowed; juvenile leaves dark green, broad; adult leaves lanceolate; buds clavate; pedicels slender; seed-cups hemispherical to pyriform, valves sometimes slightly exsert, (5 x 6 mm.). Timber pale pink to brownish, hard, interlocked, one of the best. N.S.W., Q. (See Group ii. 19.)

E. Papuana: F. von Mueller. C.R. Pt. xxxvii. 192; Vol. iv. 192.

A large tree, with a smooth white bark except at the base; juvenile leaves broad, ovate to elliptical; adult leaves narrow-lanceolate, undulate; buds small, blunt, club-shaped; seed-cups small, urn-shaped to bell-shaped, papery, (8-10 x 7-9 mm.). Timber dark brown, soft. A tropical species. Papua, W.A., N.T.

E. PARADOXA TO E. PHOENICEA.

E. paradoxa: Maiden & Blakely. C.R. Pt. lxxi. ; Vol. viii. .

A moderately large Gum tree, bark smooth, except at butt; juvenile leaves broad, glaucous; adult leaves long, falcate-lanceolate; buds 3-6 in the head on long stalks, clavate; seed-cups pedicellate, mallet-shaped to nearly globular, disc thick, smooth, covering the short, thick valves (10 x 11 mm.). Timber yellowish brown, of good quality. V., rare.

E. Parramattensis: Hall. C.R. Pt. xxxii. 37; Vol. iv. 37.

A medium-sized Red Gum; bark smooth, blotched; leaves narrow-lanceolate; buds ovate to conical; seed-cups very small, hemispherical to mallet-shaped, valves exsert (5 x 6 mm.). Timber red, inferior. N.S.W.

E. parvifolia: Cambage. C.R. Pt. xxv. 88; Vol. iii. 88.

A small shrubby tree, 20-30 feet high; bark smooth; leaves small, linear-lanceolate to ovate-lanceolate; seed-cups egg-shaped, very small, sessile, (6 x 5 mm.). N.S.W.

E. patellaris: F. von Mueller. C.R. Pt. xxxix. 257; Vol. iv. 257; Pt. lxix. 408; Vol. vii. 408.

A tree 30-40 feet high; bark rough, persistent on trunk and branches; leaves narrow-lanceolate, 5-12 inches long; buds large, clavate; seed-cups medium, bell-shaped, (12 x 10 mm.). Timber reddish-brown, heavy, coarse-fibred. N.T.

E. patens: Bentham. C.R. Pt. xx. 304; Vol. ii. 304.

A large tree, with rough greyish bark on the trunk and branches; juvenile leaves very broad, opposite, sessile; adult leaves narrow, lanceolate; buds clavate; seed-cups large, roundish, (9-14 x 10-15 mm.). Timber pale, soft. W.A. (See Group i. 8.)

x E. Peacockeana: Maiden. C.R. Pt. liii. 113; Vol. vi. 113.

A supposed natural hybrid. A medium-sized Ironbark, with narrow-lanceolate leaves; buds small, oval; seed-cups pear-shaped, small (8 x 7 mm.). Timber yellowish to pale brown. Rare. N.S.W.

E. pellita: F. von Mueller. C.R. Pt. xxx. 214; Vol. iii. 214.

A tree 40-80 feet high, bark rough, fibrous, persistent throughout; juvenile leaves broad, ovate to broadly lanceolate; adult leaves moderately broad; seed-cups broad, top-shaped, large, often angular, (12 x 15 mm.). Timber red, durable. Coast range, N.S.W., Q.

E. peltata: Bentham. C.R. Pt. xlii. 33; Vol. v. 33.

A small or medium-sized yellow-barked Bloodwood; juvenile leaves peltate, broadly lanceolate, setose or bristly; adult leaves narrow-lanceolate; inflorescence terminal; buds large, seed-cups medium, urn-shaped, (10 x 9 mm.). Timber brownish, not very durable. Q.

E. Penrithensis: Maiden. C.R. Pt. xlvii. 213; Vol. v. 213.

A medium-sized tree; bark hard, fibrous on trunk, smooth on branches; leaves lanceolate; buds small, clavate or club-shaped; seed-cups pilular, (about 5 mm. in diameter). Timber reddish-brown, gummy. Rare. N.S.W.

E. perfoliata: R. Brown. C.R. Pt. xliv. 103; Vol. v. 103.

A crooked tree, 20-40 feet high; bark rough, persistent; leaves large, opposite, in young stage united or perfoliate; buds oval; seed-cups very large, urceolate or urn-shaped. (33 x 30 mm.). Tropical W.A.

E. perplexa: Maiden & Blakely. C.R. Pt. lxxi. ; Vol. viii. ; Plate 288.

A medium-sized Ironbark; bark dark-coloured, deeply furrowed; juvenile leaves broad, oblong; adult leaves narrow, oblong-lanceolate; seed-cups small, sub-globose, truncate, (4 x 5 mm.). Timber red, hard, durable. N.W.W.A.

E. Perriniana: F. von Mueller. C.R. Pt. xxvi. 103; Vol. iii. 103.

A small or medium-sized White Gum, with glaucous perfoliate juvenile leaves; buds in threes, egg-shaped; seed-cups basin-shaped (5 x 7 mm.). Timber brittle. An alpine species allied to **E. Gunnii** and **E. cordata.** T., V., N.S.W.

E. phoenicea: F. von Mueller. C.R. Pt. xxii. 41; Vol. iii. 41.

A small or medium-sized tree; bark flaky, more or less persistent; leaves narrow-lanceolate; buds clavate to urn-shaped; filaments (flowers) orange or scarlet; seed-cups large, urceolate to cigar-shaped, usually two-celled, (25 x 12 mm.). A gorgeous species for tropical cultivation. N.T., N.Q.

E. PILLIGAENSIS TO E. PRUINOSA.

E. Pilligaensis: Maiden. C.R. Pt. xlvii. 210; Vol. v. 210.

A medium-sized tree, with light grey, persistent bark; leaves linear to narrow-lanceolate; buds oval, very small; seed-cups very small (5 x 4 mm. or less). Timber brown, interlocked. N.S.W., Q.

E. pilularis: Smith. C.R. Pt. i. 26; Vol. i. 26.

A tall, stately tree; bark rough, sub-fibrous on trunk for 6-30 feet, remainder of stem smooth; juvenile leaves sessile, narrow-lanceolate, richly coloured on upper surface, pale underneath; adult leaves thick, falcate-lanceolate; buds medium, pointed; seed-cups medium, globular, (9-13 x 10-12 mm.). Timber pale, strong, and durable. Prefers stiff clay or shale formation. Coast districts, N.S.W., Q. (See Group ii. 20.)

E. Pimpiniana: Maiden. C.R. Pt. xvi. 211; Vol. ii. 211; Pt. lxix. 410; Vol. vii. 410.

A shrub, 3-8 feet high, with dark green leaves; buds large, elongated; seed-cups deep, club-shaped, large, (16 x 10 mm.). Sand plains, near Ooldea, N.T.

E. piperita: Smith. C.R. Pt. x. 299; Vol. i. 299.

A medium-sized umbrageous tree, with a Peppermint-like bark on trunk; juvenile leaves ovate to broadly lanceolate; buds narrow, pointed; seed-cups small, ovoid, (6-9 x 6-7 mm.). Timber pale, gummy, inferior. Cool, damp situations, on well-drained soil. N.S.W. (See Group iii. 38.)

E. Planchoniana: F. von Mueller. C.R. Pt. ix. 291; Vol. i. 291; Pt. li. 11; Vol. vi. 11.

A large tree, with a yellowish, fibrous, persistent bark; leaves heavy, slightly glaucous; buds large, corrugated; seed-cups very large, globular to urn-shaped, ribbed, (20-30 x 25-28 mm.). Timber pale, hard, durable. Sand with clay bottom. North coast districts of N.S.W., S.Q.

E. platypus: Hooker. C.R. Pt. xxxv. 118; Vol. iv. 118.

A Marlock, attaining a height of 30 feet; bark smooth, except at butt; leaves glossy, orbicular; buds horn-like, cylindrical, obtuse; seed-cups somewhat bell-shaped, thick, often ridged, medium, (10-12 x 8-12 mm.). Sand plains, W.A.

E. polyanthemos: Schauer. C.R. Pt. xiii. 109; Vol. ii. 109; Pt. xlii. 58; Vol. v. 58.

A medium-sized scrambling tree, with a short trunk, covered with short, scaly bark, branches moderately smooth; juvenile leaves orbicular, glaucous; adult leaves broad, slightly glaucous; buds oval, pointed; seed-cups very small (4 x 5 mm.). Timber red, durable. N.S.W., V. (See Group iii. 39.)

E. populifolia: Hooker. C.R. Pt. x. 339; Vol. i. 339.

A small to medium-sized shapely tree; bark sub-fibrous or Box-like, persistent on the trunk and branches; leaves broad, with long petioles; buds and fruits very small; seed-cups with very short stalks, (5 x 4 mm.). Timber pale brown, durable. Dry interior of N.S.W., Q.

E. praecox: Maiden. C.R. Pt. xxvii. 131; Vol. iii. 131.

A small drooping Gum, with more or less blotched bark; juvenile leaves broadly ovate; adult leaves narrow, lanceolate; seed-cups short-stalked, small, globular, rim and valves prominent, (6 x 6 mm.). Timber pale, rather brittle. Rare. N.S.W.

E. Preissiana: Schauer. C.R. Pt. xviii. 243; Vol. ii. 243.

A spindly shrub 6-10 feet high; leaves dark green; buds large, filaments yellow; seed-cups very large, bell-shaped, thick, sessile, (24 x 30 mm.). W.A.

E. propinqua: Deane & Maiden. C.R. Pt. xxix. 191; Vol. iii. 191; Pt. lix. 504; Vol. vi. 504.

A tall, straight Grey Gum, with a moderately smooth, blotched bark of various shades of pink, grey and green; leaves lanceolate, venation very fine; buds oval, pointed; seed-cups small, valves protruding, (5 x 6 mm.). Timber red, close-grained. North coast districts of N.S.W., Q. (See Group i. 9.)

E. pruinosa: Schauer. C.R. Pt. xii. 74; Vol. ii. 74; Pt. lix. 495; Vol. vi. 495.

A medium-sized tree, with a persistent, grey, thin, fibrous bark; juvenile and adult leaves large, glaucous, sessile; seed-cups medium, deep, sometimes angled, (8-10 x 5-9 mm.). A tropical species. Q., N.A., W.A.

E. PSEUDO-GLOBULUS TO E. REGNANS.

x E. pseudo-globulus: (Hort) Naudin. C.R. Pt. lii. 78; Vol. vi. 78.

A hybrid; reputed parents, **E. globulus** and (?). Algiers.

E. ptychocarpa: F. von Mueller. C.R. Pt. xliv. 105; Vol. v. 105.

A medium-sized tree; bark rough, persistent; leaves broad, 6-12 inches long; buds large, strongly ribbed; filaments (flowers) reddish; seed-cups 1-1½ inches long, barrel-shaped, prominently ribbed. N.W.W.A., N.T.

E. pulverulenta: Sims. C.R. Pt. xxi. 12; Vol. iii. 12.

A scraggy, spindly shrub, up to 15 feet high, and 2-3 inches in diameter; bark moderately smooth, greenish-white; leaves glaucous; seed-cups oval to somewhat globose, medium, (9-10 x 10-11 mm.). The wood is pale-coloured, hard and tough. An ornamental species. Rare. N.S.W.

E. pumila:. Cambage. C.R. Pt. l. 300; Vol. v. 300.

A Mallee-like shrub or small tree, 15-20 feet high, with a stem diameter of 2-3 inches. Seed-cups small, basin-shaped, (5 x 7 mm.). N.S.W.

E. punctata: De Candolle. C.R. Pt. xxix. 194; Vol. iii. 194.

A typical Grey Gum. Bark dull grey, and white with various shades of pink, and often irregularly blotched; juvenile leaves broad; adult leaves narrow to broad-lanceolate, buds oblong with long points; seed-cups small to medium, valves protruding, (7 x 8 mm. or larger). Timber red, hard, durable. N.S.W. Q. (See Group ii. 21.)

E. Pygmaea: Blakely. C.R. Pt. lxxi. ; Vol. viii. .

A Mallee-like Stringybark, 3-4 feet high, with broad, thick juvenile and adult leaves, and small, closely sessile buds and seed-cups. N.S.W.

E. pyriformis: Turczaninow. C.R. Pt. xvii. 229; Vol. ii. 229.

A small shrub, with long, weak stems; leaves glaucous; seed-cups sometimes more than 1 inch in diameter, (4 x 7 cm.). An ornamental species inhabiting the sand plains of W.A. Three well-marked varieties worthy of cultivation.

E. pyrophora: Bentham. C.R. Pt. xl. 320; Vol. iv. 320.

A medium-sized Bloodwood; bark rough; leaves narrow to broad-lanceolate; buds pear-shaped, reddish; seed-cups thick, large, (20-30 x 15-22 mm.). Timber red; inferior. W.A., N.T., Q., N.S.W.

E. quadrangulata: Deane & Maiden. C.R. Pt. xxiv. 76; Vol. iii. 76.

A tall tree; bark close, light grey, Box-like; juvenile leaves sessile, narrow-lanceolate; adult leaves narrow; branchlets very angular; seed-cups small, valves protruding, (6 x 5 mm.). Timber pale, interlocked. Prefers rich, heavy soil. N.S.W.

E. radiata: Sieber. C.R. Pt. xxxviii. 229; Vol. iv. 229; Pt. lxi. 19; Vol. vii. 19.

A medium-sized tree, with a fibrous, persistent Peppermint bark on the trunk and portion of the main branches, the rest smooth and ribbony; seed-cups small (7 x 5 mm.). Timber pale, moderately fissile and durable. N.S.W., V. (See Group v. 61.)

E. rariflora: Bailey. C.R. Pt l. 303; Vol. v. 303.

A tall to medium-sized tree; bark hard, fibrous; persistent; juvenile leaves orbicular to reniform, on long stalks; adult leaves narrow to broad-lanceolate; seed-cups small, wine-glass shaped, (7 x 6 mm.). Timber brown, hard, durable. Seems to be the narrow-leaved form of **E. populifolia.** Dry parts of N.S.W., Q.

E. Raveretiana: F. von Mueller. C.R. Pt. xii. 61; Vol. ii. 61.

A large tree; bark flaky or Box-like on trunk and main branches; juvenile leaves broad; adult leaves narrow-lanceolate; flowers terminal; seed-cups extremely small, valves protruding (3 x 3 mm.). Timber brownish. N.Q.

E. redunca: Schauer. C.R. Pt. xxxiv. 93; Vol. iv. 93.

A small Mallee, 3-4 feet high; buds with horn-shaped lids; seed-cups medium, (10 x 7 mm.). Sand plains, W.A.

E. regnans: F. von Mueller. C.R. Pt. vii. 183; Vol. i. 183.

A tall shaft-like tree, measured specimens of which have exceeded 300 feet in height; bark on lower part of stem fibrous, above that ribbony or smooth; juvenile leaves broad, lanceolate, crinkled; adult leaves lanceolate, falcate, distinctly veined; buds slender, low-pointed; seed-cups top-shaped, flat at rim, small, (9 x 8 mm. or less). Timber pale, freely fissile. T., V. (See Group v. 62.)

E. resinifera: Smith. C.R. Pt. xxx. 207; Vol. iii. 207.

A large tree, with a rough, reddish, fibrous, persistent bark; juvenile leaves broadly lanceolate; adult leaves narrow to broad lanceolate, finely veined; buds long, rostrate; seed-cups on long pedicels, ovate to hemispherical, valves protruding, small, (5-8 x 5-8 mm.). Timber red, durable, of excellent quality. Coast districts of N.S.W., S.Q. (See Group ii. 22.)

E. rigidula: See E. angusta.

E. Risdoni: Hooker, f. C.R. Pt. vi. 172; Vol. i. 172; Pt. lxii. 60; Vol. vii. 60.

A smooth-barked tree of medium size, but always more or less scaly at butt; leaves glaucous; juvenile leaves opposite, sessile, often connate or united at their bases, cordate or lanceolate; buds clavate, blunt; seed-cups pyriform to top-shaped, (6 x 8 mm.). Timber reputed durable. T. (See Group v. 63.)

E. robusta: Smith. C.R. Pt. xxiii. 45; Vol. iii. 45.

A medium-sized tree; bark rough, sub-fibrous, persistent; juvenile leaves very large; adult leaves moderately broad, lanceolate, finely veined; buds club-shaped, pointed; seed-cups medium to large, urn-shaped, (12-15 x 10-12 mm.). Does remarkably well in sub-saline swampy land and on the edge of salt water, in deep alluvial soil. Timber red, used for many purposes. Coast districts of N.S.W. and S.Q. (See Group ii. 23).

E. rostrata: Schlechtendal. C.R. Pt. xxxiii. 65; Vol. iv. 65.

A large umbrageous tree; bark more or less flaky, deciduous, leaving the stem dull white; juvenile leaves very slightly glaucous, lanceolate; adult leaves narrow-lanceolate or falcate-lanceolate; buds small, plump, rostrate; seed-cups small, hemispherical, rim sharp; valves exsert or protruding, (5 x 7 mm.). Timber red, durable; a first-class timber; flourishes well in flooded land. Found in all the States, except Tasmania. (See Group iii. 40.)

E. rubida: Deane & Maiden. C.R. Pt. xxvi. 110; Vol. iii. 110.

A medium-sized tree, smooth for the most part, the outer layer of bark falling off in short strips or ribbons; juvenile leaves orbicular, opposite for an indefinite number of pairs; adult leaves lanceolate, falcate, undulate; seed-cups top-shaped, small, (7 x 6 mm.). Timber red, worthless. T., S.A., V., N.S.W., Q.

E. Rudderi: Maiden. C.R. Pt. xiii. 118; Vol. ii. 118.

A tall tree, 50-140 feet high; bark persistent, Box-like throughout; leaves thin, moderately broad; flowers paniculate or in long clusters; buds small, clavate, acute; seed-cups oval, very small, (5 x 4 mm.). Timber red, hard, durable. Rare. N.S.W.

E. rudis: Endlicher. C.R. Pt. xxxiii. 75; Vol. iv. 75.

A medium-sized tree, often somewhat scrambling in habit; bark blackish, rough, persistent; leaves narrow to broad-lanceolate; seed-cups small, top-shaped, valves protruding, (5-7 x 5-6 mm.). Timber brown, worthless. W.A.

E. Rummeryi: Maiden. C.R. Pt. lviii. 427; Vol. vi. 427.

A large forest tree; bark Box-like, rough at butt only; branches smooth; juvenile leaves elliptical to lanceolate, undulate; adult leaves thin, narrow-lanceolate; seed-cups very small, top-shaped, (5 x 5 mm.). Timber pale brown, hard and tough. N.S.W.

E. saligna: Smith. C.R. Pt. xxiii. 56; Vol. iii. 56.

A tall, shaft-like tree, with smooth but more or less sub-flaky bark at butt; some trees quite smooth to the ground; leaves lanceolate; venation fine; buds small, shortly pedicellate; seed-cups small, bell-shaped, valves slightly protruding, (5-6 x 5-8 mm.). Timber red, of excellent quality. On shale formation, coast districts N.S.W. and S.Q. (See Group iii. 41.)

E. salmonophloia: F. von Mueller. C.R. Pt. xvii. 217; Vol. ii. 217.

A tree up to 100 feet; bark smooth, shining; leaves narrow; seed-cups very small, round, valves long, (5 x 5 mm.). Timber reddish-brown, valuable. W.A.

E. SALUBRIS TO E. SIEBERIANA.

E. salubris: F. von Mueller. C.R. Pt. xxxvi. 156; Vol. iv. 156.

A medium-sized tree, the whole stem often twisted like a gigantic corkscrew; bark smooth, shining, ash-coloured to olive-green; leaves narrow; buds small, ovate; seed-cups small, hemispherical, valves exsert. W.A.

E. Sargenti: Maiden. C.R. Pt. lxii. 58; Vol. vii. 58.

A tree of medium size; bark smooth and very astringent, hard-flaky at butt; juvenile leaves linear-lanceolate; adult leaves narrow-lanceolate; buds cylindrical, curved; seed-cups ovoid, valves protruding, (8 x 5 mm.). The bark is used for tanning purposes. W.A.

E. Schlechteri: Diels. C.R. Pt. lxi. 7; Vol. vii. 7.

A small tree with broadish leaves and small buds and seed-cups. Confined to Papua (New Guinea).

E. scoparia: Maiden. C.R. Pt. xxix. 186; Vol. iii. 186.

A slender smooth-barked tree, 30-40 feet high, with narrow pendulous foliage; seed-cups very small, club-shaped, (5 x 4 mm.). In general appearance and botanical characters the tree resembles **E. maculosa.** Rare. N.S.W.

E. Seeana: Maiden. C.R. Pt. xxxii. 29; Vol. iv. 29.

A rather tall tree, more or less smooth, mottled bark, with pendulous branches and narrow leaves; juvenile leaves very narrow; buds slender, horn-like; seed-cups very small, valves exsert, (5 x 6 mm.). Timber red, soft; not very durable. North coast districts of N.S.W. and S.Q.

E. sepulcralis: F. von Mueller. C.R. Pt. viii. 244; Vol. i. 244; Pt. lvii. 346; Vol. vi. 346.

A small, slender, willow-like tree, with smooth, white bark and narrow, glaucous leaves; seed-cups very large, urn-shaped, (30-35 x 25-27 mm.). Rare. W.A.

E. setosa: Schauer. C.R. Pt. xxxviii. 210; Vol. iv. 210.

A small to medium-sized Bloodwood, with rough bark; leaves usually broad, sessile, hispid; buds small, setose or bristly; seed-cups very large, globular to urceolate, (20-28 x 15-30 mm.). Timber reddish, hard, tough. W.A., N.T., Q.

E. Sheathiana: Maiden. C.R. Pt. li. 1; Vol. vi. 1.

A slender tree 12-25 feet high; leaves lanceolate; buds ovoid, medium; seed-cups small to medium, somewhat bell-shaped, (10 x 10 mm.). Allied to **E. dumosa.** Rare. W.A.

E. Shiressii: Maiden & Blakely. C.R. Pt. lix. 512; Vol. vi. 512.

A medium-sized Grey Gum, with a beautiful blotched bark which falls off in rather large patches; juvenile leaves narrow; seed-cups small to medium, bell-shaped, (10 x 9 mm.). Timber red, equal to **E. punctata.** Coast sandstone. N.S.W.

E. Shirleyi: Maiden. C.R. Pt. lviii. 425; Vol. vi. 425.

A small tree, with mealy, glaucous, broad, opposite, stem-clasping leaves, acutely angular buds, and large sessile ribbed seed-cups, (12-15 mm.). Rare. Q.

E. siderophloia: Bentham. C.R. Pt. x. 324; Vol. i. 324.

A large tree; bark flaky, firm, sometimes deeply furrowed; juvenile leaves very broad, coarse, glaucous; adult leaves lanceolate, falcate; buds elongated, rostrate; seed-cups small to medium, pyriform, valves protruding, (6-9 x 7-8 mm.). Timber red, durable. On heavy clay soil. N.S.W., Q. (See Group ii. 24.)

E. sideroxylon: A. Cunningham. C.R. Pt. xii. 82; Vol. ii. 82.

A medium-sized tree, often gnarled; bark hard, deeply furrowed; a typical Ironbark; juvenile leaves narrow; buds large, pedicellate, drooping; seed-cups medium, stalked, goblet-shaped, (8-10 x 8-9 mm.). Timber red, durable, but not equal to that of **E. crebra.** V., N.S.W., Q. (See Group iii. 42.)

E. Sieberiana: F. von Mueller. C.R. Pt. x. 306; Vol. i. 306; Pt. lxi. 10; Vol. vii. 10.

A tall tree; bark hard, deeply furrowed, like an Ironbark on main portion of the trunk, deciduous from small branches; juvenile leaves glaucous, thick, broad; adult leaves green, pendent; seed-cups pyriform, truncate, small, (7-9 mm.). Timber pale, used for wide range of purposes. Cooler districts of T., V., N.S.W. (See Group iv. 55.)

E. SIMILIS TO E. STRICKLANDI.

E. similis: Maiden. C.R. Pt. xliv. 109; Vol. v. 109.

A medium-sized tree, with yellowish, flaky bark; leaves narrow; seed-cups medium, urn-shaped, (12 x 10 mm.). A dry country species, confined to Central Queensland.

E. Simmondsii: Maiden. C.R. Pt. lvii. 344; Vol. vi. 344.

A tree 50-60 feet high, with a somewhat Peppermint-like bark; juvenile leaves slightly glaucous, narrow to broad lanceolate, sessile; adult leaves narrow, lanceolate; buds small, club-shaped; seed-cups small to medium, conoid to turbinate, (8 x 8 mm.). Timber pale and reputed durable. T.

E. Smithii: Baker. C.R. Pt. xii. 76; Vol. ii. 76.

A tall tree, bark rough, furrowed, persistent on lower portion of trunk; juvenile leaves glaucous, sessile, narrow-lanceolate; adult leaves narrow-lanceolate; buds small, ovate, acute; seed-cups semi-ovate, small, valves protruding, (6 x 5 mm.). Timber pale, hard, durable. Southern mountain ranges of N.S.W. (See Group iii. 43.)

E. spathulata: Hooker. C.R. Pt. xxxv. 124; Vol. iv. 124.

A shrub 6-8 feet or more; bark smooth, except at extreme base; leaves narrow, spathulate; buds elongated, blunt; seed-cups bell-shaped, (7-8 x 5-8 mm.). W.A.

E. Spenceriana: Maiden. C.R. Pt. xxxviii. 206; Vol. iv. 206; Pt. lxi. 18; Vol. vii. 18.

A tree 50 feet high; bark rough, flaky throughout; juvenile leaves very broad; adult leaves narrow to broad-lanceolate; venation very fine; seed-cups very small, bell-shaped, (6 x 5 mm.). Timber dark reddish-brown, interlocked, like **E. microtheca.** W.A., N.T., Q.

E. squamosa: Deane & Maiden. C.R. Pt. xvii. 221; Vol. ii. 221.

A small tree; bark rather dark, scaly; juvenile leaves thick, broadly lanceolate to orbicular; adult leaves narrow-lanceolate; seed-cups mallet-shaped, small, valves prominent, (5 x 7 mm.). Timber red, of fair quality. Sydney district (mainly), N.S.W.

E. Staerii: Maiden. C.R. Pt. lxviii. 374; Vol. vii. 374.

A tree 40-50 feet high; bark dark, rough; adult leaves ovate-lanceolate; seed-cups large, round, (23 x 25 mm.). Timber pale, yellowish. Allied to **E. marginata.** In saline soil. W.A.

E. Staigeriana: F. von Mueller. C.R. Pt. xii. 69; Vol. ii. 69.

A medium-sized tree, with rough, persistent bark, glaucous leaves; seed-cups pear-shaped, very small (5 x 6 mm.). Tropical Q.

E. stellulata: Sieber. C.R. Pt. v. 127; Vol. i. 127.

A small to medium-sized tree; bark rough, flaky at butt only; juvenile leaves broad-lanceolate to ovate, strongly veined; buds narrow, pointed, stellate; seed-cups sometimes extremely small, (3-5 x 3-5 mm.). Timber not durable. V., N.S.W.

x E. Stopfordi: Maiden. C.R. Pt. liii. 114; Vol. vi. 114.

A supposed natural hybrid. An Ironbark with pale-coloured timber; adult leaves glaucous; buds small. Rare. N.S.W.

E. Stowardi: Maiden. C.R. Pt. xliii. 98; Vol. v. 98.

A shrubby Mallee, 4-10 feet high; leaves lanceolate; buds up to 1 inch, thick, blunt; seed-cups large, pear-shaped, deeply ribbed, (15 x 12 mm.). W.A.

E. striaticalyx: W. V. Fitzgerald. C.R. Pt. li. 3; Vol. vi. 3.

A tree, 30-40 feet high; bark dark grey, Box-like on lower part of trunk; juvenile leaves broad, coarse; adult leaves lanceolate; buds thick, blunt, lid striate; seed-cups medium, cylindrical, to bell-shaped, (11 x 10 mm.). Timber brown, durable. Rare. W.A.

E. Stricklandi: Maiden. C.R. Pt. xvi. 202; Vol. ii. 202; Pt. li. 7; Vol vi. 7.

A small tree; bark rough on lower part of trunk; leaves thick, broad, glaucous; buds sessile, thick, blunt, angular; seed-cups medium, sessile, angular, urceolate. Timber deep brown. Dry interior. W.A.

E. STRICTA TO E. TETRODONTA.

E. stricta: Sieber. C.R. Pt. xl. 335; Vol. iv. 335.

A Mallee-like species, forming an almost impenetrable scrub, 6-12 feet high, with a stem diameter of 1-3 inches; seed-cups medium, urn-shaped, (6-13 x 7-12 mm.). N.S.W.

E. Stuartiana: F. von Mueller. C.R. Pt. xxvi. 67; Vol. iii. 67.

A large, often scrambling tree; bark soft, thick, sub-fibrous; juvenile leaves broad, glaucous, sessile; adult leaves long, lanceolate-falcate; seed-cups very small, top-shaped; valves often strongly protruding, (5 x 6 mm.). Timber pale pink, soft, brittle. V., N.S.W., Q. (See Group iv. 56.)

x **E. Studleyensis:** Maiden. C.R. Pt. liii. 121; Vol. vi. 121.

A supposed natural hybrid; reputed parents **E. rostrata** and **E. ovata.** Buds oval, pointed; seed-cups small, goblet-shaped, (6 x 7 mm.). Rare. V.

E. subcrenulata: Maiden & Blakely. C.R. Pt. lxxi. ; Vol. viii. .

A dwarf alpine tree with crooked stems, broad light green sub-crenulate leaves, small round smooth buds, and small somewhat bell-shaped seed-cups. T.

E. subviridis: Maiden & Blakely. C.R. Pt. lxxi. ; Vol. viii. ; Plate 290.

A medium-sized tree; bark matted-fibrous on trunk, branches smooth; juvenile and adult leaves broad, ovate, lanceolate; buds ovoid, smooth; seed-cups mallet-shaped to globular, with a prominent rim and exsert valves, (7-9 x 9-10 mm.). Timber red, inferior. N.S.W.

E. taeniola: Baker & Smith. C.R. Pt. li. 5; Vol. vi. 5.

A tree of 40-50 feet, with a Peppermint bark; leaves long and narrow; buds and seed-cups similar to **E. Sieberiana.** Seed-cups medium, (10 x 8 mm.). Rare. T.

x **E. Taylori:** Maiden. C.R. Pt. lxii. 63; Vol. vii. 63.

A supposed natural hybrid. A tree 60-80 feet high; bark half Ironbark, half Box; juvenile leaves sub-glaucous, oblong-lanceolate; adult leaves narrow-lanceolate; buds small, clavate; seed-cups very small, conoid or cylindrical-conoid, (6 x 5 mm.). Timber pale red, hard, heavy. N.S.W.

x **E. Tenandrensis:** Maiden. C.R. Pt. liii. 112; Vol. vi. 112.

A supposed natural hybrid; supposed parents **E. crebra** and **E. bicolor.** Seed-cups pear-shaped, small, (7 x 6 mm.). Rare. N.S.W.

E. tereticornis: Smith. C.R. Pt. xxxi. 1; Vol. iv. 1.

A tall tree with a thick trunk; bark deciduous in patches; buds elongated, horn-shaped; seed-cups with prominent valves, small, (6-8 mm.). Timber red, durable. Gippsland V., coast districts of N.S.W., and S.Q. (See Group iii. 44.)

E. terminalis: F. von Mueller. C.R. Pt. xl. 305; Vol. iv. 305.

A large grey-barked Bloodwood; juvenile leaves broad, elliptical, slightly setose; adult leaves narrow-lanceolate; inflorescence, a large terminal panicle; buds large, clavate; seed-cups medium to very large, cylindrical to urceolate, (20-30 x 12-14 mm.). Timber deep red, durable. N.S.W., Q., N.T., W.A.

E. tessellaris: F. von. Mueller. C.R. Pt. xxxviii. 201; Vol. iv. 201.

A medium to fairly large tree; bark persistent on lower part of trunk, the upper portion and branches smooth and white; leaves narrow, finely feather-veined; buds clavate, small; seed-cups small to medium, papery or shell-like, (9 x 7 mm.). Timber brown, tough, interlocked. W.A., N.T., Q., N.S.W. (See Group i. 10.)

E. tetragona: F. von Mueller. C.R. Pt. xlvi. 161; Vol. v. 161.

A low shrub, densely covered with a white meal, to a small tree of 20-25 feet; leaves coarse, glaucous; seed-cups large, bell-shaped, strongly ribbed, glaucous, (17 x 15 mm.). W.A.

E. tetraptera: Turczaninow. C.R. Pt. xxii. 33; Vol. iii. 33.

A small ornamental shrub 4-10 feet high, with thick, leathery leaves, large quadrangular buds, and pink flowers. Seed-cups very large, (5 x 6 cm.). Sand plains, W.A.

E. tetrodonta: F. von Mueller. C.R. Pt. xlv. 139; Vol. v. 139.

A tree 40-50 feet; bark persistent, fibrous; juvenile leaves very long and broad; adult leaves long, lanceolate; buds campanulate, quadridentate; filaments yellowish; seed-cups medium to large, campanulate, with prominent teeth (15 x 11 mm.). Timber pale, hard. A tropical species. W.A., N.T., N.Q.

E. THOZETIANA TO E. URCEOLARIS.

E. Thozetiana: F. von Mueller. C.R. Pt. xi. 48; Vol. ii. 48.

An erect slender tree, 60-70 feet high, with fluted trunk, and moderately smooth bark; buds narrow, curved; seed-cups very small, (6 x 3 mm.). Timber brown, durable. Q.

E. Todtiana: F. von Mueller. Pt. xx. 306; Vol. ii. 306.

A small scrambling tree; bark sub-fibrous; juvenile and adult leaves narrow-lanceolate; buds elliptical to clavate, medium; seed-cups large, globose, (11-15 x 12-20 mm.). Timber brittle, non-durable. W.A.

E. Torelliana: F. von Mueller. C.R. Pt. xxxix. 239; Vol. iv. 239.

A tall tree, bark scaly on base of trunk, upper portion smooth, glossy, greenish-white; juvenile leaves broad, setose; adult leaves narrow; panicles terminal, many-flowered; buds semi-ovate; seed-cups roundish to urn-shaped, large, (10-15 mm.). Timber white to pale brown, excellent for waggon-building. N.Q.

E. torquata: Luehmann. C.R. Pt. xxxviii. 225; Vol. iv. 225; Pt. lvii. 348; Vol. vi. 348.

A small tree; bark rough, flaky; buds fluted, filaments pink or reddish; seed-cups fluted, medium, (12 x 10 mm.). An ornamental species. Sand plains, W.A.

x **E. Trabuti:** Vilmorin. C.R. Pt. lii. 79; Vol. vi. 79.

A hybrid; reputed parents, **E. rostrata** and **E. botryoides.** Algiers.

E. trachyphloia: F. von Mueller. C.R. Pt. xlii. 43; Vol. v. 43.

A medium-sized Bloodwood; bark rough, persistent; juvenile leaves narrow to broad lanceolate, peltate, setose; adult leaves narrow, finely veined; buds small; seed-cups medium, urceolate, (10 x 8 mm.). Timber brownish, soft, brittle. N.S.W., Q.

E. transcontinentalis: Maiden. C.R. Pt. xxxix. 268; Vol. iv. 268.

A small tree, with more or less smooth bark, with few flaky ribbons; foliage somewhat glaucous; buds beaked; seed-cups sub-globose to urn-shaped, small, points of valves protruding, (8-9 x 7-10 mm.). Timber reddish-brown, mostly used for fuel. N.S.W., V., S.A., N.T.

E. tropica: Cambage. C.R. Pt. lxxi. ; Vol. viii. ; Plate 289.

A tree 30-40 feet high, with a light-grey Box-bark on trunk and large branches; juvenile leaves thick, ovate to orbicular; adult leaves thick, ovate-lanceolate to lanceolate; seed-cups obconical to pyriform, valves exsert, (4-6 x 5-7 mm.). Tropical Q.

E. umbra: R. T. Baker. C.R. Pt. ix. 269; Vol. i. 269.

A small to medium-sized Stringybark; juvenile leaves opposite for an indefinite number of pairs, large, lanceolate, sessile; buds rostrate; seed-cups small to medium, mallet-shaped, rim slightly domed or convex, (5-8 x 6-10 mm.). Timber pale, durable. Coastal districts of N.S.W. and S.Q.

E. Umbrawarrensis: Maiden. C.R. Pt. lvi. 257; Vol. vi. 257.

Mountain Blue Gum. A large crooked tree; bark smooth, bluish or white, deciduous; leaves dull green, narrow-lanceolate; inflorescence paniculate; buds small, egg-shaped; seed-cups very small, goblet-shaped, (5 x 5 mm.). Timber yellowish. Rare. N.T.

E. uncinata: Turczaninow. C.R. Pt. xiv. 143; Vol. ii. 143; Pt. lvi. 262; Vol. vi. 262.

A slender Mallee, 4-10 feet high; seed-cups barrel-shaped, small (7 x 5 mm.). Confined to the southern coastal districts of W.A.

E. unialata: Baker & Smith. C.R. Pt. li. 8; Vol. vi. 8.

A medium-sized Gum tree, with more or less deciduous, ribbony bark; juvenile leaves narrow to broad lanceolate, sessile; adult leaves long, narrow-lanceolate; seed-cups in threes, medium to large, broadly top-shaped, valves protruding, (13 x 14 mm.). Timber pale. Rare. T. (See Group vi. 69.)

E. urceolaris: Maiden & Blakely. C.R. Pt. lxxi. ; Vol. viii. ; Plate 288.

An erect tree, 50-80 feet high; bark rough, sub-fibrous on trunk, branches smooth; juvenile leaves broad, slightly glaucous; adult leaves falcate-lanceolate; buds pedicellate, numerous in the head, long-pointed; seed-cups urn-shaped, (9 x 7 mm.). Timber pale pink, moderately fissile. N.S.W.

E. URNIGERA TO E. YARRAENSIS.

E. urnigera: Hooker, f. C.R. Pt. xviii. 261; Vol. ii. 261.

A tree, 15-20 feet; bark smooth, blotched with red and brown; juvenile leaves almost orbicular, sessile; adult leaves narrow; buds with low cap-like lid; seed-cups large, urn-shaped, (15 x 10 mm.). An alpine species, confined to T. (See Group vi. 70.)

E. vernicosa: Hooker, f. C. R. Pt. xxviii. 157; Vol. iii. 157.

An erect shrub, 6-12 feet high; bark smooth; leaves ovate, dark green, resinous. Seed-cups bell-shaped, small (7 x 7 mm.). Confined to T.

E. viminalis: Labillardière. C.R. Pt. xxviii. 167; Vol. iii. 167.

A large tree; bark more or less hard, and flaky at butt; otherwise smooth and white; juvenile leaves narrow-lanceolate, sessile; adult leaves rather long, lanceolate, sometimes undulate; buds in threes with cone-like lids; seed-cups small with rising rims and protruding valves, (5-6 x 7-8 mm.). Timber pale, in about third grade for durability. T., V., S.A., N.S.W. (See Group v. 64.)

E. virgata: Sieber. C.R. Pt. ix. 273; Vol. i. 273; Pt. xxxix. 283; Vol. iv. 283; Pt. lxi. 11; Vol. vii. 11.

A slender smooth-barked Mallee, 6-20 feet high, with coarse, glaucous leaves, and large angular buds; seed-cups medium to large, (12-14 x 11-13 mm.). Confined to cold, moist, barren peaks, mainly in the Port Jackson district, N.S.W.

E. vitrea: R. T. Baker. C.R. Pt. vii. 189; Vol. i. 189.

A small tree, with short scaly bark; branches pendulous; leaves long, with prominent veins; allied to **E. coriacea**; buds club-shaped; seed-cups small to medium, with reddish rim (10 x 9 mm.). Timber pale, inferior. V., S.A., N.S.W.

E. vitellina: Naudin. C.R. Pt. vii. 189; Vol. i. 189.

A small tree, closely allied to **E. vitrea,** but differing in the venation of its leaves. Seed-cups medium, (10 x 9 mm.). Habitat unknown. It is a French-grown hybrid.

E. Watsoniana: F. von Mueller. C.R. Pt. xlii. 40; Vol. v. 40.

A small yellow-barked Bloodwood. Bark rough, scaly, yellowish; juvenile leaves broadly lanceolate; adult leaves lanceolate-falcate; inflorescence terminal; buds large, club-shaped; seed-cups large, urceolate, (20 x 20 mm.). Timber pale, inferior. Q.

E. Websteriana: Maiden. C.R. Pt. xxxiv. 107; Vol. iv. 107; Pt. lxiii. 81; Vol. vii. 81.

A shrub 6-10 feet high, with smooth stems and rather short broad leaves; seed-cups goblet-shaped, small, valves protruding, (6 x 8—8 x 10 mm.). Sand plains, W.A.

x **E. Westoni:** Maiden & Blakely, C.R. Pt. lxix. 413; Vol. vii. 413.

A supposed natural hybrid, with a rough scaly bark, otherwise resembling **E. maculosa.** Federal Territory, N.S.W.

E. Whitei: Maiden & Blakely. C.R. Pt. lxviii. 369; Vol. vii. 369.

A small glaucous Ironbark; juvenile leaves oblong, obtuse; adult leaves glaucous, oblong-lanceolate; flowers in short racemes; seed-cups glaucous, semi-ovate, (5-7 mm. long). Timber dark brown. N.Q.

E. Wilkinsoniana: R. T. Baker. C.R. Pt. lxxi. ; Vol. viii. .

A medium-sized Stringybark; bark more or less furrowed, extending well out on the large branches; juvenile leaves elliptical to lanceolate, slightly denticulate; adult leaves lanceolate to falcate-lanceolate; buds small, usually pointed, 7-12 in the head; seed-cups hemispherical to sub-spherical, rim thick, valves small, exsert, (7 x 8 mm.). Timber pale, close-grained, of good quality. N.S.W., Q.

E. Woodwardi: Maiden. C.R. Pt. xvi. 213; Vol. ii. 213.

A tree, 40-50 feet; bark smooth, somewhat scaly at butt, all parts very glaucous; buds pointed, seed-cups bell-shaped, large (15 x 13 mm.). An arid species. W.A.

E. xanthonema: Turczaninow. C.R. Pt. lxi. 5; Vol. vii. 5.

A small Mallee-like species, with numerous slender stems and narrow leaves. W.A.

x **E. Yagobiei:** Maiden. C.R. Pt. liii. 118; Vol. vi. 118.

A supposed natural hybrid; assumed parents, **E. melanophloia** and **E. microtheca.** Seed-cups very small, valves protruding (5 x 5 mm.). N.S.W.

E. Yarraensis: Maiden & Cambage. C.R. Pt. li. 17; Vol. vi. 17.

A medium-sized tree with woolly bark on trunk and branches; leaves glossy, rather broad; seed-cups small, goblet-shaped, (6 x 7 mm.). Timber pale. Rare. V.

EXTRACTS FROM MAIDEN'S *CRITICAL REVISION,* VOL. 7, PAGES 397, 398, and 340.

EXAMINATION OF ORGANS AND GENERAL APPEARANCE IN THE BUSH.

Some of them promptly fade, or are readily deciduous. (The leaves, flowers, fruits of some species become discoloured and detached, although this does not specially apply to Eucalyptus.) Some organs, *e.g.*, bracts and bracteoles and outer opercula are usually only seen on the early umbel or operculum; they are deciduous and prone to shrivel. The most certain way to see them is on a visit to the tree. The colours of filaments soon fade, even amongst those classed as "white," which often should be recorded as cream-coloured, or even pale yellow. The anthers should, if possible, be studied from the fresh flowers. The shape of the bud, of the fruit, is best noted on the living plant, as the herbarium specimen always shows shrinkage, and sometimes different shapes. I have already (Part LVI. p. 331) drawn attention to the fact that the colours of young leaves, which fade almost as soon as gathered, can only be satisfactorily examined in the bush.

A proper knowledge of the foliage of seedlings, of shoots, and of their correlation, shapes, and general morphological characters, can be studied adequately only in the bush, and by many consecutive visits to the bush. In the days to come the refinements of the cinematograph will be applied, with the view to securing a permanent record of the growth changes of foliage and other organs.

Then, obviously, the best place to describe the general appearance of a tree is standing near it, a photograph being an inferior substitute. The appearance of the bark should be described while standing in front of the tree, especially as there are so many textures and colours. An axe-cut of the bark is valuable, but it should be borne in mind that the rough bark varies in the height to which it ascends up the trunk and branches, and this height of rough bark, the appearance of the smooth bark, and the diameter of the tree are all necessary data best recorded in the forest. An axe-cut of the timber may be taken at the same time, and the appearance of the fresh (and subsequently well seasoned) wood noted. The botanist never does any harm to the forest, and it is remarkable with what little sacrifice of plant-life he secures valuable data.

THE AESTHETIC ASPECT OF THE GENUS.

When the vastness of the genus and the infinite variety of the species is better understood by the average botanist, and he communicates his knowledge, obtained in the field, to the literary man, I am confident that the beauty and interest of Eucalypts will form the theme of many a poem, many an essay, many a descriptive account of an area more or less extensive. Eucalyptus is an intensely Australian theme, but no one not imbued with the Australian spirit will ever be able to properly handle it. I have casually referred (Part LII., p. 85) to the perennial interest of the Australian bush so far as the Eucalypts are concerned, and it is a matter of great satisfaction to observe that artists are endeavouring to understand Eucalyptus, a *sine qua non* if they desire to pictorially interpret it to others. Painters will arise who will be able to depict the characters of scores (and additional ones eventually) of trees, which possess their own individualities, not at present understood by the man, botanist or other, who is unable to devote the time necessary for a knowledge of those individualities, which must, obviously, precede their interpretation. Lister-Lister, Hans Heysen, and Gruner (to select but three) are artists who depict Eucalypts as they see them, and who do not attempt to produce results which the botanical student knows to be impossible.

HOW TO FURTHER THE STUDY OF BOTANY.

I hope that the morphological (minute and other) characters that I have brought under notice, will be found to include subjects of investigation for students in Universities, Technical Colleges, Schools, etc., and other workers for a long time to come. I have given frequent references, not only to elucidate or confirm statements, but also because I think they will be useful to teachers and students for the purpose just stated.

Of one thing I am certain, that a proper study of Eucalyptus must begin with the rising generation. I believe that, in the near future, children will be taught more of the wonders of the bush than hitherto, and to accomplish that end, photographs of typical trees and reproductions of selections from the beautiful drawings of Miss M. Flockton will be found in every school throughout the Commonwealth. These should be coloured wherever possible, for colour is a great help to the minds of children, and, indeed, of older people.

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