

The Essential Oils of the Eucalypts.

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THE timbers and the resinous exudations, or 'gums,' of the eucalypts have deservedly attracted much attention; but chemically, if not economically, the greatest interest of this leading genus of Australia centres around the eucalyptus oils. These 'essential' oils are produced abundantly in the minute leaf-glands of the eucalypts, and sometimes they may also be distilled from the bark and timber. Essential oils, as the name indicates, possess fragrant odours; they are more mobile and more volatile than the 'fixed' plant oils, with which they must not be confused; further, unlike the fixed oils, they are unassimilable, being in no way related to the fats.

The early settlers in Australia were quick to notice the value of the eucalypts as sources of essential oils. Dr. John White, surgeon-general to the first settlement, attracted by the strong peppermint odour of a common species growing around Port Jackson, was led to make the first distillation of a eucalyptus oil in 1788. In his "Journal of a Voyage to New South Wales" (1790, p. 227) it is recorded that "the name Peppermint Tree has been given to this plant by Mr. White on account of the very great resemblance between the essential oil drawn from its leaves and that obtained from the Peppermint (*Mentha piperita*) which grows in England. This oil was found by Mr. White to be much more efficacious in removing all cholicky complaints than that of the English Peppermint, which he attributes to its being less pungent and more aromatic." The species of eucalypt which furnished this oil is now known as *Eucalyptus piperita*, and it is common in the Sydney district and the Blue Mountain Ranges of New South Wales. It was sixty-six years later that the first eucalyptus oil factory was established in Australia by Bosisto, while the first chemical investigation was made by the French chemist, Cloëz, in 1870, upon an oil yielded by specimens of *E. globulus* grown in France. Such were the modest beginnings of the utilisation and scientific examination of eucalyptus oils.

Every Australian knows that a eucalyptus leaf, when crushed, often emits an agreeable odour; many know that these odours may vary considerably, from tree to tree, throughout a stretch of bush; and some are able to effect a rough classification of these trees, based upon such observations. Few, however, are able to proceed beyond this point, and it is remarkable that so little exact knowledge should exist, in the popular mind, of a genus which is rightly held in such esteem as an emblem of Australia. In remote parts of Tasmania 'bush-whackers' born and bred among the eucalypts have been known to assert that there are five kinds of 'gums'; but Australian men of science who have devoted their lives to a study of this wonderful genus have distinguished some two hundred and fifty species, and the tale is even yet incomplete. So interwoven are the relationships, so refined the distinctions, that in some instances discrimination between closely related species has been rendered

possible only through the combined efforts of the botanist and the organic chemist. Investigations of this nature, which were prosecuted with unflagging zeal through a period of more than thirty years by R. T. Baker and H. G. Smith, of the Sydney Technological Museum, have demonstrated the remarkable constancy of composition of the leaf-oil derived from any particular species of eucalypt, and have rendered possible a chemo-botanical classification of the various species, through the elucidation of certain remarkable relationships between chemical and botanical characteristics in the genus.

It is usually taken for granted that 'eucalyptus oil' consists mainly, or wholly, of the familiar eucalyptole, or cineole, the smell of which is so familiar during epidemics of colds and influenza. In point of fact, however, cineole is merely one out of about forty chemical components which have been discovered in the oils of this genus since 1870. According to the interesting evolutionary theory of Baker and Smith, the original eucalypts were evolved in north-western Australia from the still older genus *Angophora*, and such species still predominate in this region; the leaves in this group, of which the well-known Bloodwood (*E. corymbosa*) is an example, possess a 'feather' venation and are very poor in oil, of which the main component is the turpentine hydrocarbon, pinene. At the other end of the evolutionary scale, the most recently evolved species occur mainly in the south-eastern portion of the continent; the leaves have a 'butterfly-wing' venation and are thickly studded with oil-glands, so that the yield of oil may exceed four per cent. of the weight of the leaves and twigs. The Broad-leaved Peppermint (*E. dives*), a widely distributed member of this group, furnishes an oil consisting largely of phellandrene, in association with an interesting peppermint ketone, called piperitone, which promises to assume considerable importance as a commercial source of synthetic menthol and thymol. Certain oils in this group are used also in the flotation process for the separation of metallic sulphides from their ores. Cineole is the chief component of the oils from an intermediate group of eucalypts; it occurs as a rule in association with pinene, in such species as *E. globulus*, *E. Smithii*, *E. Australiana*, and many others. Oils of this type are used largely in pharmacy, and they are sometimes so rich in cineole that the crude 'first-hour oil' readily deposits a solid glacial mass of this substance when placed in a freezing chamber.

Chemically, therefore, it is possible to discern three main groups of eucalyptus oils; but in addition there are many exceptional species the leaf-oils of which contain such valuable components as geraniol (*E. Macarthuri*), citronellal (the Citron-scented Gum, *E. citriodora*) and citral (the Lemon-scented Ironbark, *E. Staigeriana*). As a rule, each chemical constituent is found to increase through a range of species until it reaches a maximum value in the final member. In exceptional

cases, such as that of *E. Macarthuri*, the end species alone appears to have survived. In spite of the intricate relationships in the genus, ability to discriminate between the main types is not particularly difficult to acquire. As a practical aid in such studies, an interesting record of the character of the leaf-venation and the disposition of the oil-glands may be obtained by making direct sun-prints of the leaves on sensitised paper. The identification of indigenous species in any particular area is helped by the fact that the chemical fastidiousness of the eucalypt is accompanied by an equally marked susceptibility to environment, so that changes in such factors as geological formation, rainfall, and altitude are reflected in the character of such species.

In harvesting eucalyptus leaves for distillation the trees may either be lopped or felled, and although the latter method may appear extravagant, yet experienced distillers often favour it. The phoenix-like eucalypt conforms to the general motto of the Australian flora, which is 'Resurgam!' It combines amazing vitality with unusual rapidity of growth; and so, after the lapse of a few years, the decapitated stump may have surpassed the ideal of Dean Swift by producing not merely two, but three, or even four, sturdy trunks where only one grew before. To that bizarre list of alleged Australian paradoxes which circulates so freely outside Australia, to the mingled amusement and annoyance of good Australians, may thus be added the less familiar but more truthful statement that a lopped or felled eucalyptus tree, rising on the stepping-stone of its dead self, may in a few years develop more foliage than it originally possessed.

The mallee scrub in the Wyalong district of New South Wales is treated in a still more drastic manner. The mallee, a type of eucalypt embracing many species, is a dwarfed form, having a number of small stems instead of the usual single trunk. In the western part of New South Wales, as also in South Australia and other regions, mallee eucalypts cover vast areas, and the essential oil of the Blue Mallee (*E. polybractea*), the dominant species in the Wyalong district, is worked extensively for cineole. A second species, *E. oleosa*, or Water Mallee, secretes water in its roots, a fact which was fully appreciated by the aboriginal inhabitants of Australia. Other important mallees are *E. odorata* and *E. cneorifolia*, from which the bulk of the South Australian eucalyptus oil is extracted; the last-named species occurs only on Kangaroo Island. In dealing with the Blue Mallee, the oil distiller flattens and partly uproots the mallee scrub by driving a heavy roller over it; and after the hardly used vegetation has dried in the sun he completes its apparent destruction by burning it off. The bare waste which repels the eye at this juncture seems to be devoid of any germ of life. In a short time, however, the irrepresible eucalypt reappears; a pleasing dull blue mantle of *E. polybractea* covers the landscape; and after the interval of a year the oil distiller is gladdened by the sight of a luxuriant growth of mallee rising to the height of his waist.

The harvesting of eucalyptus leaves from the mallee forms is simpler than from the trees, but the subsequent operations are the same for material from either source. In order to liberate the oil, the leaves are brought into contact with steam, which ruptures the oil-glands and causes a slow vaporisation of their contents. The primitive form of bush-still consists of the cubical iron tank so familiar to Australians; this contains the tightly packed leaves resting upon a grating, below which water is boiled by means of a wood fire underneath the tank. As the steam forces its way up through the mass of leaves it becomes charged with the vaporised oil, and the mixed vapours are condensed during their passage through an exit tube cooled by immersion in a creek, or in some more refined manner. The resulting mixture of water and oil runs down the tube and is collected in a receiving vessel, which is so constructed as to allow the relatively small layer of oil to be drawn away from the water upon which it floats. Other types of plant possess an independent boiler which supplies steam under pressure to a series of digesters, these latter being sometimes sunk into the ground to facilitate the handling of the fresh and the spent leaves.

The prices realised by eucalyptus oils range over a wide scale. The value of the oil depends upon its chemical composition, which, although sensibly constant for any particular species, varies enormously from one species to another. The Blue Mallee, for example, yields a cineole oil having a market value of somewhat more than a shilling a pound to the distiller, while the citronellal oil of the Citron-scented Gum of Queensland brought in as much as six shillings per pound during the War. The reputation of the cineole oils has suffered in the past, owing to the multiplicity of species yielding such oils and to the confusion which has existed between these species in the field. A vernacular name, such as Messmate, may easily be interpreted in half a dozen different ways, according to the tastes of the individuals concerned. It is therefore a satisfaction to find reputable oil distillers adopting the systematic Latinised names; and although the use of scientific nomenclature in the Australian bush may occasion some degree of surprise, yet—as a 'bushwhacker' once remarked in different words—there is nothing inherently difficult in the pronunciation of 'Eucalyptus Macarthuri,' and the name is decidedly more euphonious than the synonymic Camden Woolly Butt or Paddy's River Box. Fortunately, neither *E. Luehmanniana* nor *E. macrorhynca* is worked for oil!

As his readiness to use these strange names shows, the oil distiller is eminently adaptable; he has been known to write his letters with home-made charcoal ink by the light of a lamp burning the oil of *E. Macarthuri*. He is, indeed, a virile and picturesque Australian type, full of the lore of the bush. Let us hope that some day an Australian master will arise to do by him as Thomas Hardy has done by the tranter and the reddleman of Wessex.