

is not much mischief I have increased it to $\cdot 06$, or even $\cdot 1$. The next essential is to continue this maximum dose (if not contra-indicated), just as mercury in syphilis and creasote in phthisis, for as long as possible. I have given an average of $\cdot 02$ for over four years to one case, with the result that though his wife and two children have meantime died of phthisis, his own mischief has slowly lessened, his other lung remained unaffected, and his general health such that he has never missed a day away from work since he began the treatment. He still has a few bacilli in his sputum, apparently just as they are found in old cicatrised cavity walls in the *post-mortem* room, in patients who have died of some other disease. Though his local patch is not absolutely clean, I believe he has acquired through tuberculin a general immunity. This is the case in the second stage that was so unpromising that I at first declined to attempt any treatment.

Lastly, all other treatment, dietetic, climatic, and remedial, of value to increase the resisting power or favourably influence the bacillus or pyococci, may be and should be combined with the injections. They help generally; my contention and belief is that tuberculin helps specifically. And to it, or improvements on it, I look not only for the recognition of obscure tubercular mischief, and the cure of early tubercular disease, but for that preventive vaccination against the disease which alone can cope with the great tubercular scourge upon anything like an adequate scale.

NOTES ON THE EUCALYPTUS OILS PRESENTLY USED IN MEDICINE, WITH A SHORT HISTORY OF THE OILS USED DURING THE LAST TEN YEARS.¹

By GEORGE BELL TODD, M.B.

THE notes submitted for your consideration chiefly refer to the oils of eucalyptus used medicinally within the last ten years. Few substances have attracted more attention and evoked so much contention in the minds of pharmacists either at home or abroad as oil of eucalyptus. There is scarcely any other substance whose materia medica is so little understood on account of the differences of opinion regarding its original source.

¹ Read at a meeting of the Glasgow Medico-Chirurgical Society held on 3rd April, 1896.

Referring to the *British Pharmacopœia* of 1885 as our official guide, we find that oil of eucalyptus is distilled from the fresh leaves of *E. globulus* and *E. amygdalina*, and probably from other species of eucalyptus.

The uncertainty at that time which prevailed as to the source of the oil is confirmed when we turn to consider shortly the history of the oil first in Australia and then in other countries.

HISTORY OF THE PRODUCTION OF THE OIL.

In 1854 Mr. Joseph Bosisto, C.M.G., C.B., erected the first still for the distillation of the oil from the leaves. *E. globulus* and *E. amygdalina* being in most abundance in the neighbourhood of the distilleries were consequently more drawn upon. *E. amygdalina* was by preference mostly used, as it yields about four times greater quantity of oil than *E. globulus*.

It is important to notice that, although *E. globulus* yields only about one-fourth of the oil compared with *E. amygdalina*, it is a hardy plant, and suits itself to various climates. When young it possesses luxuriant foliage, and has always been a favourite with Australian horticulturists. From 1 lb. weight of the seeds of *E. globulus* alone it is said that 160,000 plants can be raised.

In 1856 M. Ramel had his attention drawn to the anti-malarial effects of *E. globulus*, and acting on the suggestion of Baron Sir Ferd. v. Mueller, botanist to the Government of Victoria, he reported to the French Government, who introduced the *E. globulus* species into Algeria between 1865-67, and shortly afterwards into Corsica. The most successful results followed in both instances, proving that the presence of these plants in marshy and unhealthy districts improved not only the health of the locality, but prevented the occurrence of malarial fevers in districts known to be pestilential in that respect.

In Algeria the French carried out the plantation of *E. globulus* on a large scale, which afterwards turned out a source of revenue to them, as we will soon relate.

As the *E. globulus* variety was the most persistently advertised, and the raising of the young seedlings had become a matter of industry, it is not difficult to see how this particular variety became transplanted in different parts of the world at or about the same time.

Thus, in 1870, we find that the plants had been introduced into the following countries and states:—Algeria and Corsica, already noted; Spain (Malaga), South of France, Italy, Sicily,

Holland, California, Louisiana, Mississippi, Florida, Mexico, West Indies, Brazil.

In 1871 M. Raveret-Wattel published a report on oil of eucalyptus to the Société d'Acclimatation de Paris, and besides dwelling on the sanitary powers of the plant, he recommends the oil for use in putrid fevers, and for application in cases of foetid suppurations owing to its marked antiseptic qualities.

In 1880 we again hear that the oil of *E. globulus* is antiseptic, and can be used as a substitute for carbolic acid, then the leading germicide; that it is also becoming largely used in the treatment of lung diseases by inhalation, and that its antiseptic properties are due to the eucalyptol it contains (a body which at that date had not been isolated).

In 1885, when eucalyptus oil became an officinal preparation in the British Pharmacopœia, it already had the same status in the Pharmacopœias of Belgium, France, and the United States; but not in those of *Austria, Denmark, Germany, or Russia*. At this time there was no reason to doubt that most of the oil of *E. amygdalina* and *E. globulus* was of Australian origin. It is therefore during the past ten years that we find such important changes taking place in the production and sources of the oil.

In the *Pharmaceutical Journal* (22nd October, 1887, pp. 907, 908), it is stated that Algeria and California are becoming powerful competitors with Australia for the production of *E. globulus* oil. Algeria was stated to be able to supply the product of 3,000,000 *E. globulus* trees. This is important considering that the plants themselves were only introduced into Algeria about twenty years before. In order to compensate for this it is mentioned that in Australia its manufacture was extending from Victoria to South Australia and Tasmania.

In 1888, while the Australian product was in a most flourishing condition, it was announced by both the French and American manufacturers that the Australian *E. amygdalina* oil was destitute of eucalyptol, while in Germany Messrs. Schimmel & Co., of Leipzig, reiterated a denial somewhat autocratically to the same effect (see *Pharmaceutical Journal*, 1st September, 1888, p. 64), which did much to harm its market value.

The matter was, however, investigated in Prof. Wallach's laboratory at Bonn by Herr Gildemeister (see *Phar. Zeitung.*, 22nd August, 1888, p. 494), who found a substance, *phellandren*, to be the principal constituent of *E. amygdalina* oil. Wallach

himself discovered a delicate test by which hydrobromic acid formed a eucalyptol compound (*Pharmaceutical Journal*, 28th July, 1888, p. 61). He also ascertained phellandren to be present, while eucalyptol was present in appreciable quantity.

On this point a discussion arose between those interested as to whether or not leaves of both *E. globulus* and *E. amygdalina* had not been previously mixed together before distillation. One would have thought that subsequent tests would have set this matter at rest. This was proved two years later by the late Mr. Davies and Mr. Pearmain of the Pharmaceutical Society's Laboratory, London (see *Year-book of Pharmacy*, 1891),¹ who gave a table showing the percentage of eucalyptol present in the fraction of *E. amygdalina* oil coming over at 170° to 175° C.

In this year (1888) a new oil made its appearance, distilled from the *E. maculata* var. *citriodora*, with marked antiseptic properties, and a delightful citron or verbena odour, manufactured at Gladstone, Port-Curtis District, Queensland, where they were using half a ton of the fresh leaves daily (see *Pharmaceutical Journal*, 12th April, 1889, p. 837).

After this time there is a notable falling off in the production of the Australian *E. amygdalina* oil.

In 1889 it became fashionable to hear and speak of the virtues of eucalyptol, the leaders being the Germans, who lauded its antiseptic qualities and its use in throat diseases. The Australian *E. globulus* oil, it should be noted, was found to be rich in eucalyptol, but it had to compete with similar products manufactured in France, Spain, and crude oil brought to Germany and refined. Being therefore far from the European market the Australian *E. globulus* oil next began to decline. In fact, at this time oil of *E. globulus* may be said to have reached its greatest production, seeing that it was being produced in increasing quantities, not only in Algeria, California, France, and Spain, but in Italy and Sicily. In consequence of this, it was certain that, the oil being derived from so many sources, its composition and quality were so very variable, remarks Mr. Holmes, Curator, Pharmaceutical Society's Museum, London, "that they could not be depended on, its odour particularly varying with nearly every sample, and presenting an opportunity for adulteration not to be thought of under conditions where uniformity of composition prevailed." It then became common to add turpentine as an adulterant,

¹ *Chemist and Druggist*, 22nd August, 1891, p. 293; *Pharmaceutical Journal*, vol. xvii, p. 235; *Pharmaceutical Journal*, vol. xxiii, p. 205.

as it can be added to the oil of *E. globulus* without interfering with the percentage of eucalyptol present.

As it was believed at this time that the usefulness of eucalyptus oil depended on the amount of eucalyptol it contained, in 1889 a new oil, prepared from *E. odorata*, was introduced from South Australia, where it grows in great abundance. Its therapeutic uses were claimed as equal to those of *E. globulus*, and it contained a very large quantity of eucalyptol.¹ In order to compete with this oil, it was announced that in Spain *E. globulus* oil had been found so rich in eucalyptol as to solidify in a cooling mixture to a white paste (see *Pharmaceutical Journal*, 12th October, 1889).

In 1890-91 the Australian distiller, Mr. Bosisto, along with other manufacturers, followed this up by introducing a new oil distilled from the *E. oleosa* (see *Pharmaceutical Journal*, 19th April, 1891, p. 940) as being very rich in eucalyptol, so that on being cooled it solidifies into a pasty mass.²

This variety is worthy of notice, as being the first oil obtained from what are known in Australia as the "mallee eucalypts," the term "mallees" being the aboriginal name for the dwarf eucalypts growing in the arid districts in the interior of Victoria, part of New South Wales, and South Australia. Mr. Robert Hedger Wallace, late agricultural expert to the Victorian Government, says—"They are shrubby in appearance, seldom more than 6 to 8 feet in height, and send up many stems from one short stock; their roots penetrate the substratum to a very great depth." They comprise a great many species, but the chief are *E. dumosa*, *E. oleosa*, *E. gracilis*, *E. incrassata*, *E. pyriformis*, *E. uncinata*, &c.

From South Australia, at Kangaroo Island, in 1891 an oil was obtained from *E. cneorifolia*, and which differs from any other in having the odour of dill or "cummin." Baron Sir Ferd. v. Mueller regarded it as a variety of *E. oleosa*. Mr. J. H. Maiden, of Melbourne, in *Notes on Australian Economic Botany*, p. 136, says—"It differs from any other eucalyptus

¹ The following details are given (see *Pharmaceutical Journal*, 20th April, 1889):—The crude oil has a specific gravity of 0.093 at 16° C., the rectified oil a specific gravity of 0.909 at 18° C.; very rich in eucalyptol, contains no phellandren. The residue from the rectified oil boils between 220° C. and 260° C., with a specific gravity of 0.945, and is used for incorporating with disinfecting soaps.

² It has a specific gravity of 0.923 at 15.5° C. In distillation 1 per cent passes over below 170° C., 72 per cent between 170° and 180° C. (this fraction contains almost all the eucalyptol present in the oil), 18 per cent between 180° and 190° C., and 8 per cent between 190° and 225° C.

oil he has examined, in having a secondary odour of 'dill' or 'caraway.'" This oil is rich in eucalyptol, from which it is extracted at present by Faulding's patent process, they being also the distillers of the oil. This oil is very rich in an aldehyde, cumminic aldehyde, resembling phellandren in its action.

In a paper read before the Pharmaceutical Society at London, 13th April, 1892, on "The *Eucalyptus* Oils of Commerce," by Mr. Holmes and Mr. C. B. Allen, it is pointed out that several eucalyptus oils, especially when recently distilled, possess an ingredient which causes a sense of irritation in the throat; they suppose the ingredient to be of the nature of an aldehyde; and it is suggested that its presence is probably of considerable importance from a therapeutic point of view, seeing that oil of eucalyptus is so largely used by inhalation in diseases of the lungs.

It is noted that oil of *E. amygdalina* and *E. dumosa* are preferred in Edinburgh and elsewhere, and that this preference seems remarkable in connection with the statement that *E. amygdalina* oil owes its medicinal value to the presence of eucalyptol, while the oil, on the other hand, has been shown to contain, without contradiction, a considerable quantity of phellandren.

It was also a remarkable fact that much of the eucalyptol that was first used in medicine consisted of the first portion passing over in the distillation of the oil, and contained a quantity of phellandren. The evidence, therefore, seems to point to the fact that oils containing "phellandren are preferred for the treatment of lung diseases."

Since 1892, I have used oil of *E. oleosa* and *dumosa* somewhat extensively by way of experiment, both in hospital and private practice, for inhalation in chronic bronchitis, phthisis, and in catarrhal cases, where there is a tendency to coughing set up by reflex action, with most successful results, particularly in a case lately under treatment at the Glasgow Samaritan Hospital, where the patient suffered from a large abdominal hernia, accompanied by a reflex cough which was set up immediately on assuming the upright position. Various remedies had been tried on former occasions, but without any relief.

My experience of the action of the oil is that the results are more marked now than four years ago, when the oil was sent direct from Mr. Bosisto, and that in keeping it in a cool place in its original package it has very wonderfully improved, and allowed of the development of its aldehyde constituents.

With regard to oil of *E. maculata*, var. *citriodora*,¹ which contains nearly 30 per cent of a "ketone" called "citral" or citronellon ($C_{10}H_{16}O_2$), and containing an alcohol, I have employed it in giving relief in asthmatic bronchitis. This oil contains no eucalyptol compounds whatever, still it is antiseptic. I have repeatedly treated gonorrhoeal cases, both acute and chronic, by its internal use with as good results as with ol. santal. flav., and without the characteristic odour of that oil appearing in the urine. In chronic cystitis I have found it useful where the patient refused to take the *oleosa* and *dumosa* oil.

It is also pleasant for inhalation in cases of catarrhal influenza, where the odour of eucalyptol or ordinary oils are objected to.

The oil is rather expensive and its employment is more that of a luxury, which necessarily limits its use.

Allied to the oil of *E. citriodora* are several scented oils, which although not in use commercially or medicinally, are of interest as showing how the absence of eucalyptol does not impair the antiseptic properties of the oil. Through the kindness of Mr. Thomas Cooke of the Research Department, Imperial Institute, South Kensington, I am able to show you samples of the following oils:—

E. Planchoniana (F. v. Mueller), of limited occurrence, found in the north of New South Wales and South Queensland. The odour of the oil is peculiar—allied to "citronella," but different from it.

E. Staigeriana (named after Mr. Staiger, of Brisbane, by Baron v. Mueller). It is the lemon-scented "ironbark" of Palmer river, Queensland. The leaves have the odour of scented verbena, and are obtained at Maytown. In addition to a lemon-scented ketone ($C_{10}H_{16}O_2$), it contains a considerable quantity of terpene. The oil has a specific gravity of 0.880, and boils between 190° and 230° C.

E. Baileyana (F. v. Mueller) named after Fred. Manson Bailey, F.L.S., colonial botanist, Queensland. A stringybark tree of northern New South Wales and South Queensland. It yields a melissa-like scented oil, strongly resinified, with a specific gravity of 0.940, and boils between 160° and 185° C. It contains some eucalyptol ($C_{10}H_{18}O_2$).

E. dealbata (A. Cunningham). It is found in dry situations in Queensland and New South Wales. The oil is believed by some to possess the finest odour of all the eucalypts. It

¹ This is a variety of the "spotted gum" of New South Wales and Victoria. It has a specific gravity of 0.905, and boils at 209° to 220° C.

contains a ketone like *E. citriodora*, and a body, probably an alcohol, with an odour resembling scented geranium.

Another oil I am able to show you is that derived from *E. hæmostoma* (Smith). It is midway between ordinary and the scented oils, and is produced commercially. It is one of the white gum-trees, is a common species, and it is found in Victoria, North New South Wales, and Queensland. The oil possesses a pleasant odour, described by Dr. Bancroft as intermediate between oil of geranium and peppermint. Messrs. Schimmel & Co., Leipzig, liken its odour to that of cummin oil. Mr. Maiden,¹ of Melbourne, says, "it is an oil which is quite *per se*, it is on the border-land between scented and ordinary eucalyptus oil." It has a specific gravity of 0.890, and boils between 170° and 250° C. It contains terpene, cymol, and menthon.

IMPORTANT CHEMICAL CONSTITUENTS OF EUCALYPTUS OILS.

Eucalyptol.—With regard to this constituent it is found that, if present at all in the oil, it will come over in the fraction of the oil distilling at 170° C., reaching its greatest at 175° C., and gradually diminishing till the temperature reaches 180° C. Its specific gravity, boiling point, melting point, and solidifying point, polarisation, solubility, &c., have all been investigated by the late Mr. Robert H. Davies, F.I.C., F.C.S., and Mr. Thomas H. Pearmain (see Pharmaceutical Conference, Edinburgh meeting, 25th August, 1892). It is the most important contribution on the investigation of eucalyptol yet published.

Melting point of the crystals,	0° to 0.5° C.
Solidifying point of the liquid,	1° to 0° C.
Specific gravity at 15.5° C.,9275
Boiling point at normal T. and P.,	174.5° C.
Polarisation, using a column of 220 m.m., uncorrected,	= -107.

They further established eucalyptol to be identical with cineol (specific gravity, .927; see *Watt's Dictionary of Chemistry*, vol. ii, second edition, p. 526). The eucalyptol shown here is made by Faulding's process (patented 1894). It consists in adding strong syrupy phosphoric acid to eucalyptus oil, when phosphate of eucalyptol is thrown down; this is decomposed in contact with water, and eucalyptol is set free. It is then collected in a perfectly pure state, and has a constant specific

¹ *Pharmaceutical Journal of Australasia*, Melbourne (December, 1889).

gravity, boiling point, melting point, polarisation, and has no odour of aldehydes. The solution contains 98 per cent of pure eucalyptol.¹

Phellandren.²—This substance is not prepared in a free state and is not yet manufactured except for investigation purposes. It is very difficult to obtain; even Messrs. Schimmel & Co., of Leipzig, wrote saying that they would require a little time to prepare the quantity I now possess. If present in oils of eucalyptus it comes over in the fractions with the lowest boiling points. It is very soluble in rectified spirits (2 to 1). It has a strong mint-like odour. The late Mr. Robert H. Davies and Pearmain give a test for its presence in oils like *E. amygdalina*—"When sodium nitrite is added to a solution of oil of eucalyptus in glacial acetic acid, a solid nitrite is formed if phellandren is present."³ Turns polarised light to the left (levo-rotary).

Terpene is a constituent of many of the oils, especially *E. globulus*; as 60 per cent in the form of "pineine," which is dextro-rotary. Also in the "mallee oils," as *E. oleosa*, *E. dumosa*, *E. uncinata*, *E. incrassata*, *E. cneorifolia*, *E. pyriformis*, *E. resinifera*, *E. hæmostoma*, *E. Baileyana*, *E. rostrata*, *E. odorata*, *E. Staigeriana*.

Ketones ($C_{10}H_{16}O_2$), "citral" or "citronellon," are found principally in the scented oils like *E. citriodora*, *E. Baileyana*, *E. dealbata*, *E. Planchoniana*, *E. populifolia* or "Bimbil box;" resembles "cajuput" more than any other eucalyptus oil.

Aldehydes.—Mint-like in *E. amygdalina* as phellandren; "cummin"-like in *E. cneorifolia* as "cumminic" aldehyde; amyl-like or verbena-like in *E. citriodora*, probably as an alcohol; geranium-like in *E. dealbata*, probably as an alcohol; lemon-like in *E. Staigeriana*, probably as an alcohol.

Acids and Alcohols.—The following have been obtained from *E. globulus* oil, coming over at the lowest boiling point:—Butyric, valeric, and caproic aldehydes, and amylic and ethylic alcohols,⁴ and a small quantity of tannin.

The following species have been tested for their oils, which are not yet produced in sufficient quantity to give them any commercial importance:—

¹ Eucalyptol is contained principally in *E. globulus*, *E. odorata*, *E. cneorifolia*, *E. oleosa*, *E. dumosa*, and other "mallees;" also in some scented oils, like *E. Baileyana*, *E. microcorys*, *E. hæmostoma*.

² *E. amygdalina* is the only commercial oil containing it.

³ See *Pharmaceutical Journal*, vol. xxii, p. 235; see also *Pharmaceutical Journal*, vol. xxiii, p. 205.

⁴ See *Pharmaceutical Journal*, 23rd December, 1893; Bouchardal and Oliviero in *Bulletin de la Soc. Chém. de Paris*, tome ix, p. 429.

E. viminalis (syn. "the manna gum tree"). The oil is yellowish-green, with a disagreeable odour. It boils between 167° and 178° C.; rich in aldehydes; specific gravity, 0·942.

E. corymbosa (syn. "blood wood tree"). The oil boils at 174° to 199° C.; specific gravity, 0·880.

E. leucoxydon (*sideroxydon*) (syn. "Victorian ironbark tree," also called "South Australian white gum tree"). Yields a large percentage of oil from the fresh foliage, equal to 1·060 per cent (Bosisto).

E. longifolia (syn. "woolly butt"). The oil has a strong camphoraceous odour; boils between 194° and 215° C.; specific gravity, 0·942.

E. obliqua (syn. "Tasmanian and Victorian stringybark" or "messmate stringybark tree"). The oil is of a reddish-yellow colour, with mild eucalyptic odour; boils between 171° and 195° C.; specific gravity, 0·899. The oil distilled from the fresh foliage equals 0·500 per cent (Bosisto).

E. rostrata (syn. "red gum tree"). This species is the chief source of the *gummi eucalypti* (B.P.), a ruby-red coloured exudation, intensely astringent to mucous membranes. Solubility, 80 to 90 per cent in cold water.

The oil, pale green, with an aromatic odour, resembles that of *E. odorata* both in smell and taste. Specific gravity, 0·918; boils between 131° and 181° C. Yields oil from the fresh foliage equal to 0·06 per cent (Raveret-Wattel).

E. tereticornis (syn. "flooded gum tree"), the "red gum" of Gippsland.

E. goniocalyx (syn. "Victorian spotted gum tree"). Yields oil equal to 0·914 per cent of the fresh foliage (Bosisto). It boils between 152° and 175° C.; has a very penetrating odour and pungent taste.

NOTES ON A CASE OF SCARLATINAL NEPHRITIS IN WHICH A GRAVE CEREBRAL LESION WAS FOUND *POST-MORTEM*.

By FRED DITTMAR, M.D.,

Late Senior Resident Physician, Kennedy Street Fever Hospital.

B. M'K., æt. 9 (female), was admitted to Kennedy Street Fever Hospital, Glasgow, on 27th March, 1896, suffering from scarlet fever.

The disease was of a very mild type, the temperature, which