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STRUCTURE OF VERATRUM VIRIDE.

BY EDSON S. BASTIN.

This liliaceous plant is a perennial herb native to eastern North America, and ranging in its habitat from Canada to the Carolinas. It prefers damp localities, such as the borders of moist thickets, the banks of mountain streams, etc. Its erect, leafy stem rises to the height of from two to seven feet and, except in the inflorescence, is unbranching. The leaves are three ranked, simple, broadly-oval, acute or acuminate, entire-margined, basi-nerved and plicate along the principal nerves, so that on their lower surface they present a strongly-ribbed appearance. They clasp the stem at their base and so ensheath it that a cross-section of its lower portion shows it to be enclosed in a succession of thin cylinders. The lower leaves, which are from six inches to a foot long, are the broadest, those above gradually decreasing in size and relative width to linear-lanceolate bracts, next the inflorescence.

The inflorescence consists of a terminal pyramidal panicle from eight to sixteen inches long, and composed of dense spike-like racemes of greenish-yellow, monceciously polygamous flowers, each subtended by a pointed bract.

The perianth consists of six pieces, the three outer (calyx) very similar in form and color to the three inner (corolla), except that they are a little longer. All of the pieces are distinct, or very slightly united at the base, lanceolate in outline, somewhat narrowed and thickish at the base, and ciliate-serrulate on the margin.

The androecium consists of six stamens, which are distinct, hypogynous, and shorter than the pieces of the perianth.

The gynaecium consists of a single, three-carpeled pistil, which is exteriorly three-lobed, and with three sessile, recurved stigmas. Internally, the ovary shows an axile placentation and numerous ascending anatropous ovules. The fruit is a septicidal capsule containing usually in each loculus from eight to ten flattish-oblong, membranous-margined seeds.

The plant is so similar to the European *Veratrum album* as to lead many botanists to regard it as only a variety of that species. The general

aspect of the two plants, however, is quite different, ours having greener flowers, its panicles more compound, and the component racemes more loosely flowered and less regular, and also having its leaves more pointed. The plate illustration conveys an idea of the general appearance of the plant.

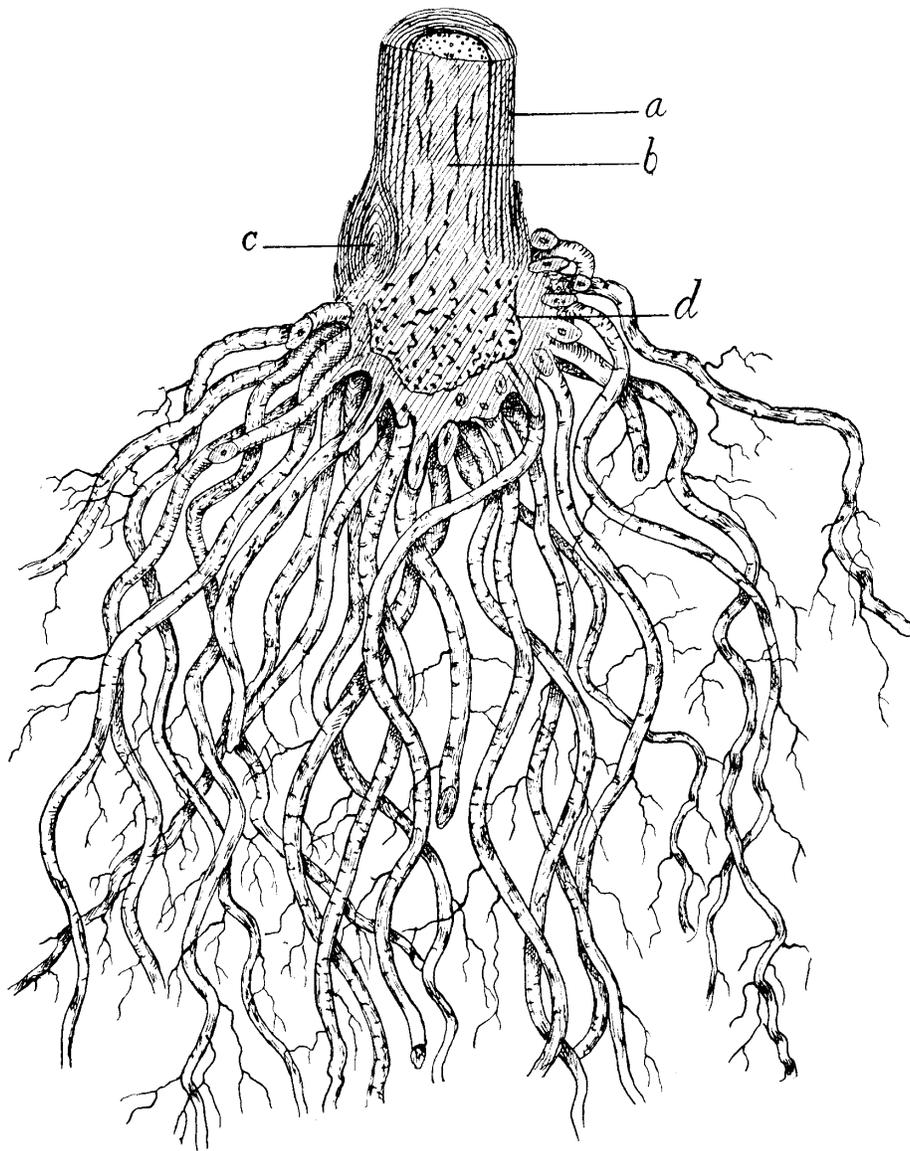


FIG. 1.

In our latitude the blossoming takes place in the latter part of June or early in July.

The rhizome is fleshy, upright or oblique, obconical, one and one-half to three inches long, and one to one and one-fourth inches thick at its

upper end, and densely covered with somewhat fleshy, simple roots, about one-twelfth of an inch thick and from six to ten inches long. Those toward the somewhat truncate lower end of the rhizome are dead, or, in older rhizomes, even withered away, leaving rounded scars. In the fresh state the roots are white, the older ones closely and irregularly wrinkled, while the younger ones are nearly smooth; but in the dried form the color is yellowish or yellowish.brown, and all the roots are much shrivelled and wrinkled. The wrinkling is due to the loosely arranged and thin-walled parenchyma of the cortex, and particularly to the numerous large, lysigenous, intercellular spaces in the cortex. Toward the lower ends of the roots are numerous fine fibrils, which, however, are only sparingly present in the dried drug.

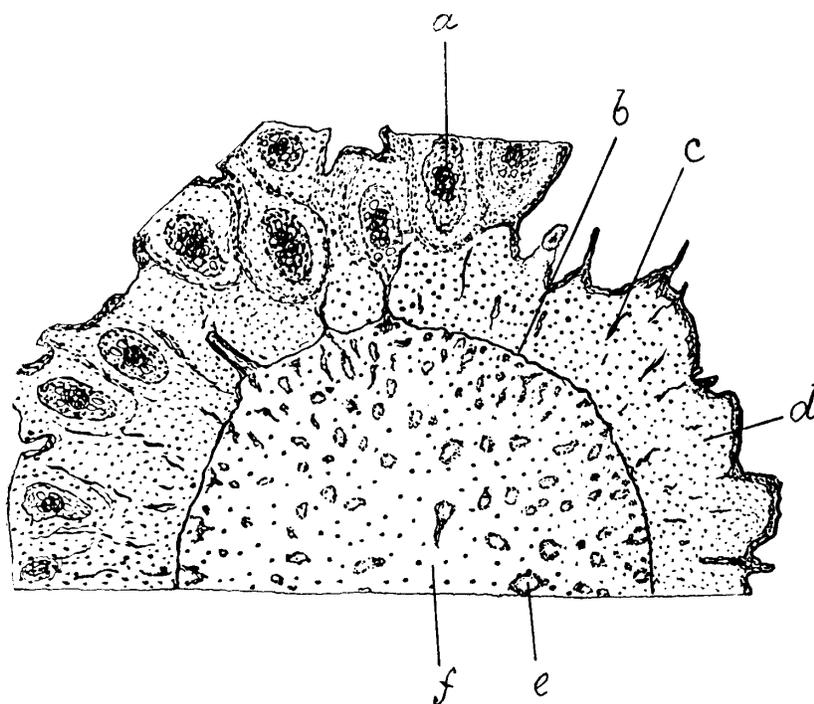


FIG. 2.

The central radial bundle of the roots is from eight to fourteen rayed, with conspicuously large scalariform ducts at the inner ends of the xylem rays, and very small ones at the exterior ends. The cells of the endodermis have their outer walls thin, but those of its cells which come opposite the phloem masses are conspicuously thickened in their inner and radial walls. Those opposite the ends of the xylem rays are usually but slightly thickened.

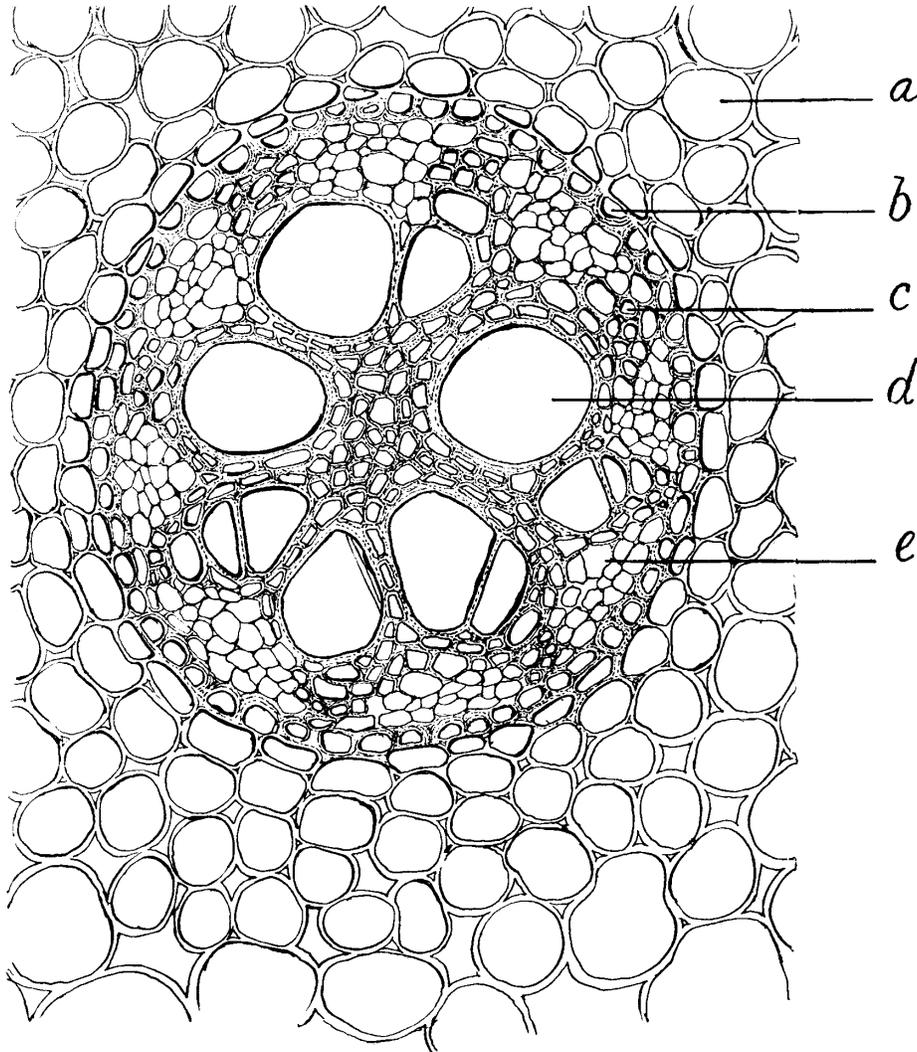


FIG. 3.

The rhizomes in the dried forms are dark brown, or blackish, exteriorly, usually crowned at their upper end with the remains of the solid above-ground stem, ensheathed by the numerous thin, tunicated leaf-bases. To facilitate drying, they are commonly split in a longitudinal direction, into two or more wedge-shaped or flat pieces. The fracture is short, and the color, internally, whitish. The cross-section shows a distinct cylinder sheath forming an irregular dark line between the central cylinder and the thickish cortex. The bundles are of the concentric type, with a small central phloem surrounded by two or three layers of small-sized scalariform ducts and tracheids, and these are bounded exteriorly by an endodermis. The ducts and tracheids are irregular in form and direction in the bundle. The bundles also pursue a very irregular course in the

rhizome, so that a cross-section cuts some of them transversely, others longitudinally, and still others obliquely, giving rise to the appearance of numerous irregular brownish dots and wavy lines, imbedded in the whitish parenchyma. In the cortex, the wavy lines and dots are also present, but less numerous, and toward the outside are seen the sections of the root-bundles near their origin.

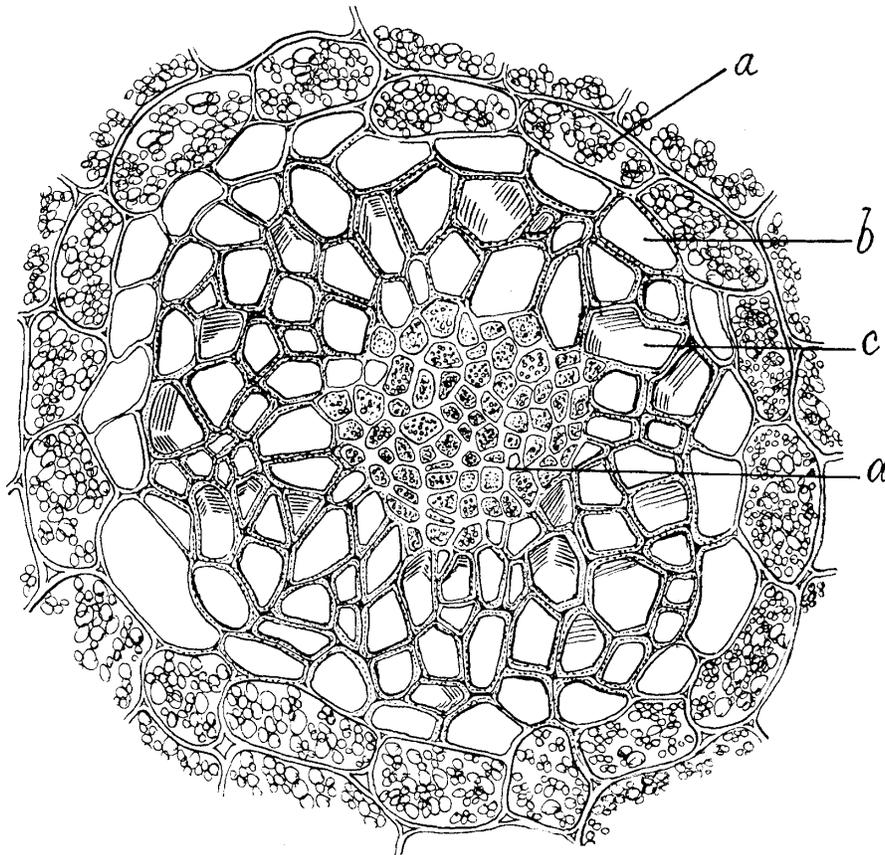


FIG. 4.

Owing to the peculiar course of its bundles, the appearance of the longitudinal section of the rhizome is not very unlike that of the transverse section.

The parenchyma of both roots and rhizome is rich in small-grained starch, and there are also in both scattered cells containing bundles of needle-like raphides.

The starch grains are sometimes nearly spherical, simple, and with a

central, and often fissured, hilum ; but they are more frequently compound, consisting of two, three, or sometimes of a larger number of easily separable grains. Stratification lines are only recognized with difficulty, even in the largest grains.

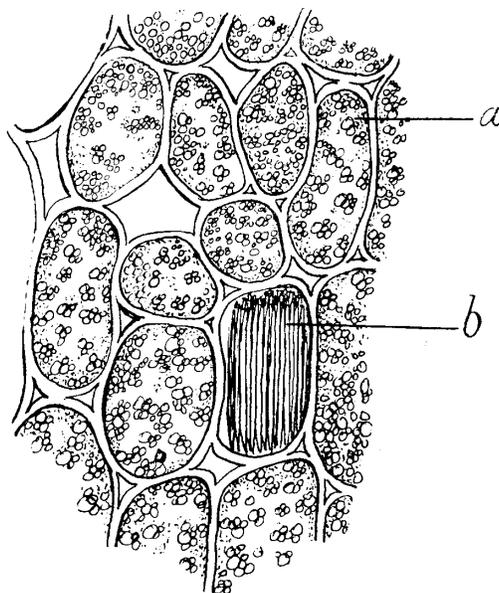


FIG. 5.

The writer has observed in one instance the fraudulent substitution of the rhizome and rootlets of *Symplocarpus foetidus* for those of *Veratrum viride*. The drug was so prepared that the incautious purchaser might easily have mistaken it for the genuine article, but the fraud could not have deceived a careful observer, for the roots of *Symplocarpus* are much coarser, averaging at least an eighth of an inch in diameter; the rhizomes also average considerably larger, the cortex is relatively thicker, the structure of the rhizome is more porous, the starch grains are much smaller, and the leaf-bases at the top are much less numerous and not tunicated. The foetid odor of *Symplocarpus* is also characteristic; but when the drug has been kept for some time, this odor becomes faint, or entirely disappears, and so is less reliable than the structural characters as a means of identification.

As between the rhizomes of *Veratrum album* and those of *Veratrum viride*, it would indeed be very difficult to distinguish by structural, or any other characters, if the drugs were trimmed alike. Fortunately, however, this is not the case, the rhizomes of *Veratrum album* having the roots mostly trimmed away, while those of *Veratrum viride* are not removed.

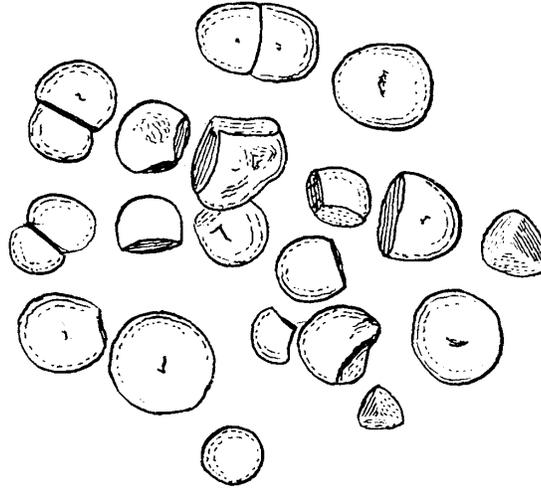


FIG. 6.

DESCRIPTION OF FIGURES.

Plate.—Plant of *Veratrum viride* in natural colors, about one-sixth natural size.

Fig. 1.—Longitudinal section of fresh rhizome, about one-half natural size. *a*, tunicated leaf-bases; *b*, above-ground stem; *c*, lateral bud; *d*, cylinder sheath.

Fig. 2.—Diagram of half of cross-section of rhizome magnified about five diameters, *a*, section of root near its origin; *b*, cylinder sheath; *c*, one of the wavy bundles in cortex; *d*, cortical parenchyma; *e*, a bundle of the central cylinder; *f*, parenchyma of the central cylinder.

Fig. 3.—Portion of cross-section of root, showing central radial bundle and a little of the surrounding cortex, *a*, cell of cortical parenchyma; *b*, endodermal cell opposite phloem mass; *c*, small duct at outer end of xylem ray; *d*, large duct at inner end of xylem ray; *e*, phloem mass. Magnification, 230 diameters.

Fig. 4.—One of the bundles of the rhizome, as seen in cross-section, magnified 370 diameters, *a*, cell of parenchyma exterior to bundle; *b*, cell of endodermis; *c*, scalariform tracheid in xylem; *d*, phloem tissues occupying centre of bundle.

Fig. 5.—Small portion of parenchyma of rhizome, magnified 230 diameters. *a*, cell heavily charged with fine-grained starch; *b*, cell containing a bundle of raphides.

Fig. 6.—A few starch grains of *Veratrum viride*, magnified 1,200 diameters.

AUSTRALIAN SANDARACH.

BY J. H. MAIDEN.

(Issued by the Department of Agriculture, New South Wales, and communicated by the author.)

Introductory.—It is a matter of common observation that a number of raw vegetable products of more or less importance are going to waste in Australia, simply because our people are ignorant of their properties and value. I can hardly cite a better instance than that of Australian Sandarach. Here we have a product absolutely and entirely identical in chemical and physical properties with a well-known article in regular demand. The price of this article at London auction sales is shown by the figures I give below (Appendix A), while its cost in Sydney is very much enhanced; and yet we actually import from Algeria, via London, at this high price, what is common enough in parts of New South Wales, and to be had for the gathering. The trees from which this resin (for Sandarach is a resin) exudes are the well-known Cypress Pines of this Colony, some species of which are found in the coast districts and tablelands, but they are far more largely developed in the drier parts of the Colony.

The collection of Australian Sandarach is one of those minor industries which could be readily undertaken by a family of children. As the resin flowed from the Cypress Pines, it could be accumulated in clean dust-proof tins, until a sufficient quantity was obtained to be sold to the local store-keeper, who would again sell to the wholesale chemist, or wholesale oil and color-man of Sydney. Sandarach is usually graded. There would be no difficulty in grading locally our local product, while any surplus available for export could be shipped without grading if found expedient.

I have no means of getting at the consumption of Sandarach in this Colony, but we ought to be able to supply the local demand and have a good surplus for export.

With these introductory remarks, I will give some further information in regard to Sandarach and Australian Sandarach, based upon a paper "On Australian and Tasmanian Sandarach," written by me and published in the proceedings of the Royal Society of Tasmania in 1889. I

do hope that educated men who may read what I have to say, and whose inclinations or duties carry them into districts where the native Cypress Pines grow, will take the trouble to encourage settlers and others to collect the product referred to.

Notes on Sandarach.—The Sandarach or gum juniper of commerce is the product of a *Callitris (quadrivalvis)*, which grows in North Africa. The following summary of its uses is taken from Morel (*Pharm. Journ.* [3] viii, 1024): "According to Gubler, the Arabs used it as a remedy against diarrhoea, and to lull pain in haemorrhoids. The Chinese used one kind (*C. sinensis*) as a stimulant in the treatment of ulcers (as promoting the growth of flesh), as a deodorizer, and to preserve clothes from the attacks of insects. In Europe it is used very little in medicine. It is most frequently employed as an ingredient in varnish, to increase its hardness and glossiness. It is used also as a fumigant, and in powder ('pounce') to dust over paper from which the surface has been scraped, to prevent the ink from running. It rarely enters into the composition of plasters."

Ordinary Sandarach exudes naturally, but the practise in Northern Africa is to stimulate the flow, making incisions in the stem, particularly near the base, and this hint might be borne in mind by our people.

When our Cypress Pines are wounded, the resin exudes in an almost colorless, transparent condition. It has obviously high refractive power, and is much like ordinary pine resin in taste, smell and outward appearance, when the latter is freshly exuding. This transparent appearance is preserved for a considerable time, the resin meantime darkening a little with age. Old samples possess a mealy appearance, but this is merely superficial. The origin of this appearance has been explained as follows in regard to *Sandarach*, and doubtless the simple explanation holds good here: "The surface of the tears appears to be covered more or less with powder, but this character is not to be attributed, as alleged by Herlant (*Etude sur les prodnits resineux de la famille des conif'eres*, p. 38), to the friction of the fragments one against another; but, as has been ascertained by a microscopical examination by Dr. Julius Wiesner (*Die chemisch-technisch verwendte Gummiarten, Harze und Balzame*, 1869, p. 129), to the unequal contraction of the resin while drying, resulting in a mass of fissures that form, as in the case of several kinds of copal, facets that gradually separate from the mass and constitute the 'powder' of many authors." (Morel, *op. cit*)

Evidence against Herlant's supposition is also found in the fact that resins of the *Sandarach* class are nearly *white on the trees* after they have been exuded some little time, showing that the appearance is brought about by exposure to the weather.

Australian Sandarach.—Australian Sandarach burns readily, and on the Snowy River (near the Victorian border) it is often mixed with fat by the settlers to make candles. The aborigines used frequently to use it for a similar purpose. Sir Thomas Mitchell (*Three Expeditions*, ii, 37) says: "Each carried a burning torch of the resinous bark of the *Callitris*, with the blaze of which these natives (Lachlan) seemed to keep their dripping bodies warm."

The *Callitris* resins soften slightly, but do not melt in boiling water, and a sample of commercial Sandarach behaves similarly. In the mouth they feel gritty to the teeth, and in no way different to Sandarach. When freshly exuded they are very irritating to a cut.

I will reiterate, at this place, in order to save'time, that the properties of Sandarach are shared by Australian Sandarach; I do not know in what respect they differ, and the one article may be substituted for the other.

It was a specimen of resin from the Oyster Bay Pine of Tasmania, sent to the exhibition of 1851, which first drew the attention of experts to the possibilities of Australian Sandarach. For "the fine pale resin of the Oyster Bay Pine (*Callitris australis*) from the eastern coast of Van Diemen's Land" and other gums and resins, Mr. J. Milligan was awarded honorable mention (*Jury Reports*, 1851, *Exhibition*, p. 182).

I have only alluded to naturally-growing trees, but Baron von Mueller. states: "Probably it would be more profitable to devote sandy desert land, which could not be brought under irrigation, to the culture of the Sandarach Cypresses than to pastoral purposes, but boring beetles must be kept off." Of course, Cypress Pine timber is very valuable, as it is ornamental, and one of the best of our timbers to resist white ants, but I propose to confine myself to the resin in this paper.

The various kinds of Cypress Pines.—Our Cypress Pines all belong to the natural order Coniferae (Cone-bearers), and are therefore allied to the pines, firs, spruces, etc., of the Northern Hemisphere. They belong to the genus *Callitris*, which is mainly a synonym of *Frenela*. [The word

Callitris is from the Greek *Kallos*, beautiful, in allusion to the appearance of the trees. *Frenela* is in honor of M. Frenel, a former member of the French Academy.]

In the Australian Colonies there are twelve species of *Callitris*, and some of them have varieties more or less marked, so that there are a goodly number of Australian Cypress Pines. Four of the species (*Roci*, *Drummondii*, *Actinostrobus* and *acuminata*) are confined to Western Australia, and have, of course, but a limited interest to us in the eastern colonies. *C. oblonga* is only found in Tasmania.

The Cypress Pines that are found in New South Wales, and which therefore especially interest us, are seven, namely:

(1) *Callitris Macleayana*. "Port Macquarie Pine," an elegant species now often seen in gardens.

(2) *C. Parlalorei*. "Mountain Cypress Pine." "Stringybark Pine." These two species are closely allied, and are both found in the North Coast districts. They are not as abundant nor do they yield Sandarach as freely as the other species.

(3) *C. verrucosa*. The "White or Common Pine," often known simply as "Pine" or "Cypress Pine," but also as "Mallee Pine," "Rock Pine," etc. Well known under its name of "Murray Pine." It is the most widely diffused of all the Cypress Pines, being found in every one of the mainland colonies. It is easily known by its rather ornamental warted cones.

(4) *C. columellaris*. This is usually known as "Cypress Pine," and it attains a great size. It appears to be confined to the coast districts and moderate elevations of Northern New South Wales and Southern Queensland.

(5) *C. Muelleri*. "Baron Mueller's Cypress Pine," "Mountain Pine." This species is often very ornamental. Its range does not appear, at present, to be very well defined. I have collected it at Middle Harbor, Port Jackson, and in the Blue Mountains (Mount Victoria). It has been sent to me from the Illawarra. Mr. Baker has collected it at Rylstone in the Mudgee district.

(6) *C. cupressiformis*. Perhaps better known by its synonym of *rhomboidea*. This pine I believe to have been a good deal confused (in New South Wales) with the preceding. Of course, the cones are quite different. It is usually simply known as "Pine" or "Cypress Pine." It is extensively diffused in the coastal districts.

(7) *C. calcarata*. Better known under its synonym of *Frenela Endlicheri*. Everybody knows it under its name of "Red or Black Pine," whose timber is so largely used in the western parts of the Colony where white ants are prevalent. I need not further allude to the species here.

Of the above, *C. verrucosa* and *C. calcarata* will be found by far the most important from a commercial point of view, but the others all produce excellent Sandarach.

EXPERIMENTS ON SOME AUSTRALIAN SANDARACH OF VARYING QUALITY FROM VARIOUS SPECIES.

Having learned what sandarach is, and what Australian trees produce it, the following notes of observation and of incomplete experiments on definite Australian sandarachs will be interesting. To push the experiments further than I have done would be more of scientific than of economic interest.

My experiments tend to show this: Given similar circumstances in regard to size and age of tree, season of flow, climatic conditions, etc., the sandarachs from all the species are precisely similar in chemical and physical properties. Conversely it follows that if two specimens of sandarach are of different qualities, the explanation is to be found in the circumstances above enumerated. What is the best season to collect sandarach or to bleed trees in a particular district, is only to be learned by experience, and I think I have said enough to show that it is worth the trouble to try and find out.

Callitris verrucosa, R. Br. (Syn. *Frenela robusta*, A. Cunn). A sample of "Murray Pine" resin from Quiedong, near Bombala, has a pale bleached appearance, much lighter than ordinary sandarach. Externally it has a very mealy appearance. Water has no effect on it. In rectified spirit, it almost wholly dissolves, leaving a little whitish resinoid substance. Petroleum spirit dissolves 5 per cent. of a perfect colorless and transparent resin.

Speaking of "Mountain Cypress Pine," or " Desert Pine" (*C verrucosa*), the catalogue of Victorian Exhibits, Colonial and Indian Exhibition, 1886, states: "A sandarach in larger tears than ordinary sandarach is yielded by this species. It yields it in considerable abundance, 8 or 10 ozs. being frequently found at the foot of a single tree, but although this exudes naturally, the supply is stimulated by incisions."

"It is a transparent, colorless or pale yellow body, fragrant and friable, fusing at a moderate temperature, and burning with a large smoky flame; very soluble in alcohol and the essential oils, and almost totally so in ether; turpentine at the ordinary temperature does not act upon it, nor do the drying oils, but it may be made to combine with these solvents by previous fusion." (*Report on Indigenous Vegetable Substances, Victorian Exhibition, 1861.*)

This resin was used to make firm the union (after lashing) of the hardwood head to the reed in the making of reed spears by the aborigines of Victoria, The resin was called by them Bij-jin-ne. (Brough Smyth, *Aborigines of Victoria*, i, 306.)

A sample of New South Wales resin of this species is of a dark amber color, and, externally, possesses the dulled appearance found on lumps of amber. It is the darkest specimen of an Australian Sandarach hitherto examined by me. It almost wholly dissolves in rectified spirit, yielding a bright yellow liquid, leaving 2-5 percent. of insoluble residue. Petroleum spirit removes 22-8 per cent. of a clear resin when the original substance is digested in it.

Callitris verrucosa, R. Br. (Syn. *C. Preissii*, Miq. partly). The following note by Dr. Julius Morel (*Pharm. Journ.* [3], viii, 1025) in regard to a specimen of South Australian resin, is interesting: "With Sandarach resin may be connected another resinous substance, which was exhibited in the Paris Exhibition of 1867, from South Australia, under the name of "Pine Gum." It is the resin of *Callitris Preissii*, Miq. The product resembles Sandarach, and might become an important article of commerce . . . This resinous substance occurs in the form of slightly yellowish tears, thicker and longer than those of ordinary Sandarach. In consequence of unequal contraction it presents, like Sandarach, numerous facets, and, consequently, the surface appears to be covered with a white powder. In its transparency and hardness the resin

corresponds to Sandarach. Its odor is very agreeable and balsamic, and the taste is bitter and balsamic."

Callitris columellaris, F. v. M. (Syn. *Frenela robusta*, A: Cunn: var. *microcarpa*, Benth.). A sample of resin from this species dissolves almost entirely in rectified spirit, forming a pale yellow solution. The insoluble residue amounts to 4.6 per cent. Petroleum spirit, when digested on the resin, removes no less than 35.8 per cent. of a transparent, colorless resin. This is a remarkable percentage, and it would be interesting to inquire whether Australian Sandarach becomes increasingly soluble in that menstruum by age. An ordinary sample of commercial Sandarach yielded 8.9 per cent. to petroleum spirit.

Callitris cupressiformis, Vent.: "The Oyster Bay Pine of Tasmania," partly. This is the pine already referred to, and a brief account of the resin has been copied into many of the text-books. I have collected resin of this species from Port Jackson, clear and transparent as water. It turns pale amber-colored if placed in a bottle, but its brilliancy shows no sign of diminution in that time. The Sydney trees readily exude their resin on slightly wounding, and the same remarks apply to the Tasmanian.

Callitris calcarata, R. Br. (Syn. *Frenela Endlicheri*, Parlat). A sample of Red Pine resin from the Lachlan River has freshly exuded, and has the color and appearance of best selected Sandarach. Rectified spirit nearly wholly dissolves it, forming a beautifully clear, slightly yellowish liquid, with 1.3 per cent. of residue. Petroleum spirit extracts 22.1 per cent. of an apparently perfectly colorless and transparent resin.

APPENDIX A.

Gum Sandarach.

London, 11th May, 1892.—The market is very dull. At auction sale last Thursday a few packages sold, without reserve, at 59s. 6d. to 61s. for fair palish gum.

London, 16th September, 1893.—Sold cheaply to-day at a decline of about 3s. to 4s. for a parcel of 13 casks, offered without reserve; it brought from 72s. to 74s. per cwt.

London, 14th October, 1893.—A parcel of 12 casks sold cheaply, without reserve, at 65s. per cwt., one lot realizing is. more.

London, 25th November, 1893.—Nineteen casks sold very cheaply to day; ordinary dirty and dusty at 48s. 6d., medium quality at from 64s., rising to 69s. per cwt.

London, 3d March, 1894.—Seven casks, mostly oil damaged, sold, without reserve, with fair competition, at 41s. to 56s. per cwt.

The latest London quotation of a wholesale London firm is 125s. per cwt.