NOTES ON

BLACKBOY AND ITS GUM

(Extracted from Forests Dept. file 589/40)

XANTHORRHOEA - BLACKBOY

INTRODUCTION.

Over many years a great deal of investigation work has been carried out on the commercial uses of the blackboy and its various derivatives. A great deal of this work has been lost to other investigators and the community generally through lack of recording of results. The writer has endeavoured to collect and summarise all available material on the subject to serve as a basis for future investigations and as a source of reference for enquiries on any particular phase.

SPECIES AND DESCRIPTION

Xanthorrhoea, shrubby or arborescent plants somewhat palm like in appearance and having long wiry narrow leaves is a genus confined solely to Australia.

Some 16 species of the plant are distributed throughout the Southern portion of the Commonwealth, of which the more commonly occurring are Xanthorrhoea Hastilis and X. Arborea (New South Wales and Queensland), X. Australis (Tasmania and Victoria), X. tateana (Kangaroo Island, South Australia) and X. Preissii and X. Reflexa (Western Australia). In this latter State are also found X. Gracilis, X. Brevistyla, X. Nana and X. Thortoni.

The name Xanthorrhoea was derived from words meaning "yellow" and "to flow", and was given to these plants first seen in N.S.W. which exuded a yellow gum - like resin. Species were later found, however, to exude a red resin, wrongly called "gum".

Although frequently called the "grass tree", this is definitely a misnomer as the genus is not a grass in any sense of the word. It belongs to the family "liliceae" and is therefore a lily. In W.A. the name "grass tree" is not now used with reference to the blackboy, but is used to describe the Kingia Australis which is rather similar in appearance to the Xanthorrhoea. (See pamphlet).

The blackboy is constructed of a centre core of a very fibrous somewhat spongy material, sometimes hard enough to be termed wood, which contains a large amount of easily fermentable sugary substance and is surrounded by a thick coating of "husk" formed of the persistent bases of the old leaves lying very closely packed together, and more or loss cemented by resin into a hard coherent mass. When the plant dies the core rapidly decays, leaving the husk as a thick cylindrical tube. In X. Preissii, the internal diameter varies from 2" to 6" and the external from 6" to 14".

The plant has no tap-root, the stem seldom extending more than 8" or 10" into the ground where it ends abruptly. Its hold upon the soil is rendered strong by reason of the numerous roots that run out for several feet around and beneath it.

In flowering a long cylindrical spike of white flowers makes an appearance giving rise to a black spike of seed capsules after fertilisation. (The Kingia Australis differs from Xanthorrhoea in having a drum stick like formation of inflorescence and contains no gum). *

Much doubt exists as to the rate of growth of the plant, it being frequently stated that Xanthorrhoea is one of the slowest growing types of vegetation known. Many old Western Australians assert that the blackboys which have been under their notice for forty or fifty years do not appear any bigger now than they were when first seen. This, no doubt, is accounted for by the fact that X. Brevistyla and X. Nana seldom exceed a stem height of from 9" to 12", and that variation in soil, rainfall, etc. will have an effect

* Reference No. 1.

It is interesting to note, however, that under favourable conditions the rate of growth of X. Preissii is not so slow as has been imagined. In 1901, on the appearance of a few blackboy leaves above the ground in his garden, a Cottesloe (W.A.) gardener decided to protect the plant for observation purposes. In 1923, the trunk height as measured by the Government Botanist was found to be 31" to the base of the crown of leaves, the average rate of growth being then 1.4" per annum. Further observation by the Divisional Forest Officer for Carinyah, who measured a specimen of X. Preissii growing on an old disused whim track that had been worked over some 35 years before (when of course the blackboy had either been reduced to the ground level, or else had not yet commenced growing) indicated that the trunk height being 15" from ground level to the top of the dry leaf bases, the minimum rate of growth must have been approximately 1/2" per annum.

It should be remembered that no information was available as to the date of germination of the above plants, which may have been comparatively well developed before building had commenced in the one case, or the whim track opened up in the other. They would probably have then been levelled to ground surface during those operations. Such plants with well-developed root systems would immediately commence growing fairly rapidly once the obstacle to growth had been removed.

It is interesting to record that the gardener of the University of W.A. has introduced a specimen of X. Preissii (of which he has recorded the date of germination) into a special section of the grounds, and intends recording observations as to rate of growth.

Though the N.S.W. variety are mostly dwarf in character, X. Tateana (Kangaroo Island, South Australia) and X. Preissii and X. Reflexa (Western Australia) grow to much larger size. The tallest blackboy of which records have been seen in Western Australia was found growing 4 miles from Cape Naturaliste Lighthouse and had an extreme height of 26 feet. The girth was 5 feet, being practically the same at the top as at the bottom. No branches had formed. The species X. Preissii and X. Reflexa grow generally to a height of 12 feet or so, single plants weighing as much as 1½ tons.

LOCATION IN WESTERN AUSTRALIA.

Blackboy is to be found growing over extensive areas in Western Australia. X. Preissii is generally found from Gingin and Perth as far south as Albany, the biggest supplies probably being found along the South-West Railway line from Armadale to Marcoona. It is characteristic of the Darling Ranges and Jarrah forest of the South West.

X. Reflexa, unlike X. Preissii, has a stem not often branched The species occurs in open formation, principally around Popanyinning and East of Narrogin, being distinguished in the field by the fact that the dead leaves, instead of remaining spread out, hang around the stem in the form of a skirt. They are more typical of the Wandoo forests of the Great Southern Railway - a region of lower rainfall.

X. Gracilis is a low species without a trunk and occurs near Perth.

X. Brevistyla is also a small form, the trunk extending perhaps 9" above ground level. They occur between Cuballing, Wagin and Yilliminning.

X. Nana is also a low growing form and is found on the arid sand plains between Bendering, Merredin and Tammin.

X. Thorntoni is an arborescent form (5 ft. to 8 ft.) and occurs on the mulga country to the North of Laverton.

* Reference No. 2.

* Reference No. 14.

It is estimated that on poor Crown land where blackboys grow in close formation, an average yield of 40 tons per acre can be obtained, yielding approximately 27 tons of "husk" or outside portion, and 13 tons of core.

BLACKBOY PRODUCTS.

The utilisation of blackboy can best be covered under the following headings:-

1. The Outer Husk or Sheathing material, the products of which may be further subdivided into -
   (a) Products from direct conversion of the resin substance.
   (b) Products from distillation of the husk material.
   (c) Other Products.
2. The Inner Core.

1. THE OUTER HUSK

(a) Direct Conversion of Resin.

Methods of Obtaining. The earliest and most primitive way of obtaining the resin was by breaking from the trunks, or gathering from the ground, the exudations that resulted from the passing of bush fires; and although the material was generally fairly free from foreign matter, the recovery was obviously poor.

Later, two general methods were introduced in -

1.- Crushing the leaf bases, and sifting for the recovery (in a powder form) of the resin that lodges both on the leaf base, and within the hollow end.

2. Crushing the leaf bases, and then steam heating under pressure at a temperature above 250°F., when an attractive, clear resin was run off in liquid form. About one-third more is obtained this way, than by the previous.

The resin varies in colour according to the species and the nature of the soil, the Western Australian species X. Preissii producing a red-coloured resin, and the South Australian species X. Tateana giving a yellow-coloured resin. As a general rule the lighter soils produce a lighter coloured resin, the lateritic soils producing a darker variety.

Quantity of Resin Obtained.

No direct information has yet been obtained by the writer relative to the quantity of resin obtained per ton of blackboy. It has been reported, however, that the yield of yellow resin is about 3 lbs. per tree, and that the red resin may average 40 lb.

Chemical Composition of Resin.

The resin is soluble in ether, alcohol, and caustic potash, the two types - yellow and red acaroides being thus treated. Fairly comprehensive details as to chemical composition, and the results of distillation and fractionising will be found in "The Essential Oils" by Horace Finnemore, and in "The Useful Native Plants of Australia" by J.H. Maiden. See also C.S.I.R. references in File 1122/32.

BYE PRODUCTS.

Preservative for Wood.

Mr. W.E. Cohen (C.S.I.R.), in a preliminary investigation conducted in 1932 on the value of Xanthorrhoea Preissii resin as a preservative of timber against termite attack, reported that the material had distinct possibilities. Results indicated that the resin was at least distasteful to termites.

* Reference No. 9.
ø Reference No. 5 (a)

Alcoholic solutions of 2, 4, 6, 8, 10 and 12 grams of the resin per 100 c.c.s. (and also solutions of the steam volatile constituents) were prepared. Results showed that the distasteful material lay in the non-volatile constituent of the resin, the steam distillation being not desirable.

General conclusions arrived at were that should the resin of X. Preissii be economically practicable to use, it may prove to be a successful preservative against termites.

Picric Acid.

During the World War, the Munitions Department in England made experiments with blackboy resin for the production of picric acid (used in explosives) and were quite satisfied with the yield, the resin apparently producing up to 50% of its weight in this form.

Mr. A.E. Mann, a former W.A. Government Analyst, reported after experiment, that direct nitration gave best results, a yield of 51% of picric acid being obtained.

For commercial purposes, however, it is understood that picric acid is produced more economically from phenol (carbolic acid), Stenhouse showing that phenol yields approximately 4 times as much picric acid as Xanthorrhoea resin weight for weight as much less expenditure of nitric acid.

Apparently a greater recovery of picric acid is obtained from the resin when this latter is simply sifted and winnowed after the crushing of leaf-bases, rather than by the melting process.

Stains and Lacquers.

Although the resin or "gum" has been used principally as a colouring for varnishes, as a stain, and as a base in various metal paints, the utilisation seems to have been confined to the cheaper and inferior types.

The varnish has several defects. Unless the solution is concentrated, it has little body and readily sinks into the wood. If it is too concentrated pronounced "checking" appears after a day or two.

Mr. W.E. Cohen (C.S.I.R.) indicated that application as a shellac is limited due to sparing solubility of the "gum" in any spirit solvents but alcohol and ether. The "gum" also becomes brittle, and apparently an application to metallic surfaces exposed to moist air, is likely to develop white patches. It also appears that the use as a lacquer for stirring purposes is restricted, due to darkening and decomposition taking place with heat treatment.

Mr. Earl, however, carried out an interesting experiment in which he removed all the free acids by hot caustic soda at 25 to 30 lbs. pressure, which hydrolysed and esters and removed all the acids. He then prepared varnishes from the treated and untreated resins, pured these on glass plates and allowed them to dry for a few weeks. He then immersed them side by side in water. The sample from untreated resin showed opaque patches after two hours' immersion and was thoroughly opaque after four hours, whereas the sample from the treated resin was hardly affected.

Attempts have been made to bleach the resin, but treatment of an alkaline solution with bleaching powder, and also with activated charcoal have not been successful. In 1930 advice was received that further work was being considered by the C.S.I.R. in this direction. Apparently the gum was readily decolorised, but exposure to sunlight gave a darker product than the original gum.

ø Reference No. 5 (b)
+ Reference No. 9
* Reference No. 5.

Miss. H. T. Cole, B.Sc., during 1931, carried out some experiments at the University of W.A. with the object of removing or reducing the colour from the red resin of X. Preissii. The experiments were of two types, dependent on whether the colour was due to a highly coloured constituent, or whether the resin was itself coloured.

Miss Cole came finally to the conclusion that the colorization probably lay in the resin itself, and that though partial decolorisation was obtained by treatment in various ways with Zinc dust, most of the products were not very stable.

It was found the resin was very soluble in caustic soda, and partly soluble in sodium carbonate, borax and lime. Among the organic solvents alcohol or methylated spirits, acetone and ether readily dissolved it. It was also soluble in chloroform, ethyl acetate and acetic acid.

Dyes.

The colour of the resin is difficult to remove and seems to be rather stable. The possibility of use as a dye was therefore suggested, and the Imperial Institute carried out work in this connection. A number of silk and woollen materials were shown which were said to have been dyed by dyes from X. Tateana. The colours were from yellow to dark brown, but were not fast to soap. The Imperial Institute obtained a number of colours from pale yellow to deep brownish black by various mordants, on wool and silk, but the colours were weak compared with fustic.

There were also disadvantages, viz. the large amount of resin required, and also the fact that it had to be used in alkaline solution, which is especially undesirable for wool. The resins were unsuitable for cotton. The dyes obtained could not compete with the natural and synthetic dyes already in use.

(b) PRODUCTS OF DISTILLATION.

The outer sheathing of the blackboy on distillation yields many substances which may possibly be of some commercial value. Among these products are drying oils and turpentine suitable for paints and varnishes, wood preservative, tar, coke, binding material for briquetting powdered fuels, and light, middle and heavy oils with their resultant products of distillation.

ø/ The yield depends on the manner of treating (whether treated after drying or not) it being found that the extreme limit yield obtained per ton of "husk" material used is -

(1) 35 to 45 gallons of water.
(2) 25 to 30 gallons of liquor containing 12% to 15% of acetic acid; 4% to 5% of methyl alcohol, and 2% to 3% of light spirit.
(3) 25 gallons of crude oil containing 10% of light oil; 10% of medium oil; 15% of phenols and acids, and 60% of pitch.
(4) 8 cwt. of coke residue of approximately 14,000 B.T.U. per pound, calorific value.
(5) 5,000 cu.ft. of gas having a calorific value of from 300 to 350 B.T.U. per cubic ft.

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ø Reference No.2. (a)
oo Reference No.10.

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*METHODS OF DISTILLATION.

Mr. Rowley's Method.

The distillation methods as practised by Mr. Rowley during his investigations into the commercial possibilities of Blackboy seemed quite satisfactory, and an outline of his procedure is given below. It should be remembered, however, that Mr. Rowley's primary object appears to have been the production of tar to be used in place of Stockholm tar. A fair amount of business was done in this connection.

The Blackboy trees, delivered, were first stacked out for air drying, and after 15% to 20% of the moisture had been removed, the leaf base material (or husk) was separated from the inner core by mechanical means.

The apparatus used in the destructive distillation process was similar to that for normal wood distillation (with several modifications) and was arranged in units of 5 retorts each, there being 3 such units. The fire grate was at one end to give a reverberating effect, and any waste gases were utilised in the furnaces for heating purposes. There was a fall of about 1 in 12 towards the discharge end of the retort.

About 2 cwt. of the air-dried material was placed in a crate frame something like a tree guard, a little over 2 feet in diameter and about 6 feet long. This was then placed in the cast iron retort (of slightly larger size), with a close fitting door. The whole was then heated to distil off the volatile matter, the distillation occupying about 2 hours, when the used crate was replaced by a similar one containing fresh material. The spent carbon in the used water represented about 50% of the original charge.

The pipes carrying off the various products were of thin steel, 15 inches in diameter and discharging into a common receptacle at the back of the furnace. This receptacle was fitted with an ejector and an exhauster, and thus provided for continual clearance.

The gases were drawn through condensers of vertical scrubbers, and the fluids separated from the tar were redistilled to give alcohol and other light oils.

As the production of gas was undesired and only led to the waste of possibly "cracked" products, it was not considered good practice to heat the furnace above 1000°F.

Rowley Forest Products Ltd. Methods.

More detailed information concerning the general methods used by the Rowley Forest Products Ltd. in the distillation of Xanthorrhoea, is supplied by Mr. F.W. Steel, Works Manager of the above firm during their period of operation at East Perth, after the death of Mr. Rowley.

Apparently the plant was of local construction and, through force of circumstances, was built of materials not entirely suitable for the work. This latter fact was contributary to the commercial non-success of the Company.

The logs, (after drying for two or three weeks after cutting) were sawn in halves longitudinally, then into 30 inch lengths and were finally packed into the hot retorts. The retorts were of the old style, horizontal, round, cast-iron, coal gas type, 6 ft. long and 2'6" in diameter. There were 19 in all, set in batteries of three.

* Reference No. 2(b).
/ Reference No. 10.

The volatile products of distillation passed from th retorts into a series of vertical cast iron atmospheric condenser pipes, the liquor outlets of which were luted in a Jarrah gutter common to all. Vapors and gas not condensed here passed into a cast iron water cooled main, and thence to a battery of earthenware pipe coolers, over which cold water was sprayed. From these coolers, the gas passed up two vertical packed scrubbers, through a Roots blower, and thence conveyed by pipe line for use as fuel under stills, retorts, etc.

The condensate, from the foregoing condensors, flowed through lutes to a separator where the tar settled and was periodically pumped to a storage tank, the liquor (pyroligneous acid) flowing continuously to the liquor well, whence it was pumped to a 1,000 gallon copper still and there boiled by the aid of a steam coil. Vapors were condensed in a long copper pipe water-cooled condenser and flowed into wooden neutralising vats where slaked lime was added to faint alkalinity, allowed to settle until clear, then run to the first spirit - "lime-lees" - still. This was of steel plate, about 500 gallon capacity and direct fired. To it was fitted a cast iron fractionating column of 12 sections each with single large bubbling cap.

Distillation proceeded in this still until the condensate showed zero on spirit hydrometer, the weak spirit being collected in a closed storage vessel. From this it was run to the second spirit still which was of iron with copper fractionating column rectifier and condenser. This second distillation could be so regulated that the majority of the condensate consisted of directly marketable wood spirit, suitable for de-naturing purposes the weaker portions of distillate being returned to the still with the next charge.

The liquor remaining in the first spirit still was run while hot to settling tanks where it was kept for as long a time as possible, and from thence to an iron direct-fired evaporating pan where it was boiled down to recrystallisation. The mass of the crystals of Calcium acetate was shovelled on to a draining tray, then spread on portable trays, and fired over the retort flues, the result being 80% grey calcium acetate. The sludge from the neutralising and settling vats was filtered and washed, the filtrate, etc. being delivered to the evaporating pan. For the neutralising of the first distillate from the pyroligneous liquor high grade lime is very desirable. Unfortunately this was practically unprocurable in Perth, and there was no alternative to using the "fair" quality lime of 50% to 60% CaO, with an occasional batch of "extra special" 80%. This low grade material greatly increased trouble and cost of working.

The dry calcium acetate after grinding to uniform powder was treated in a cast iron direct fired decomposer fitted with stirring gear, with concentrated sulphuric acid. Acetic acid vapour passed through a dust chamber to a copper condensing coil. The crude acid so obtained was re-distilled in a copper still attached to which was copper and porcelain plate column having a rectifier and a special sulphur dioxide eliminating device on top. The acetic acid was condensed in a pure tin coil. At least two redistillations were generally necessary to obtain acid of the required degree of purity.

Sulphur dioxide and a certain smaller amount of sulphurated hydrogen derived from reduction of sulphuric acid by tarring matter (impurity in the acetate) in the decomposer are very objectionable, and difficult to eliminate completely. Both will attack the tin condenser unless completely removed prior to allowing the vapour therein. The most satisfactory condenser for pure acid is either silver or silica.

The deparated tar (Sp. gr. 1.100) was distilled in a capacious iron still with copper coil condenser yielding acid liquor, light and heavy oils, and leaving pitch as a residue. The oils consisted principally of mixtures of phenols, cresols, creosol, and hydro-carbons with sundry other substances in small amount. The pitch was acid (5% to 6% calculated as acetic) and gave 2% of ash (substantially all ferric oxide.)

A feature of the use of cast iron condensers was that the iron got in to the primary products, pyro-acid, tar, etc., causing the subsequent formation of intensely black organic iron compounds. It is a well known fact that cast iron in such situations as connecting pipes and condensers becomes soft and easily cut while retaining its original form.

It would appear that, in the case mentioned, the iron is attacked by the acids present, going into solution where it becomes associated with some resino-tannols, which have come over in the vapour. The result is that on evaporation of the pyroligneous acid an intensely black tar was left behind. This so-called soluble tar was not easily denuded of its acid content (amounting to 16% calculated as acetic) by steaming. Moreover, it formed masses of sticky pitch like material which were very difficult to remove from the still. On examination it gave 14% ash, which consisted practically all of ferric oxide.

Proposed Methods of J. L. Strevens.

J. L. Strevens, Technical Chemist and Chemical Engineer, reported that in his proposed project retorting at low temperatures and under vacuo would be required to produce the required constituents (i.e. drying oils, turpentine substitutes, disinfectants celluloid substitutes etc.) with as little of the drying properties destroyed as was possible, and with minimum decomposition of the cellular material. The fine pitch derived from the distillation of the drying oils could be used as a binder in briquetting the coke residue.

This method apparently gives the maximum oil and coke residue yield, and the minimum of gas, (for which there is little use) and is the most economical way of retorting from the point of view of external fuel consumption.

Strevens stated that, as a minimum yield, 1 ton of blackboy material would give:-

35 lbs. acetic acid.
1½ gallons methylalcohol
½ gallon spirit
25 gallons drying oil
8 cwt. of residue.

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* Reference No.7.

BYE-PRODUCTS.

FROM DISTILLATION.

Preservative for Wood - Xantho Tar. *

Xantho Tar was a proprietary line being produced by the Rowley Forest Products Ltd. when that firm was in operation, and was advertised as a wood preservative. The A.N.A. building on the Swan River front was treated with this material.

In 1926 a certificate of analysis * was issued by the Government Analyst, in connection with an independent examination of tar being produced by the Forest Products firm.

This is given as under:-

	Percent (by volume)
AQUEOUS DISTILLATE (water, methyl alcohol etc.)	9.8%
Total tar acids.	30.2%
Neutral Oils	9.0%
Residue after Distillation (to 316°C. (pitch etc.)	51.0%

The preservative constituent of the tar was thus 30.2% as compared with values of about 1% of coal tar and 5% for Stockholm tar. Apparently the Postal Department in the Eastern States adopted the tar for treatment of Telegraph poles and other timbers.

Mr. J.E. Cummins (Now of the C.S.I.R.) reported in December of 1926, that a sample of Xantho Tar he had examined appeared unsuitable as a preservative for sawn hardwood timbers on account of:-

1. Prohibitive cost at 2s. per gallon. The capital expenditure for storage amounting to £6,000 as against about £750 for fluarising materials when working at full capacity.

2. Difficulties in handling in plant, and also difficulties in handling treated timber.

3. Insufficient penetration.

4. Lack of knowledge in service and laboratory tests.

It is considered desirable, however, that investigations be carried out with regard to:-

1. Penetration into the outer layer of sapwood on round posts, and also into the heartwood in split, green and seasoned timbers.

2. The effect of retaining the tar at a comparatively high temperature for long periods.

3. The effect of toxicity to white ants.

4. Costs of treatment etc.

With the dissolution of the Rowley Forest Products Ltd., no further work was done with Xantho Tar.

Briquetting for Fuel Purposes.

In 1919 investigations were carried out by a

syndicate (Strevens) in Western Australia, with the intention of extracting crude oils from the blackboy.

Results apparently proved satisfactory, and negotiations were opened with the Collie Coal Mining Companies for the complete briquetting of the fines and smalls from Collie Coal, in order to convert it into a smokeless non-sparking fuel.

The carbonised coal (Low Temperature Process) was successfully briquetted using up to 20% of the Blackboy oil residuum as a binder. The pressure attained for suitable briquettes averaged 5 to 6 tons per square inch. Calorific value averaged 13,000 B.Th.U. per pound. The briquettes were reported to be water proof, practically smokeless and very free-burning, with an ash content of less than the original carbonised coal.

Negotiations fell through in 1920.

The Coke as a Fuel.

The coke residue of which 8 cwt. is produced per ton of "husk" material (as a limit) when this latter is treated in retorts, also has good fuel possibilities, especially when briquetted.

An analysis of the coke residue * has been given as:-

Water	2.4%
Volatiles	8.1%
Fixed Carbon	87.8%
Ash	1.7%

The sulphur content was 0.06% and the calorific value, 14,350 B.Th.U. per pound.

The Gas. x

One of the considerations actuating the transference of operations by the Rowley Forest Products Ltd., to East Perth, was the object of selling to the Gas Department the large quantity of gas produced in the retorting of Xanthorrhoea.

One of the principal constituents of the gas was carbon dioxide of which it contained up to 50% and though attempts were made to remove this by passing through purifiers containing lime, the gas engineer blamed the purified gas for excessive corrosion of the gas holder. The purification was then discarded, and the gas went to waste.

Attempts were later made to reduce the carbon dioxide content by passing it through a pipe packed full of charcoal, kept hot. A considerable decrease in CO_2 content was recorded, but not a corresponding increase in B.Th.U.

Printing Ink ≠

A very satisfactory printing ink can be made from the quantity of sticky pitch like material that remains after the distillation of Xanthorrhoea.

The acid content was removed, and experiments apparently proved so good, that the printing ink produced was successfully used in an issue of the Government Gazette. The ink is intensely black.

Linseed Oil Substitutes. ∅

Linseed oil substitutes have been obtained (Strevens 1919) by suitably treating the oil distillate with manganese driers, and then boiling.

* Reference No.7. x Reference No.10. ≠ Reference No.10.
∅ Reference No.7.

Driers. *

Driers have also been prepared (Strevens) by the interaction of manganese, lead and cobalt compounds with the phenols and acids.

Lacquers and Varnishes.

The Rowley Forest Products Ltd.(W.A.), when in operation intimated that Steam and Refrigerating Pipe Coatings, Lacquers such as Japan Black, and paints for ironwork that required stoving at high temperatures were among their standard products.

In considering these claims, Mr. W. E. Cohen's report (previously given) should be considered.

It is generally understood that where the lacquer is to be stored, it may be quite desirable to use Xanthorrhoea resin to obtain a final finished red coloration. The property of darkening with heating militates against its use in light-coloured lacquers.

Other Uses.

Light, middle and heavy oils can be distilled from Xanthorrhoea, the heavy oil being successfully used in mineral flotation work, more especially with copper.

The pitch from the tar distillation was used for such purposes as the caulking of ships' decks, and coffins, and for general marine insulating being readily sold.

Tar for veterinary purposes, and oils for the treatment of sheep against blowfly, and in connection with lamb-tailing were being used quite frequently. The tar was also used for rope dressings and sanitary purposes.

Calcium acetate and acetic acid could be prepared, although at higher cost than from other sources, and the pyroligneous acid fluid had some value as a weed-killer.

The ash could be used in the manufacture of fertiliser, as had a fairly high potash value.

Experiments were also carried out with the object of utilising portion of the resin in chewing-gum manufacture. This however, seemed unsatisfactory.

There is also the possibility of the resin having some value in candle-making, as it burns with a bright flame, and mixes with fat in all proportions.

In 1933, the C.S.I.R. was approached by a Mr. Teesdale of Victoria with a process for making synthetic resin from the blackboy "gum". This is then used in making a moulding powder for the manufacture of articles of the Bakelite type.

6. OTHER PRODUCTS.

Matches.

Investigations were carried out by a Mr. Olsen (who claimed to have had experience in match making in China) with the object of utilising blackboy leaves for this purpose.

At first, trouble was experienced due to the leaf material

* Reference No.7.

being very hygroscopic, this difficulty being then overcome by obtaining a varnish to make it damp proof, and which also gave it better burning qualities.

After glow in the ash was also prevented by means of treating with a certain solution.

Unfortunately, it was found that with the match stick of normal size, breakage occurred too readily. To overcome this disability it was necessary to make the match of such size that it was not commencially successful.

Gum. *

A true gum is secreted by the plant, the source being the sugars of the core. This gum exudes in places between the leaf basis; its occurrence is capricious, only an occasional trunk displaying it. Possibly it may be caused by the presence of an intruder such as boring larva, or some other irritant. It is entirely different from the resin, being dirty white in colour, soluble in water and mucilaginous. It also appears to be resistant to moulds, etc.

2. THE INNER CORE.

Several useful products (among which are alcohol, sugars, cattle fodder and material for turnery work) are obtained from the inner core of the blackboy.

Method of Treating.

The cores, after separation from the outer husk, were cleaned from dust and loose gum and passed under a high speed revolving drum set with knives placed obliquely (Rowley Forest Products Ltd.)

The slicings were quite thin, and were readily air-dried, after which they were passed through heating tubes in the flues, and then into a rotary drying apparatus.

The contained substances were then readily separated from the fibre.

Products obtained.

Alcohol.

Alcohol, which was originally prepared from Xanthorrhoea by the early settlers as a stimulant, is obtained fairly freely with the necessary treatment.

The spirit content of the core has been investigated by Mr. E. A. Mann, Government Analyst for Western Australia, who gave the following results:- x

Month.	Wt. of Sliced Core.	Proof Spirit (galls) per Bushel (60 lbs)	Equivalent Sugar per 100 core.	Percentage of Sugar by Analysis.
Sept.	3.5 grams	1.24	20.6	26.1.
Feb.	6 lbs.	0.8	13.2	not determined.
June	2½ cwt.	0.5	10.0	10.5

* Reference No.10.

x Reference No.2. (a)

It will be seen that the core or inner part contains at least 10% of sugars, which are readily fermentable and yield alcohol to the extent of 0.5 to 1.24 gallons per bushel of 60 lbs. The lower figure (0.5 gallons) is equivalent to a yield of 17 galls. of proof spirit per ton of core.

Fodder.

When the contained substances are separated from the fibrous substance, material rich in fodder value is obtained.

Turnery Work.

The bole of the Blackboy core has some value for turnery work bowls and other small articles being successfully made from it. The core higher in the stem is not so dense, and is unsuitable for turnery.

Paper Making.+

Experiments on paper-making from the core and leaves have been carried out. In one experiment was obtained a yield of 40.9% of dried pulp calculated on weight of core dried at 100°C. The pulp was of satisfactory quality, but difficult to bleach.

The bulk of the material was a disadvantage on account of the large volume of liquor required to completely cover it in the digester. A test with X. Preissii gave only 23%. Some of the leaves also seem to have possibilities.

ATTEMPTS AT COMMERCIALISATION OF XANTHORRHOEA.

Rowley Forest Products Ltd.

Apart from the collecting and marketing of resin very little practical large scale work had been done in connection with the commercialisation of blackboy, until the late Mr. H.Rowley, who had been Perth City Analyst, and had carried out fairly extensive investigations, commenced manufacturing operations at Maylands in 1913, for the production of tar and other of the products previously mentioned.

Towards the end of 1918, after the death of Mr. Rowley, a Company was formed called the Rowley Forest Products Co.Ltd., which acquired the patent rights, processes and concessions. This company in August, 1919, had spent something like £3,000 on the plant, consisting of 19 sets of retorts and furnaces, condensers, receiving tanks, stills, etc. and had removed to East Perth. The plant was capable of dealing with 100 tons of blackboy per week and when fully staffed employed 15 men exclusive of office and selling staff, and three or four cutters continuously employed supplying the raw material. This firm used approximately 80 to 100 tons of blackboy per month during 1922.

References to this firm as a producing concern have not been found after 1926, when it is assumed they went out of business.

Strevens. x

In 1919 a Mr. Strevens, an industrial chemist and chemical engineer of Victoria, became interested in Xanthorrhoea as a commercial proposition and got in communication with the then Conservator of Forests (W.A.) with a proposal for erecting a plant capable of dealing with 36,000 tons per annum. With a working capital investment of £100,000 it was estimated a net profit of £50,000 would be obtained. This plant was to work in conjunction with the Collie Coal Mines, in briquetting the fines and smalls produced during normal coal working. Other bye-products, as drying oils, turpentine, substitutes, etc. were also to be produced.

+ Reference No. 9.
x Reference No. 7.

With this in mind, tenders were brought out for the removal of 1,250 tons of blackboy per month as a minimum from Crown land, the upset royalty to be 4d per ton. Strevens applied for the concession and his tender was accepted.

Apparently an insufficient period was allowed for by Strevens in estimating the time necessary for finalising of negotiations, and he applied for a 6 months extension of time relative to the commencement of cutting and factory erection. This was granted. He then received a re-exemption for a further 3 months, but his application for further exemption over a period of 6 months was refused. His tender then lapsed and the project fell through.

W.A. Forest Bi-Products Ltd. +

This Company, consisting of -

F. Atkins, of Subiaco (now Kalgoorlie)
F. Wilson, of Collie
T. Hogg, of Claremont
T. Cooling
W. Atkins

had in 1924 registered offices at Collie, and a small factory at that place.

In that year an application was received from F.Atkins for a permit to cut and remove blackboy from approximately 100,000 acres, situated West of the Midland Railway Line. He proposed erecting plant to the value of £500 to £700 for the production of "gum" and bye-products.

He then cancelled this application and applied for areas in the Collie State Forest and in the Mundaring District, and it was proposed to treat about 10 tons of blackboy per day. The permit was granted, and a small amount of work done in the Mundaring District. In 1925, this area was abandoned as the type of blackboy was not considered good, and excessive burning on the area had caused deterioration of the "gum".

In 1925 applications were received and granted by the Forests Department to this firm for permission to work approximately 100,000 acres of land situated West of the Midland Line, between Muchea and Mogumber (South of the area originally applied for). The area had originally been put up for tender under an application by Mr. J.E. Harrison, of Adelaide, who finally did not tender.

The firm proposed treating 20 tons of blackboy per day; plant and factory was erected to the value of about £600, and the syndicate commenced work.

In 1926 notice of their intention to abandon the project was received, due apparently to inability to compete with the South Australian Yacca Gum trade.

Teesdale. x

In 1933, a Mr. Teesdale, of Victoria, approached the Division of Forest Products with a process for making synthetic resin from blackboy "gum". This was to be used in Bakelite work. It is claimed that the resin can be produced at 9½d per pound from gum at £5 per ton.

Apparently designs have been prepared for a 10 cwt. per week plant (one unit of a commercial plant) which might cost £1,000 and possibly is to be installed in Western Australia. Nothing further has been done to date.

+ Reference No. 8.
x Reference No. 5.

VALUE OF THE "GUM".

Large quantities of the resin are available at present at following prices, f.o.b. Fremantle:-

Black £12 per ton, double cleaned in new bags.

Yellow Lump £18 per ton
Powder £18 per ton

Red Concentrated £14 per ton in 60 lb. kerosene tins, 2 tins per case.
Powder £10 per ton, consisting of 50 : 50 coarse and fine.

Rosewood £10 per ton

Small samples are held in the Forests Department Museum.

alty Rate.

At present a royalty rate of 6d. per ton is payable on crude ckboy "gum". This has been a nominal royalty only to control loitation, and would be subject to revision, according to the ure of any projected operations.

McGlew & Co., Perth.

ENQUIRIES FOR "GUM".

Rex Jones. In November, 1924, enquiries were received from Rex Jones, 25 Park Hill, Rise, Croydon, Surrey, England, with reference to acaroid resin from Xanthorrhoea. Acaroid resin was one of the chief ingredients in a material being introduced for the manufacture of gramophone records.

W.A. Forest Bi Products Company were put in touch with them, and though it was found that the red resin was unsuitable for the purpose, (yellow being required) they were very interested in a sample of red resin sent; if this could be supplied in quantity. Nothing further was heard.

Suter & Co. In December, 1924, an enquiry was received from A.F. Suter & Co., Shellac and Varnish Gum Merchants, 133 Fenchurch Street, London, E.C.3, for the regular supply of Blackboy "Gum". The firm stated great difficulty in getting gum, and if certain experiments proved satisfactory could utilise up to 100 to 150 tons per annum. Apparently they had failed in a quest for larger quantities of yellow acaroid resin, of which they imported quantities. They had discovered however that some of the red W.A. type could be treated to give similar results as the yellow, and they gave a trial order to W.A. Forests Bi-Products for 5 tons. This was reported to be very inferior to sample, although the firm stated that "we ourselves are of the opinion that supply of these resins ought to develop into a considerable industry, and we are prepared to co-operate on our side to the best of our ability.

Further enquiries have been received from -

In 1927 - Messrs. H. Hecht & Co., Chancery House, Little Collins Street, Melbourne, Victoria.

In 1929 - Hermann Hnege Ltd., 379 Kent Street, Sydney, N.S.W.

J.D. Thompson & Co.Pty.Ltd., 568-578 Lonsdale Street, Melbourne, Victoria.

In 1930 - J.H. Browne, Box 2989, G.P.O., Sydney, N.S.W.

In 1933 - F.W. Turner, C/o Hallet, Lewis & Co., 63 Pitt Street, Sydney, N.S.W.

Charles Lavy & Co. Ltd., 23 Ropemaker Street, London, E.C.2, England.

In 1934 - A. Hicks, W.A. Bank Chambers, 18 William Street, Perth.

National Products Pty., Sydney, N.S.W.

R.M. Gibson, Cottesbrooke House, 200 Queen Street, Melbourne, C.1., Vic.

Dr. Wolff, C/o Dr. Heinrich Zellner, Liusenstr. 21, Berlin, N.W.6, Germany.

LOCAL FIRMS.

Among the local firms dealing or interested in Blackboy "Gum" are:

McGlew & Co., Howard Street,	Perth.
Henry Wills & Co.	Perth.
W.D. Moore & Co.	Perth.
A. Hicks, William Street,	Perth.
L.M. Cullen & Co., Howard Street,	Perth.
H.C. Ittershagen, Railway Road,	Subiaco.

Collectors of "Gum".

Mr. Harrison, of Gingin, Western Australia, who said

Formed Materials", Page 23

He had had 15 years experience in connection with the commercial exploitation of Blackboy Gum on Kangaroo Island, stated in 1926 that he was then collecting and selling a limited amount (a few tons per month) and that his price was approximately £12. f.o.b. Fremantle. He stated that if he could produce "gum" at £9 per ton f.o.b. he could dispose of 1,000 tons per annum.

Mr. Harrison is still acting as a collector (1934) mainly for McGlew and Company.

REFERENCES.

The following references have been consulted and information extracted to 30.6.34.

1. W.A. Forests Department, Bulletin No. 11.

2. W.A. Forests Department, Main File No. 1109/27.

   (a) Extract by C.E. Lane-Poole from "Science and Industry" Vol. 2, 1920.

   (b) Extract from paper "The Commercial Utilization of the Grass Tree (Xanthorrhoea) and Zamia (Macrozamia) in Western Australia" by H. Rowley, 1916.

3. W.A. Forests Department, Main File No. 956/16.

4. W.A. Forests Dept. File No. 643/21.

5. W.A. Forests Department, File No. 1122/32.

   (a) Project C.4 of C.S.I.R.
   (b) Project M.P.3, C.S.I.R. Working Plan.

6. W.A. Forests Department, File No. 153/27.

7. W.A. Forests Department, File No. 234/19.

8. W.A. Forests Department, Files Nos. 1151/24, 1152/24

   (a) Files 579/19, 1124/22, 1142/20, 1201/23 and 219/32.

9. "Xanthorrhoea and Its Resins" by Helen T. Cole, Chemical Engineering and Mining Review, December, 1931, pp. 92 to 95.

10. "The Commercial Utilisation of Grass Tree" by F.W. Steel, Chemical, Engineering and Mining Review, July, 1932, pp. 362 to 365.

11. "The Essential Oils" by Horace Finnemore.

12. "The Useful Native Plants of Australia" by J.H. Maiden.

14. Newspaper clippings of W.A. Forests Department Library.

15. Circular No. 201. National Varnish Manufacturers Assn. "Notes on Gum Accaroides". Copy in W.A. Forests Dept. File 1109/27.

The following literature also exists which may prove to be of some value. These have not been seen by the writer.

Bulletin of the Imperial Institute 18, pages 155-162 (1920).

Barry, Drummond and Morrell - "Natural and Synthetic Resins" (1926) page 87.

Morrell and de Waele - "Rubber, Resins, Paints and Varnishes" (1921) pages 101 and 217.

Morrell - "Varnishes and their Components" (1923) page 127.
Livache and McIntosh - Vol. III "Spirit Varnishes and Spirit Varnish materials". Page 235

Circular No. 201 COPY Issued March, 1924.

Scientific Section,
Educational Bureau,
Paint Manufacturers' Assn.
of U.S.

National Varnish Manufacturers' Association (Co-operating)

NOTES ON GUM ACCROIDES.

(YACCA GUM-RED GUM)

Yacca gum, often referred to as red gum, a low resin now coming into this country, is obtainable in substantial quantities in Australia. It is shipped in the form of small pieces, some of which are almost cubical in shape and about the size of a pea. The balance is generally in the form of particles of very small size. The resin is dark red in colour.

It has lately been used to partly replace shellac in the manufacture of anticorrosive and antifouling paints for use on the bottoms of vessels. Being spirit soluble, it may be used to replace at least 50 per cent and possibly a greater amount of the shellac now used, with satisfactory results. Its action in water appears to be somewhat similar to that of shellac, in that a soft film ultimately is formed, which probably emulsifies with the water and dissolves slowly, carrying out such quantities of contained toxics (copper and mercury compounds) as are necessary to discourage the attachment of barnacles, hydroids, etc. Its content of phenol-like bodies may also have a bearing on its action. Other possible uses for the resin have been proposed, including the making of stains insulating compounds, and other similar uses where light coloured solutions are not important.

Some tests recently made with a quantity received at this laboratory are described below:-

Solubility in benzol: Almost entirely insoluble either hot or cold.

Solubility in mineral spirits: Almost entirely insoluble either hot or cold.

Solubility in turpentine: Almost entirely insoluble either hot or cold.

Solubility in acetone: Readily soluble either hot or cold.

Solubility in diethyl ether: Slightly soluble.

Solubility in alchohol: Completely soluble (with exception of foreign material like sticks and sand) either hot or cold in 95 per cent ethyl alcohol, denatured alcohol, or in wood alcohol.

Benzol can be added to a 4 pounds cut of yacca gum in 95 per cent alcohol in equal proportion by volume, without throwing the resin out of solution. Even greater quantities of benzol can be added.

The drying time of a 4 pound cut of yacca gum in 95 per cent alcohol is the same as a similar cut of pure orange shellac.

The dried film of yacca gum on tin is badly and permanently whitened by drops of water allowed to stand for a short time on the surface. This effect of water is more marked on the yacca film

than on an orange shellac film.

Attempts to bleach an alkaline solution of yacca gum with hypochlorite in the manner employed for shellac were not successful. Treatment of an alkaline solution of yacca gum with activated charcoal did not destroy the characteristic red colour to any extent.

Some yacca resin was heated in a distilling flask in the vacuum obtained by a water pump. A small amount of deep red liquid, smelling somewhat like phenol was distilled over. The residue in the flask showed marked decomposition and evidence of charring. It was evident that yacca resin was very different from the fossil resins in its behaviour on heating and showed more of the characteristics of shellac from this point of view.

A letter received at this laboratory from an Australian who has had wide experience in the handling of this gum states that it is usually forwarded in such admixture that a bag would contain two parts of coarse and one part of fine. A concentrated grade in the form of lumps is also shipped. This has been cleansed by steam.

There are also presented below some extracts from various textbooks on varnish resins, in which gum accroildes is mentioned.

"The Composition and Uses of Australian Xanthorroea Resin. Bulletin No. 2, Vol. XVlll, April 1920 of the Imperial Institute of Great Britain.

"The genus Xanthorrhoea comprises a number of species of tree-like plants belonging to the lily family, and known under the general name of "Grass-trees"; they are found only in Australia. The trunks consist largely of the old leaf-bases in which is deposited a resin, either yellow or red in colour, according to the species. The chief species yielding these resins are: (1) hastilis, R. Br., of Eastern and South-Eastern Australia, which yields a yellow resin, known commercially as yellow gum acaroid Botony Bay gum, yellow yacca gum etc., (2) X. Arborea, R. Br., of Queensland and New South Wales, (3) X. australis, R.Br., of New South Wales, Tasmania, and Victoria, (4) X. Tateana, F. Muell, of South Australia, and (5) X. Preissii, Endl., of South-Western Australia, all of which yield a red resin, known as red resin acaroid red yacca gum, black gum, etc.

"The resins have been used to some extent in the past for making varnish, sealing wax, etc., and before the war some 200-300 tons are stated to have been exported annually from Australia mainly to Germany. It was demonstrated many years ago that the resin could be used as a source of picric acid, but its use for this purpose was discontinued when phenol became available cheaply from tarcoal; but there is some evidence that prior to 1914 Germany had revived the use of yacca gum as a source of picric acid. In this connection it must be remembered that phenol is generally cheaper in England than in Germany, and consequently it might be feasible to use Xanthorrhoea resin in Germany for making picric acid when this would not be economically possible in the United Kingdom. From time to time, vague statements have appeared as to the discovery of new uses for the resin in Germany. Rumours were persistent that it was being used there in the manufacture of high explosives, but enquiries made by the Imperial Institute before the war as to the uses to which it was actually being put in Germany yielded no confirmation of this, and all the evidence collected seemed to indicate that it was being used chiefly for varnish and lacquer manufacture, and as a cheap substitute for shellac.

EXAMINATION OF THE RESIN.

"Preliminary experiments with Xanthorrhoea resin were conducted in 1915 with samples of yellow and red resin forwarded from Australia. Both kinds contained woody impurities, the amount in the yellow resin being fairly large. The resin gave the following results on examination :

	Yellow per cent	Red per cent.
Moisture (in vacuo at ordinary temperature)	3.0	3.5
Ash	1.3	0.24
Matter insoluble in alcohol (chiefly woody matter)	13.14	4
Matter insoluble in ether	23	16
Melting point (determined on the powdered resin in a capillary tube)	97° C.	110° C.

"Lauterer (Botany Bulletin No. XIII, Queensland Dept. Agriculture, 1896) states that he obtained 9.4 per cent of benzoic acid from the resin of X. hastilis and 5.6 per cent. from that of X. arborea; whilst, according to the Perfumery and Essential Oil Record (1915, 6, 212) red acaroid resin has been found to contain 4.6 to 7.2 per cent of benzoic acid. In view of the samples of both the yellow and red resins which were investigated, no appreciable quantity of benzoic was present.

"According to Stenhouse (Journal Chem Soc. 1845,3,10) the resin on dry distilling yields an oil which appears to be completely identical with phenol. Attempts to distil the resin at the Imperial Institute were unsatisfactory, as the resin foamed very strongly and charred. Only small quantities of oily distillate were obtained. This possessed a phenol-like colour but no definite indication of the presence of phenol was shown by the ferric chloride test."

I. COMPOSITION OF THE RESIN.

"The approximate composition of the resin purified by extraction with alcohol was as follows, as compared with the results obtained with red resin by Tschirch and Hildebrand (Arch. Pharm. 1896, 698):

	Per cent.	Results obtained by Tschirch and Hildebrand. Per cent.
p-Coumaric acid in free state	0.5	1.0
p-Coumaric acid combined	1.5	2.0
Cinnamic acid	0.1	nil
Styracin	0.1	nil
Aldehyde	1	p-Hydroxbanzaldehyde 0.6
Complex phenolic body	The residue	85.0

1 Not determined; probably vanillin is present in small quantity as it w as isolated after the oxidation of the resin.

II. RESULT OF FUSION OF THE RESIN WITH POTASH.

"The following products were obtained after potash fusion of the resin, compared with those obtained similarly from the yellow resin by Hlasiwetz and Barth (Annelen, 1866, 139, 78

p-Oxybenzoic acid	1.5	13.0
Resorcinol	2.0	1.4
Phenol	0.4	-
Pyrocatichin	Not detected	1.8
A double compound of protocatechuid acid and p-Oxybenzoic acid	Not detected	2.3
Carbonic acid	much	-

V. EFFECT OF HEATING THE RESIN IN SEALED TUBES.

"The resin is only slightly affected at a temperature of 150°C. and at higher temperatures undergoes decomposition with the production of products similar to those obtained on destructive distillation.

VI. DESTRUCTIVE DISTILLATION OF THE RESIN.

"Small-scale experiments gave a yield of about 17 per cent of an oily distillate of a phenolic nature. The experiments were difficult to carry out, owing to the excessive frothing of the melted resin.

AS A SUBSTITUTE DISTILLATION OF THE RESIN.

"1. Lacquer for Metals. - Solutions of the yellow and red resins in methylated spirit (containing 10 per cent of the proportions of shellac, as lacquers for brass and steel. The solutions containing only Xanthorrhoea resin gave brilliant coatings which, however, appeared to be more brittle than shellac; this defect could probably be remedied by the addition of other ingredients. The solutions of the Xanthorrhoea resins in admixture with shellac were more satisfactory. The dark colour of the red resin and its property of darkening still further on heating would prevent its use in light-coloured

resin) were tested both alone and also in admixture with different

lacquers, especially where the lacquer is to be stoved, but should be advantageous in cases where a red colour is desired.

"Lacquers prepared from Xanthorrhoea resin appeared to stand exposure in a dry atmosphere satisfactorily; they withstood a test of short duration in a moist atmosphere fairly well, but deteriorated rapidly on immersion in water and in this respect compared unfavourably with shellac.

"2. As Spirit Varnish for Wood. - A 30 per cent solution of the red resin in methylated spirit gave a fairly lustrous but dark coat on sized wood. The yellow resin gave a similar but lighter coloured coat.

"The Xanthorrhoea resin varnish appeared to be less brilliant than resin (colophony) varnish, but showed better resistance to wear; it is, however, inferior to shellac varnish in the latter respect. It should be possible to use Xanthorrhoea resin alone in cheap varnishes for floors, etc., or in admixture with shellac.

"The use of Xanthorrhoea resin for the preparation of lacquer or varnish is somewhat limited by the fact that it is insoluble or only partially soluble in turpentine, fatty oils, benzine or petroleum spirit, although soluble in alcohol. The colour of the red resin would also be a disadvantage in certain cases.

"3. Sealing Wax. — The red and yellow resins and mixtures of these resins with shellac were incorporated with turpentine and chalk to form sealing wax. The wax made from the red resin darkened and decomposed rather readily on heating; this resin could only be used for very inferior grades of sealing wax. The yellow resin gave a wax which showed much less tendency to darken on heating, and it might be used either alone or in admixture with shellac.

The Manufacture of Varnishes and Kindred Industries. Livache and McIntosh, Vol. III, 235-237. Scott, Greenwood and Son, London. -- "The Xanthorrhoea or grass tree are Liliceae, confined to Australia and Tasmania.

They are plants with a short, thick ligneous stem, generally simple, terminated by a tuft of long leaves about 3 feet, with cutting edges. The inflorescence emerging from this crown of leaves consists of a bunch of sessile flowers supported on a rigid peduncle of 5 to 8 feet in length. The three most interesting species are X.hastilis R.Br., the stem of which, on the contrary rises some feet in height. From the trunk of these trees there flow in virtue of a continuity of accidents or by incisions a resinous substance which concretes in the air in contact with more bulky pieces. Sometimes the fragments detach themselves spontaneously and collect at the foot of the tree, where they are often buried, semi-fossilized. The resin is collected thus, according to Miden; the pieces or resin are detached with a pick or hatchet and collected on a cloth. The product is sifted, then assorted and put on the market. The X.arborea yields abundant bulky masses of a reddish-brown resin, brittle, with a brilliant fracture which pulverizes readily and is reduced to a brown colour like Terra di Sienna.

The resin of X.Australis exudes at the base of the trunk near the roots in globular irregular masses, brownish or of a homogeneous ruby red which exhales an odour of benzine. The product of X.hastilis has also this same odour of benzine. All these resins by exposure to light exhibit a superficial red-brown layer which encroaches on the paler internal colour. The resin of the Xanthorrhoea is very soluble in ether, which would appear to be its best solvent. It is soluble also in alcohol and potash. It is insoluble in benzine, turps and toluene.

"Red Accroïdes, Earth Shellac -- This resin is derived from Xanthorrhoea Australis R.Br., also from X. tateana and X.arborea, likewise the ruby red basal plates from X. quadrangularis.

"Minor use for Red Accorides - A concentrated solution of the red resin containing a little castor oil or copaiba balsam has a magnificent red colour which is employed to coat the windows of photographic laboratories so as to exclude the active rays.

"Yellow Gum Accorides - Botany Bay resin, blackboy gum, grass-tree gum, resina lutea novae belgiae, the product of X. hastilis.

"This product is but little used. In Australia, European workmen and Chinese use it in making certain varnishes. Although produced so abundantly in Australia these were, until comparatively recently, practically unknown in this country. Even now they only are occasionally imported, though it is true they, to a certain extent, could replace a dragon's blood, gamboge and other tinctorial agents in the colouring of pale lacquers.

"Analysis of Resins, Balsams, and Gum Resins. K.Dieterich p.130, Scott, Greenwood & Son, London. - The red resin, or "Grass-tree gum", forms small, red-brown, dusty lumps, with lustrous fracture, and about ten percent of impurities; it is completely soluble in alcohol and gives the cinnamic acid reaction.

"The yellow resin (resina lutea, Botany Bay Gum), is of a transparent yellow colour, also dusty, and gives the cinnamic acid reaction.

"Australian acaroid resins are now being collected, and are justly recommended as substitutes for colophony, particularly for sizing paper, for which purpose they have long been used in America, as well as for enriching gas, and in the manufacture of varnishes and perfumery ware. The resins of the various Xanthorrhoea species differ not inconsiderably both externally and inwardly. (K.Dieterich, H.A. 1897, pp.37-38).

"Adulterants, etc. - Owing to the relatively low price of these resins, the only impurities likely to occur are extraneous mineral and vegetable matters. The different qualities of acaroid resin are also liable to be mistaken one for another.

"Analysis. - Although actual analytical reports on the acaroid resins are scarce, this technically important material has been mentioned here on account of its introduction into Europe, and employment in the preparation of varnishes, paper, and perfumery. Its application to the production of gas is worthy of mention; and in America it is used medically as a tincture (60 grms. of resin per litre of alcohol) in doses up to 70 grms., for phthisis and chronic catarrh. At the present time, acaroid resin from X.quadrangularis is obtainable at a low price from Australia, and has rightly found favour.

"According to Maiden, the yellow acaroid resin does not soften in the mouth. Petroleum ether dissolves ½% and alcohol 91-94 per cent. According to the author's researches, the acaroid resin from X.quadrangularis, and other red varieties, resembles the yellow resin in containing no cinnamic acid.

"The red resin from X. arborea is soluble to the extent of about 5 per cent in petroleum ether, but dissolves entirely in alcohol, except for the 5/10 per cent of contained impurities. Hirschsohn found three different kinds to be completely soluble in alcohol, but only imperfectly so in chloroform and ether.

ACAROID RESIN

"Analysis. - M. Bamberger found -

I. Yellow Acaroid -

	1	11	
Acid value (direct)	132	133	From
Saponification value (hot)	220	225	purified resin.
Methoxyl value	27-66	28-97	Crude resin
Methoxyl value	34.73	-	Purified resin

II. Red Acaroid -

Methoxyl value	60.3	60.9	From
Methoxyl value	71.2	-	crude resin.
Carbonyl value	0.97	-	Purified resin
			Purified resin.

"Owing to the dark colour of the red resin solution, the acid and saponification values could not be determined.

"The following are analyses of acaroid resins by A. Ruding :-

	Water	Substances Insoluble Alcohol	in acid value	Saponification value	Iodine value
Yellow acaroid resin	5.65	0.93	82.3	98.0	176.2
Yellow acaroid resin (Adelaide)	4.50	3.52	67/2	105.5	176.2
Yellow acaroid resin (Victoria)	4.40	0.88	72.8	164.0	175.0
Red acaroid resin	4.90	5.26	18.5	67.7	164.5

"L.E. Andes (Chem. Rev. Fett.Harz-Ind. 1909, 16, 160) gives the following interesting account of the acaroid resins :-

"Of the various species of Xanthorrhoea, X. drummondi (W.Australia) is reputed to afford most resin, a single tree yielding an average of 23 kilos. of a yellow resin. X.tateana (South Australia and Kangaroo Island) furnishes a ligneous, vesiculated, readily friable res and odourous resin. The mass is dark red; the powder is yellowish and imparts a blood-red colour to hot water. Petroleum ether extracts 1 per cent of a colourless, odourless resin; strong alcohol dissolves it entirely, forming a fiery red solution, which deposits crystals of benzoid acid on evaporation. X. hastilis (N.S.W. and Queensland) produces a resin of sweetish odour, resembling that of benzoin; it is readily friable, the powder resembling gamboge, and undergoing change of colour when exposed to light. It melts in boiling water, rendering the latter turbid yellow. Petroleum ether extracts 1 per cent of a pleasant-smelling substance, alcohol dissolves 94 per cent and the solution affords feathery crystals of benzoic acid on evaporation. The purified resin melts at 97.7%. Another sample showing a lower melting point, yielded to petroleum ether 2 per cent. of a faintly coloured viscous body, probably composed of essential oils and resin. X. arborea (N.S.W. and Queensland) furnishes compact pieces mixed with leaves; the colour of the product varies from purple-brown to carmine red. It forms a readily friable powder, of the colour of raw sienna, and 92 per cent the alcohol extract deposits crystals of benzoic acid, but in less quantity than the other Xanthorrhoea resins. X. Australis (Tasmania and Victoria) affords irregular shaped spheroidal masses of friable resin of a dark red colour, in the fused state resembling dragon's blood. Its alcohol solution is clearer than those of the resins of other species of Xanthorrhoea.

The following table shows the quantity and value of acaroid resin shipped from Australia during the past four years, and the countries of destination (compiled from the Overseas Trade Bulletin)

AUSTRALIAN STATES OF EXPORT

Australian State	1929 - 30		1930 - 31		1931 -32		1932 - 33		Average		Valu per t
	Quantity Cwt.	Value £	Quantity Cwt.	Value £	Quantity Cwt.	Value £	Quantity Cwt.	Value £	Quantity Cwt.	Value £	£
New South Wales	1434	2872	1244	1753	1362	1436	307	413	1087	1618	29.
Victoria	28	29	500	110	881	256	-	-	470	132	5.
South Australia	42753	16346	38988	11087	38884	10588	37895	10120	39630	12035	6.
Western Australia	526	502	41	22	609	191	247	56	356	193	10.

COUNTRIES OF IMPORT

Country											
United Kingdom	9255	3972	7328	2657	7471	2364	5799	1548	7466	2635	7.
Canada	-	-	-	-	1630	501	800	210	1215	355	5.
[illegible]							-				
New Zealand	443	547	10	161	443	141	-	-	299	283	19.
Other British countries	150	128	764	247	-	-	345	242	420	206	9.
Belgium	1800	625	7015	1803	3249	816	605	179	3167	874	5.
France	7110	2642	6694	2117	3905	1095	5088	1576	5699	1807	6.
Germany	13285	6190	14751	4609	13778	4389	14141	3790	13898	4744	6.
Netherlands	2140	761	80	90	8112	2297	10266	2882	5149	1507	5.
United States America	7596	2663	3980	1236	2987	788	1305	366	3967	1256	6.
Other Foreign Countries	72	75	141	52	60	40	100	26	93	48	10.