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FOREST NOTES

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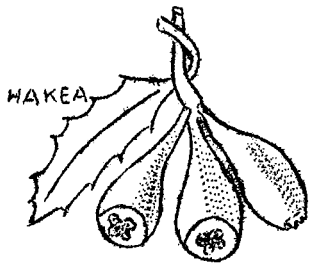


E. microcorys

We feel obliged to offer our apologies for the last issue Vol. 3, no. 3 being issued late, but we felt that the inclusion of the Exam results was worth the delay.

The attention of ALL contributors is drawn to the relatively low cost of various abridged dictionaries. Surely each Division or District Office should boast at least one dictionary, which would provide manuscripts of simple spelling errors.

There is no outright winner of the Vintage Car Trial as no correct, or for that matter any answers, were received. The car was a 1908 Lancia-Alfa (see cover of Reader's Digest, November 1963).

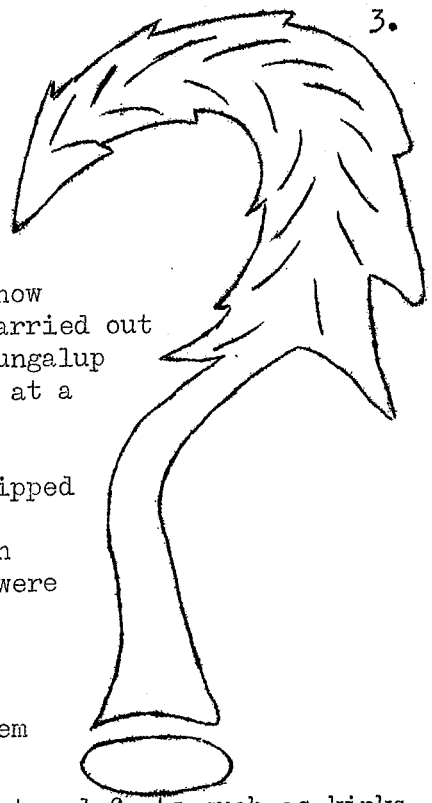
May we offer Season's Greetings to you all, with the wish that your support for Forest Notes will continue in 1966, and with our thanks to publishing staff, editorial whips and contributors for their assistance during the year.

P. N. Hewett J. A. W. Robley

JOINT EDITORS

FORM OF PINUS RADIATA ON A HIGH QUALITY SITE

by F. H. McKinnell



It is generally recognised that stem form in pine plantations is worse on high quality sites than on poor sites. To gain some figures on how bad it can be a stem form assessment was recently carried out in P. radiata planted on a former pasture site at Mungalup A-15, Collie. This compartment was planted in 1958 at a nominal spacing of 9' x 9' or 540 stems per acre.

In the assessment the compartment was stripped at roughly 5-row intervals, every tree along a row being booked except edge trees. Trees wer judged on the form of the lower 35 - 40 feet of the bole and were placed into one of the following classes:

(1) Straight - trees truly straight.

(2) Slightly crooked - trees with a slight stem defect but still acceptable stems.

(3) Markedly crooked - these trees had major stem defects such as kinks, sweeps, forks etc.

In order to give a clearer picture of the stand composition the latter two classes were subdivided as follows:

Slightly crooked - (1) trees worth retaining.

(2) suppressed trees normally eliminated in the first thinning.

Markedly crooked - (1) forks and multiple leaders.

(2) millable trees - those which would yield a minimum of two straight 7' billets.

(3) non-millable stems failing to meet the specifications in (2).

Results.

		Number	Percentage	
Straight		19	2.2	
Slightly crooked	Retained	269	30.9	36.5
	Thinned	49	5.6	
Markedly crooked	Forks etc.	81	9.3	61.3
	Millable	278	32.0	
	Non-millable	176	20.0	
		872	100.0	

While these figures are not claimed to be characteristic of all high quality P. radiata there is evidence that they are not uncommon.

If we reduce these figures to a per acre basis we get:

Straight		10 stems.
Slightly crooked	Retained	155 stems.
	Thinned	30 stems.
Markedly crooked	Forks	45 stems.
	Millable	160 stems.
	Non-millable	100 stems.
		500 stems.

500 surviving stems per acre at this age is probably an optimistic assumption. Figures from a series of thinning plots in the adjacent (but older) compartment on a similar site indicate that the true average stocking is more likely to be 400 - 450 per acre.

How will the future management of this compartment be affected by this situation? Consider the first thinning, which is due in 2 years' time at the present rate of growth of this area.

On the current thinning prescription the stand will be reduced to 300 per acre at height 60'. To begin with, of the 200 stems to be eliminated, 100 are not millable. Of the 100 remaining to be chosen, 30 are suppressed trees which must come out. We also have 45 forks and multiple leaders. These also should come out, so we are able to mark only 25 of the 160 millable markedly crooked trees. This means that we have to carry on 135 stems of undesirable quality into later thinnings. They will still not all be removed after the second thinning.

The first thinning yield will be greatly reduced. Half the trees to be removed will yield nothing at all and many of the remainder will have their marketable volume reduced because of the necessity to dock out defects in the stem. The normal yield of 25 loads per acre will be reduced by at least half. If the true average stocking is less than 500 stems per acre the picture is even worse. Hence it may not be economical to thin at all.

In fact the best solution to the problem in this case seems to be to clear fell the lot and start all over again, planting this time at a much closer spacing, say 8' x 6', or about 900 stems per acre. An initial stocking of this nature would ensure that 300 stems of acceptable form would be available.

This compartment also demonstrates the necessity for tree breeding in P. radiata. Perhaps as a first step we might confine our seed collection to "plus stands" only.

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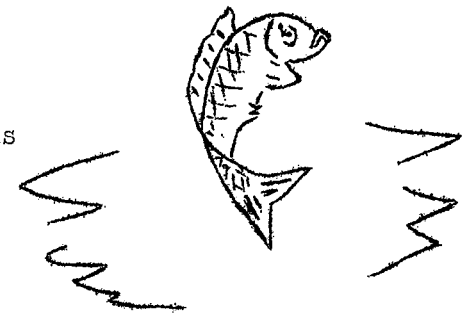
CATCHMENT AREAS - A THING OF BEAUTY OR A FORBIDDEN SECRET?

by J.A.W. Robley



The State Forest of Western Australia is largely situated on existing or potential catchment areas.

As a result of this the Forests Department is not the sole party responsible for administration and it is necessary for Officers of the Department to work in co-operation with water supply authorities.

The Department appears to suffer little or no interference from the water authorities so far as operations of a purely silvicultural nature are concerned. Some small cases of friction do occur from time to time but these are invariably of a very trivial nature and are usually easily overcome.

Difficulties do arise however, with regard to access to the catchment areas for tourists and sightseers, and also the construction of small dams, river crossings etc., on the catchment by the Department. Taking as an example Mundaring Weir and dealing first of all with the question of river crossings, it is difficult to take seriously, complaints that a river crossing in the Division is impeding the flow of water when water is overflowing the Weir Wall by 8" - 10", particularly since the crossing in question is only raised about 9" above the old stream bed.

This also applies to some small dams which were constructed across small annual creeks to act as a source of water during the summer months. It is true that these dams impede the flow of water to an extent, but this extent is so small as to be negligible. The value of these dams as an integral part of the protection of the catchment from destruction by fire is very large indeed.

The hardest pill of all to swallow is the ban on tourists on Forest roads surrounging the Weir at Mundaring.

Mundaring Weir has two attractions to offer the tourist, firstly the opportunity to see some of the finest unspoiled scenery in the Perth area, and secondly to see some really good examples of the work of the Department in the field of Pine plantations.

By virtue of the fact that a good all weather road passes very close to the edge of the water all the way round the Weir, little or no extra expense would be involved in opehing this road as a tourist scenic drive, apart from the erection of suitable sign posts to make sure no-one loses themselves.

The value of encouraging the public to view at first hand the work of the Department in the plantation areas must not be overlooked. No member of the public could fail to be impressed with the pines around Greystones and I feel it is important for the public to realise that the Department is engaged on useful productive work as well as regarding us as a glorified fire brigade.

To take the tourist angle a stage further, it would be of advantage to open the Weir to fishing, or in other words to legalise an existing past-time.

I have never heard of a case where stocking a reservoir with fish and permitting angling has led to pollution of the water.

I am certain there are many freshwater anglers around Perth who would welcome a move in this direction and who would be prepared to pay for this privilege.

Money raised in this manner could be put to improving the fishing by stocking and removing snags and debris.

In conclusion, the present restrictive notices around the Weir deter none but the "bona fide" sightseer. The vandal or "roo-shooter", whichever expression you prefer to use, comes and goes on the catchment almost unheeded. If the area were opened to the type of tourist we want, his movements would be bound to be curtailed. We would also create a public with an awareness to Forestry, and would extend the present drive to open up the West as an unrivalled tourist attraction in Australia.

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QUOTABLE-- QUOTES

(Taken from 'A Discussion of Australian Forestry, by D.E. Hutchins, 1916')

All Foresters should be armed and be soldiers of the State. This is very important against fire setters and marauders - - - - - - - the military value of Foresters and their Forest stations would possibly come somewhere near their whole cost to the State leaving their forest duties out of the question!

With the organisation and opening up of the forests of Australia with roads there will be brought into the range of the tourist the most beautiful part of Australia - - - - - - at present the usual result of a tour in Australia and New Zealand is the unfortunate verdict that New Zealand is a tourists' country and Australia is not - - - - - - - I may perhaps, venture to express the opinion that this verdict is unjust and the the reason of it's being arrived at is that the tourist from the Northern Hemisphere is unable to visit the best parts of Australia that is to say, the Forests!

There are many good trees in inaccessible places which can only be worked by pit-sawing, and the work is so invigorating and healthy that many men who cannot stand a sedintary town life could earn a healthy livelihood by it.

Public opinion on Forestry is nearly absent in Australia. Among all strange sights and sounds on the island Continent there is nothing more remarkable than the attitude of the people with regard to modern scientific Forestry.

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MINING TIMBER IN COLLIE DISTRICT

by Roy Button

Last year two million two hundred thousand super feet of mining timber costing approx. £33,500 was used in the Collie coal mines of which 15% was used in the Griffin and 85% was used in the Western collieries.

At the pit heads you will see stacks of timber ready for mine use. Sizes and quantities vary to meet the particular needs of each mine. These stacks will vary in quantity not only because of earth movements in the mines, but also due to the rate of splitting in the bush.

It is the job of the timber contractor to fulfil these requirements. In Collie there are 12 men employed in this work. The supply system is worked on the lines of the tender system.

Before the timber reaches the mine there is little sweat lost by the timber getter. The timber has to be firstly tree marked by a Forest Officer who takes into consideration all the values of the tree, making sure it will produce one or more lengths of mining timber. It has to be fallen, cut, barked and split into required sizes. The tree often yields various items and the cutter utilizes each tree to the fullest extent, what is left - a salvager removes.

A track is then put into each fallen tree and a light truck is taken in where the timber is then loaded and delivered and stacked above the ground at the mine. This work is normally heavy and arduous because of the scattered stumps, thick-wooded, stony country. Trucks are too light and can't stand too much rough treatment, they bog easily, causing areas to be left, due to the unfavourable lie of the land and the scattered trees.

Over recent years there have been mechanical improvements but replacements like crawler tractors, better trucks, are needed to improve the situation as much as in the Eastern States.

Sawn timber and round timber will have to displace split timber as suitable trees are becoming scarcer each year. The split timber life is only estimated for the next seven years in the Collie district.

In the early days, round timber was used untreated, the split timber was used for sleepers. It was not realized that this timber could be suitable mining timber in future years.

Repeated cutting of the straight grained trees on accessible forest areas has resulted in an increasing percentage of tight and windy grain trees, but this has not altered the percentage of good formed trees due to the splitting timber being widely scattered, and average of two trees per acre.

Timber cutters at a later date will be forced further afield, into poorer stands of timber - factors which send up timber costs.

There are 56,500 acres of State Forest within economic range of the Collie coalfields, but because of the poor quality timber only a third of it is suitable for the production of split mining timber.

The State Forests Department is now trying to introduce treated round mining timber, as there are a great number of high quality round mining timber stands within economical distance of the Collie coalfields.

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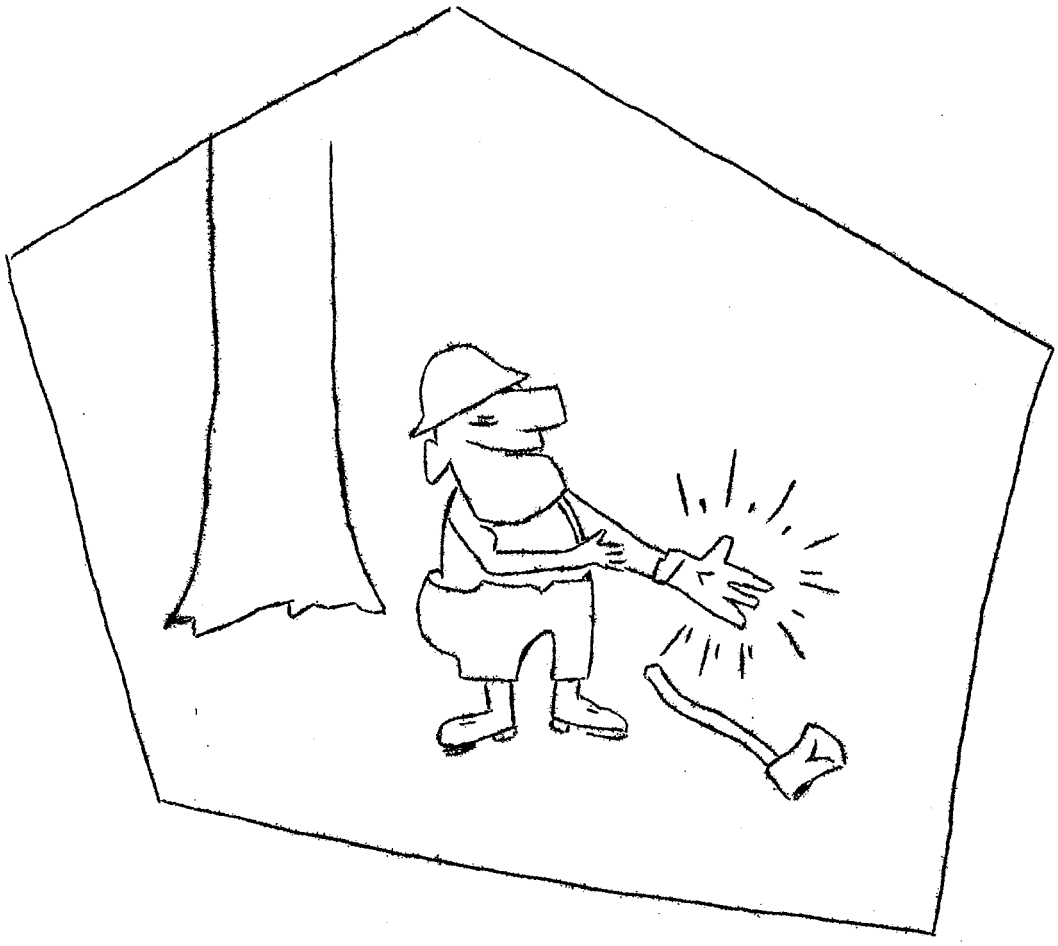
SAFETY NOTES



If gloves are provided, then wear them. Dress for the job!

MOUTH-TO-MOUTH RESUSCITATION

Mouth-to mouth resuscitation should be applied immediately a person has stopped breathing, or is breathing weakly, as a result of drowning, electric shock, lightning, suffocation, heart attack or serious accident.

Where possible, lay patient on his back. If this can't be done start resuscitation where he is. Every moment counts.

In the case of electric shock switch off power first. Have someone call a doctor.

Turn patient's head from side to side and clear his mouth and throat. Tilt his head back as far as possible to open his air passage and to keep his tongue out of his throat.

Pinch patient's nose closed and take a quick deep breath.

Place your mouth over patient's mouth and breathe into him until his chest rises. For babies, place your mouth over both mouth and nose and just puff.

Remove your mouth and let patient's chest fall. Listen for gurgling which indicates an obstruction in the throat.

Make your first ten breaths fast and then continue at ten to fifteen per minute. Continue until patient recovers.

In drowning cases over-inflation of lungs may cause damage so blow only until chest begins to rise.

J.W. Hallam, Safety Officer.

Source: Coresearch, no. 81, December 1965.

PLANTATION BURNING

by P.N. Hewett

Over the past few years, a great deal of discussion has revolved around the prospects of controlled burning of Pine Plantations in Western Australia.

The winter of 1965 saw unprecedented activity in this field, with upwards of 800 acres of plantation burning completed in the Metropolitan and Wanneroo Divisions alone. It is pertinent therefore, to look at some of the arguments both FOR and AGAINST this approach to plantation fire control, since it seems certain to become a "HOT ITEM" in one way or another in the next four or five years.

1. THE CASE AGAINST.....

The biggest threat to our plantations, in the absence of widespread fungal or insect attack, is undoubtedly, the threat of FIRE. It is therefore unwise to deliberately introduce fire to the plantation, if it can possibly be avoided. A very cool fire will do little to reduce the quantity of fuel, and a very warm fire may kill the crop trees, or at least destroy surface feeder roots which are concentrated in the Ao and Aoo horizons. Somewhere in between these two extremes lies the ideal pine burn, but can this degree of precision be guaranteed, when we are dealing with fuel as sensitive as pine needles. Can anyone be sure that the burning conditions can be judged to such a fine tolerance when a windchange of 2 mph. can completely alter the fire!.

Pine burns are costly, since only small areas can be handled at any given time, and the manpower component is high. In addition, the winter conditions necessary will normally limit actual burning time to three or four hours per day. Much less is known about winter weather conditions and fuel behaviour at low temperatures, than is known about summer fuel conditions. The number of suitable burning days is small, and wind strength is the principal factor which determines spread rate, intensity of fire, and length of burning time. It was most apparent in winter 1965, that winter high pressure systems are not accompanied by steady winds, except for a few hours before the low pressure trough comes in.

Regular burning of the same areas could result in such a fuel reduction that early Spring conditions are needed for an effective burn. This invokes risks from underground fires, 'Sleeper' fires, and smouldering stumps.

Experience of summer fires in plantations has shown that some of the fire damaged trees take up to four or five years to die. How then, can a controlled burning programme be assessed as effective in time to organise future programmes on an annual basis.

The principal marketing problem after a summer fire, is the effect of charcoal fragments scoring the freshly sawn pine surface. Will control burned areas produce logs which lack this feature!

2. THE CASE FOR.....

Those of us whor have had some experience of wildfire in plantations, will agree that there are many difficulties, and among the greatest problems are: -

a) Intense temperatures at the headfires, even under relatively mild conditions.
b) Rapid spreadrate and early development of intense spotting.
c) Lack of a proven technique for attack on the headfire.
d) Inability to use handtools effectively, especially in thinning slash and inter-woven tops.

For the coastal plantations, we should perhaps add a fifth problem, namely, the lack of immediately available manpower, and the poormanoeuvrability of even four-wheel drive plant.

An effective and extensive controlled burning programme will decrease headfire intensity and spotting intensity, and will facilitate control of spots which do occur. As headfire intensity decreases so does rate of spread, and at the same time, it is anticipated that normal headfire attack methods as used in the hardwood forest, will be applicable. Personnel engaged in the plantation control burning will gain vital experience in the least understood branch of fire control, and this must assist in wildfire suppression.

Experience at Somerville and at Gnangara this year, has shown that a 30% decrease in fuel quantity has been achieved, and that areas of heavy thinnings slash can now be readily raked down to mineral soil with conventional handtools.

Firebreak maintenance is an annual event, and costs 25/- per acre or more. Cost studies on controlled burning suggest that 5/- peracre is about the minimum possible with present techniques, and although greater areas may be involved, we are at least growing timber on the burning areas. It seems logical therefore that once thetechniques have been perfected, it should be possible to decrease the width of major cleared breaks. In addition, the flotation properties of coastal sands within the plantation are at least 50% better than on the ploughed breaks, and this could help with movement of plant at fires and for general management purposes.

There is no evidence in Western Australia that controlled burning in plantations will decrease growth rate, and in the short term a reverse effect may result from the increased Potash available to trees. Several studies have been initiated to investigate short and long term effects, but no valid results will be available for at least a couple of years.

One final argument in favour of controlled burning in plantations is rather local in character. The Metropolitan plantations, (Collier & Somerville) are rapidly becoming surrounded by suburban development, and the incidence of summer fires in these areas has increased in proportion to the number of homes built. The larger plantations of the Wanneroo Division are somewhat remote from this problem at present, but one suspects that the position will not remain static, especially with the development of small FARMLETS on the Western and Southern flanks. In these circumstances, it is submitted that there is no choice. Controlled burning MUST be tried on a large scale for plantations such as these...

TREATED ROUND FENCE POSTS.

by D. Spriggins

The type of jarrah tree capable of yielding good quality, easily split fence posts will usually also produce good quality millable timber, either to-day or in the future.

The exploitation of such trees for posts, if allowed, could reduce the amount of millable timber available from the forest. Although this amount is probably not great at the moment it could, over the years, become quite significant. Quite apart from this, the splitting of posts from otherwise millable timber is invariably wasteful of actual wood volume and would yield a much smaller royalty return per tree than if the tree was milled into sawn timber.

To overcome the problem, an attractive alternative in quality to the split post is required. This is available in the treated round fence post. There is, in the forest and on many farmers' properties, a large volume of marri and jarrah saplings capable of producing good quality round posts suitable for treatment, and it is in our interest to promote the use of this class of timber.

The methods of treatment are fairly well known to most foresters and they are summarized briefly:

a) Pressure treatments - used exclusively by commercial firms.
b) Non-pressure treatment - suitable for farmer himself.

a) Pressure

Either creosote or water borne salts of Copper-Chrome-Arsenic base are used. Posts must be dry. They are placed in a special cylinder, subjected to a vacuum to remove air and then after filling the cylinder with creosote or water borne salts, subjected to a pressure of about 200 lbs./sq. inch to force the preservative into the wood vessels.

b) Non-pressure

i) Creosote - Posts are cut, barked and stacked to dry for 2 - 3 months dependent on weather. Butts are soaked to 20" depth for 5 - 7 days, tops given a few hours. Variations include heating the creosote to reduce the soaking time to hours instead of days.

ii) Water borne salts - Posts are cut, barked and stood upright in a container of Cu - Cr - As solution the same day they are cut. The sap is gradually displaced by the salt which remains "fixed" in the timber.

The cost of creosote or salt used in the Non-pressure treatments is approximately 1/1d. per post.

Commercial plants charge 2/- to 3/- per post, dependent on size for treatment (i.e. 5/- per cubic foot). This is in comparison with 2/10d. per post

(£14 per 100) which is the current charge for split posts. Obviously, if the farmer's time to cut and treat the post himself or deliver to a commercial plant for treatment, is allowed for at, say 2/5d. per post, the split post at 2/10d is cheaper on initial cost compared with 3/6d. for a treated post.

If, however, we compare the costs of posts on an annual charge basis, defined as the cost per year necessary to extinguish to initial cost of the post over the life of the post, by means of equal annual payments, a different picture is obtained.

Post type	Life	Cost/Post	Annual Charge/Post
Split jarrah in hill country	25	2/10d.	2.4d
Split jarrah in irrigated flats	10	2/10d.	4.4d.
" "	15	2/10d.	3.3d.
" "	20	2/10d.	2.73d.
Round marri (treated) cut and treated by farmer	45	3/6d.	2.4d.
Round marri, cut by farmer, carted to and treated by a commercial firm	45	4/-	2.7d.
Treated pine bought ex Picton plant.	45	6/6d.	4.4d.

Assuming a 5% rate of interest.

Interesting points from this comparison are:

i) 2/10d. per split post, provided it lasts 20 years, is the best buy for the farmer. Many farmers in the Harvey irrigation area are not getting more than 10 - 15 years per post and in these places a treated post at 3/6d. is more economical.

ii) A cost of 2/10d. per post is very low compared with Eastern States price of 4/- (Euc. obliqua), lower durability than Jarrah, 6/- (River Red Gum) comparable with Jarrah, 6/6d. (Euc. melliodora - Yellow Box), superior to Jarrah. Obviously at these prices the treated round fence post is a most attractive competitor.

Until the price of split posts is raised it is doubtful if there will be a big swing to the use of treated posts in the South-West.

At Harvey, some interest in treated posts is being displayed by a few farmers who have irrigation country where split posts are lasting in some cases less than 15 years.

Traditional use of the split post dies hard, however; and any interest in treated posts has been aroused only after discussion with the farmer in that common meeting ground, the saloon bar of the Harvey pub. Whilst the farmer's defences are lowering after he downs his ninth schooner, the following advantages of treated posts are usually hammered home:

i) Greater life (45 years compared with 15-20 for split jarrah).

ii) Posts can be pointed before treatment and driven, instead of digging holes first and this gives a firmer post.

iii) By the use of $1\frac{1}{2}$ - 2" staples, wire can be attached direct to posts and the need for boring eliminated.

iv) By using fabricated fencing and staples, erection time can be reduced considerably.

v) The round post is stronger and more resistant to fire than a split post.

After this treatment the farmer is usually convinced and several have promised to put in a trial fence of treated posts.

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PINUS RADIATA SITES AND LAND FORM.

by A.L. Clifton

In the northern divisions, there are 4 land-form types which have considerable bearing on the distribution of P. radiata plantation sites. This will shortly be demonstrated, but first, a comment on the requirements of P. radiata.

It is generally recognised that P. radiata plantation sites need to be on soils derived from rocks relatively high in ferro-magnesian (dark coloured) minerals in order to give a fairly high nutrient content. However, pines require more than mere nutrient. The soils should have depth for anchorage and the ability to store the large quantities of moisture demanded by an actively growing stand of pines.

It will be seen, then, that steep rocky slopes even if high in nutrients, can be expected to have only poor moisture retention. This is due to the effect of accelerated erosion on steep slopes, leaving only shallow soil. Such steep slopes as these occur along the face of the Darling Ranges. The traveller on the South West Highway will quickly observe that this area is suitable only for light pasture. If, however, he were to go into the hills, following valleys he will find in a few miles that steep slopes are less prevalent. This is particularly noticeable in tributary valleys. Larger trees will be seen growing in dense stands. It is in such localities that the best plantation sites are likely to occur.

Going still further up the valleys, the sides will become dominated by long, gentle slopes of gravel colluvium, mixing with the better soils of the medium slopes.

The valleys will ultimately terminate in the gently undulating ancient laterite plateau.

Summing up, it will be seen that the valleys have formed on watercourses, first cutting through the laterite cap, then down into the country rock. The present-day effect can be observed in four stages. I will refer to these as "erosional phases", and these are the land-form types referred to above.

Phase (a). Laterite - massive ironstone and gravel. Unsuitable for P. radiata.

Phase (b). Laterite undercut resulting in long, low spillways of lateritic detritus, on gradients commonly up to 1 in 7. (Steeper spillways do occur). Unsuitable for P. radiata.

Phase (c). Medium slopes. 1 in 7 to 1 in 3 gradient. Soils on these slopes are normally formed directly from underlying rock. Most pine sites occur in this zone.

Phase (d). Steeper slopes than 1 in 3. Normally, rocky, shallow. Some pine sites but mostly unsuitable, as at the face of the Darling Scarp.

Naturally, the limits given for each phase are not rigid, and there will be considerable overlapping. Some ironstone gravel will be found contaminating phase (c) soils, but this is usually in transit down-slope through the surface layers. Deeper seated gravels in quantity may occur on the gentler slopes of (c) phase and these usually indicate soil deterioration. The gravels can be forming in the soil, or merely accumulated lateritic colluvium. In either case their presence in quantity indicates static land-surface conditions, which in turn are associated with age and leaching of nutrients.

Only where underlying rocks in the (c) phase are high in nutrient bearing minerals are the soils derived from them likely to be suitable for P. radiata e.g. basic* and intermediate rock types are better than acidic* types.

It should be noted that soils derived from acidic (e.g. granite) parent materials are more subject to erosion, leaching, (Podsolisation), and gravel formation (lateritization) than are 'basic' soils. Granite outcrops are frequently found on slopes of only 1 in 5 whereas basic-rock types rarely outcrop until slopes exceed 1 in 3. This could be explained in terms of "angle of repose".

Loose granular materials (representing sandy acidic soils) if poured into a heap, tend to settle at a much gentler slope than a more coherent material such as loam or clay i.e. sand has a lower angle of repose than loamy materials. So the former is eroded from steep slopes while loams cling to them. Using these concepts, the distribution of P. radiata sites in the Darling Ranges can be explained. There would be more plantations along the Helena Valley if the parent rocks were not so acid. The remaining phase (c) occurrences are low in nutrients and the remainder of the valley falls into phase (d) or the lateritic phases.

Water storage facilities limit development along the Serpentine, and downstream, phase (d) occurrences make management difficult as do fire protection problems. There are some sites worth considering, though short streams such as the Wungong and Dandalup system have relatively small drainage areas. Their valleys taper off so rapidly into (b) and (a) phases, that the distribution of P. radiata sites is limited.

The Murray, on the other hand, with its heavy volume of water, has cut a long, deep valley through the hills and gained many tributaries, in country with a high proportion of basic rock. The result is gradual phase transitions giving very extensive areas of the important (c) phase.

The Harvey and Brunswick phase (c) areas are rather limited and most available plantation sites have been earmarked. Some (c) phase remains on undeveloped private property on the Brunswick.

* "Acidic" and "basic" terms refer only to the predominant mineral types in the parent material, not to the "sourness" or "sweetness" of a soil.

The Collie River has a deep, steep-sided valley with only short tributaries within the area where desirable parent rocks occur. Hence the (d) phase occurrences dominate the scene. Phase (c) occurs in pockets well above the main valley floor, separated from it by phase (d) which makes management difficult.

The Blackwood from Nannup to Boyup Brook, also has a deep valley but it is wide. Also the country rock is mostly basic, producing a heavy textured fertile soil, capable of clinging to the many occurrences of 1 in 3 slopes. Further, with a wide drainage area, it has long broad tributaries like the Murray, and large areas of soil suitable for growing P. radiata. (Grimwade is on such a tributary). However, much of the land is under agriculture and must be repurchased for pine projects.

South of the Blackwood, there are considerable changes in climate, geology and soil patterns. The concepts considered above cannot be applied.

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