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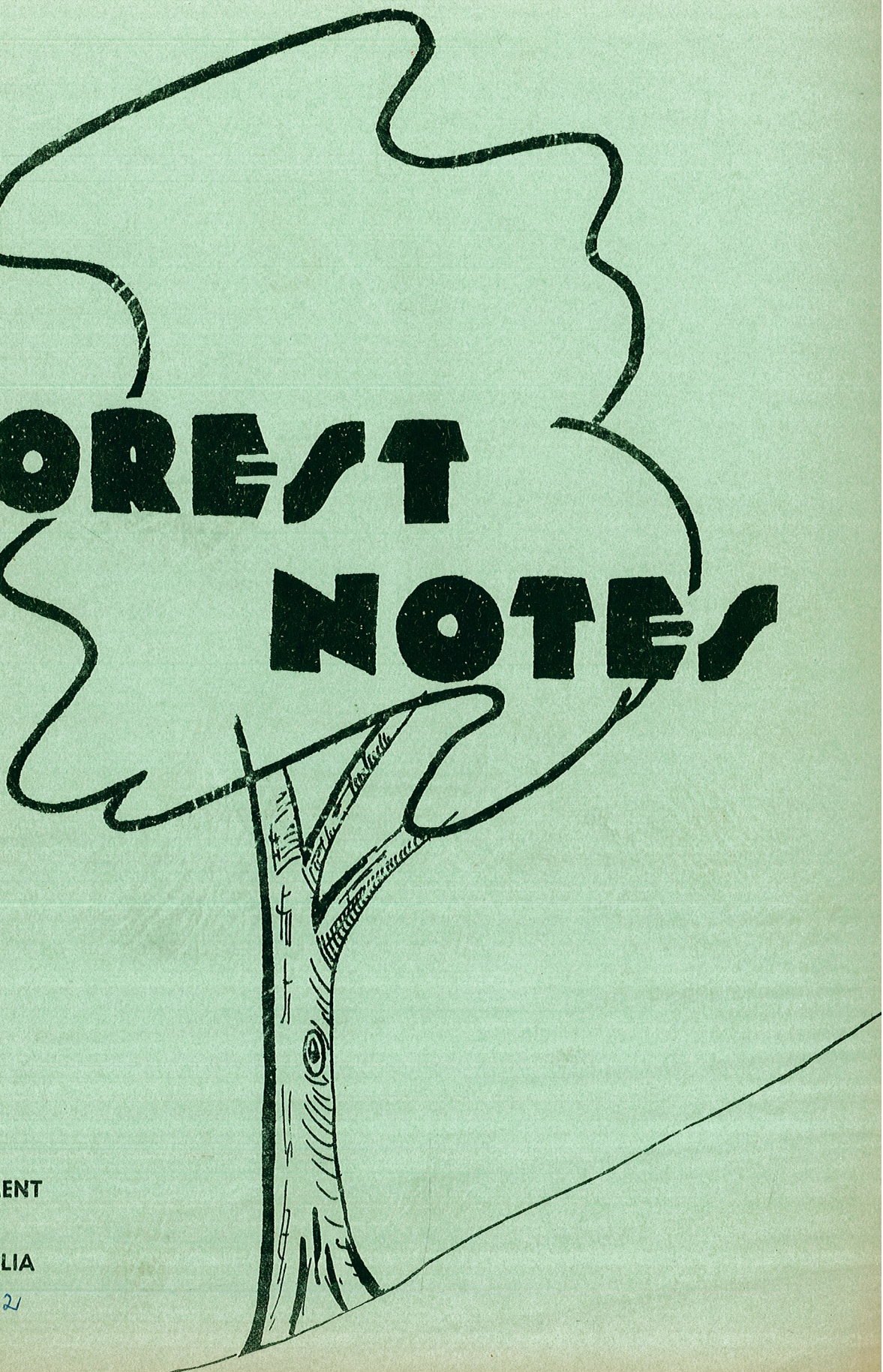
MR. UNDERWOOD

FOREST NOTES



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FOREST NOTES

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LETTER TO THE EDITOR

Dear Sir,

I have just received the latest "Forest Notes" Vol. 7 No. 1, and was interested in the Frequency Rates quoted on pages 36.

Not being an expert in statistics, I could be off the beam, but it seems to me that these F.R. as shown, are hiding some real information on accidents in pine logging and/or pine milling practices and therefore I would be glad if you could perhaps show separately F.R. for pine logging gangs instead of lumping them all together.

A point which may emerge (unpleasantly probably) is that old equipment such as "Quads" are involved in poor logging practices, not to mention other bits of equipment.

Yours sincerely,

A. J. HART
SILVICULTURALIST
(Nurseries)

KARRI SEED SAMPLING

by P. Christensen.

Large areas of Virgin Karri are cut over by the mills every year. Since Karri is a valuable timber tree and its growth rate compares favourably even with the fastest exotics, these areas are usually regenerated naturally to Karri. In the past, Karri was managed on a group selection system but recently a system of clear felling with seed trees has been adopted in many areas. Since this means that there are less seed trees per unit area, it has become increasingly important to know as accurately as possible the amount of seed available in the crowns and also when it will be available.

A glance at Graph 1 (page 4) will reveal that the problem of seed supply is not a new one; records of seed years have been kept since 1925, so one may assume that it was considered important even in the early days. A more interesting fact also revealed by this graph is that in general, seed years only tend to occur every 4-5 years. It is important therefore to be able to forecast these years well ahead if possible.

From at least 1956 onwards, 1/10 mil/acre seed trays have been used under Karri canopy in various locations to give a quantitative measure of seed supplies.

The numbers of the various floral stages (Pin buds, cylindrical buds, Clavate buds, opercula, hypanthia, immature capsules, and mature capsules) collected were recorded, and the approximate No. /acre could be calculated.

Fortunately the Eucalypt flower opens by the opercula or cap, on the end of the bud abscising from the rest of the bud or hypanthia (flower cup). Thus the number of opercula shed per acre represents the number of opened flowers per acre. By adding the number of Pin buds, cylindrical buds, or clavate buds previously collected from the area, we can calculate the amount of each stage that were present per acre at the time. Further, by subtracting the number of hypanthia and immature capsules subsequently collected we can make an estimate of the numbers of mature capsules present per acre.

Complete records of seed tray sampling exists for the last ten years, and it has been possible to use these to calculate the numbers of each floral stage present per acre in any one year. This has been done for two complete floral cycles in Fringe Karri areas, e. g. Wheatley, Glenoran, Northcliffe, Shannon River; and Central Karri areas, e. g. Pemberton.

Graph II illustrates how a percentage of each floral stage is lost as one progresses through the floral cycle towards mature seed-bearing capsules. Fringe and central Karri are remarkably similar, indicating that the Karri in different areas follows the same general pattern. The two cycles 1959 - 62 and 1963 - 66, whilst differing by some 15 - 20%, still exhibit similar curves. The former was a rather poor seed cycle and the latter a very good one; thus by using the mean we get a graph which should express an average year.

This graph can be used to estimate what percentage of any given crop of Pin buds, cylindrical buds, etc. are likely to reach full maturity as seed-bearing capsules. Thus Graph III illustrates the adapted version which can be used to read off directly the percentage of a crop of pin buds or cylindrical buds, etc. which is likely to reach maturity under normal average conditions. The season in which they are likely to mature can also be forecast and a further additional part of the curve allows an estimate of the number of capsules likely to carry over into successive seasons.

A figure of 1 seed/capsule is used when estimates of seed per unit area are made. This figure can be considered conservative.

Seed trays are no longer used in routine sampling, the "twig count" method is employed instead. This method is based on the fact that it has been variously calculated that there are approximately 10, 000 twigs per sq. chain of crown area in the capsule bearing region in an average Karri stand. Using hand samples taken either from felled trees or from standing trees by Rifle Shot sampling, the number of twigs, Pin buds, cylindrical buds, etc. present are counted and used to calculate the numbers of each floral stage present per 1/10th acre.

The advantages of this method over that of the seed tray method are that it is a more direct method, it is quicker and involves less work. Also it enables the entire Karri area to be sampled by a few people, ensuring that sampling is the same in all areas.

Now if we have an estimate, calculated from hand samples, of the number of pin buds present per sq. chain of crown area, it is possible by consulting Graph III to calculate approximately what percentage of these buds are likely to reach maturity as ripe capsules; e. g., If we had 400, 000 Pin buds per sq. chain of crown area and sampling had been done in Sept., 1968 we would consult the graph, Region I, Sept., and find that about 27% of them are likely to reach maturity; i. e. 108, 000 will become mature capsules. They will reach maturity in Region 4 (they are now in Region1),

Graph 1

Karri seed years over the past forty-three years.

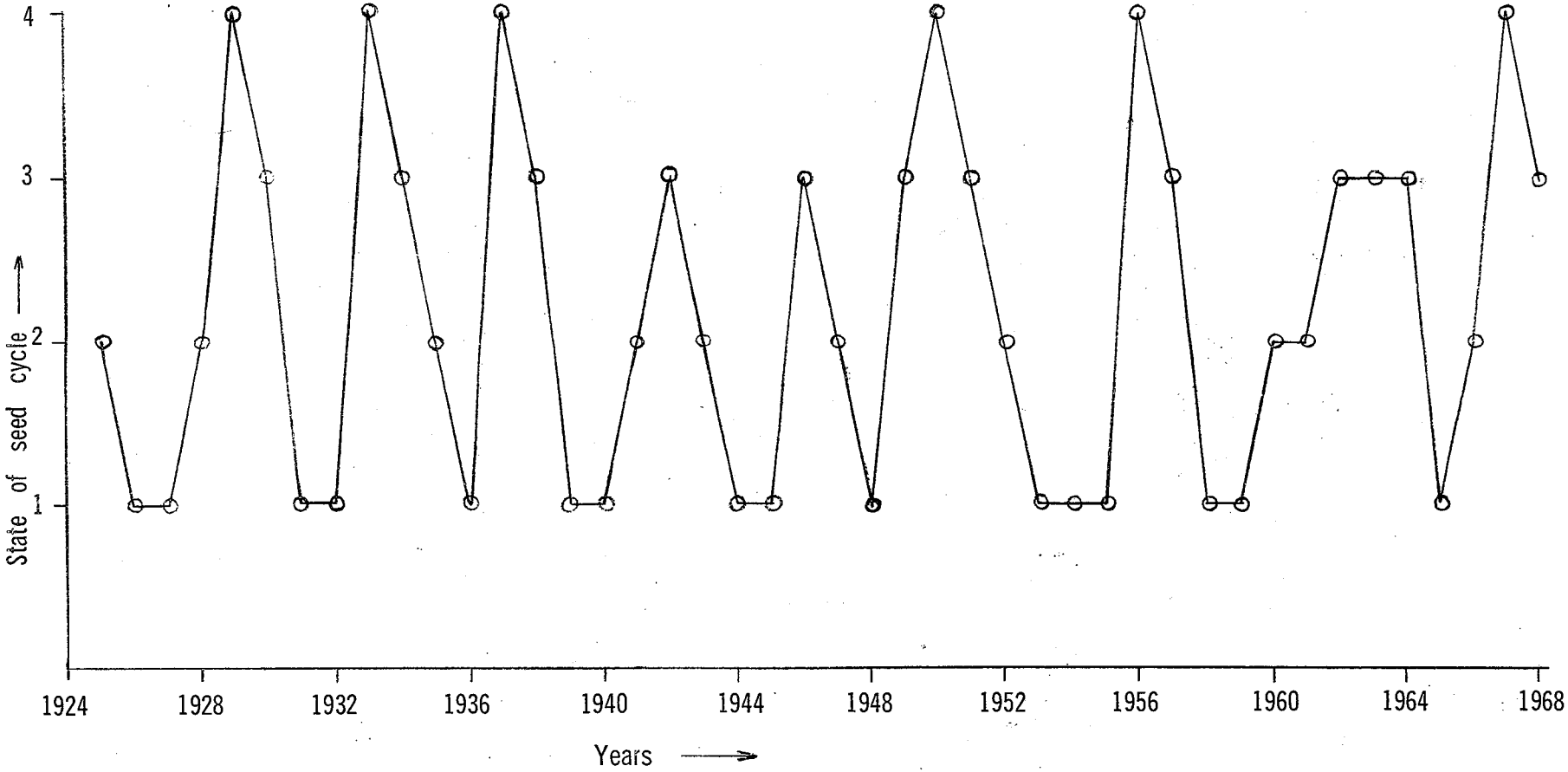
State of seed cycle.

1 = Seed – none to rare

2 = Seed – local only

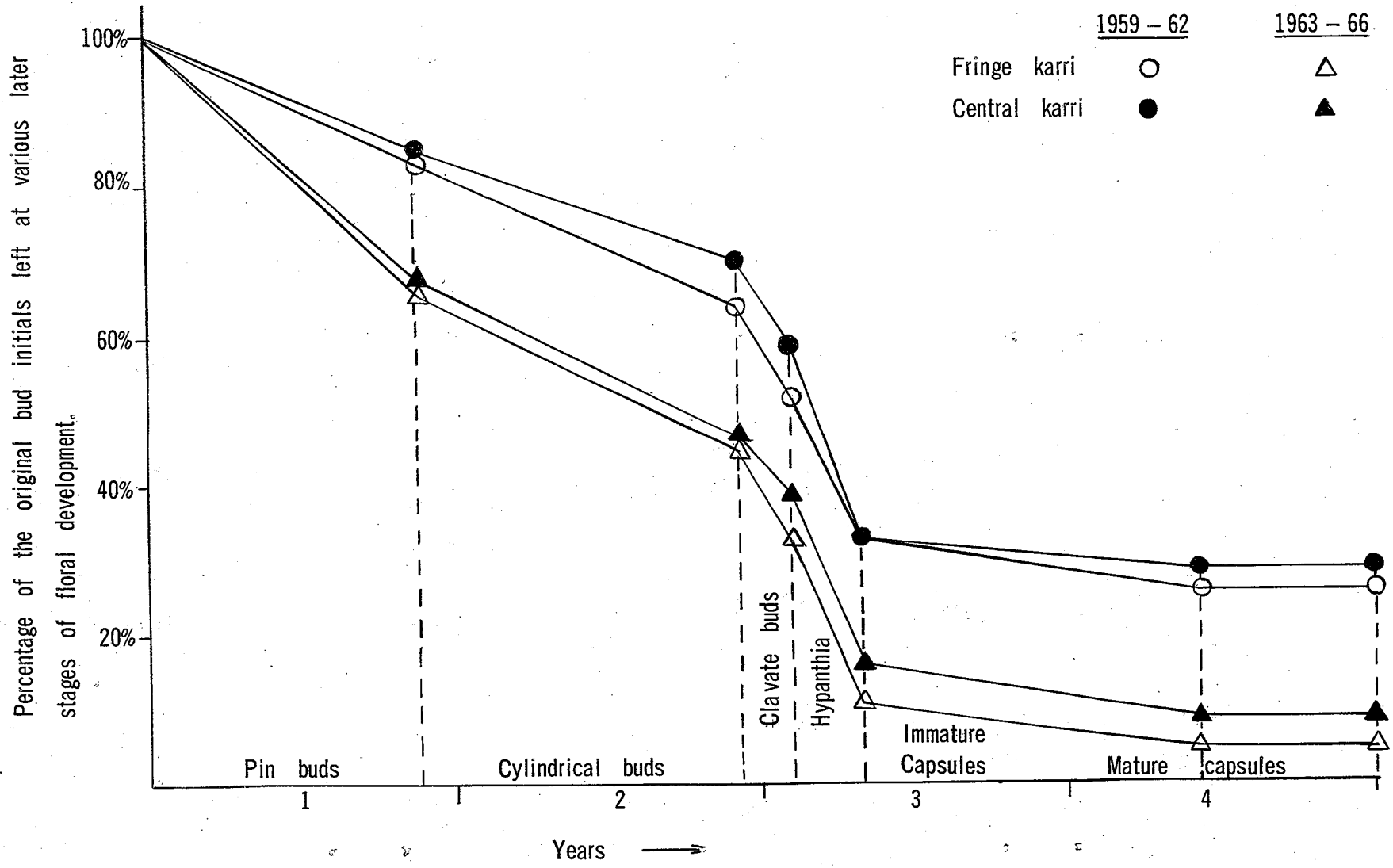
3 = Good seed years

4 = Main seed years

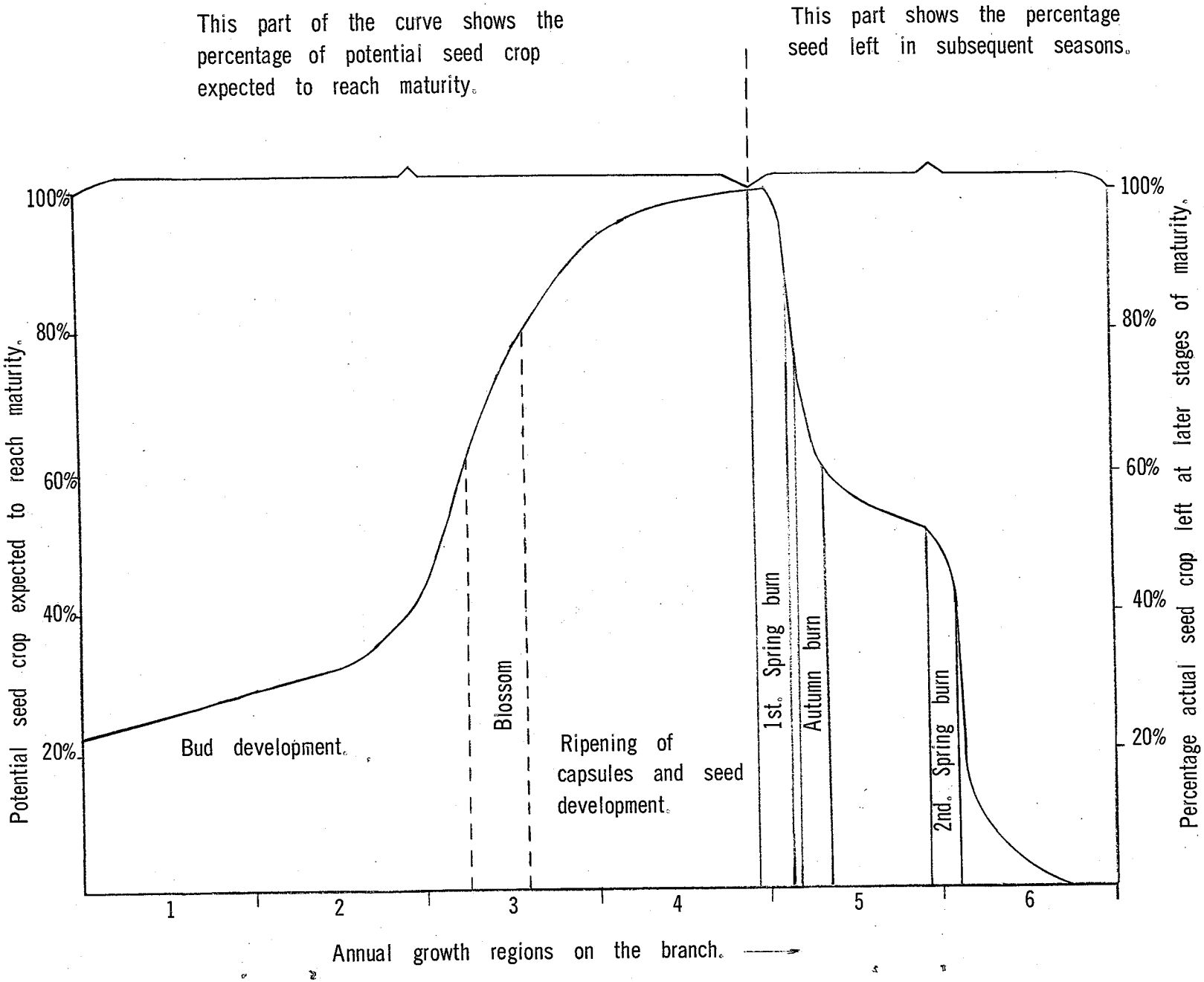


Graph II

This graph illustrates how a percentage of the various floral stages drop off as the floral cycle progresses towards mature seed-bearing capsules.



Graph 111


This part of the curve shows the percentage of potential seed crop expected to reach maturity.
This part shows the percentage seed left in subsequent seasons.
100%
80%
60%
40%
20%
Potential seed crop expected to reach maturity.
Bud development.
Blossom
Ripening of capsules and seed development.
1st. Spring burn
Autumn burn
2nd. Spring burn
Percentage actual seed crop left at later stages of maturity.
1
2
3
4
5
6
Annual growth regions on the branch.

therefore they will be mature in Spring, 1971. Since we assume 1 seed per capsule, it is estimated that approximately 108,000 seeds per sq. chain of crown area will be available in Spring, 1971. If the burn is delayed till Autumn, about 60% should still be left; i.e. about 65,000 seeds, or in Spring 1972 there should still be 54,000 seeds available per sq. chain of crown area.

Estimates of this nature will in future be carried out in each of the SMP's where Karri is cut, twice a year, once in Spring and once in Autumn. The sampling will be carried out in the areas where the mill happens to be felling at the time. These estimates can be taken to be an estimate of the seed for the area in the general neighbourhood of the felling where the sampling was carried out.

Adjacent areas do not, as a rule, differ widely. Thus with twice yearly samplings being carried out, fairly reliable estimates of future seed supplies should be available two or three years before seedfall. A record in the form of a Histogram will be kept at the Manjimup Research Station for each SMP, so that an overall picture of the state of the Karri seed cycle will be available at any time.

The emphasis throughout has been on similarity rather than differences in seed crops. This does not mean that we are unaware of the tremendous differences which may exist between two adjacent areas or two adjacent trees and even adjacent branches on the same tree. However, on the whole, adjacent areas are usually similar, and though trees in one area may differ widely it has been shown recently that a fairly small but representative sample will give a good estimate of the area in general. The main aims of the method are to provide some sort of "system" in the sampling so that reliable records of the Karri floral cycle can be kept. Thus records for one seed cycle will be comparable with those of any other since similar methods were used to compile them. This will enable one to refer back later if Regeneration failures occur and perhaps gain some understanding from them. It is also hoped that the estimates will be of some use in planning Karri operations in the field.

P.S. This sampling for forecasting future seed supplies should not be confused with the "confirmation of seed supplies sampling" done just prior to Regeneration burning.

PINE INVENTORY CHECK.

by J. Williamson.

The assessment of plantations for volume figures by Working Plan crews is now based on plots selected at random and measured by the angle count principle. The aim is to put in enough plots to produce an estimate with a sampling error of $\pm$ 5% (at the 95% confidence level) for the most important areas. Larger sampling errors are accepted for less important areas.

In order to test the angle count method and the computer program used to process the plot data, every tree in a selected compartment has been measured. The volume obtained from this complete enumeration has been compared with the estimate of volume from 100 plots measured in the standard way by the angle count principle as used in the pine inventory.

The relevant data and results are as follows:

A. Background information

Species:	P. pinaster
Location: Compartment 28 North Kendall,	Gnangara
Age at complete enumeration:	17 years
Area of Compartment 28:	26.7 acres
Total number of stems on 26.7 acres:	15,372

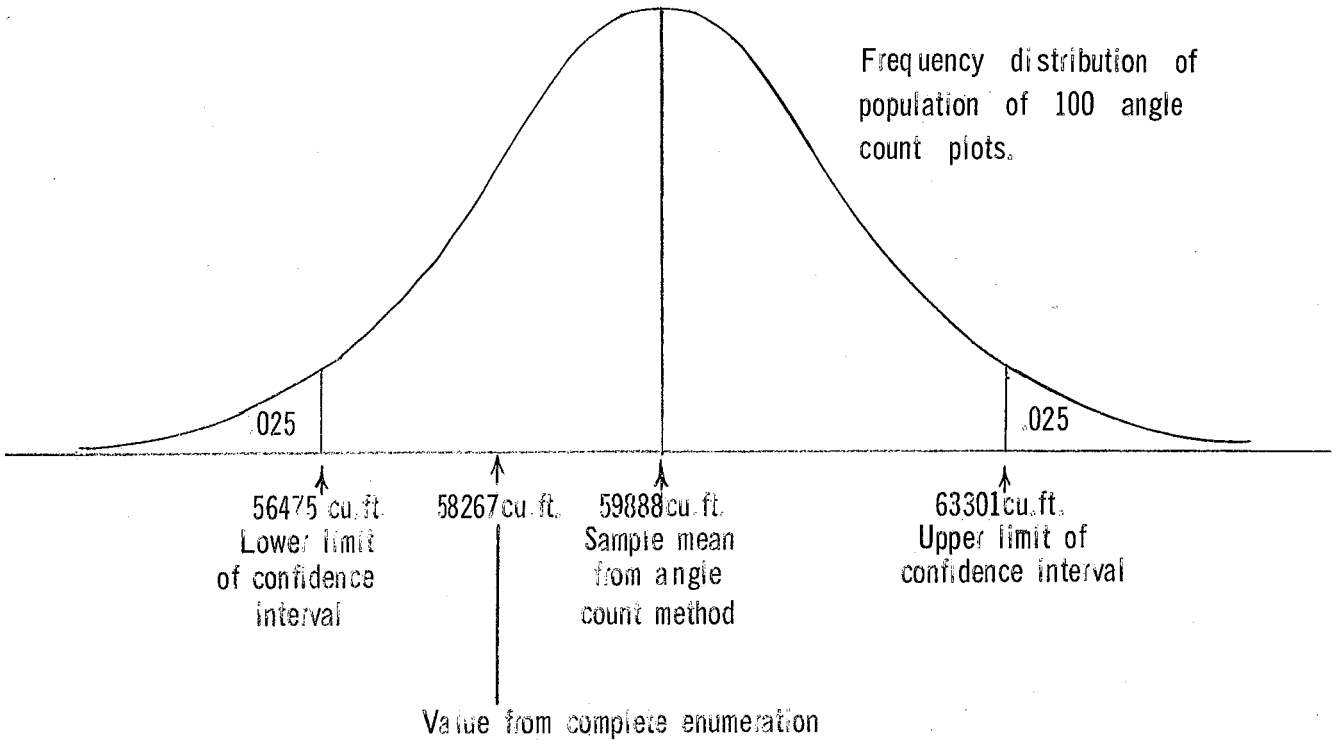
B. Volume information

Complete enumeration (volume U.B. to 2.5" T.D.L. on 26.7 acres)	=	58267 cu. ft.
Volume by angle count method (100 plots)	=	59888 cu. ft. $\pm$ 5.7%
i.e. confidence interval of angle count method = 56475 cu. ft. to 63301 cu. ft.		
Difference = 59888 - 58267	=	1621 cu. ft.
Difference % = 1621/59888	=	2.71%

C. Conclusion

The volume from complete enumeration (58267 cu. ft) lies within the 95% confidence interval of the sample mean from the angle count method. The angle count sampling method can therefore be accepted as quite satisfactory for our pine inventory work.

Diagrammatically, this can be shown as:


Frequency distribution of population of 100 angle count plots.
.025
.025
56475 cu.ft.
Lower limit of confidence interval
58267 cu.ft.
59888 cu.ft.
Sample mean from angle count method
63301 cu.ft.
Upper limit of confidence interval
Value from complete enumeration

SUPERING TRIALS - KELMSCOTT

by F. G. Quicke.

Midway through the 1968 planting on Peel Estate coastal sands, crew members of planting machines came up with an idea.

Why not put a man on the back of each machine with a tin of super, to fertilize each plant as it is planted?

It sounded a good and economical scheme, but one objection was that fertilizer may damage the plants so fresh from the nursery. Some experience was available to indicate that this may happen.

However, the trial was commenced.

A crude platform was welded to the rear of the planting machine, a seat added for the operator and two bins ($\frac{1}{2}$ 44 gallon drums) one on each side for convenient access for the operator, to maintain balance of weight of the machine and to provide sufficient carrying capacity.

An opening was made in the platform, square shaped in the middle with the base of the square at the operator's seat and the seat facing to the rear. When the planter is operating, the platform would be about six inches above the ground. The seat is set at a comfortable height to avoid operator's arms and knees interfering with one another (See figure 1).

As the newly planted seedling appears behind the planter in the square hole of the platform, the required amount of fertilizer is tossed near the plant. It is not tossed onto the foliage. It is preferable, to maintain balance of weight on the machine, to scoop from left and right bins alternatively, thus avoiding emptying one bin before the other.

An increase in tyre pressures on the planting wheels is necessary, depending on the condition of the soil.

Refilling the fertilizer bins coincides with loading plants and therefore does not delay the planting operation.

Man Power:

1 Tractor Driver, 2 Planters, 1 Fertilizer, 1 Supervisor.

Safety

1. The platform must be made in such a way as to prevent roots interfering with operator's feet and legs.
2. Eye protection and gloves, as provided for other operators on the machine.
3. Extend the existing cover to provide protection from weather.
4. An alarm system. A horn mounted in the cabin of the tractor with buttons for all operators and tractor driver to signal stops and starts.

Results

At November survival counts we found no evidence to indicate damage from early fertilizing.

Costs

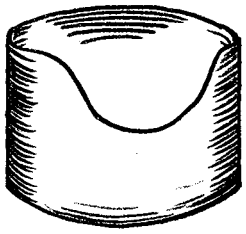
Costs may be assessed in two ways.

1. By costing the one man only, per day to fertilizing and all plant costs to planting.

OR

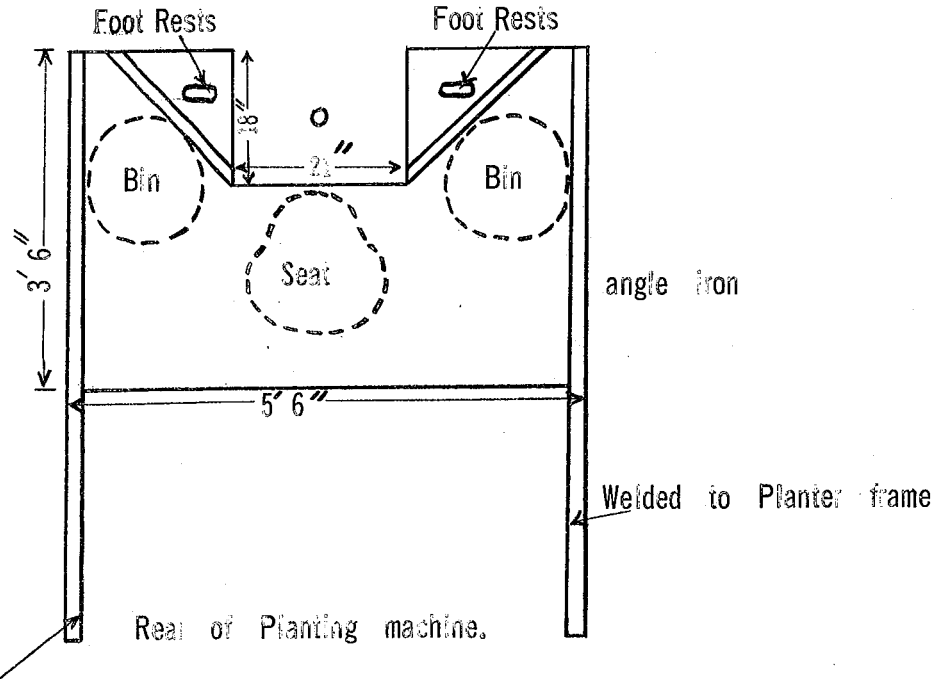
2. By reducing the planting costs in proportion and adding proportion of machinery and transport costs to the fertilizing. Comparing the above method of fertilizing with another method currently used, we saved 30% on fertilizer costs.

Figure 1 – Fertilizing platform for attachment to planting machine.



Bins cut away for access.

o Plants



Angle iron frame about 2"x 3/8"

ROTATIONAL CONTROL BURNING MIXED JARRAH-KARRI FOREST AREAS

by S. J. Quain.

INTRODUCTION

The protection of the Forest areas from severe fires by Rotational Control Burning is a well established principle and practice in the Northern Jarrah Forest. In the Southern mixed Karri-Jarrah forests the aircraft makes possible the application of Rotational Control Burning for the first time. At present we are attempting to put into practice rotational control burning by extending techniques that have been proven successful in the Northern Jarrah Forest. The following article will indicate both the similarities and differences in applying these techniques to the mixed forests of the South.

All southern forest burns are carried out by the normal system of securing the perimeter early in the season by edge burning. The area is then stripped out by dropping incendiaries across the wind at predetermined distances so it burns out under controlled conditions. These burns are programmed for the late spring and early summer in much the same manner as the Northern Jarrah burns.

Although these basic steps are similar, the actual fuels, weather conditions and execution of the burns are entirely different. Some of the differences are as follows:

The heavy undergrowth prevents ready access off the tracks for all concerned. This causes major difficulties in locating hop-overs or drop-overs during the burn.

The mixed forest in the majority of burns generally contains jarrah types, flats and karri types. This requires three different burning conditions and so each area is commonly flown three times to take out the flat types, jarrah types and finally, if weather permits, the karri types. This treating of the area for three different burns also requires at least two and generally three edging burns to get an edge. The time lag between the jarrah and karri burns is commonly between two and four weeks. This combined with the more prolonged wet spring weather as compared with the Northern Jarrah, leads to the major difficulty that in some years the karri forest does not dry out to permit control burning before the close of the karri burning extension, usually 15th January.

When this happens we have the highly dangerous condition of

heavy karri fuels adjacent to recently burnt jarrah fuels with burning logs etc. all through the prohibited burning season. These areas could have weak edges because of the late drying of the karri along the edges.

There is always a distinct possibility of having an extremely rapid fire danger build up between the jarrah and karri burns in December and early January.

Because of the problems of unsuitable weather, lack of access and extensive areas of forest, there has been a far greater build-up in fuel in the Southern Forest areas as compared with areas further north. This in turn has increased the difficulty of the aircraft burning because the burning is adjacent to heavy fuels which ignite easily and prove difficult to control. Although the air crew is becoming highly skilled, it is generally an exception if the occasional stray incendiary does not drop into adjacent country.

There appears to be a major difference in the drying characteristics of karri fuels and jarrah fuels in that the heavier the jarrah fuel becomes, the milder the conditions required and the earlier in spring the burn can be carried out. (In discussion with some of the Foresters who carried out the initial burning in the compartments around Gleneagle and Dwellingup, they mentioned that a lot of the initial burning was done in the dry spells in winter in June, July and August). It appears that regardless of how heavy the karri fuels get this does not permit burning earlier in the spring. The indications at the moment suggest that the heavier the fuel the longer it takes to dry out and so the later in spring or summer it can be burnt.

Because of the troubles encountered, it has been necessary to plan aircraft burns like a fairly large fire with a full complement of Fire boss, Sector bosses, gangs and bulldozers. In the past it has commonly been necessary to shift gangs from outside the Divisions because the gang strength in one Division is insufficient to maintain adequate patrol and control around the perimeter.

CONCLUSION

I have no doubt that further basic data regarding burning in the area will greatly assist in both the ease and safety of carrying out these burns; but at present, it is not correct to regard the Southern burning as directly comparable with the Northern Jarrah burning because of the advent of the aircraft burning technique.

ECONOMICS OF FORESTRY.

by D. Spriggins.

In recent issues of Forest Notes, several writers have made mention of the economics of growing different forest crops. It was therefore with the hope of maintaining interest in this fairly important aspect of forestry, that this article has been written.

Whether the growing of a particular crop is economic or not is certainly not an easy matter to determine, and the terms "economic" and "uneconomic" are all too often bandied about to either justify or discredit the growing of a particular crop one is in favour of or opposed to growing.

If we accept the view which is widely gaining acceptance, that all of the wood products of the forest are these days no longer indispensable to mankind, and can be substituted in technical efficiency by substitutes such as steel, aluminium, and synthetic fibres not produced from wood pulp, then it is possible to make some predictions.

It should be reasonable to expect that the extent to which wood products are replaced by substitutes will, to a large degree, be strongly influenced by the difference in price between timber products and its substitutes.

If this is so, then timber production forestry should aim to produce as cheaply as possible, the basic raw materials which when converted into their final form, can compete favourably in price with likely substitutes.

As with any other form of business, it is essential that the return from the sale of goods, in this case the raw forest material, be greater than the cost of producing these goods; i.e., that the business runs at a profit. Failure to recognize this would really amount to an unwitting subsidy to the timber-using industries, and whilst this may not be a cause of concern in that the manpower and capital directly and indirectly employed in timber conversion may by taxes, etc., contribute to the economy a considerable amount of revenue it would have not otherwise received, it is fairly essential that the extent of the subsidy, if any, be known.

The reason it is important to know the level of the subsidy, if any, being given towards the growing of a particular crop is that if the subsidy is a large one, it could be a better proposition for the community to invest that same amount in other fields, such as one of the non-wood industries or if it was cheaper, even to assist the importation of timber. (Heresy!!)

It may be felt that as forests provide other services such as recreation, water yield, etc., that such a hard business-like approach is not required for forestry operations. This, however, should not necessarily be so, for the fact that forests may also yield non-wood products, should not justify highly unprofitable timber production on the same area. If water production or recreation was the chief use of a particular forest, this could probably be achieved simply by conserving the original forest, and with limited access protective burning and fire protection as the only major costs involved.

Accepting the principle, then, that forestry which has timber production as its main goal, should aim to run at a profit, a comparison has been made of the estimated costs of production and possible returns from some typical forest crops.

Figures quoted for yields should be regarded as estimates only, nevertheless they are probably reasonable enough to give an indication for comparison purposes between crops.

As the money invested in the different timber production crops could have been invested in alternative fields such as loans to local government authorities etc., on which rates of interest would be charged, it is considered reasonable to charge an interest rate of 5% compound on all costs involved in producing the timber crop, i.e., it gives a measure of the cost of the use of establishment monies and the necessary waiting until the crop grows and becomes saleable. In the following exercises this is done by discounting back to the time of planting, all future returns and costs using the 5% rate of interest. For comparison purposes, interest rates of 2%, 3% and 4% have also been included.

Exercise 1.

A high site quality jarrah forest 50 miles from Perth has just been clear fallen. Assume that the site is also capable of growing an average crop of Pinus pinaster.

Alternative 1. (a) Re-grow another crop of jarrah on a 130 year rotation.

1. (b) Grow a crop of pinaster on a 55 year rotation.

Basic assumptions.

The jarrah stand is given a non-commercial thinning at age 40, as it has been fairly well established that for mill log production this is financially a better proposition than waiting until age 70 when a commercial thinning would be possible.

For the jarrah forest an annual expenditure of 40 cents per acre has been chosen. This is derived by dividing the annual Dept. budget (less pine grants) by the total acreage of State Forest. This gives a figure of 45 cents, but assuming that only 80% is spent directly for timber productive reasons, 40 cents should be a fair figure.

Over and above any direct costs incurred in producing a crop of timber, there must be levied charges for overheads such as leave, pay-roll tax, head office administration, research, etc. To cover these in these exercises 40% overheads on any direct costs have been used. It is considered that these overheads would be conservative.

Exercise 2.

An area of native forest on the Swan Coastal Plain some 25 miles from the Perth market is converted to a Pinaster plantation and worked on a 55 year rotation, produces an average yield.

An annual maintenance charge of 3 dollars per acre has been used, which may be considered to be a little high to cover such things as firebreak maintenance, control burning, maintenance of roads, water points, etc.

Exercise 3.

A former jarrah and blackbutt site of red soil, 50 miles from the Perth market is cleared, and a low site quality (SQ IV to V), P. radiata plantation is established and worked on a 40 year rotation.

Discussion.

With the figures used and a 5% interest rate on money used in producing the different crops, only the radiata crop shows a positive return. The fact that the pinaster and jarrah crops do not break even may not necessarily be a bad thing if, as mentioned previously, it can be demonstrated that by using capital indirectly and by providing employment, the community may benefit in the long run. As an index of these indirect returns and benefits, I understand that the British Forestry Commission declare a crop economic if it yields a positive return or breaks even using a 2% interest rate. On this basis, all of the crops in the exercises would be "economic".

It is interesting to note (whether you agree with this method of analysis or not) the large difference between pinaster and radiata crops, and this would suggest that on many of the marginal radiata sites which at present are usually planted with pinaster, it could be a good investment to upgrade these sites to radiata suitability (if this is technically possible),

by the heavy application of fertilizers, as the higher financial return from the radiata crop would certainly permit a fair amount of expenditure on this or other methods of site improvement.

Exercise 1. (a) Re-growing a crop of jarrah (high site quality), 50 miles from the Perth market.

Operation	Year	Direct costs dollars	plus 40% O'heads	vol. lds. per acre	Royalty dollars per ld.	Rev-enue dollars	Discounted values at 5% compound	
							Costs	Returns
Thinning (un-merch)	40	8	11.2	-	-	-	5.05	
2nd thinning, mark and top disposal	70	2	2.8	14	4.40	61.6	0.09	2.02
3rd thin and top disposal	100	2	2.8	37	4.40	162.8	0.02	1.24
Clear fall	130	-	-	78	4.40	343.2		0.62
Annual maintenance 40 cents per acre.							11.2	
					TOTALS		12.90	3.88
Comparative residuals using different interest rates. 2% + $29.66 3% + $0.82 4% - $6.44					Residuals		-$9.02	

Exercise 1. (b) Pinaster on former jarrah site, 50 miles from Perth.

Operation	Year	Direct costs dollars	plus 40% O'heads	U/B Vol lds per acre by size classes	Stumpage residual dollars per load	Rev-enue dollars	Discounted values at 5% compound	
							Costs	Returns
Establish-ment.	0	40	56	-	-		56	
Weed control	2	5	7				6.4	
Road upgrade	5	10	14	-	-		7.1	
Low prune	10	15	21	-	-		13.0	
Re super	10	6	8.4	-	-		5.1	
High prune	15	10	14	-	-		6.7	
1st thin	18	-	-	Chip. 18	1.12	20		
				5"-7" 10	3.81	38(58)	-	24
Re-super	20	6	8.4	-	-		3.2	
Re-super	30	6	8.4	-	-		2.0	
2nd thin	30	-	-	5"-7" 9	4.18	38		
				7"-9" 4.2	4.77	33		
				9"-12" 1.4	11.44	16(87)		20
Re-super	40	6	8.4	-	-		1.2	
3rd thin	42	-	-	5"-7" 3.4	4.18	14		
				7"-9" 5.2	7.77	40		
				9"-12" 8.2	11.44	94		
				12"- 1.1	14.59	16(164)		21
Clear fall	55	-	-	5"-7" 2.5	4.18	10		
				7"-9" 5.0	7.77	39		
				9"-12" 8.4	11.44	96		
				12"- 28.0	14.59	408(553)		38
Annual maintenance		3	4.2	-	-		78.0	
					TOTALS		$178.8	$103
					Residual		-75.8	

Comparative residuals using different interest rates.

2% + $79 3% - $4 4% - $52

Exercise 2. Pinaster crop on the Swan Coastal Plain, 25 miles from Perth.

Operation	Year	Direct costs dollars	plus 40% O'heads	U/B Vol. lds per acre by size	Stumpage residual dollars	Revenue dollars	Discounted values at 5% compound	
							Costs	Returns
Establishment	0	20	28.0	-	-	-	28.0	-
Cultivation	2	2	2.8	-	-	-	2.5	-
Cultivation	3	2	2.8	-	-	-	2.4	-
Road upgrade	5	7	9.8	-	-	-	7.6	
Low prune	10	15	21.0	-	-	-	13.0	
Re-super	10	6	8.4	-	-	-	5.1	-
High prune	15	10	14.0	-	-	-	6.7	
1st thin	18	-	-	Chip. 18	2.84	51		
				5"-7" 10	5.53	55(106)		44
Re-super	20	6	8.4	-	-	-	3.2	
Re-super	30	6	8.4	-	-	-	2.0	-
2nd thin	30	-	-	5"-7" 9	5.90	53		
				7"-9" 4.2	9.49	40		
				9"-12" 1.4	13.16	18(101)		23
Re-super	40	6	8.4	-	-	-	1.2	
3rd thin	42	-	-	5"-7" 3.4	5.90	20		
				7"-9" 5.2	9.49	40		
				9"-12" 8.2	13.16	108		
				12"- 1.1	16.31	18(195)		25
Clear fall	55	-	-	5"-7" 2.5	5.90	15		
				7"-9" 5.0	9.49	47		
				9"-12" 8.4	13.16	110		
				12"- 28.0	16.31	456(628)		43
Annual maintenance		3	4.2	-	-	-	78.0	
					TOTALS		149.7	135
					Residual		-$14.7/acre	

Comparative residuals using different interest rates.
2% + $189 3% + $87 4% + $22

Exercise 3. A crop of low site quality P. radiata, established 50 miles from the Perth market.

Operation	Year	Direct costs dollars	plus 40% O'heads	U/B Vol. lds per acre by size classes	Stumpage residual dollars per ld.	Revenue dollars	Discounted values at 5% compound Costs	Returns
Establishment	0	100	140				140.0	
Weed control	2	5	7				6.4	
Road upgrade	5	15	21				16.4	
Low prune	8	15	21				14.2	
1st thin	14	-	-	Chip. 16	2.50	40		
				5"-7" 16	7.26	106(146)		74
High prune	15	10	14				6.8	
2nd thin	20	-	-	5"-7" 14	7.54	105		
				7"-9" 4	10.54	42(147)		56
3rd thin	25	-	-	5"-7" 8	7.54	60		
				7"-9" 14	10.54	148		
				9"-12" 6	13.61	82(290)		86
4th thin	30	-	-	5"-7" 4	7.54	30		
				7"-9" 7	10.54	74		
				9"-12" 16	13.61	219(323)		75
5th thin	35	-	-	5"-7" 3	7.54	23		
				7"-9" 3	10.54	32		
				9"-12" 12	13.61	164		
				12" + 7	16.17	113(332)		60
Clear fall	40	-	-	7"-9" 10	10.54	105		
				9"-12" 21	13.61	286		
				12" - 64	16.17	1030(1421)		200
Annual maintenance		3	4.2				72.0	
						TOTALS	255.8	551
						Residual	+295.2	

Comparative residuals using different rates of interest.
2% + $1001 3% + $715 4% + $470

THE NEW BEARD TOWER

by R. J. Underwood.

It is saddening to record that another of the great "Tall Tree" Lookout Towers in the Karri forest has been taken out of service. Beard Tree (176' to the cabin floor), located on the Deeside Coast Road in the northeast of the Pemberton Division, has now been replaced by Beard Tower, a metal construction.

Beard Tree Tower was built in 1952 and was an extremely valuable lookout during the 17 years it saw service. The tree overlooked portions of the Pemberton, Shannon and Manjimup Divisions, and provided an important "right angle" to bearings from Burnside, Boorara and Kepal Towers. However, a routine inspection of the tree during the 1967-68 season indicated that the top of the bole and one major limb supporting the cabin were dangerously decayed. The tree was condemned and later felled so that close study of the extent of the internal rot could be made. This study completely vindicated the condemnation of the tree.

In February, 1969, work commenced on the replacement of Beard Tree with Beard Tower. The new tower, located about 1½ chains west of the old tree, is a four-legged structure made of galvanised steel. It towers 200 feet above ground, topped by an 8 feet diameter circular cabin. The view from the top is tremendous, surpassing that from the Tree. The climb is still a rigorous one, and it is surprising to find that the whole structure sways considerably. The cost of the new structure is expected to be in the vicinity of $16,000 which compares unfavourably with the cost of the tree lookout it replaced (cost of tree, nil; cost of pegging and cabin, about $400).

Incidentally, the old tree being felled, the iron pegs were lifted out with a kangaroo jack and a 28-load log cut and sent to Jardee Mill. A mundane end for a mighty tree!

The new tower is certainly a spectacular structure, but somehow it lacks the appeal and the romance of the tree.

Another of the trees to go recently was the old Gardner Tree Number 1. This tree was used as a lookout between 1939 and 1942, at which time the Gardner Tree Number 2 (about ½ mile to the southeast of Number 1) was brought into service. The old tree snapped off last winter at a point about 15-20 feet below the crow's nest - a sight which brought a mild sense of alarm to this writer who had climbed the tree only two years previously. Examination of the break indicated that there

was only about 1" of wood around the bole holding it up. One gets a sense of history at the foot of this old tree - there is a sign there reading "persons who climb this tree do so at their own risk, (signed) S. L. Kessell, Conservator of Forests" !

The other tree towers still in use in the Karri country are Gloucester Tree, Boorara Tree, Gardner Number 2 and Diamond Tree. In addition there is a small tree outside the Pemberton office which is occasionally climbed by brave officers. It seems likely that Gardner will have to be replaced during the next 10 years, and the other major trees perhaps over the next 20-30 years. It is doubtful that any new tree towers will be built because (i) the best trees on the best spots have now gone and (ii) George Reynolds and Len Nicol would probably no longer relish the job of pegging and cabin construction.

One finds the prospect of the old tree towers going an extremely sad one. They seem to represent an era of development and originality in the history of karri forest management.

AERO-BURNING IN PINE PLANTATIONS

by J. McCormick.

The present advances made by the department in controlled burning operations will only be fully appreciated in the light of its future fire history. I now pause to wonder whether or not the department will be first in the air in so far as controlled burning of pine plantations is concerned. Who knows but that the future workhorse in plantation burning may be that most attractive of all man-made machines, the helicopter.

We can consider three stages at which a P. pinaster plantation may be control burned: firstly, the stand at about fifteen years of age, pruned but unthinned with fuel quantities ranging from five to eighteen tons per acre; secondly, after first thinning and after top disposal burning has been carried out - on foot; and thirdly, the stand at about thirty years of age and over with green crowns at about twenty to fifty feet above ground level. These statistics vary, yet I cannot foresee any great technical difficulty in controlled burning from a helicopter in any or each of the three stand categories mentioned. The danger of crown scorch would decrease with increase in tree height, thus ground area covered by burning would increase considerably with tree age. One assumes that top disposal burns have been carried out on foot whilst tops were in a semi-green condition, thus removing the major scorch element; also, that consideration is given to the moisture content of the 'hang-up' which reaches a critically low state early in September. However, the danger presented by hang-up ignition is virtually removed by thinning, and more so where high pruning has been practised.

Let us look at a plantation as a whole and view the manner in which fuel drying takes place immediately after rain which has caused complete fuel saturations. Firstly, the western edge dries out rapidly and all exposed edges of compartments follow suit, therefore compartment edges, particularly those bordering the west side of the plantation, would be given priority of burning. It will be appreciated that compartment edges will often carry a burn to a depth of one to two chains inward, but that very often several days' drying is necessary before the inside of a compartment will carry a burn. (This applies more so in unthinned compartments with dense canopy cover.) It will also be appreciated that where a spot fire is allowed to run out to a dry compartment edge that this is the area most susceptible to crown scorch.

We are thus presented with a picture of the order in which lighting by helicopter would take place.

(a). The helicopter would buzz plantation and compartment edges immediately they will carry a burn to a distance of at least one chain inward.

(b). On prescription, individual compartments would be taken out as a whole and the helicopter put down at a convenient spot to allow for inspection of the burn in progress and also compartment(s) next for treatment. Average flame heights greater than three feet would not be appreciated. The task of burning by helicopter could only be carried out by a specialised team and then only after considerable ground research.

REGIONAL NOTES

HARVEY REGION.

Staff.

D.F.O. J. Sclater has been seconded for 2-3 years to the Department of External Affairs. John is on his way to Laos to take charge of a small Australian Forestry contingent under the Colombo Plan.

D.F.O. J. Smart has been appointed to the Harvey Division.

A.D.F.O. Scambler also a Scots trained forester who saw forestry service in Malaya has been appointed at Harvey.

In the professional field at Harvey if you don't know your Robby Burns nowadays you can't get a word in anywhere. You can just imagine the situation at the local on each Friday evening.

Fire Control Superintendent F. Campbell has received promotion and is now posted at Como, although he still retains some interests at Harvey.

Forester Mick James has been transferred from Lewana to Harvey.

Forest Guard in training Bill Adams of Dwellingup has resigned to work in the industry in Perth.

Kap Joon Han, a professional forester from South Korea, has been attached to the W.P.O. at Harvey, Manjimup and Como on a United Nations F.A.O. fellowship.

Golf.

The Institute of Foresters golf day will again be held at Harvey on Sunday, June 1st.

Eucalypt planting.

Many eucalypts succumbed to the very dry conditions prevailing this summer. Efforts to isolate this as being caused by Phytophthora cinnamomi have to date failed and drought conditions are thought to have caused the deaths. Greater care will be taken to select deeper soils for any large scale planting of "Grave Yard" areas in future. The plants affected are mainly 2-3 year-olds. The older plantings 8 years old are still thriving.

A large scale experiment for planting along ripped rows is under way at Dwellingup. Using a large dozer with angled blade and two rippers 6' apart total preparation costs prior to planting appear to be in the vicinity of $5 per acre.

With the use of a V blade in future further savings could result. The ripped lines are two feet deep. Small scale areas have been tried in Harvey in the past and the method appears to have some potential.

METRO. REGION.

Staff.

The Wanneroo Division recently welcomed Andy Robertson, who has been appointed to the Gnangara district. His principle charge will be tending the 6 million P. pinaster plants in the nursery.

Mineral wealth?

For many years the presence of black, strongly aromatic mud in Gnangara swamps has been well known, but in recent months a company has been formed to mine this PEAT. In combustion tests these deposits have been proved to be up to 98% carbon and the other 2% mainly diatoms. A series of trials in the most highly leached sands of the Gnangara nursery have shown that incorporation of peat will improve the seedling growth and a large trial was initiated in the August 1968 seeding.

New dozer trial.

A series of tests with a four-wheel drive rear steering shovel loader has been carried out in light Jarrah forest near Gosnells. There are several machines in the 75H. P. class which have potential for light bulldozing, and tests so far conducted are very promising. If these light machines can do part of the job formerly done with a small tracked machine, then we stand to gain by lower initial cost, lower running costs (no costly trackgear overhauls) and no need for heavy transport when the tractors themselves are capable of 25 m. p. h. or more on good roads.

BUSSELTON REGION.

Staff.

Len Talbot worked with this Department from 1954-1963, when he resigned to take up a position with the Commonwealth Forestry and Timber Bureau, stationed in the Northern Territory. Len then accepted a position for two years as a Voluntary Worker with the Bathurst Island Mission.

He has now returned to this State and is working in the Kirup Division.

Sue Mader, the office assistant from Kirup, has resigned. Sue's happy disposition will be missed by those who had dealings with the Kirup office. Sue has been replaced by Paula Waters of Balingup.

Mick James, who was stationed at Lewana for five years, was promoted and transferred to be Forester stationed at Harvey in February. The vacancy at Lewana was filled with the transfer of Terry Ashcroft from Carinya in April.

John Smart transferred to Harvey in February; this position being filled by Don Keene moving from Shannon River.

Ted Hopkinson was transferred from Collie to Busselton to become Plant Inspector for the Busselton Group, in February.

Logging contract.

Logging of the Grimwade Plantation has just been put out to contract. The Contractor will be responsible for moving 10,000 loads of round timber per annum from the stump to the Grimwade Mill, Kirup Siding or the C.P.I. mill in Busselton.

Golf.

Arrangements are in hand for the Nannup Golf Day, to be held on August 3rd. Further course improvements are in hand to establish a second nine tees. The Nannup Committee is confident the day will prove to be an even better day than those held previously.

Cricket.

The annual cricket match between Manjimup Division and Nannup Division resulted in a crushing defeat for Manjimup: by 9 runs.

SOUTHERN REGION.

Staff.

Appointments:

Heberle, G.	A.D.F.O. (W.P.O.-Manjimup)	2.12.68
Sneeuwjagt, R.	A.D.F.O. - Manjimup	28. 1.69
Pettingill, T.R.	Acting Plant Inspector vice L.J. Marshall on three months L.S.L.	17. 2.69

Transfers:

F/G M. Kokir	Nannup to Walpole	9.12.68

(Incidentally, F/G Kokir has taken into himself a "Forest Guardess" - he was recently married.)

D.F.O. D.J.Keene	Shannon River to Busselton	7. 2.69
ADFO N.G. Ashcroft	Harvey to Shannon River	6. 2.69
T/A Voutier	Pemberton to Manjimup	28. 3.69
F/G L. Court	Mundaring Weir to Manjimup	27. 3.69
Miss M. Ward	Manjimup to Como (Research)	31. 3.69

Forest recreation.

An intensive programme aimed at development of recreation facilities in State Forests has been initiated at Pemberton. A fund of $10,000 was allocated in the current financial year and this money is being spent as follows:

i) Upgrading the State Forest section of Rainbow Trail. This old formation, running from the Trout Hatcheries out to Big Brook Arboretum and thence on to the Pimelea Road has been re-aligned, piped, gravelled and widened out to a 12 foot road surface. It is now a most attractive, all-seasons tourist route.

ii) Construction of Picnic Spots. These are being placed along Rainbow Trail on the banks of the Lefroy and Big Brooks. They comprise rustic bush "furniture" (log tables and chairs, hewn benches), stone fire-places, rubbish bins and gravel parking areas.

iii) Construction of guided walks and bush hiking trails.

iv) Designing and erecting "Tourist Information Signboards" giving, in laymen's language, details of forest history and management objectives.

v) Opening up the Lefroy Brook Regrowth Area with a good access road, an information signboard, a picnic spot, parking area and a short loop walking trail.

The work is now well advanced and is already receiving favourable comment from the public.

Tall Tree.

Measurements made by expert and completely unprejudiced local officers revealed that a P. radiata in the south east corner of Compartment 1, Pimelea Plantation, is the largest known plantation grown conifer in W.A. The tree's vital statistics are:

Date planted:	1929 (i.e., 40 years old)
G.B.H.O.B.	8'8"
Total height:	161'.00"

This makes the local tree more than 10 feet taller and nearly a foot larger in girth than the previous champion in the 46-year-old radiata of Compartment 3, Greystones at Mundaring Weir.

Not bad really for a so-called "failed" plantation.

"West Manjimup".

The nursery has been moved from Manjimup D.H.Q. to the 400 acres acquired from the Agricultural Department known as the "Old Tobacco Research Training Centre" - re-named for our purposes as "West Manjimup". Peter Gnuske is running the nursery where we are raising 11,000 pine seedlings and 31,000 Euc. seedlings as well as specimen trees for Pemberton Arboretum. The embryo training centre is now well under way at West Manjimup where the kitchen, dining room, and 18 single bedrooms have been established. Ross Gobby and his cadets have used these facilities on two visits. A lecture room and offices have to be made this winter. It is a very attractive spot and we hope that full use will be made of this pleasant residential school.

"Funny at the time"-(1969 NOT 1869)

Settler built a new windmill, expensive job, 14 ft. wheel on a 40 ft. stand. Built it right up against State Forest and was upset to find that it wouldn't turn; no wind, you see. Even more upset (and gave a very good imitation at the office counter of a windmill out-of-control) when he found out that we wouldn't cut the forest down, to quote, "give him wind".

SAFETY NEWSLETTER

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INTRODUCTION

During the period July-December 1968, 56 disabling injury accidents occurred throughout the Department, as compared with 73 for the same period last year.

This continuing reduction of accidents is proof that we are slowly but surely succeeding in our efforts to combat the accident problem which has long been a matter of concern.

Although we can derive considerable satisfaction from our achievement over the past 18 months in reducing our frequency rate from 100 to 54 we must be ever mindful that Safety is a never ending battle. We must be constantly aware that accidents do not just happen - they are caused. They are undesirable, and they can be prevented.

Accident prevention programmes are so designed to instil in us a safety awareness not only on the job, but on the road, in the home, and indeed in everything we do.

With this end in view, a number of divisions have availed themselves of the services of safety officer Marshall by having Safety film evenings for employees, their wives and children. That this form of safety training is valuable is evident by the increasing requests for safety film shows throughout the Department.

Film evenings may be arranged through Mr. Marshall.

Statistics for the period under review have been included in this edition of Safety News to show divisional progress.

Worthy of note for achieving spectacular results are Kirup, Busselton and Nannup. Congratulations are extended to the Officers and employees of these, and the other divisions who have improved, or at least maintained their Safety record.

As it appears that in some divisions the Safety programme has become accident or even injury observation programmes rather than true accident prevention programmes, an article on the ratio of unsafe acts to unsafe conditions is included in this edition, which it is hoped will be of benefit to those still experiencing difficulty in implementing their Safety Programme.

Although the overall Safety record is good, it can be better. Do not let us become complacent in feeling that we have achieved our goal.

We still have a long way to go, and to get there requires a complete acceptance by each and every one of us that safety is no accident.

SAFETY STATISTICS. JULY - DECEMBER 1968-69.

	July D.I.A.	Aug	Sept	Oct	Nov.	Dec.	Total D.I.A. '68-69	Total D.I.A. '67-68	Total M.H.W. '68-69	Fr. Rate July-Dec '68-69	Frequency Rate Based on Previous 12 Months
Busselton	1	Nil	2	Nil	Nil	1	4	10	86168	46	40
Mundaring	Nil	1	Nil	Nil	Nil	Nil	1	3	52844	18	98
Dwellingup	1	1	Nil	1	2	Nil	5	4	65823	75	43
Collie	Nil	Nil	Nil	1	Nil	Nil	1	1	72137	13	14
Kirup	Nil	1	Nil	Nil	Nil	1	2	16	66826	29	53
Manjimup	4	Nil	Nil	2	2	1	9	7	83725	107	53
Narrogin	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	9279	Nil	No Previous Figures
Kelmscott	Nil	Nil	1	1	1	1	4	Nil	35057	114	81
Collie-Somerville	1	Nil	Nil	Nil	Nil	1	2	3	35715	56	93
Wanneroo	2	1	3	Nil	1	1	8	6	71200	112	78
Harvey	2	1	4	2	Nil	2	11	10	108765	101	79
Pemberton	Nil	Nil	Nil	1	Nil	Nil	1	3	52169	19	39
Nannup	Nil	Nil	1	Nil	Nil	1	2	7	69438	28	70
Shannon River	Nil	1	Nil	Nil	Nil	Nil	1	1	35216	28	60
Kalgoorlie	Nil	Nil	Nil	Nil	Nil	1	1	Nil	4080	245	No Previous Figures
Trainees	Nil	Nil	Nil	Nil	Nil	Nil	Nil	2	13885	Nil	Nil
Research	Nil	1	Nil	1	Nil	Nil	2		40822	49	No Previous Figures
W/Plans	Nil	Nil	Nil	Nil	1	Nil	2		22205	45	No Previous Figures
Head Office	Nil	Nil	Nil	Nil	Nil	1	1		58498	17	No Previous Figures
TOTALS	11	7	11	9	7	11	56	73	983852		
1967-1968	14	18	10	13	9	9					

Departmental F.R. July-Dec. 1968-69 $= \frac{56,000,000}{983,852} = 56$

Departmental F.R. Based on Previous 12 months $= \frac{107,000,000}{1,945,360} = 55$

ACCIDENT FACTS.

Although there is evidence throughout the Department of an increasing acceptance that - "Accidents do not happen, they are caused", - accidents are still occurring which could have been prevented.

Remember, the object of accident investigation is not in any way an attempt to fix the blame, but to gather all relevant facts so that accidents of a similar nature may be avoided.

As we have been practising accident prevention for a period approaching two years, surely we should be in a position to know the hazards connected with our job, and the correct procedure to adopt in eliminating or minimising the risk of accidents from them.

We definitely should not be waiting for accidents to occur to tell us what the hazards are, and what action is necessary to avoid a re-occurrence.

The material for the following factual reports has been obtained from divisional investigation reports, and proves conclusively that personal failure on the part of both officer and employee can be identified in most cases, as the basic causes of these accidents.

Adequate Clothing and Protective Equipment not Worn.

An employee whilst engaged on pine pruning (low) suffered infected arms through contact with Acc. pulchella prickle bush.

He reported the occurrence to his O'seer. The following day he reported to the district office where he was given a quantity of Dettol and instructed to bathe the infected arms.

He next reported to the district office eight days later, and it was found that he had been under medical treatment for seven days.

Causes.

Unsafe conditions.

Acc. Pulchella - prickle bush.

(Officers and employees are well aware of this environmental hazard, and should be aware of necessary preventitive action to minimise the risk of injury from it.)

Unsafe acts.

Employees working with bare hands and arms.
Supervisory failure in allowing employees to work unsuitably clad for the job.

Accidents from this source can be prevented or at least minimised by the use of safety gloves and the wearing of long-sleeved work shirts.

It also appears feasible that this accident need not have become disabling if the following procedure had been adopted:

1. Arrangements made for medical attention to the injured employee.

2. Arrangements made for alternative employment for the injured person, if in the opinion of the doctor, the injury did not entirely incapacitate him.

THE ANATOMY OF ACCIDENTS.

The Ratio of Unsafe Acts to Unsafe Conditions.

It is generally accepted in safety circles that 88% of all accidents result primarily from unsafe acts, 10% from unsafe conditions and 2% from acts of God. These ratios have done much to establish the importance of the human element in accident prevention. However, complete acceptance of this theory without consideration of prevailing conditions in a particular industry could be detrimental to successful safety performance.

It may lead to a lack of appreciation of the importance of the need for developing safe working conditions by good housekeeping and adequate machine guarding - why spend the time and money correcting unsafe conditions that will prevent only 10% of the accidents?

Actually the percentage of accidents which are triggered by either an unsafe act or unsafe condition varies considerably from job to job. In an industry where a great many unsafe conditions prevail and there is a high percentage of heavy machine work performed, it is likely that the unsafe condition will be the predominant factor in a large number of accidents. In an industry with the maximum of machine guarding and a high percentage of light assemble operations, the unsafe act will prevail as the principle cause of accidents.

Maximum results in safety will be achieved by concentrating on those factors which are causing accidents in a particular job; unsafe acts, unsafe conditions, or both.

Also, over emphasis of the concept that 88% of all accidents are attributable to unsafe acts can lead to trouble because many of the so-called unsafe acts may turn out to be unsafe conditions when all the facts are thoroughly examined. Evidence exists which indicates that many worker errors have been touched off by faulty design, inadequate guards, poor working conditions - in short, unsafe conditions that actually trapped the worker into performing the so-called unsafe act. Perhaps a close examination of unsafe acts and unsafe conditions would reveal that many accidents result from a combination of unsafe acts and unsafe conditions, rather than solely from an unsafe act or an unsafe condition.

The Anatomy of an Accident.

There are four distinct parts in the anatomy of an accident:-

1. Contributing causes.
2. Immediate causes.
3. The accident.
4. The results of the accident.

These four parts of an accident may be outlined as follows:-

1. Contributing Causes of Accidents.

(A) Supervisory safety performance

1. Safety instruction inadequate
2. Safety rules not enforced
3. Safety not planned as part of the job
4. Infrequent employee safety contacts
5. Hazards not corrected
6. Safety devices not provided

(B) Mental condition of person

1. Lack of safety awareness
2. Improper attitude
3. Slow mental reaction
4. Inattention
5. Lack of emotional stability
6. Nervousness
7. Temperament

(C) Physical condition of person

1. Extreme fatigue
2. Deaf
3. Poor eyesight
4. Physically unqualified for the job
5. Heart condition
6. Infirmity

2. Immediate Causes of Accidents.

(A) Unsafe acts

1. Protective equipment or guards provided but not used.
2. Hazardous method of handling. (Failure to allow for sharp or slippery objects, wrong lifting, loose grip, etc.)
3. Improper tools or equipment used although proper tools were available.
4. Hazardous movement (running, jumping, stepping on or

climbing over, throwing, etc.)
5. Horseplay.

(B) Unsafe conditions

1. Ineffective safety devices
2. No safety device although one is needed
3. Hazardous housekeeping
4. Defective equipment, tools or machines
5. Improper dress or apparel for the job

3. The Accident.

A. Fall
B. Slip
C. Slide
D. Strike against
E. Caught in or between
F. Burns

4. Results of the Accident.

A. Annoyance
B. Production delays
C. Reduced quality
D. Minor injuries
E. Disabling injuries
F. Fatality

For a complete understanding of the anatomy of an accident, a full knowledge of the contributing and immediate causes of accidents is essential. The focal point in accident prevention activities in the past has been the immediate causes of accidents - unsafe acts and unsafe conditions. Additional information that is now available indicates that progress in accident prevention can be accelerated by a shift in the emphasis to the contributing causes of accidents - the mental and physical condition of the worker and supervisor safety performance.

Some safety programmes have become accident - or even injury - observation programmes rather than true accident prevention programmes. That is, steps are not taken to correct a condition until an accident occurs that indicates the problem. The emphasis is all on the elimination of unsafe working conditions instead of the development of safe working conditions and safe work habits. In true safety work unsafe acts and unsafe conditions must be considered only as end products of symptoms, the unsafe

acts and unsafe conditions are not what is wrong; they are only the results. It is the factors which contribute to unsafe acts and unsafe conditions that are wrong. Control these contributing factors and the need for eliminating unsafe acts and unsafe conditions is minimised.

Of course, supervision must continue to deal effectively with the immediate causes of accidents, but much more time and attention must be given to the contributing causes. This means giving more attention to the relationship between men and machines, laying out the plant to meet the mental and physical needs of the operator, and including safety training in all job training. With this approach both operator safety and operator efficiency should improve.

Accident-control steps.

When an accident does occur, it is an indication that something has gone wrong. Somewhere along the line someone has not done a good job of accident prevention and unsafe acts and unsafe conditions have been created. The supervisor who is sincere in his efforts to prevent accidents will want to have a working knowledge of the fundamental steps he can take to control the contributing causes of accidents - the mental and physical condition of the worker and his own safety performance. These are the steps:-

1. Supervisor Safety Performance

   A. Job-hazard analysis
   B. Enforcement of safety rules
   C. Adequate safety knowledge
   D. Promotion of employee participation in safety
   E. Proper job placement
   F. Development of safe working conditions

II. Mental Condition of Person

   A. Regular safety contacts by supervisor
   B. Adequate safety indoctrination and on-the-job safety training
   C. Safety promotion and publicity
   D. Employee participation in safety programme
   E. Regularly scheduled safety meetings
   F. Adequate supervisor-employee communications on all matters concerning the employee

III. Physical Condition of Person

   A. Preplacement physical examinations

B. Periodic re-examinations
C. Proper job placement
D. Adequate medical facilities
E. Careful check of physical condition of worker on all transfers and changes in jobs
F. Recognition of the physical limitations of workers new to a job, especially if heavy work is involved

The Accident Flow Chart.

The attached flow chart (see page 44) shows graphically the anatomy of an accident. The contributing causes of accidents, sources of unsafe acts and unsafe conditions, are shown at the top of the chart. From each of the three sources the flow is into a central reservoir labelled unsafe acts and unsafe conditions - the immediate causes of accidents. The position of the overflow on the reservoir indicates that an accumulation of unsafe acts and unsafe conditions leads to accidents, which in turn account for production delays, spoilage and injuries. The flow chart illustrates these basic accident-prevention fundamentals:

1. The supervisor's safety performance , the physical condition of the worker and the mental condition of the worker are the main sources of unsafe acts and unsafe conditions. These three factors should be focal points of accident-prevention work.

2. Not all unsafe acts and unsafe conditions result in accidents, but all accidents result from unsafe acts and unsafe conditions, usually in combination.

3. All work accidents cause a delay in production, spoilage or waste.

4. Some accidents cause injuries and in a small percentage of the cases, the injury is disabling.

Supervisors must be taught to give attention to all types of injuries regardless of their severity. Although X number of minor injuries do not equal a major injury like 100 cents equal one dollar, it is true that some minor injuries might have been disabling injuries except for the matter of luck involved. A tree falls and hits two men; one man is killed and the other sustains minor injuries. One man falls from a ladder and gets up unhurt; another man has the accident and breaks his arm. Even the minor cut can lead to infection, and in some cases, death.

There is no such thing as a minor accident; just some of them

result in minor injury.

Thus it is important for a supervisor to give personal attention to all types of injuries regardless of their severity. Also, it should be evident that each minor injury is an indication that a number of no-injury accidents are occurring with resultant delays in production and waste. Perhaps the ratio between no-injury accident and the injury producing accident is high, but what this ratio is could be anybody's guess.

The important point to recognise is that the no-injury accidents also deserve the prompt personal attention of supervisors.

From the basic principles and philosophies of accident prevention are evolved the elements of effective safety effort. In order to achieve good results in accident prevention, line supervisors must include these four elements in their safety programme:

1. Development of safe working conditions.
2. Creation of safe work habits on a personalised basis.
3. Promotion of employee participation in safety.
4. Corrective action when safety rules are ignored.

Because of his direct control over the people in his gang and the direct action he is able to take to maintain safe working conditions, the first-line supervisor is in a key position to prevent accidents.

But regardless of the soundness of an organised approach to accident prevention, any attempt to control accidents without first creating a proper safety philosophy, teaching safety principles, and eliminating misconceptions about the causes of accidents, would be relatively ineffective. Supervisors, safety officers and workers must believe that accidents are caused and they can be prevented.

A Flow-Chart Presentation of the Anatomy of an Accident.