(5) WHITE LAND. Land left unshaded on the map includes essentially all the land suited to large scale culture of *radiata*. Territorial limitations will immediately be evident.

The White Land includes the greater part of all South Island agricultural land and, together with the Blue Land, the bulk of all improved or improvable hill pasture. Population pressures must, increasingly, forbid further significant alienation, to forest, of White Land or of reasonably fertile Blue Land. Only the poorest of the White Land soils and poor Blue Land soils are likely to become available for State afforestation and such soils must largely prove marginal or sub-marginal for *radiata* culture, (e.g. Eyrewell and Balmoral). Large scale re-afforestation, employing *radiata*, would appear possible only in the Moutere Gravels and on lands already acquired in other districts.

Greater attention should, therefore, be paid to the selection and silviculture of species suited to poor Blue Land soils and for afforestation of Brown Land. *Radiata* would seem destined, eventually, to be a species of primary significance only in so far as it is employed as a species of farm wood-lots and miscellaneous local body plantations.

THE LIMITATIONS OF RADIATA IN EXOTIC STATE FORESTS IN CANTERBURY

R. M. MARTIN.

(Paper read at Annual Meeting)

Emphasis placed in recent years on our dwindling resources of indigenous softwoods has tended to throw new light on the silviculture of exotic forests. The very magnitude of forest establishment in the exotic field has created in the minds of many people the impression that the problem of meeting future timber demands is well in hand. In point of fact this is only the initial steps and the more important task, that of protecting and tending our forests, lies before us and with a steadily increasing population it is likely that further large areas must be planted if the future timber demand is to be met by home production.

Canterburys consumption of timber today is over 16 million cubic feet of which 10 million cubic feet is imported mainly from the West Coast. By the year 2000, G. N. Calvert estimates that the population will more than double and on this basis the annual timber requirements will be for at least 32 million cubic feet. Production from all forest areas including farm woodlots is estimated optimistically to be in the vicinity of 13 million cubic feet so that an annual deficit of 19 million feet will have to be met. Rationed supplies from

native forests will possibly provide 2 million cubic feet and overseas importation of luxury timbers possibly will supply another 2 million cubic feet but the remaining 15 million cubic feet will have to come from resources nearer at hand. The need for exotic plantations has long been recognised and a vigorous planting programme was pursued until today there are established 50,000 acres of exotic species in 4 State Forests all north of the Waimakariri River. Planting is continuing at Ashley forest and a constant search is being made for available land suitable for afforestation purposes particularly in South Canterbury. It would appear from the achievements on paper that the situation does not call for any pessimism when the timber future is considered. Nothing could be further from reality. The object of this paper is to focus attention on to the very poor yields which have been returned and which may be anticipated from *P. radiata* from the majority of existing stands.

In a previous paper I dealt with the silvicultural problems of forest management in the plantations of the Canterbury lowlands where the biggest single factor influencing tree growth is the frequency of north-west gales. These strong winds in themselves are sufficient reason to cause apprehension about the future but when they are coupled with soils of the poorest root-holding qualities, nothing, it seems, can prevent serious windthrow. Of the total area planted, 38,500 acres have been established on these shingle soils in the path of periodic gale force winds; and of the 38,500 acres, 27,000 acres carry *P. radiata* on two extensive forests. The balance of 11,500 acres of which 3,000 are under *P. radiata* is to be found on more favourable sites where wind damage to date has been on a small scale. Reduced to percentages, *P. radiata* makes up 60% of the total area planted and 90% of the species established on shallow soils.

Indicating the yields to be expected from *P. radiata* are the results to date from salvage operations at Balmoral forest where, of a total area of 12,000 acres of *P. radiata* ,some 4,000 acres have been windthrown. Salvage has been completed over 3,050 acres and the total yield has amounted to slightly less than 2 million cubic feet in sawlogs and 1½ million cubic feet of cordwood. On an acre basis this is equivalent to only 655 cubic feet in sawlogs and 5 cords of firewood. The average of the trees at the time of the salvage was 25 years. Higher yields would have been obtained if the windthrow could have been foretold and the necessary salvage organisation created in advance, but results comparable to clear-felling would be impossible. Insect and fungoid attack soon cause decay and the operations are hampered by the tangle of branches, trunks and roots. Even in areas of apparently insignificant windthrow yields are poor as shown by the clearfelling of an area aged 21 years, slightly wind damaged, where only 1800 cubic feet to the acre are being produced. This stand is better stocked than average. The persistent windthrow of isolated dominant trees in every minor gale is progressively wasting

increment. Until recently timber wastage has been almost entirely confined to the effects of wind, but serious insect threats are beginning to be felt. It is significant that aerial spraying on a large scale was carried out for the first time in New Zealand over *P. radiata* planted on these shingle soils. Sirex, following in the wake of the defoliating insect responsible, is causing serious loss and at Eyrewell clearfelling of defoliated stands is resulting in the production of only 2,000 cubic feet to the acre at 15 years.

It is easy to be pessimistic about the future of these forests but there are few grounds for optimism. Essential to the scheme of management of any forest is the ability to forecast with reasonable confidence the probable trend of silvicultural events. It becomes increasingly important as the demand for timber steadily outstrips supply. Under the present system of salvage following windthrow it is not possible to guarantee the all-important, regular series of age gradations and in fact it is impossible. Not only is the full productive capacity unattainable but we are faced with the large expenses of fire-protection, road maintenance and other necessary operations over extensive areas. By way of comparison, Ashley forest will have a yield of over four times that of Balmoral forest, acre for acre, with a considerably reduced annual expenditure and enhanced confidence in the future.

It has been suggested that natural regeneration following windthrow will develop root systems providing greater anchorage which will minimise wind damage. In my opinion, this is wishful thinking. Research in Europe (1) on the establishment on shallow soils subject to drought may be significant. Survival of transplants was greatly increased when the young trees were planted in shallow trenches but subsequent survival was rendered more doubtful owing to the roots being nearer to an impervious layer close to the soil surface. At Balmoral regeneration is more prolific in, and in some areas confined to, the depressions caused by the upheaval of windthrown trees. Tree roots at Balmoral seldom penetrate deeper than 2 feet and this is the depth of the depressions. Our own research on wind and its effects on tree growth has been neglected. Until damage by wind is fully understood and overcome, such refinements as Yield Tables, Permanent Sample Plots and other similar projects will be of limited practical use. There is a strong case for the initiation of study of the wind and its numerous effects on the forest environment.

I must stress again Canterbury's growing population and increasing timber demand. To meet requirements at the year 2,000 on the present annual consumption of 270 board feet per capita, a further 140,000 acres will have to be producing timber. Holloway has demonstrated the territorial restrictions of *P. radiata*; the shingle soils of the lowlands are unsuitable for large scale establishment particularly of *P. radiata*; and land which is suitable for forest crops

along the present lines is prohibited if in any way considered of use to Agriculture. Where then are the trees to be grown? Solution to the problem rests largely in the hands of the farmers. If they are not prepared to release suitable soils for exotic forest establishment they must be ready to pay heavy costs of importation and transportation of their timber supplies from the North Island. In any event it will be necessary for an immediate start to be made with a vigorous farm forestry campaign. Such a campaign will be successful only if full use is made of the experience gained by the Forest Service and this can be achieved with greatest benefit by the appointment of a Forest Extension Officer to deal solely with the education of the farmers in the relevant forestry matters. While no forester could presume to dictate to the farmer the layout and working of his farm, there are many matters which are overlooked by the farmer and about which he could be warned by the forester. With few exceptions the modern farmer shows little enthusiasm for trees, is unaware of the great advantages of trees both as a crop and as a local climate improver and on the whole confines his planting to a few rows of *P. radiata* as a shelterbelt.

If the forester is to bear his full measure of responsibility in meeting future timber demands, he will have to relegate *P. radiata* to a minor position on the species siting list of the future. This ituation is not of the foresters' making but had been forced on him by the type of land with which he is likely to be provided. Any land smade available at the lower altitudes below 1,000 feet will be negligible in area and more than likely will be suitable for better quality timber such as Douglas Fir or Larch so that requirements will be for species less exacting in their range of altitude and grown on a longer rotation.

In conclusion I must emphasise that I am not belittling *P. radiata* as a species. It is certainly a most remarkable pine showing great adaptability and on a wide range of tolerance but it has met its match in the shallow soils of Canterbury and the excessive altitude of the land which will probably be made available for afforestation purposes. It is essentially a "farmers" tree and the Forest Service must look to others as the major species in the future Canterbury exotic State Forests.

REFERENCE

(1) Kacinskii. No. 318, Forestry Abstracts, Jan., 1953.

GRADE IN SAWN TIMBER AND ROUND PRODUCTS OF *PINUS RADIATA*.

J. S. REID

(Part of Symposium "Silviculture of *Pinus radiata*"—paper was presented in abbreviated Form)

1. SUMMARY

Clear wood of New Zealand grown *Pinus radiata* has excellent physical properties which commend it for a very wide range of uses. Sawn timber from the unthinned and unpruned stands now being felled, however, yields too high a proportion of low grades. The capacity of the species to yield a large volume of good quality wood in a given time suggests that pruning of butt logs is economically justifiable and nationally essential to meet domestic needs for high utility clear timber and peeler logs in the near future. If stands can be managed on longer rotations, there are notable advantages to be gained also from heartwood and from an all round increase in density

2. INTRODUCTION

I had hoped that the aspect of the general theme which is introduced in this paper would have been bolstered up by a discussion of the basic properties of *P. radiata* timber as determined by heredity, site, and silvicultural treatment. A large mass of work has still to be carried out before a comprehensive analysis of these relationships can be presented. It may be equally contended that comment on the grade relationships is somewhat premature. Scant attention is paid for instance to :

(a) Branching habit and size of laterals as affected by spacing.

(b) Conditions conducive to heartwood development.

This paper simply presents ideas upon grades of timber and round products which *should* be yielded by the forests. From a brief discussion of the properties of the timber, it passes on to grades produced, and produceable in tended forests.

Untended stands of *P. radiata* being milled today fall far short of giving us in correct proportions, the grades of timber which we need for many of our important uses. It is probably equally true to say that the timber cannot be regarded as a good and satisfactory alternative to Northern European and North American softwoods at present used in some of our more important potential export markets. There have to be balanced supplies of good grades to go with the lower grades, before those markets can contemplate severing connections with the North Hemisphere sawn softwoods trade.

The sawn product requires to be criticised also for its relative "youth". There is a notable degree of unbalance in its basic qualities which must be considered in conjunction with the defects ; both features are characteristics of youth (in trees).