

trees were spaced widely and in irregular formation, height growth is lower and rate of girth increase greater. To assess timber production on these soil types it would be necessary to make a complete statistical analysis of standing crops throughout all the plantations of this species.

P. radiata was not planted pure to any extent in the earlier operations, but was used as an edge strip on the exposed border of the old plantation planted in 1903.

Before 1912 a big area in Rakautautuni paddock, comprising the basin formed from the junction of five streams, began to give much trouble with flooding of the streams and "toe slumping" of the streambanks. After initial fixation with willows and poplars, the vulnerable areas were planted with *P. radiata* strips around blocks of *Cupressus macrocarpa*. This partly arrested the main ground movements, but after 10 to 15 years, when the *C. macrocarpa* had reached an average height of 35ft., most of them were carried away in a flood resulting from an exceptionally-heavy rainfall of 4 to 6in. in 10 days. The whole area was then replanted in *P. radiata* alone, and after about 20 years the area appears to be stabilised along 4 out of the 5 streams. The difficulty in the remaining streambed lies in the lower reaches, and it will require to be tackled by a combination of mechanical protection and special streambank planting.

The trees of *P. radiata* growing on Puketiti are of good timber-production type, with fairly-light side branches and regular boles. No excessively-large cones were observed, the average size being 4 to 5in., which is considered a good silvicultural type of cone. Unfortunately, no record exists of the origin of the seed from which the crops were produced, as most of the planting has been done throughout the years with bought-in commercial tree stocks.

On the whole, *P. radiata* in regular plantation has been planted too closely, the usual distance being about 6ft. x 6ft. in the early operations. This is shown in the belt planted along the northern border of a bush area in the nursery paddock where *P. radiata* at 6ft. spacing has made rapid growth and provided effective high shelter for the bush from the dry, cold winds, but has selected itself naturally with a wastage of killed-out stems amounting to about 40 per cent., and a consequent irregular crop. In 1928 *P. radiata* was planted from 8 to 10ft. apart as a northern border to the block of *Eucalyptus sieberiana*, and after 20 years these pines form an even stocking on the ground, though somewhat heavy branching would appear to indicate rather too wide spacing for best timber production.

P. radiata establishes readily from good 1-year seedlings, 12 to 15in. high, planted in autumn or late winter. This species is now regenerating freely both on grassed hills and within the older plantations of mixed evergreen and deciduous trees. This propensity to seed and regenerate is useful on ground where slips occur and provides a means of obtaining easy tree growth on unstable back areas of the station, but there is a possibility that in time this pine may become a "weed" species on these hills, especially as Mr. Williams has used it as protective belts



Some of the original widely-spaced preventive planting of Lombardy poplar and *Eucalyptus obliqua*. The land was closed to stock temporarily and now provides good pasturage.

around certain surviving bush areas and these belts may act as centres of seed dispersal.

In the light of the satisfactory growth shown by certain other species planted at Puketiti and the silvicultural disadvantages of *P. radiata*, it would appear that this is not the best timber tree to use on this land where other species such as Oregon pine or Lawson's cypress of good quality can be grown. Confirmation of this view must await an area return in terms of timber utilisation and financial return, which will be obtained from the projected milling of the older timber crops to be carried out in the near future.

Cupressus macrocarpa

In the earliest plantings *Cupressus macrocarpa* was used either as marginal belts, only 2 or 3 trees wide, or in mixtures of species, and in general this has resulted in the formation of heavy-crowned, wide-branching trees. Even old trees which can be spared from the shelter belts are difficult to utilise, as they form the outer break, and when grown in mixtures where they have spread and suppressed the surrounding crop their removal would be difficult without damage to neighbouring good trees. These plantings demonstrate the mistake of planting *C. macrocarpa* in mixtures of trees which will not compete with it and thus produce a heavily-branched, unsuitable type of cypress tree. A certain number of posts can be procured from the branches, but

usually there is a basal length of stem which requires too much labour to split and is often left as waste timber.

On Puketiti *C. macrocarpa* has been grown also in close plantation formation in 2 plantations, and growth can now be compared under different spacing conditions. A block in the lower section of the sheeppark plantation was planted in 1928 with pure *C. macrocarpa* spaced at 6 to 7ft., and this now shows a crop with good height growth, up to 50ft., but uneven and low diameter growth—probably the result of too close planting.

This may be compared with the growth on an adjacent block in which the cypress was planted in 1928 at an average spacing of 5 to 6ft. but in a mixture in which a proportion of trees (possibly 30 per cent.) were *Pinus ponderosa*. Growth of this species is slow and in the young state crown form is compact, so that the effect produced for the *C. macrocarpa* was one of wide spacing with excessive lateral branching partially controlled by the pine stems. The result was that the *C. macrocarpa* formed a crop of trees of more even growth than that in which close competition induced natural selection and uneven production. The *P. ponderosa* in this mixture may form a satisfactory permanent timber crop, on a rotation of possibly 50 to 60 years, while the cypress should furnish 2 classes of timber trees—smaller stems for fencing strainers and posts in the round or split, and mature sawn timber at 40 to 50 years of age for building construction.