NOTES ON UNDERPLANTING OF CUTOVER BUSH AREAS WITH EXOTIC SPECIES.

(M. Sutherland.)

Experimental planting of exotic species on native bush areas has been undertaken by the State Forest Service, particularly in the past few years; and trial plantings are now under observation, such as in milled rimu-silver pine forest in Westland, in poor quality beech forest in the Nelson region, in milled black beech \textit{(N. solandri)} bush in North Canterbury, and in cutover rimu-silver pine bush in the King Country. Most of these trials are of recent establishment, and no data are yet obtainable from them.

Two such experiments, however, were initiated a number of years ago, and the following information is selected from their records.

\textbf{Mamaku Experiment.}—The earliest trial of underplanting native bush with exotic species was initiated by H. A. Goudie at Mamaku, Rotorua region, in 1916, when eight species of exotics were set out on cutover land. The area is situated at an altitude of 1,800 feet, the rainfall being 78 inches, and the soil pumice with much local outcrop of rhyolitic rocks.

The condition of the area was typical of the cutover lands of the rimu-tawa type of the Mamaku plateau. That is, the rimu had been removed, leaving a top storey of scattered tawa, tawhero and tawari; an undergrowth of makomako, whauwhau, karamu, kotukutuku, etc.; and a ground cover mainly of the tupari or low hard fern.

Logging had been done some years previous to establishment, though it is stated that the underscrub was not very thick. However, lines were cut in the underscrub, and some large tawa felled prior to planting. This was done to an average stocking of 200 trees per acre.

The secondary growth shot away quickly, and clearing round the trees was practised at least twice between 1916 and 1923. A count and measurement was then made in 1927, and the data given here are from the 1927 report.

The species planted were Douglas fir, Port Orford cedar, redwood, western red cedar, eastern white pine, Sitka spruce, silver fir, and Monterey cypress, or "macrocarpa." The results are summarized as follows:

Port Orford cedar had taken the lead with an average height in 1927 (11 years planted) of 7.3 feet, and a maximum
of 16.5 feet. The largest trees were near the bush edge with a light overhead canopy and with an underscrub somewhat kept down by intruding cattle. However, the growth of the specimens under the least open conditions was still superior to the other species, and little damage was suffered from actual smothering by the underscrub. Once clear above the undergrowth the broken canopy of the tawa top storey seemed favourable to development. Diameter growth increased rapidly and many trees of round about 10 feet in height had a D.B.H. of 1 to 2 inches.

The redwood plot had been subjected to heavy windfall in 1923, burying much of the underplanted trees, and opening up the canopy. A few individuals had reached a maximum height of 7.5 feet, but the majority of the trees were still struggling with the undergrowth. Damage by defoliating insects was recorded.

Western red cedar had an average height of 3.2 feet, and a maximum of 4.2 feet, but was healthy and well established, being considered second to the Port Orford cedar.

Eastern white pine had a hard struggle with the undergrowth, and where this was dense, as strong growths of makomako, puna and Alseuosmia macrophylla, the pine had gone out. Elsewhere, however, it was emerging above the undergrowth in groups. Although the average height was but 3.2 feet, individuals were measured up to 9.1 feet.

Sitka spruce had attained an average height of 3 feet and a maximum of 5 feet, but was not generally healthy.

Silver fir had died out fairly extensively in the first few years, but those survivors which had their leaders free were vigorous. An average height of 2.5 feet and a maximum of 6.1 feet had been attained by this species.

**Taranaki Experiment.**—The second experiment was carried out at Whangamomona, near Kohuratahi, in eastern Taranaki, where an extensive system of sample plots was laid out in 1922, part of which was devoted to underplanting of indigenous forest with exotic species.

The area lies at 1,750 feet elevation, the rainfall is 50-70 inches per annum, the aspect north-east, and the soil a brown clay loam formed from volcanic mud on a light subsoil over papa clay. The soil depth varies from about a foot at the bottom of the slopes to a few inches only in steeper portions. On the steep slopes frequent slips expose the papa clay.

The forest cover was an almost pure tawa type, with a small proportion of hinuau, and occasional miro, matai, kahikatea and black maire. A seedling regeneration was present,
abundant of kahikatea, and sparse of other species, but no saplings or poles existed. The top storey canopy was complete, and under it the forest floor was remarkably open. A sparse undergrowth of mahoe, kotukutuku, makomako, whauwhau, putaputaweta, and rangiora occurred throughout, somewhat more heavily in the gullies. Grasses were present but not prolific, while ferns occupied scattered patches of the floor.

Prior to planting the top canopy was thinned on two plots, and the tree ferns cut out on four plots, on one of which the underscrub was further completely removed.

Planting was carried out in August, 1922, at 8 ft. spacing, using three-year trees except in the case of redwood, where one-year seedlings were used. Inspections and measurements were made in 1923, 1927 and 1930.

Japanese cedar was planted on the plot from which all undergrowth had been removed. By 1923 considerable ground cover had appeared, consisting of new fern growth, thistle, cocksfoot and native grasses, and many seedlings of makomako, mahoe, karamu and kotukutuku. The exotics had suffered no deaths and had made an average growth of 8 inches in spite of the fact that many had been rooted out by pigs and simply replanted by a visiting officer.

By 1927 a very marked increase in all secondary growth had occurred all over the plot, a dense undergrowth being in possession to a height of 5 to 12 feet. The undergrowth varied with the density of the top canopy from a heavy competing cover of karamu, makomako, mahoe, etc., to sparse scrub with a heavy growth of tupari fern on the forest floor, or to groves of punga fern in whose shade no growth of either native or exotic species had survived.

The Japanese cedar had shown a rapid growth, however, and many of the plants had leaders above the surrounding vegetation, though competition with the underscrub was still acute, strangling and twisting by the vine Parsonsia heterophylla was evident, and damage by Tortrix excessana was prevalent on individuals still beneath the underscrub. The average height at this time, 1927, was 4·5 feet and the maximum 9·9 feet.

By 1930, although suppressed trees, and trees with their tops still beneath the scrub were still in evidence, the majority had their tops above the undergrowth, and 58 per cent. were recorded as being completely free from undergrowth competition, and forming a definite under-storey to the tawa canopy. The average height in 1930, or eight years since planting, was 5·3 feet and the maximum was 13 feet.

Douglas fir and Eastern white pine were planted on a plot in which the tree ferns were cut out, and the top canopy
lightly thinned. The resultant luxuriant growth of thistle and then of underscrub species induced very heavy competition, and this, combined with the heavy shading of the top canopy, was causing heavy mortality and poor growth. The best Douglas fir in 1930 were beneath an opening in the top canopy, where they were competing successfully with a heavy surrounding vegetation, so it seems that the dense overhead shade rather than the overcrowding of the scrub was the more deleterious factor. Eastern white pine was planted also on another plot in which the top canopy was not disturbed, though tree ferns were cut out prior to planting. Here again it failed to make good growth.

Port Orford cedar was planted in two plots, in both of which the top canopy was left untouched, but tree ferns were cut out. The tree has grown vigorously with few deaths in spite of a dense shading and a hard struggle with a dense ground cover, and later, with a vigorous secondary growth. The average height in 1930 was 4.5 feet with maximum of 13 feet. Mortality has been low, and most of the plants are recorded as probably free from competing vegetation.

Monterey cypress or "macrocarpa" failed almost wholly. Redwood was planted under a heavy top canopy on a plot from which the tree ferns had been cut out. A grass and low fern cover has developed, but although the exotic has had practically no competition from native undergrowth, development has been very slow, the maximum height in 1930 being only 3.7 feet. The species has not been attacked by insect pests, however, and seems now to be making regular growth. One-year seedling stock has been used for this species, probably accounting for initial non-development.

Western red cedar was planted under the same conditions as for redwood. It showed nil mortality in 1923. By 1927 heavy competition was in evidence, the trees being completely overtopped but still making a regular growth of 5 to 6 inches. Some distortion was evident, however, where active whipping or obstruction was met with. By 1930 the majority of the trees were free from competition, but even where still in competition and under complete shade, were healthy and growing well. In 1927 part of the area was totally underscrubbed with a view to comparing the growth of the cedar when free from undergrowth. By 1930 the vegetation had grown again to such an extent that the cleaned area was to casual observation indistinguishable from the untouched area. However, the trees on the cleaned area had an average height of 4.7 feet as against 3.5 feet on the uncleaned area. Maximum heights went to 6.7 feet.
LIST OF BOTANICAL NAMES OF PLANTS MENTIONED.

Black maire: *Olea Cunninghamii*
Douglas fir: *Pseudotsuga taxifolia*  
(syn. *douglasii*)
Eastern white pine: *Pinus strobus*
Hinau: *Elaeocarpus dentatus*
Japanese cedar: *Cryptomeria japonica*
Kahikatea: *Podocarpus dacrydioides*
Karamu: *Coprosma grandifolia*
Kotukutuku: *Fuchsia excorticata*
Mahoe: *Melicytus ramiflorus*
Makomako: *Aristotelia racemosa*
Matai: *Podocarpus spicatus*
Miro: *P. ferrugineus*
Monterey cypress: *Cupressus macrocarpa*
Port Orford cedar: *Chamaecyparis lawsoniana*
Redwood: *Sequoia sempervirens*
Rimu: *Dacrydium cupressinum*
Silver fir: *Abies pectinata*
Silver pine: *Dacrydium colensoi*
Sitka spruce: *Picea sitchensis*
Tawa: *Beilschmiedia tawa*
Tawari: *Ixerba brexioides*
Japanese cedar: *Cryptomeria japonica*
Western red cedar: *Thuja plicata*
Whauwhau: *Nothopanax colensoi*

SOME NOTES UPON PINEUS (CHERMES) PINI BÖRN.

(A. F. Clark.)

The following are a few brief observations taken by the writer during the last 12 months upon the habits of *Pineus pini* in New Zealand.

*Pineus pini*, which is often popularly known as the "white blight" of pine trees, is found throughout the Dominion particularly in young stands, infesting many species of the genus *Pinus* and is especially severe in the case of some two needle pines.

The insect is of European origin and has been recorded in New Zealand since 1884, so that it is by no means a recent occurrence. The usual form in which it is encountered is as a wingless, reddish, soft bodied insect which is covered by white flocculent material; in fact, so dense is this whitish material that it has to be removed before the insect can be discovered. These wingless forms are female insects which reproduce parthenogenetically, that is, without mating.

*Pineus pini* is found upon the young bark, needles and cones of pines, a favoured place being at the base and in between the needles. The sucking mouth parts are inserted deeply into the plant tissues, the insect feeding upon the nutrient juices.

The life-history of the insect as it has so far been observed in New Zealand is very much more simple than that recorded from Europe. In Europe the insect has two hosts, the primary host which is *Picea*, and a secondary host which is either *Pinus* or one of several other genera such as *Larix*, *Pseudotsuga* or *Abies*. Upon the primary host galls are made, but upon the