THE RECOVERY OF AN INDIGENOUS FOREST AFTER WIND-THROW.

By A. P. THOMSON.

Mention has previously been made in New Zealand forestry literature of the factor of windthrown in the life histories of New Zealand indigenous forests. We hear of the major calamities which have in the past brought down smaller or larger areas of podocarp forests, leaving a completely smashed-flat surface. It is postulated that the conditions which obtain after such an occurrence, the removal of the broad-leaf second and third tiers of vegetation, disturbance of organic humus and exposure of the mineral soil to light and warmth, coincide with the optimum silvical requirements of rimu, and pave the way for the germination and successful establishment of large quantities of rimu seedlings. These subsequently develop into the pure even-aged stands so frequently encountered. This theory, first put forward by F. E. Hutchinson (*Te Kura Ngahere,* 1928) has received general acceptance not only for rimu but for even-aged stands of Nothofagus species. Corroborative evidence came from H. Roche (*Te Kura Ngahere,* 1929) who noted, as have other observers, series of mounds and depressions in such stands, the respective remnants of the trunks and root systems of wind-blown trees, and the hollows from which they came. From such evidence there seems little doubt that this explanation of the origin of some even-aged stands is correct, in spite of the fact that it has not been backed up by direct observation following any specific case of extreme wind damage. That some even-aged stands have resulted from blow-downs is established : that all severe blow-downs are followed by profuse regeneration of the dominant forest tree or even by major alterations in the floristic composition of the forest concerned, are questions yet to be answered. An opportunity to investigate these problems presented itself when there occurred, on February 2nd, 1936, a gale* whose severity surpassed anything previously recorded in the annals of meteorological history for the area of its greatest velocity, namely, the Tararua Mts. and Manawatu district. It is proposed here to record some observations made in two smashed-flat areas in indigenous forests, namely, the Mangahao and Ohau valleys in the Tararua Range.

1. **The Mangahao valley.**—The westerly and south-westerly faces of the Mangahao valley and its tributaries suffered almost complete devastation, the blow-down, though scattered, comprising some thousands of acres. The area examined was originally occupied by a mixed podocarp-broadleaf forest of a poor type. Rimu (*Dacrydium cupressinum*) and rata (*Metrosideros robusta*) formed the physiognomic dominants overtopping red beech (*Nothofagus fusca*),

*(A note on this gale, its scope, and the damage wrought, appears elsewhere in this issue.—Ed.)

kamahi (*Weinmannia racemosa*), and to a lesser extent hinau (*Elaeocarpus dentatus*) and tawa (*Beilschmiedia Tawa*); Miro (*Podocarpus ferrugineus*) was also present. The third and ground tiers were characterised by *Suttonia salicina*, *Wintera axillaris* and *W. colorata*, *Nothopanax arboreum* and *N. Edgerleyi*, *Carpodetus serratus*, *Pseudopanax crassifolium var. unifoliatum*, *Coprosma robusta* and *C. foetidissima* and *Senecio Hectori*; Kamahi was the floristic dominant.

Destruction of the association was practically complete, the post-gale surface consisting of a tangled mass of fallen trunks and crowns, and upturned root systems. Shrubs were brought down with the larger trees and, where not uprooted, were broken off or bent over and in all cases whipped about to the point of defoliation. An occasional kamahi survived with part of its foliage intact and a few overmature rimus and beeches stood up. Otherwise, chaos and confusion. Here, then, we should have conditions conducive to the initiation of a new cycle. While fully realising that it is as yet too early to draw conclusions on the course of this cycle, it is considered desirable to place on record the conditions holding prior to the gale and the changes which are to be seen immediately following. In November, 1936, nine months after the gale and with the growing season well under way, the area was reinspected. The first noticeable feature was the resumption of a green appearance after months of desolate brownness and apparent death. Trees lying prostrate but with a few roots still in the ground had managed to keep their hold on life and were sending up new shoots, both normal and epicormic. This shooting was observed on nearly all shrub species, on beech and rata, most noticeably on hinau and kamahi, but not on rimu and miro. Epicormic branching of hinau and kamahi was particularly profuse and occurred even in stumps with the crowns broken off; Tawa shows little power of recuperation. The following list summarises, for the main species, the observations taken :—

All dead or dying	Rimu and miro.
A few green leaves persisting ...	Tawa.
New normal shoots appearing ...	Rata, beech, five-finger, pate, Coprosma species and lancewood.
New normal shoots and epicormic shoots appearing	Kamahi, hinau, toro, Wintera species, Fuchsia, wineberry and mahoe.

All this resulted in a lessening of the exposure of humus to light and warmth, as is assumed to occur after blow-downs. The tangled mass of branches and trunks had itself served as partial protection to the ground floor and the mortality among shade-loving ferns, mosses, and bryophytes was surprisingly small. No signs of podocarp regeneration were present: Beech seedlings, however were appearing in numbers on exposed surfaces, particularly on the mineral soil from

upturned roots. *Aristotelia* was gaining a hold in some openings and seedlings of *Fuchsia, Wintera* species and *Coprosma* species were also coming away.

The Ohau valley.—Here, as in most other areas in the Tararuas, the damage was wrought on the southern and south-eastern faces, and was considerably more extensive than on the opposite (Mangahao) side of the main range. The association occupying the area examined differed from that described above in the following main points : the absence of beech, the presence of overmature rimus only, the prevalence of supplejack (*Rhipogonum scandens*) and the presence of the nikau-palm (*Rhopalostylis sapida*). The damage was similar and the tangled mass of supplejacks made penetration even more difficult. Two features were noticeable, Nikau palms and mamakus (*Cyathea medullaris*) stood up well and over large areas form the only vegetation erect. More striking is the fact that nearly all over-mature and dead rimus remained upright. It would seem that there is a stage in overmaturity wherein wind-resistance is greater than at normal maturity, due no doubt to the lighter stag-headed crown. Also that windblow following death does not occur till butt-rot is far advanced. In general, the conditions to be seen now are similar to those in the Mangahao—new shoots, normal and epicormic on most species, absence of rimu regeneration, and evidence of the particular aggressiveness of kamahi. Although beech was not present here it occurs in the same forest at slightly higher levels, but no seedlings have appeared.

Conclusions.—Any deductions made at this early stage must be somewhat in the realms of speculation. Present indications point to strong powers of recuperation in the broad-leaf species and a lesser exposure of the humus than was expected. It would appear that if an even-aged forest is to result it must still come up through a broad-leaf cover, except where beech seedlings have a start on bare gound. To consider the lack of rimu regeneration in the light of the windblow theory, several important factors must be kept in mind. Firstly, the density of the original stand was not sufficient to restock the area fully: Roche's mounds and depressions indicate a heavier stand than occurred on either of these areas. Secondly, the gale occurred on 2nd February, **before** the maturing of rimu seed. Unless (a) Rimu seed remains viable for longer than one year, (b) Seed is distributed on to the areas from an outside source, or (c) Seed trees are left standing, it is obvious that regeneration cannot be expected. Investigation of the first point is incomplete and all that is known at present is that most germination occurs in the spring following seeding, though there is evidence of a longer period of viability. Rimu seed is distributed either by birds or by wind, depending on the presence or absence of a fleshy aril. The effective radius of wind-distribution is only five chains. Considering the large areas involved in the blow-down, and the fact that bird-life is not prolific in the

Tararuas, it becomes evident that the factor of adjacent seed-source is of little import except on the edges of the blow-down. This leaves only the surviving trees to provide seed. These, however, are sparsely scattered and over-mature and will most likely prove inadequate. Consequently, regeneration must depend upon seed stored in the duff, and if it appears, will afford evidence in proof of the longer period of viability. As mentioned above, the original stands were light and no great quantity of stored seed can be expected. It would seem, therefore, that these areas cannot be used to provide proof or disproof of the wind-blow theory. Other observers have reported areas where rimu was present in greater quantities and where younger trees, which would act in the capacity of seed-bearers, have survived. It will be interesting to see on such tracts, whether the coming-back of broadleaf species is too fast and profuse to allow the development of rimu. Observation on this point over a number of years should prove profitable. For beech, the position is different. Seed had ripened by the time of the gale and in the Mangahao Valley a good number of seed-trees were present. Last summer was an exceptional seed-year for beech, as for most other species. It will be interesting to note if its germination and development is more prolific than on undamaged areas. Again it would seem as if the recuperative powers exhibited by the broadleaf species will be the inhibiting factor. The subsequent development of these and other wind-blown areas will be watched with interest.

DEFORESTATION AND STREAMS.

By E. PERCIVAL.

Professor of Zoology, Canterbury University College.

Particularly during the nineteenth century the removal of the primeval forest cover has been taking place, partly for the utilisation of the timber, partly for the utilisation of the land, and partly for both objects. Very often when the first object was attained all further interest in the area was lost. In the second and third cases the interest in the area has often grown and the fate of the land surface has been vitally bound up with that of the people concerned.

The use of the land after original deforestation is various. It may be recovered by plantations, continuously cultivated, or sown down to grass. Sometimes it is allowed to recover naturally under care, sometimes it is left to its own fate. Whatever happens is of interest to the forester.

Indiscriminate clearing and carelessness afterwards, and the introduction of herbivorous animals, which are partial to bark, young shoots, seedlings, etc., as a diet, have resulted in serious damage to