

of great importance in holding together the easily loosened soil. Unfortunately, the alpine shrub-associations are readily burned, especially when they contain species of needle-leaved heath, or turpentine-scrub, as it is sometimes called (*Dracophyllum*).

Photograph on page 89 shows what vast heaps of stone may be brought by quite a small stream into the valley below. Watercourses of this kind, which only flow during heavy rain, make hundreds of acres in the aggregate quite useless, spreading stones, gravel, and sand over the fertile land. A stream fringed by shrubs, or one passing through the forest, is much less liable to sudden changes, and will flow all the year round. It is quite common in the Southern Alps to find a watercourse absolutely dry where there are no trees, which higher up, perhaps a few yards away in the forest, is always running.

Where the forest has been removed channels are cut on the slopes, gullies deep out of all proportion to the general rainfall are formed, landslips are not infrequent, the surface may become quite bare, and no vegetation can recapture its barren and unstable surface. Finally, streams on which the settler depended will become dry, exposed to scorching sun, drying wind and bright light.

The flood-waters from the denuded areas pour down the streams and gullies, bearing with them to the land below *débris* of all kinds, which, choking up the main rivers, leads to change of streams, erosion of banks, and destruction of fertile lands. Matters such as this are apt to be overlooked in a sparsely populated country. Only the unfortunate sufferer whose acres are being borne away on the turbid stream, or whose grazing-land has become a receptacle for stones and mud, can bewail the apathy or ignorance which permits the mountain-forests, and those fringing the streams, the natural safeguards of the plains and fertile slopes, to be destroyed.

Were it possible to at once clothe the surface with grass, the evil of removing a tree- or shrub-covering would be to some extent mitigated, but the settler wishes to make use of his land as soon as possible, and the early grazing of sheep or cattle forbid the grassy covering becoming close enough to stop denudation. On the higher mountains, too, where the principal rivers have their source, the chance of herbaceous plants occupying the ground before damage to the surface takes place is very poor. Only the native species slow of increase are suited to the conditions, and they can advance but slowly from the margin of the bare area inwards. A natural mountain "meadow" indeed is no great protection against denudation, there frequently being more bare patches than vegetation-covered ground.

It is the closely populated countries that have grasped the vital significance of the mountain-forests. Nor can such countries seek to mitigate the evil, as we can, by the cheap means of forest-conservation. They have been forced to adopt the more drastic method of reforestation. Thus in 1866 in France it was estimated there were 2,964,000 acres of denuded forest lands needing reclothing with trees. The Government of the day took 780,000 acres, spending on them £2,000,000, while private owners and communities added £6,000,000 more, and all to repair the want of foresight in the past. Corea, Professor Macmillan Brown tells me, is suffering from the reckless cutting of the forest, and everywhere is fertile ground being damaged by *débris* coming from the now bare hills. Example after example could be given both from the Old World and America, but these will suffice.

So far as New Zealand is concerned, the Department of Lands has not been unmindful of its duty in this matter. Mr. W. C. Kensington, in his interesting introductions to the Forestry Reports of the past, has made many allusions to the importance of the New Zealand forests from the climatic standpoint. Nor is this all by any means. The practical course has been adopted of making climatic reserves. The upper forests of the Ruahines, Tararuas, the Seaward Kaikouras, and other forests, I understand, have been so reserved. This is a wise and long-sighted policy, and one which will meet with warm approval in the Old World, where the evils of reckless forest-destruction are so well known. Unfortunately, there is in New Zealand a constant cry to cut down the forests. The lessee of a grazing-run cares little what becomes of his leased mountain-land—it will serve his time. He would rather see the subalpine forest burnt than standing: its site might grow a little more grass. The scrub is fired for the same purpose, and in order to signal during mustering. Patches of bush, too, are burned. Vain hope that a run may be thus improved: its area of grass is reduced rather, its value is diminished. Nor is this the worst, since the fertile lands below may eventually suffer. The policy of conserving the mountain-forests should be unhesitatingly adhered to. There are many small areas along mountain-streams of importance. There is scrubby bush on certain of the lower hills which would be far better if left intact than if meddled with. Finally, the larger forest-areas, partly destroyed, if on worthless ground, are better standing than cut down to encourage settlers to take up land which will yield an uncertain and very scanty livelihood at best.

(4.) *Shelter.*

In most parts of New Zealand the wind exercises a very powerful influence upon the plant-life. So great is this in some places that the presence of particular species or combinations of plants is altogether a matter of exposure with regard to wind. Similarly this same factor exercises the greatest influence upon the welfare of the farmer's crops, and in an area of farm land the protection, which trees alone can give, becomes a vital necessity.

From the point of view of affording shelter, then forests are of much moment. It has already been noted how the settler, having cleared his land, at once is forced to plant belts of trees. Pieces of beech forest in the mountain districts are of great value in time of heavy snow for sheltering the flocks. The plantations of the Canterbury Plains, some of which are large artificial forests, are worth many thousands of pounds to the Dominion as a whole, and their threatened destruction some time ago by a species of aphid was feared as a national disaster. Drifting sands are best coped with by a forest covering, but unfortunately, except in parts of Chatham Island and Stewart Island, and a few places on the mainland, this is absent. The general question of wind-breaks rather concerns tree-planting than natural forests, and need not be further discussed.