Although the above evolutionary treatment will not be neglected, it is simpler to deal primarily with the plant covering as it at present exists, dividing it into the antagonistic classes (41) of forest and steppe, and referring our formations, the bog vegetation excepted, to the one category or the other.

(B.) FOREST FORMATIONS.

(*a.*) General Remarks.

Forest is undoubtedly the climax of vegetation up to a certain altitude, since the climate not only of the volcanic plateau but of the whole New Zealand region is of the rain-forest type; it is merely the edaphic conditions which inhibit its presence. These, as has been shown in the geological section, are of a truly desert character, and it is only when the grass and shrub formations can have prepared something of a soil, or the changed topographical conditions have provided shelter, that forest can replace the steppe or scrub. Shade is the greatest friend to forest-growth, and a south exposure, or a gully, will be first afforested. This fact an examination of any gully shows, where all stages in the life-history of a forest may be traced. So, too, a specially abundant rainfall may counteract desert conditions; and thus we find on the western side of Ruapehu a garment of forest continuous with that of the lower altitude, and reaching a fairly uniform height on the mountain. On the east there is nothing of the kind, but only isolated patches in places where special climatic conditions prevail. On the Kaimanawas, however, is a rich clothing of trees, though the rainfall there must be the same as that of eastern Ruapehu and Tongariro. This forest clothing of the Kaimanawas is no doubt due to the different nature of the rock and immunity from the more recent volcanic ashes, &c. It is then merely a question of time, and nature, if not interfered with, will afforest the eastern side of the volcanoes, though the process of changing the present deserts into associations of trees will of necessity be a very lengthy affair.

With the exception of the forest at the north of Tongariro, the remainder consists of various species of *Nothofagus* as the dominant trees. Where unbroken, there is a distinct zonal arrangement, each zone, however, gradually merging into the next. *N. fusca* forms the lowest zone (Photo. No. 12), then *N. Menziesii*, and finally *N. cliffortioides*. Even on the east, where the forests are separated by wide intervals of steppe or desert, and often concealed in river-gorges, the zonal arrangement holds good, altitude or exposure determining the class of forest.

A considerable number of species are common to the different forests, and their presence or absence is most likely rather their individual relation to altitude than a preference for growing in company with any particular species of *Nothofagus*. Other species, again, require the maximum rainfall—*e.g.*, *Luzuriaga parviflora*, *Libertia pulchella*, *Coprosma Colensoi*, *Gahnia pauciflora*—and these occur only on the west and south of Ruapehu, except the latter, which is in the north Tongariro forest.

Generally speaking, there is an abundance of young forest trees and seedlings, and many examples occur where the old trees are dying and being naturally replaced. Thus, if undisturbed, the forests will exist for long periods. But this natural rejuvenation under present forest-conditions is a quite different matter to what would happen should they be destroyed by fire. Then undoubtedly the soil-conditions would overbalance the climatic, retrogression would ensue, and steppe or desert once more appear.

The beech forests have all a strong relationship, yet accordingly as one or other species is the dominant tree, so is the general physiognomy distinct. Thus the close dark-coloured foliage, arranged in layers, of the mountain-beech (*Nothofagus cliffortioides*) is very distinct in appearance from the bright-green and much more open foliage of *N. fusca*, while there is no comparison between the size of the respective species. *N. Menziesii* comes midway between the two in its physiognomy.

(*b.*) The Leading Physiognomic Plants and their Life-forms.

There are no plants recorded up to the present time as peculiar to the forests of the volcanic plateau.* All are such as are found in other parts of New Zealand. The following are the species which most affect the physiognomy of the formations: (Fagaceæ) *Nothofagus cliffortioides*, *N. fusca*; *N. Menziesii*; (Rubiaceæ) *Coprosma fœtidissima*, *C. tenuifolia*; (Myrsinaceæ) *Suttonia divaricata*; (Araliaceæ) *Nothopanax simplex*, *N. Colensoi*; (Taxaceæ) *Phyllocladus alpinus*; (Compositæ) *Lagenophora petiolata*; (Filices) *Hymenophyllum multifidum*, *Polystichum vestitum*, *Blechnum penna marina*.

(1.) *Trees.*

Nothofagus cliffortioides (mountain-beech) is, on the volcanic plateau and its environs, a fair-sized evergreen tree, frequently 50 ft. tall, and with a straight trunk 2 ft. or more in diameter, covered with a dark-coloured moderately smooth bark. The branches when the trees are not crowded are spreading, but in the forest are much contracted but branch freely in a more or less distichous manner, bearing numerous short twigs, which have on their flanks many close, hard, stiff, and coriaceous small, dark, glossy, green leaves of an ovate type, which are clothed beneath with white adpressed hairs. The whole of the leafy branch-system is more or less flattened, presenting the appearance of close layers of foliage one above the other. The flowers are monœcious, the male being very numerous and red and showy when the tree is in full bloom. The seeds germinate freely, and seedlings are extremely numerous. These have rounded membraneous leaves without the adpressed hairs.

Nothofagus fusca (tooth-leaved beech) is a very large evergreen forest-tree attaining a height of 70 ft. and frequently much more, and having a straight trunk often 6 ft. in diameter, covered with deeply furrowed bark, which comes off in flakes. The base of the trunk is very frequently expanded into large, moderately thin plank buttresses (Photo. No. 13). The head of foliage is slender, but almost equals the bare trunk: the branches short, and more or less horizontal. The

* This statement is not true if the forests near Lake Taupo are considered as belonging to the plateau, since they contain the recent remarkable find by Mr. Hill, a species of Bagnisia which belongs to an order, Burmanniaceæ, not previously known in New Zealand.