

(h.) THE SUBALPINE SCRUB.

On the west and south of Ruapehu, between the upper forest and the steppe, there is a more or less continuous belt of shrubs or even low trees such as is usually encountered on a New Zealand mountain, many of the constituents descending into the upper forest, the two formations merging gradually into one another.

The following is from notes taken at 3,700 ft. on the southern slopes of Ruapehu: "The association consists of stunted mountain-beech (*Nothofagus cliffortioides*) 20 ft. tall, and the following: *Phyllocladus alpinus*, *Dacrydium biforme*, *D. Bidwillii*, *Coprosma cuneata*, *Nothopanax Colensoi*, *C. fœtidissima*, *Myrtus pedunculata*, *Nothopanax simplex*, *Griselinia littoralis*, *Astelia montana*, a little *Veronica lævis*, *Gleichenia Cunninghamii*, *Blechnum fluviatile*, *Styphelia fasciculata* (this as a prostrate plant), *Podocarpus nivalis*, *Gahnia pauciflora*, *Styphelia acerosa* (as a carpet plant), small *Libocedrus Bidwillii*. The ground is carpeted with moss and the umbrella fern, the *Astelia*, the *Gahnia*, and seedlings growing through." "Approaching the outskirts, the beech gets much lower—say, 12 ft. tall, more or less." Also, patches of scrub appear on the steppe which succeeds it, portions of this latter formation or of semi-bog penetrating into the final scrub-belt, and forming open patches of ground of considerable size.

So far as the east of the volcanoes is concerned, there is no continuous zonal arrangement of the formations. Altitude certainly affects distribution, but the associations are governed chiefly by the nature of the ground, its slope, and its exposure to wind and sun. Thus both forest and scrub do not form belts, but simply patches in favourable positions.

The scrub usually occurs in the shelter of river-gullies, "wash-outs," or ridges. Disintegrated lava-flows, where the stones are in large blocks, also afford shelter to a shrubby growth. Frequently the scrub extends over the river-bank out on to the original flood-plain.

Generally speaking, the formation under consideration has nothing like the denseness of typical New Zealand subalpine scrub (Cockayne, 6). The shrubs touch, it is true, and there are cases where on rocky slopes the rigid stems and branches point downwards, making an obstruction of a more typical kind for the explorer.

Subalpine scrub is an advanced phase of shrub-steppe: the shrubs are much the same, but they are taller, and arranged as a closed formation, whereas the latter is an open one. Also, much more *Veronica lævis* and *Senecio Bidwillii* enter in, while *Phyllocladus* is extremely abundant (Photo. No. 26).

Owing to the varied hues of the shrubs the formation has no uniformity of colour. The bright green of the *Veronica* contrasts with the paler green of other plants, and with the brown or reddish hue of the *Dracophyllums*.

The chief plants of the eastern scrub are *Veronica lævis*, *Dracophyllum Urvilleanum* var. *montanum*, *D. subulatum*, *Pimelea buxifolia*, *Phyllocladus alpinus*, *Olearia nummularifolia*, *Senecio Bidwillii*, *Nothopanax Colensoi*, *Veronica tetragona*, *Dacrydium Bidwillii*, *Pittosporum rigidum* South Island var., *Cassinia Vauvilliersii*, *Dracophyllum recurvum*, *Aristotelia fruticosa*.

Another phase of subalpine scrub which might almost be classed as forest is not uncommon here and there. *Phyllocladus alpinus*, with its very pale whitish-green "leaves," is dominant and in places almost pure. There is plenty of *Dacrydium Bidwillii*, no longer prostrate, but a small tree, with many stems each half a foot thick or so. *Nothopanax Colensoi* and *N. simplex* are also frequent. In short, the above is rather the beech-forest undergrowth without beech-trees, growing luxuriantly, than a kind of scrub. The plants grow very closely, and this and the strong and stiff stems and branches makes the formation almost impenetrable.

On Tongariro dense subalpine scrub is abundant in the gullies between 4,000 ft. and 5,000 ft., *Phyllocladus alpinus* being dominant. Such scrub, if sheltered or on better soil, assumes larger proportions, the *Phyllocladus* becomes of tree-dimensions, *Podocarpus Hallii* enters in, and there is low forest such as before described. Where the scrub is lowest *Dracophyllum Urvilleanum* var. *montanum* may be dominant. The formation will present a fairly even surface; the physiognomy is dependent also on the green of the two species of *Nothopanax*, the glaucous hue of *Phyllocladus*, and the erect habit of the *Dracophyllum*, here light green rather than brown. In such scrub there are the following species: *Dracophyllum Urvilleanum* var. *montanum*, *Phyllocladus alpinus*, *Nothopanax Colensoi*, *N. simplex*, *N. Sinclairii*, *Griselinia littoralis*, *Olearia nummularifolia*, *Coriaria thymifolia*, *Coprosma cuneata*, *C. fœtidissima*, *C. parviflora*, *Leptospermum scoparium*, *Gleichenia Cunninghamii*, *G. dicarpa*. Where most exposed this formation gives place to shrub-steppe, which is not only distinguished by its more lowly growth, but by the brownish shrubs and the straw-coloured tussock.

(i.) SHRUBS OF RIVER-GULLIES.

At about an altitude of 3,000 ft. in such gullies as do not contain forest are close-growing associations of shrubs. Where driest will be *Leptospermum scoparium* and *L. ericoides*; but where more shady conditions prevail, then there is *Pittosporum Colensoi*, *Veronica salicifolia*, *Arundo conspicua*, *Olearia nitida*, *Griselinia littoralis*, *Nothopanax arboreum*, *N. Colensoi*, *Pseudopanax crassifolium*, *Phormium tenax*, or *P. Cookianum*.

(D.) STREAMS, BOGS, AND WET GROUND.

(a.) VEGETATION OF RUNNING WATER.

The rivers issuing from the volcanic ranges are altogether too rapid for the higher plants, and are populated merely by a few algæ, which are either submerged or mark on the boulders the average level of the stream. Those torrents which issue directly from solid-looking lava-flows are at first wide and pond-like (Photo. No. 28), and, although running rapidly enough, spread out and are shallow at their sides, wetting, too, the adjacent ground and making boggy conditions. In such, *Montia fontana* forms beautiful bright-green cushions (Photo. No. 27), and, where shallower, *Ranunculus rivularis* forms a close growth, spreading out on to the constantly wet silt. With it is mixed *Montia*, *Juncus novæ-zelandiæ*, and a small-leaved and short-stalked form of *Epilobium pedun-*