

the dead "boom" towns of the old digging days. The southern Maoris say that the *kotuku* is an inhabitant of the nether world, the spirit-land of the *Reinga*. An old funeral lament ends with these words, in apostrophe to the departed: "*Ko te kotuku to tapui, e Tama—e!*" ("The white heron is now thy sole companion, O my son!")

The beautiful onomatopoeic Maori names of many New Zealand birds have no doubt been remarked upon by some of our nature-lovers. A considerable number of our indigenous birds derive their names from their cries and songs. To enumerate a few, there are the *kuku* (or pigeon), the *koko* (or *tui*, the parson-bird), the *kaka* parrot, the *hakoakoa* (seabird), the *whio* (blue mountain duck), *kea* (mountain parrot), and the *riroriro*, the little grey warbler. One can readily understand how these names came to be given, particularly in the case of the wild pigeon; *ku-ku* is simply an imitation of the sound uttered by the bird as it flaps from tree to tree, or sits up in the branches feasting on the berries—literally a "coo," the softest, most loving of forest calls. The *whio*, or "whistler," generally called the blue mountain duck, is much more abundant in the South Island than the North, and is to be seen at particularly close quarters on such routes as the foot-track leading through the mountains from Lake Te Anau to Milford Sound. Here, in many of the clear pools and calm reaches on the Clinton River, you will see little fleets of *whio* sailing round and round, uttering now and then the peculiar cry, like a whistle with a cold in it, that has gained for them their Maori name. They have never learned to fear man or his gun, and their confidence and tameness are pretty to see. Finally, there is the *kea*, the remarkable alpine parrot, the outlawed of squatterdom. Far up in the mountains, in the wastes of rock and ice, the *kea*'s scream will be heard, as he circles round you on the cliffs, or hops across the surface of the glacier after you—for he is as inquisitive and impudent as the *weka*—yelling "Kay-ah! kay-ah!" at you at the top of his voice.

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ART. XLIII.—*On a Specific Case of Leaf-variation in Coprosma baueri, Endl.* (Rubiaceæ).

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[Read before the Philosophical Institute of Canterbury, 6th September, 1905.]

Plate LII.

*Coprosma baueri* is a common New Zealand shrub or small tree frequently occurring in exposed situations on the North Island coast. It also extends to the South Island, having its southern

limit in the west of Nelson. It is found, too, in Norfolk Island, but whether the form there is identical with the New Zealand plant appears to be somewhat doubtful.\* When growing on cliffs and rocks it is frequently prostrate, being flattened closely against the rock-surface, but when in more sheltered situations and in deeper soil it is a small tree with a fairly thick trunk and dense crown of foliage; in fact, the two extreme forms are so unlike that they might easily be mistaken for two different species. It is most amenable to cultivation, and in consequence is very frequently made use of as a hedge plant in many parts of New Zealand, especially in the North Island. Now, as in many cases such hedge plants are growing under conditions different from those of the species in its natural seaside habitat, an opportunity is afforded of instituting a comparison between the cultivated and wild plants. Thus, during my recent residence at Island Bay, Wellington, I had an opportunity to observe such differences as existed between the leaves of a certain shelter hedge in that neighbourhood and those of plants growing near the sea, both of the tree and prostrate forms.

The hedge in question was so planted, between a paling fence on the one side and a house on the other, that it was sheltered in its lower part from the north-west wind, and altogether from that from the south-west, these two winds being, as is well known, extremely severe in the above locality. Moreover, the basal portions of the plants were in almost complete shade, receiving little, if any, direct sunlight.

In contradistinction to this wind-still, shady environment, that of the seaside plants is very different. There they are exposed to frequent and furious winds and to bright, direct sunlight. Some plants also may receive at times a certain amount of sea-spray, which of course will tend to increase the succulence of their leaves.

A glance at the photograph (Plate LII) shows at once the great difference which exists between such shade leaves and those exposed to sun and wind, which latter, however, belong to the normal leaf-form of the species. To go into further details, the leaves of *Coprosma baueri* when growing in its natural habitat are somewhat fleshy in texture, glossy green on the upper surface but much paler beneath, and the margins are recurved.

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\* Thus, Hooker writes, "The New Zealand specimens are much more succulent and stout in habit than those of the Norfolk Island, but I find no differences in the flower or fruit" ("Flora Novæ-Zelandiæ," vol. i, p. 104).

Maiden ("The Flora of Norfolk Island," Proc. Linn. Soc. N.S.W., 1904, p. 706) did not observe *Coprosma baueri* during his visit to Norfolk Island, and considers that it is probably rare.

This latter character is frequently carried to such a pitch that each half of the blade is rolled round itself, or the one half may be rolled round the other, the leaf thus presenting the appearance of a pipe. Such leaves may be called "rolled leaves." As for the dimensions of the leaves, the following are taken from Island Bay coastal plants:—(1) Leaves of the tree (*laminæ*): 3.2 cm. by 1.9 cm.; 4.4 cm. by 2.4 cm.; 4.5 cm. by 2.2 cm.; 3.1 cm. by 1.8 cm.; 2.8 cm. by 1.6 cm.; 5 cm. by 2.8 cm.; 2.7 cm. by 1.5 cm. (2.) Leaves of the prostrate shrub (*laminæ*): 4 cm. by 3.1 cm.; 4 cm. by 2.8 cm.; 3.4 cm. by 2 cm.; 3.8 cm. by 2.3 cm.; 3.1 cm. by 2 cm.; 4.3 cm. by 2.9 cm.; 5 cm. by 3.3 cm.; 2.6 cm. by 1.7 cm. From the above figures it will be seen that there is not much difference in size between the leaves of the prostrate shrub and those of the tree; perhaps, if a considerable number of measurements were taken, the prostrate plant, owing to the superior shelter from wind provided by its habit of growth, would show a larger average leaf-surface.

Turning now to the shade leaves of cultivated plants, some of which it must be pointed out belonged to semi-sucker shoots, they are much larger, slightly thinner, and not quite so glossy as the leaves of normal coastal plants. Actual measurements of various *laminæ* read: 12.3 cm. by 9.7 cm.; 11.8 cm. by 8.5 cm.; 11.3 cm. by 8.8 cm.; 12.8 cm. by 10.1 cm.; 10.1 cm. by 7.9 cm. Leaves from certain other shade shoots are not quite so large, but still are much larger than the normal—for example, the following: 6.5 cm. by 5.9 cm.; 8 cm. by 4.9 cm.; 6.5 cm. by 5.8 cm.; 6.9 cm. by 6.1 cm. From the above it may be seen that the shade leaves, especially when belonging to suckers, are frequently more than three times the size of normal sun-and-wind leaves, and that they are always flat, whereas the latter have always recurved and frequently rolled leaves.

Ordinary *Coprosma* hedges, such as are so common in the City of Wellington, are especially instructive for purposes of comparison, since they show all degrees of leaf-form from flat leaves to those with considerably recurved margins. Generally speaking, such hedges occupy more sheltered positions than plants near the sea, and this shelter is frequently enhanced by the hedge being on the lee side of a wooden fence of some kind or another. In such hedges the leaves near the base are more or less flat, becoming gradually more recurved towards the summit of the plant, where they are exposed to the wind. Even the uppermost parts of plants of considerable size, if sheltered from the prevailing winds, may possess some flat leaves. Such hedges, moreover, possess few rolled leaves of an extreme type, but are intermediate in character, so far as leaves are

concerned, between shade leaves and normal sun- and -wind leaves.

Whether in the case of *Coprosma baueri* a leaf having once become possessed of a recurved margin can again become flat, or an extreme rolled leaf unroll itself, is a matter requiring investigation. It seems to me, however, that there is a strong tendency in the plant to produce recurved leaves, and that such under normal conditions are characteristic of the species. Seedlings have flat leaves, but there is sometimes a trace of recurving, especially at the base of the lamina. As for the leaves of semi-sucker shoots referred to above, their being flat might in part be attributed to their being reversion-shoots, since such are especially wont to make their appearance at the bases of plants. The large size of such leaves may also in part be due to the well-known luxuriant growth of suckers. All the same, many of the shoots observed were clearly not suckers, and there is no doubt but that shade and absence of wind played a most important part with regard to the leaf-form.

Of course, the rolling of a leaf and consequent reduction of leaf-surface in a xerophytic station is very beneficial for the well-being of the plant, but that such is a benefit is no explanation of why such rolling should occur; it only explains in part how the plant in question can exist in its particular station. On the other hand, the presence of rolled leaves where exposed to sun and wind, and of flat leaves in the shade and in a still atmosphere, points to the wind factor and the light factor, one or both, as having been instrumental in originally causing these structures, which now they are able to evoke, thanks to an hereditary tendency in the plant to respond to their stimulus. Were there no plants of *Coprosma baueri* except those of exposed stations on the coast, then large, flat leaves would be unknown, and the rolled-leaf form would be held to come "true" from seed. Or, again, were there no stations suitable for the tree form, only the prostrate form would exist. That this is not an absurd suggestion is shown by the fact that another New Zealand coastal tree, *Myoporum laetum*, Forst. f., only exists on the Moko Hinou Islands as a prostrate shrub, and were that its sole habitat its power of becoming a tree could never be dreamed of. Such plastic species, indeed, have really no one fixed form, but as Klebs\* has shown (if I understand him rightly), their so-called normal characters are merely a few of a larger series, and are of no greater specific value than those others which may be evoked by a different environment.

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\* "Willkürliche Entwicklungen anderungen bei Pflanzen," Jena, 1903, pp. 145-46; indeed, the whole of chapter vii, p. 139 *et seq.*, requires consulting.

Another New Zealand plant, *Olearia cymbifolia*, Hook. f., is of interest with regard to the question of flat and recurved leaves. This species is a moderate-sized shrub, and a member of the subalpine scrub of certain mountains in the South Island. Its leaves are small, very hard, thick, tomentose beneath, and *much recurved*. This leaf-form remains quite constant even when the shrub is cultivated at sea-level in good garden soil. But occasionally, from the base of such plants, shoots with flat or almost flat leaves are given off, resembling exactly the adult leaves of a closely allied species, *Olearia nummularifolia*, Hook. f. In this case the recurved leaf is a more stable quantity than is that of *Coprosma baueri*, but the difference is at best one of degree merely, and yet in the case of the *Olearia* is a plant of which the adult was considered by Sir Joseph Hooker, who was certainly no "species-maker," a distinct species,\* whilst its basal reversion-shoots† are clearly, if they should flower, *O. nummularifolia*, another of Hooker's species. In such cases as these, and others which could be cited, using only the New Zealand flora, the methods of the systematists appear to break down, and experiment alone can decide as to specific rank.

Before concluding, I wish to express my thanks to Mr. R. Ewing, of Island Bay, and also to Mr. F. G. Gibbs, M.A., of Nelson, who have sent me a large quantity of fresh material, especially seedlings, in connection with this paper.

#### EXPLANATION OF PLATE LII.

Photograph of shade leaves on left and rolled leaves of seaside plant on right of *Coprosma baueri*. Centimeter scale. Photo by the author.

\* Mr. T. Kirk wrote ("Students' Flora," p. 273): "Var. *cymbifolia* appears to be a depauperated condition largely caused by the ravages of insects." For a long time I was much puzzled how Kirk could have come to this conclusion, but quite recently Mr. F. G. Gibbs sent me some specimens damaged by insects, such as described above. However, such insect-affected plants are quite rare, and the leaf-form of this species does not in the least owe its shape to such a cause.

† I called attention to this phenomenon some years ago in "A Sketch of the Plant Geography of the Waimakariri River Basin" (Trans. N.Z. Inst., vol. xxxii, 1900, p. 123). At the present time I am making certain definite experiments with this plant, which it is hoped may throw fresh light on its variability.