

where water oozes from the Red Crater of Tongariro, grows to ten times its normal size. Finally may be cited *Claytonia*, equally at home on scoria slopes and in running water. The truth is that this matter of bog xerophytes is as yet not explained in any satisfactory manner. All we know is that certain plants occur in bogs and in the most arid stations, and that they do not occur in those intermediate and more inviting ones. This can, of course, be explained on the supposition that they were driven into these extreme positions during the struggle for existence with the other plants, and there is much in favour of this view, but it does not at all explain the special xerophytic structure, which evidently in some cases is neither a particularly benefit nor hindrance to its possessor. *Drosera* and *Utricularia* are carnivorous plants, and their structure is similar to that of others of the genus elsewhere: so, too, with the sedge form of certain of the bog-plants.

(c.) HOT POOLS AND STREAMS.

From the boiling springs of Ketetahi flow several streams of warm water, which certainly vary much in temperature at different times. Not far from their margin *Hierochloa redolens* grows both luxuriantly and in great abundance, and there is also plenty of the fern *Hystiopteris incisa*, so common in similar situations at a lower altitude.

The hot pools themselves contain abundance of a blue-green alga, and this also covers with a thick mantle the stones exposed to the stream. Professor Setchell, of the University of California, who came to New Zealand some few years ago in order to study the algæ, has very kindly sent me some notes *re* those of the hot springs of New Zealand. "I found," he writes, on the 20th December, 1904, "particularly at the Terraces at Taupo, conditions very similar to those of the so-called 'jelly-basins' of the Yellowstone, only in miniature. I found, in fact, that while there is the greatest resemblance between the thermal districts of New Zealand and those of the Yellowstone Park, the display of the algæ-growths in the hot waters is comparatively slight in New Zealand. In New Zealand, acid waters and mud-holes abound, and such localities in both regions have very little life. I did find, however, that the main facts given in my 'Upper Temperature-limits of Life' hold for both regions." "I did not find anything living in the New Zealand springs above a temperature of 75° C." The following is the reference alluded to (pp. 934, 935) inasmuch as it applies to New Zealand:—

"1. No animals were found in strictly thermal waters, although careful search was always made for them.

"2. No living diatoms were found in strictly thermal waters. At times a few empty valves were found, but these may easily have been blown in, since the localities were in the neighbourhood of extensive areas of diatomaceous earth.

"3. All the organisms found in my own collecting in strictly thermal waters belong to the groups of plants designated as *Schizophyta*, being either *Schizophyceæ* (*Cyanophyceæ*) or *Schizomycetes* (*Bacteria*). These two groups possess a simple morphology and peculiar cell-structure.

"4. The chlorophyllose *Schizophyceæ* (or *Cyanophyceæ*) commonly continue up to 65°–68° C., and in some cases, but scantily, up to 75°–77° C.

"5. No organisms were found in springs reputed to have a decided acid reaction. This needs more study, but where a strong acid (sulphuric) character is given for a spring the waters are free even from *Schizophyta*."

VII. THE HISTORY OF THE VEGETATION.

The number of species in the Tongariro National Park and its environs, so far as my observations go, is 260 (ferns, &c., 38; spermatophytes, 222). Of these, 188, or 72 per cent., are endemic; 60, or 23 per cent., Australian or Tasmanian; and 17, or 6·9 per cent., South American. As for their distribution in New Zealand itself, 164 species are found also in the Northern Province, but of these a considerable number are found only on the Thames mountains, and so they are not really northern New Zealand plants. By far the greater number of species (236) extend into the Southern Province, which leaves very few as peculiar to the Central Province—*i.e.*, to the land bounded on the north by latitude 38°, and on the south by latitude 42°. The forest-plants number 112, the grass-steppe 59, the shrub-steppe 46, bog and wet ground 48, and the desert 15; but these numbers are at best approximate. The true alpine or subalpine plants are about 42, but it is hard to draw the line as to what plants should be included as such: all the remainder are more or less common at comparatively low altitudes.

The higher land of the Central Plateau, with the two exceptions discussed further on, contains no species which have not been found on the older adjacent land-surfaces, so there can be little doubt but that the plants as a whole have come from thence, and that no direct accessions have been received from the South Island.

Before the uprising of the volcanoes a uniform flora would occupy the present volcanic plateau, containing probably much the same species as exist at similar altitudes in that part of the North Island at the present time, although most likely forest species would predominate, and a richer vegetation on the whole be present owing to the absence of volcanic *débris* on the surface of the ground.

The destruction of the vegetation that would ensue from the building-up of the volcanoes and their many eruptions would supply new ground again and again for colonisation by plants, but there would always be a gradual transition from deeply buried to untouched vegetation, and this latter would extend by tongues, long or short, into the devastated areas. Thus would go on side by side destruction and reoccupation, the one or other gaining the mastery according to the activity of the volcanoes, though after a time the intervals between the eruptions would become much longer and the successive plant-coverings closer and more permanent. Thus in all cases it would be merely a repopulating of new ground from an adjacent fully populated area, and the species of the one would be the species of the other, though fewer in number on the more xerophytic new ground. That this is the case has been abundantly shown in what has gone before in this report. But the species which came would be exposed to quite new conditions which not all could tolerate, and so there would be a survival of the fittest, so that not all the present flora of the