*Plantago major*, L.—Common in cultivations.

„ *lanceolata*, L.—Common amongst grass on both islands.

*Polygonum aviculare*, L.—Only seen in old cultivations on the main island; not common. (Possibly introduced from the main land, but most probably indigenous, *T.K.*)

*Rumex obtusifolius*, L.—Chiefly in grass fields on Pitt Island; supposed to have been introduced from Tasmania.

*R. acetosella*, L.—Common all over the islands, and in all soils.

*Phalaris canariensis*, L.—Chiefly on Pitt Island.

*Dichelachne crinita*, Hook. f.—Common; chiefly in old cultivations on Pitt Island. (Certainly indigenous, and has increased in a remarkable manner with the progress of agriculture in the North Island, *T.K.*)

*Holcus lanatus*, L.—Chiefly in swamps on main island.

*Poa annua*, L.—Chiefly on Pitt Island, about old tracks.

„ *pratensis*, L., var. *sub-cærulea*.—Common on Pitt Island; not noticed elsewhere.

*Dactylis glomerata*, L.—In a few places on main island; common on Pitt Island.

*Bromus unioloides*, Humb.—Most common on Pitt Island.

*Lolium perenne*, L.—Common on both islands.

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## Art. XLII.—*Notes on the Flora of the Lake District of the North Island.* By T. Kirk, F.L.S.*

[*Read before the Auckland Institute, 24th June and 22nd July*, 1872.]

### Tauranga.

The immediate vicinity of the township of Tauranga presents but few plants of interest to the botanist. The naturalized grass *Cynodon dactylon*, the doab-grass of India, forms a dense sward, and during the excessive drought of the last season afforded a good supply of herbage when other kinds were scorched up. *Carduus marianus* is abundant on the cliffs, and in many places the sweet-briar forms troublesome thickets. *Plantago coronopus* is established in one spot on the beach, the only instance so far as I am aware of its naturalization in the colony.

Between Matapihi, on the opposite side of the harbour, and Otupapora the neglected cultivations of the Maoris are literally covered with *Œnothera*

* This paper embodies the results of an examination of the natural vegetation and agricultural capabilities of the district, made by the author for the Geological Survey Department in the autumn of 1872. See also *N. Z. Gazette*, No. 43, 4th Sept., 1872, for official report.—Ed.

*stricta*, which is naturalized to a greater or lesser extent all through the Bay of Plenty, and thence more sparingly to Lake Taupo. This American weed appears to be as incursive in its habits as any of the European viatical plants, and in this district causes much trouble to the natives. The usual arenarian plants are abundant between Otupapora and Maketu, and present but little variety.

## MAKETU.

At Maketu *Ruppia maritima* occurs in the tidal portion of the Kaituna river, and fragments of *Potamogeton ochreatus*, Raoul, are floated down the stream. This species has been erroneously referred to *P. compressus*, Sm., and to *P. gramineus*, Sm., and is the sole representative in New Zealand of the grassy-leaved section of the genus. At the mouth of the river is a fine clump of the angi-angi* (*Coprosma baueriana*, Hook. f.), which, according to native tradition, is composed of descendants of the original tree to which the Arawa canoe was made fast on the arrival of the tribe at the island. *Limosella tenuifolia* and *Elatine americana* occur near the beach, the latter attaining here its most easterly known habitat. *Cynodon dactylon* is abundant, and from its capability of resisting drought its diffusion must be beneficial, notwithstanding the pointed objections urged against it by settlers in cultivated districts on account of its poor yield during the winter season. Other naturalized plants are abundant.

The Kawa swamp at Maketu is probably the most extensive habitat for the marsh shield-fern (*Nephrodium thelypteris*, var. *squamulosum*) in the colony. It is here a prominent plant over hundreds of acres. *Nephrodium unitum*, Br., is said to occur about some hot springs in the centre of the swamp, but I had not time to verify the statement. *Calorophus elongatus* is abundant a short distance from Maketu; *Psilotum triquetrum* is found in several spots amongst the tea-tree, and attains its most eastern habitat on Motuhora Island. *Eleocharis sphacelata*, *E. gracillima*, *Cladium articulatum*, and other marsh plants, are abundant.

For a few miles from Maketu the country has evidently formed part of an ancient sea-basin. A littoral grass, *Zoysia pungens*, produces extensive patches of turf, and is sparingly mixed with *Microlæna stipoides*, *Danthonia semi-annularis*, and a few English grasses and trefoils. *Pimelea prostrata*, *Pteris esculenta*, *Pomaderris ericifolia*, *Haloragis micrantha*, *Potentilla anserina*, and stunted manuka, form the chief portion of the scanty vegetation.

On ascending the first hills, about six miles from Maketu, the *Zoysia* at once disappears, but the other grasses named become more frequent, and notwithstanding the sterile appearance of the soil the fern exhibits greater

* Taupata?—ED.

luxuriance; thickets of tupakihi (*Coriaria ruscifolia*, Br.,) are frequent, and of large size. Occasional patches of *Lycopodium densum* and *Pomaderris phylicifolia* are found, but are decidedly rare when compared with their abundance north of the Waitemata. The forest through which the road passes is composed chiefly of *Nesodaphne tawa*, *Metrosideros robusta*, *Podocarpus totara*, *P. ferruginea*, *Atherosperma novæ-zealandiæ*, *Tetranthera calicaris*, *Knightia excelsa*, and *Suttonia australis; Cyathea dealbata*, *C. medullaris*, *Dicksonia squarrosa*, and *D. antarctica* were frequent, in many localities the last named being the prevalent form, and exhibiting a marked extension of its range northwards. *Erechtites prenanthoides* is abundant on moist banks. In places where the forest has been cleared for the line of telegraph a dense rank growth of *Solanum aviculare* and *Fuchsia excorticata* has made its appearance. These plants, sometimes alternating with *Pteris esculenta* and *Gleichenia circinata* are the first to occupy the soil after the destruction of forest in the northern part of the province. Their seeds must often have been lying dormant for lengthened periods as the phenomenon takes place in districts where mature plants are absent or extremely rare.

## Rotoiti.

At the pa Mourea, on the narrow strip of land which separates Rotoiti from Rotorua is the largest specimen of *Coprosma baueriana* I have seen. At a short distance it may readily be mistaken for the kohe-kohe (*Dysoxylum spectabile*, Hook. f.) It is said to have been planted by Hatupatu, a chief of the district, who also planted the pohutukawa on the Island of Mokoia, and attempted to naturalize the snapper in the waters of Rotorua, thus on a limited scale anticipating the efforts of the acclimatization societies of the present day. The Ohua stream, which connects Rotorua with Rotoiti, contained masses of *Myriophyllum variæfolium*, *Potamogeton*, n.s., *Callitriche muelleri*, *Azolla rubra*, *Lemna minor*, etc. A close growth of uliginal plants occupied the margin of the lake, but presented nothing worthy of special mention. *Glossostigma elatinoides* formed extensive patches in various places, often submerged.

On the high ground above Rotoiti *Poa australis*, var. *lævis*, was first observed but sparingly; on approaching Te Ngae it becomes more abundant, and is intermixed with *Danthonia semi-annularis*, *Microlæna stipoides* and *Leucopogon frazeri*. Its isolated dwarf tussocks become abundant in the small valleys further south, and at a distance present a similar appearance to the northern *Dichelachne stipoides*, so common on sea shores and the margins of mud-flats. In nutritive qualities it is greatly inferior to the typical form which occurs sparingly on the Auckland Isthmus.

## TE NGAE.

At the telegraph station, Te Ngae, formerly the residence of the Rev. Mr. Chapman, the false acacia, English elms, elder, hawthorn, poplar, apple, walnut, and other trees, have attained a large size, and are growing with the greatest luxuriance, clearly demonstrating the capabilities of the soil, notwithstanding the sterile appearance of its surface. Introduced grasses also flourish. The sweet-briar has escaped from the garden and become a complete pest; the old road by the telegraph line is so completely overgrown that it is difficult even for horses to thread their way through it. In some parts of the district it is spreading rapidly, the fruit being greedily eaten by horses; the seeds are distributed far and wide. It is easy to foresee that this plant is destined in a few years to effect a considerable change in the scanty vegetation of the whole Taupo district, as similar instances of its diffusion, although in a lesser degree, are not uncommon. The shelter it affords is highly conducive to the growth of native and introduced grasses, which in many spots are destroyed by the scorching summer sun acting upon the pumiceous sand not yet decomposed into soil. Horses, moreover, are said to fatten upon the fruit, so that its spread will not be entirely prejudicial.

## ROTORUA.

Rotorua is nearly circular in shape, its greatest diameter being under seven miles. The wonderful volcanic phenomena to which this lake owes its interest are confined to the southern extremity between Te Arikiroa Bay and the Pukeroa stream, and to the Island of Mokoia, which attains the height of 400 feet, and is situated near the centre of the lake. On the south and west sides a low tolerably level plain extends one or two miles to the base of the hills, which attain their greatest altitude, 2,500 to 2,600 feet, at Whangapakau on the eastern, and Ngongotaha, an outlying spur of the Horohoro range, on the south-west; on the north and north-west the country rises more gradually until it reaches the elevated forest-land separating the district from Tauranga and the coast.

In spots where the scrub attains a luxuriant growth the numerous boiling springs and fumaroles are objects alike of interest and danger. The unwary explorer suddenly finds himself on the extreme verge of chasms with vertical sides from three to twelve feet in depth, which are constantly falling in from the action of steam; at the bottom liquid mud in a violent state of ebullition presents a most repulsive appearance. In many mud-springs the contents are less fluid and are occasionally ejected with considerable force; in others the contents appear to be about the consistency of putty, with the surface undisturbed, a bubbling sputtering noise is heard, and in a moment the centre of the mass rises in a somewhat domed shape until it breaks from the apex in

masses more or less regular, which still retain their plasticity, and as they gradually expand towards the circumference of the pit assume the appearance of decorative leather-work on a large scale, until becoming thinner they are gradually absorbed in the general mass. All degrees of consistency are to be found. No vegetation was observed on the walls of mud-springs, although the sides of simple boiling-springs, when not too violently agitated, were usually covered with a dense growth of fern or club-moss. At Whakarewarewa, on the south-east, are mud-volcanoes with elevated cones, which are constantly overflowing, and a series of intermittent geysers, fumaroles, and boiling springs, with terraces second only to those of Rotomahana, but the locality is seldom visited by tourists.

As may be readily imagined from the foregoing sketch, the conditions under which vegetation exists are not favourable to the development of a luxuriant flora, and it is especially worthy of note that throughout the whole of the Taupo country the number of naturalized plants is disproportionately small as compared with other districts, even when all allowance is made for the slow progress of settlement; it is, moreover, largely composed of species introduced by the missionaries for cultivation, mere garden escapes, as the stramonium, fennel, potato, strawberry, peach, cherry, tobacco, purslane, elder, horehound, sweet-briar, *Lycium barbarum*, etc., only a few of which are extensively distributed, the majority marking the sites of deserted cultivations.

Near Te Arikiroa Bay a dense growth of *Dracophyllum urvilleanum*, *Leptospermum scoparium*, dwarf states of *L. ericoides*, etc., prevails to such an extent that it is difficult to force one's way to many spots. Where the surface of the soil is more decomposed *Gaultheria rupestris* occurs sparingly; about the boiling pool, Oruawhata, the scrub is much more luxuriant, and mixed with *Coprosma lucida*, etc. *Datura stramonium* is abundantly naturalized on the sulphur sand of the beach towards Ohinemutu, in some places growing with *Lycium barbarum*. On the low land at the back of Ohinemutu, much of the vegetation is stunted and diminutive. Amongst the manuka may be found two plants which here approach their northern limit—*Gnaphalium filicaule* and *Lycopodium magellanicum*. A *Carmichælia*, which in the absence of flowers I refer to *C. juncea*, Col., is occasionally met with. *Lycopodium densum*, *L. laterale*, *Celmisia longifolia*, *Geum strictum*, *Potentilla anserina*, *Viola cunninghamii*, *Hydrocotyle novæ-zealandiæ*, *Botrychium virginicum*, *Thelymitra pulchella*, *Alternanthera sessilis*, *Epilobium tetragonum*, *E. billardieri*, *E. alsinoides*, *Pimelea prostrata*, with patches of *Agrostis æmula*, *Microlæna stipoides*, mixed with *Cynodon dactylon*, and other naturalized grasses, are the chief plants found in this vicinity. *Cladium junceum*, *C. gunnii*, and similar plants are abundant in the swamps and wet places; *Eleocharis sphacelata* and *Sphagnum squarrosum* occupied the whole of one large swamp.

The Pukeroa stream contained exactly the same plants already mentioned as having been collected in the Ohura. *Elatine americana*, with various uliginal plants, fringed its banks. One or two small patches of kahikatea form the only timber on the low lands.

The summit of Ngongotaha and the adjacent hills is clothed with luxuriant forest, the margins of which have been from time to time cleared by the natives for their scanty cultivations. The chief trees are the rimu, rata (*Metrosideros robusta*, Sm.), tawa, rewa-rewa, mangiao, and pukatea; the puka-puka (*Brachyglottis repanda*, Forst.) and *Coprosma grandifolia* are abundant, and especially *Alseuosmia macrophylla*, which forms the densest of the undergrowth down to 1,700 feet. *Senecio glastifolius* and *Drimys axillaris* are comparatively rare. *Griselinia lucida* and *Pittosporum cornifolium* occur as epiphytes with *Astelia solandri* and *A. cunninghamii*. *Cyathea medullaris*, *C. dealbata*, and *Hemitelia smithii* are frequent, and a few noble specimens of *Dicksonia antarctica* occur near the summit, but as a rule the paucity of species extends to ferns, no less than to phænogamic plants.

The open country towards the north end of the lake presents still fewer plants of interest; *Dracophyllum subulatum*, Hook. f., the most characteristic plant of the Taupo plains, attains here its northern limit. Near the point where the road to Tauranga crosses the Kotukuroa creek, two or three bushes of a large-leaved *Pittosporum*, four to six feet high, were observed with immature fruit. In the absence of flowers, I identified the plant with *P. tenuifolium*, var. *fasciculatum*, although the peduncles are erect. *Lycopodium magellanicum*, which attains its extreme northern boundary a few miles nearer Tauranga, was plentiful; when growing luxuriously, as in the present instance, it is a far more graceful plant than its European representative *L. clavatum*, L., and presents a totally different appearance to the stunted condition common on high open lands. *L. scariosum* covered the rocks with its long pendent stems, the bright yellow spikes harmonizing well with the deep green leaves. *Gaultheria oppositifolia*, Hook. f., was plentiful in one spot, although the specimens had a stunted appearance; with *Craspedia fimbriata*, DC., it attains its northern limit in this habitat.

The forest on this side presented few plants of interest when compared with the forests of the northern part of the province, and was remarkable from the absence of kauri, tarairi, and puriri. The hinau, rata, (*Metrosideros robusta*, Sm.) matai, miro, tawa, mangiao, and rewa-rewa are abundant. *Weinmannia racemosa*, *Santalum cunninghamii*, and *Ixerba brexioides* are much less frequent, but I have reason to believe that on the Tauranga side the number of species is much larger.

To return to the lake, on the north side I was surprised to find on the beach the littoral plants *Bromus arenarius*, Lab., *Carex pumila*, Th., *Scirpus*

*maritimus*, L., and *Ranunculus acaulis*, with patches of *Zoysia pungens*, Willd. *Deschampsia cæspitosa*, Palisot, attains its northern boundary at this part of the lake. About hot springs at Ohinemutu a *Chenopodium* occurs with the leaves farinose beneath, which in the absence of flowers or fruit I refer to *C. ambiguum*, notwithstanding the sub-erect flaccid habit. *Leptocarpus filiformis* is abundant with *Cladium junceum* in a hot-water swamp. *Viscum salicornioides* occurs sparingly on *Leptospermum ericoides*, etc., in several places near these springs, and flourishes in the steamy atmosphere.

A few plants flourish on the heated mud, *Limosella tenuifolia* and *Glossostigma elatinoides* exhibit remarkable luxuriance when the roots enjoy a temperature of 90° to 95° Fahr. *Scirpus lacustris* flourishes in one or two spots with a temperature of 93° at the roots, but in others it appears scalded and stunted at a much lower root temperature, probably the result of a sudden increase in the temperature of the surrounding water. *Fimbristylis dichotoma* is a most abundant plant in Ruapeka Bay, and is to be seen everywhere, flourishing with a root temperature of 95°, whether growing on heated mud or where a faint steam jet has broken through the crust. In these situations it exhibits the greatest luxuriance, and contrasts forcibly with the pigmy specimens growing in soil of the ordinary temperature. It is abundant near the so-called sulphur sea, Te Arikiroa Bay, but so diminutive that it might readily be passed without attracting notice, notwithstanding its peculiar habit, and in size and development exactly resembling specimens collected at Peringa and Te Pakaruna in the Lower Waikato. It is probable that the plant has been conveyed to those habitats by Maoris travelling to the Waikato Heads.

*Lycopodium cornuum*, L., a common plant about hot springs in all parts of the world, is more abundant at Ohinemutu, often lining the sides of hot pools and luxuriating amongst steam jets, its roots must often endure a much higher temperature than 95°, but from accidental causes I was unable to continue my observations in this direction. *Pteris incisa*, Thunb., was usually associated with the *Lycopodium*, and showed a like partiality for a warm atmosphere. Perhaps the most singular plant found in these situations is the terrestrial Alga, *Chroolepus aureus*, Mitt., which is abundant on dead twigs, fern-stalks, etc., its clotted orange-brown filaments being often conspicuous at a considerable distance. Wherever the traveller descries this singular Alga in the brushwood before him he has a sure indication of the close vicinity of a boiling mud-spring, or of heated vapours escaping from treacherous ground, and should at once walk warily. The filaments of specimens from this locality are much longer than in northern specimens.

The absence from the Ohinemutu district of any of the tropical ferns found in the vicinity of the hot springs further south is a singular circumstance, for which no explanation can be offered at present. On the other hand, the

restricted distribution of *Fimbristylis dichotoma* is no less remarkable. With one exception it is confined to the hot springs of Ohinemutu. At Otumakokori, where it occurs very sparingly, it has doubtless been carried by travellers within a very recent period.

The appended list of plants shows the paucity of the flora found in the immediate vicinity of Ohinemutu; including naturalized plants it numbers less than 300 species.

Tobacco is extensively cultivated by the Maoris about Ruapeka Bay, in small inclosures containing from 10 plants to 400, which are usually kept in the greatest order and neatness, the leading shoot being carefully pinched back as soon as the fourth or fifth leaf is fairly developed. Tobacco might be grown to a large extent in this district, and as the dried leaf sells wholesale for one shilling per lb. in Auckland, the natives might readily secure a considerable income. Unluckily, however, they have no idea of the dignity of labour, and confessedly rank amongst the least industrious of their race.

## ROTOKAKAHI.

The country between Whakarewarewa and Rotokakahi presents few objects of special interest, although the soil is more fertile than in the vicinity of Ohinemutu, and much of the vegetation more luxuriant. At Pareru the road runs through a small piece of bush in which *Dicksonia antarctica* is abundant, its massive column-like stems and umbrageous fronds present a most imposing appearance. I cannot assent to the correctness of Sir William Hooker's conclusions in uniting *D. lanata*, Col., with this species;* to me they appear to be abundantly distinct, the peculiarities of each being clearly developed even in diminutive specimens.

In the narrow vallies *Poa australis* var. *lævis* is abundant, occasionally mixed with *Sporobolus elongatus*, *Microlæna stipoides*, and several introduced grasses. *Dracophyllum subulatum* is abundant in certain localities, *Pomaderris phylicifolia* and *Lycopodium densum* become very local, and are not observed south of the Waihorepa Valley, although I believe both these plants have an outlying locality in the South Island.

In a stream fed by a small swamp near the southern extremity of Rotokakahi, *Montia fontana*, L., occurs in great plenty. This is probably the northern limit of this widely distributed plant, which is here associated with its European congener *Lemna minor*. I estimate the altitude of the locality at under 1,500 feet.

Rotokakahi presents but little variety in its vegetation, especially amongst the aquatic section. The fistulose form of *Crantzia lineata* occurs in from one to seven feet of water, as does a small *Myriophyllum*, which is probably

* See Art. XLIII.

undescribed. *M. variæfolium* is found in several spots. *Isoëtes kirkii*, H. Br., appears to be rare, but the water was too rough to admit of a thorough search being made. A scanty growth of *Scirpus*, *Cladium*, *Eleocharis* and *Carex* is found at a few places in the margin, backed by a sparse growth of shrubs and small trees, chiefly *Metrosideros robusta* and *Weinmannia racemosa*. Several fine karakas occur on the Island of Motukawa. In many places the rocks are elegantly clothed with masses of *Bolbophyllum pygmæum*, *Earina autumnalis*, *Dendrobium cunninghamii*, *Trichomanes reniforme*, *Hymenophyllum rarum*, etc. *Hydrocotyle heteromeria*, DC., which occurs in abundance with the naturalized *Mentha viridis* at the north-east end of the lake, is worthy of special notice. *Gaultheria oppositifolia* Hook. f., one of the rarest and most handsome flowering shrubs, covers a cliff near Kaitiriria, and must present a noble appearance when in flower in the beginning of January. *Barbarea præcox*, *Portulaca oleracea*, *Verbascum thapsus*, and other naturalized plants occur near the native settlement and in other localities near the lake. The hills are chiefly covered with fern, often luxuriant, and intermixed with native and introduced grasses, often to a considerable extent. The only outlet of the lake is by the Wairoa River, which, after a descent of 300 feet, finds its way into the Tarawera Lake.

### Tikitapu.

Tikitapu, the "Little Blue Lake," is separated from Rotokakahi by a low ridge; crateriform in appearance, it has no visible outlet, and is probably connected with Rotokakahi by a subterranean channel; it is the most picturesque lake in the district, and owes much of its attractiveness to the magnificent forest which clothes the hills on its northern and western sides. An undescribed *Cladium* and a new species of *Myriophyllum* were collected here. *Tupeia antarctica* is frequent, being usually parasitic on *Panax arborea*, and from the unusual yellow tint of its leaves was conspicuous at a considerable distance. Immense specimens of the rata were abundant in the forest. *Hemitilia smithii*, *Dicksonia squarrosa*, and other tree ferns, attained an unusual height. *Davallia novæ-zealandiæ* was remarkably luxuriant, its fronds often being from four to five feet in height, but with all this luxuriance of growth the paucity of species, when compared with the rich forests of the north, continually forced itself into notice.

The raupo (*Typha latifolia*) occurs in small quantity at the north end of the lake; it is so extremely rare in the district, that the whares are usually constructed of sedges and grasses, even *Poa lævis* being employed for this purpose.

In the Wairoa Valley, between Rotokakahi and Rototarawera, the pansey (*Viola tricolor*) and other garden plants are abundantly naturalized, doubtless

escapes from the mission gardens. Amongst dilapidated buildings in the native settlement of Hereapauki the European ivy is flourishing with a degree of luxuriance I have not seen elsewhere in the colony.

### TARAWERA.

Lake Tarawera is of irregular shape, its greatest diameter being, from east to west, about seven miles; it receives the discharge of Rotokakahi, Rotomahana, and three smaller lakes; its outlet being by the Tarawera River, which leaves the lake at its eastern extremity and falls into the sea at Matata. It is more or less margined by cliffs often clothed with pohutukawa, especially at the southern arm Te Arikiki, which forms the flank of the Tarawera mountain. In this arm the pohutukawa is abundant, and attains a development only inferior to that which it exhibits in sheltered bays in the northern parts of the province. I was informed by Captain Gilbert Mair that it occurred along the course of the Tarawera River to Matata. In the same bay, at the mouth of the warm river, the Kaiwaka, are hot springs, about which *Chenopodium ambiguum* occurs, having a strong tendency to the semi-erect habit of the Ohinemutu plant. A flat-leaved state of *Potamogeton pectinatus* is floated down the Kaiwaka from the warm lake, but I was unable to discover it *in situ*. The angi-angi (*Coprosma baueriana*) occurs in the vicinity of deserted native settlements, but evidently planted. *Ophioglossum gramineum* is found on rocky ledges on the cliffs under Tarawera mountain; its bright yellow spikes, often washed by the waves, were conspicuous at a considerable distance. Masses of submerged *Myriophyllum* and *Isolepis* were abundant in the clear water, while the cliffs, clothed with masses of *Astelia trinervia* and the littoral *A. cunninghamii*, overshadowed by pohutukawa of dimensions that would have gladdened the eyes of a shipbuilder, and laden with epiphytic ferns and shrubs—*Griselinia lucida*, *Pittosporum cornifolium*, and *Astelia solandri*—presented near the centre of the island a fac-simile of scenes only to be found elsewhere in the northern part of the province; but with this marked difference, the aquatic plants were fluviatile, not marine.

Ascending the warm river, floating masses of *Potamogeton pectinatus* were constantly met, and large submerged tufts of *Isolepis setosus*. *Lemna minor*, with larger fronds than usual, formed small floating patches in quiet places. A dense growth of sedges occupied the swamp on either side, amongst which the tropical *Nephrodium unitum* grows in vast abundance, covering acres with its dull green fronds which are sometimes five feet high and seven inches across, but in this state are usually barren. It is easily picked from the canoe when ascending the rapids, which mark the upper part of the stream. *Viscum salicornioides* and *Loranthus micranthus* are not unfrequent on the tea-tree in the swamp, which contains few plants worthy of special notice.

## Rotomahana.

Rotomahana is of small size, its greatest diameter being less than a mile. From the numerous swamps which surround it, the absence of wood, the dirty green colour of the water, and the stunted aquatic vegetation which certainly exists under unfavourable circumstances, the first view of this remarkable lake is strangely disappointing. But in a moment all this is forgotten, as landing from the canoe the traveller walks round a projecting point of the swamp and stands at the base of Te Tarata. This paper is, however, concerned only with the vegetation of the locality, and the conditions under which it exists.

The height of the terraces of Te Tarata is about eighty feet; at its base is a small clump of *Leptospermum* growing amongst *Cladium junceum* and other uliginal plants. *Nephrodium unitum* occurs sparingly, and by careful search a stunted specimen of *Gleichenia dichotoma*, another tropical fern of wide distribution, may perchance be found. *G. circinata* is abundant. Ascending the terraces until the verge of the geyser is reached, *Pteris incisa*, *Lycopodium cernuum*, *Dianella intermedia*, *Leucopogon fasciculatum*, *Haloragis micrantha*, *Leptospermum ericoides*, *Gleichenia circinata*, and var. *dicarpa*, are found occupying a small rocky knob from which the troubled surface of the fountain may be viewed in safety. The steep upper lip which forms the opposite side of the crater is clothed in many places with a dense growth of *Lycopodium cernuum*, large patches of which exhibit a scalded appearance, as if from the effects of over-heated steam. On the opposite side of the terraces *Nephrodium unitum* covered the thin crust overlying the scalding mud, and from its erect, rigid habit, and strict sori-laden pinnules, presented a forcible contrast to the luxuriant swamp form previously described. Its rhizomes are massed together in dense masses, sufficiently firm to bear the weight of a man, and produce fruited fronds from two inches to two feet high in countless thousands.

Proceeding for some distance along the shore of the lake and ascending the hill side nearly opposite Rotokiwi the entrance to a small glen known as Rotokanapanapa is attained, and after crossing a patch of steaming mud amongst miniature mud-volcanos in an active condition, the little green pond from which the glen takes its name is seen; its green colour is doubtless due to the presence of a minute *Conferva*. The sides of the glen in many places are dotted with steam jets which have destroyed much of the vegetation. In this remarkable habitat *Gleichenia dichotoma* attains a luxuriance not to be seen in any other locality in the colony. Where sheltered by low scrub it reaches the extreme height of from five to six feet, and is repeatedly branched. In exposed places it is restricted to a single pair of simple pinnæ, but in all cases it is marked by the small accessory pinnæ at the base. In several instances steam jets had burst through spots occupied by this fern, and

destroyed patches of it two or three feet in diameter. The temperature endured by the roots must have been over 100° Fahr. In one spot the ground gave way under my feet, when a steam jet immediately broke through and destroyed the fern all round. My natives did not approve of fern-collecting in such situations, and for the most part contented themselves with looking on, occasionally giving a warning cry of danger as an apology for their laziness. The steamy atmosphere in which the plant grows in this habitat rendered the specimens so extremely delicate that many of them shrivelled during the short period occupied in carrying them to our camp. *Psilotum triquetrum*, in a similar condition as regards delicacy of texture, was collected in several spots in the glen. *Microtis porrifolia* and *Orthoceras solandri* were common amongst the stunted manuka in open places.

## ROTOKIWI.

At Rotokiwi a curious instance of the effects of the moist, heated atmosphere on plant-growth was observed. A specimen of *Leptospermum ericoides*, twenty feet high, overhung a boiling spring on the side of the terrace in such a manner that the branches were exposed to the heated steam without being scalded. The tips of the branches had been punctured by a small insect, but instead of giving off from each gall a few stunted shoots with aggregated leaves almost without vitality, as is usually the case under such circumstances, a vigorous growth of long slender branchlets had been produced, so that the affected branches had been transformed into handsome green plumes, and had apparently overcome the injury instead of succumbing.

At Otukapurangi, the terraces of which impressed me with a sense of their stately magnificence far more than those of Te Tarata, the whole of the adjacent vegetation had been recently burned, so that the entire fountain was naked and bare. One or two tufts of *Nephrodium unitum* were growing on the lower terraces, but no other plants worthy of notice were observed.

The New Zealand form of *Lastrea thelypteris* occurs in the swamp on the south margin of the lake, and in the lake itself *Eleocharis sphacelata*, *Scirpus lacustris*, and *Cladium articulatum*, but all appear more or less scalded, as if occasionally affected by a sudden increase in the temperature of the water.

Amongst floating *Conferva*, on the west side of the lake, I discovered a pretty bladder-wort, new to science, in general appearance it resembles *Utricularia intermedia*, Hayne, but has the bladders attached to the leaves; unfortunately it was long past flowering, and from its general appearance I am inclined to believe that it also resembles *U. intermedia* in producing flowers but rarely.

The restriction of *Nephrodium unitum* to the vicinity of the hot springs and the warm water swamp between the two lakes, with the limitation of

*Gleichenia dichotoma* to a single habitat, are significant facts, but I defer further remark on this head until referring to their distribution in the Taupo district. It is extremely difficult to account for the absence of all notice of *Nephrodium unitum*, as it occurs in vast abundance in situations where it could not possibly have been overlooked by the numerous travellers who have visited the lake. *Gleichenia dichotoma*, originally discovered in this locality by Captain Gilbert Mair, although far more striking in general appearance, may easily have been passed by, owing to the difficult and unlikely nature of its habitat. Although this fern was first described as a native of New Zealand by Forster, it has been generally considered that he did not collect it in these islands. Its discovery at Matata, on the East Coast, however, throws a new light on the subject, and suggests the possibility of its having been collected by him at some other isolated locality in the Bay of Plenty or in Poverty Bay, although its inclusion amongst the plants used by the Maoris as food is probably an error.

### Tarawera Mountain.

The land between the eastern extremity of Tarawera Lake and the base of Tarawera mountain is much broken by deep ravines with precipitous sides. The majority of these are filled with *Leptospermum* and other common shrubs, the most prominent being large-leaved forms of *Pittosporum tenuifolium*. Much of the open portion had been burnt shortly before my visit, and in many spots the surface was hidden by a young growth of common *Danthonia* and *Agrostis quadriseta*, the latter excessively rigid and scabrid. The base of the mountain is strewed with masses of fallen rock, amongst which a few common shrubs are growing in a more or less stunted condition. Large terrestrial specimens of *Metrosideros robusta* occur at the entrance to the gorge separating Ruawahia from Te Wahunga. The ascent of the central portion, Ruawahia, is attended with some little difficulty on account of its precipitous character, and the danger arising from loose fragments of rock which become detached with the slightest touch. Single aneroid observations gave rather less than 2,500 feet as the height of the central peaks above the lake level; this added to the usually received altitude of the lake gives a result nearly identical with that published by the Director of the Trigonometrical Survey from corrected observations, 3,609 feet.

The vegetation on the face of the mountain is scanty and stunted, but notwithstanding the arid nature of the situation diminutive specimens of *Hymenophyllum bivalve* and other species occurred in crevices. *Astelia trinervia* grew in sheltered places up to 3,200 feet, with *Gaultheria oppositifolia* and *Cyathodes acerosa*, etc. A dwarf shrubby vegetation occurs in sheltered places on the summit, and affords cover for a luxuriant growth of

mosses and lichens, in which the epiphytic *Chiloglottis traversii* attains its northern limit in company with the common *Thelymitra longifolia* and *Orthoceras solandri*. *Raoulia monroi* attains here its northern limit, and forms small patches on the bare surface, but of so inconspicuous a character that it might easily be overlooked but for the white silky hairs displayed by the recurved margins of the leaves. *Olearia furfuracea* and *Corokia buddleoides* have not, I believe, been recorded from a more southern locality, or a greater altitude. *Dracophyllum longifolium* occurs sparingly, and attains its northern limit; it has not previously been recorded as occurring in the North Island. *Panax colensoi* is the most prominent shrub, forming handsome dwarf bushes, widely different from the small tree-like habit it assumes at its northern limit on the Cape Colville ranges. It affords a welcome shelter to *Hymenophyllum bivalve*, *H. multifidum*, and a few other ferns more or less common; the total number of species collected above 3,000 feet did not exceed seventy, but owing to the approach of night I was able to examine a small portion of the central range only. Still, making every allowance, the vegetation of the mountain comprises a remarkably limited number of species.

### WAIHOREPA.

The Waihorepa valley, about two miles from Kaitiriria, appears to have been the bed of an ancient lake, and is remarkable for the singular fissures and holes which break its surface, and have probably been caused by earthquakes. The most striking of these fissures extends for more than half a mile, although much interrupted, and in the deepest places affords a favourable habitat for several plants of a southern type. *Clematis colensoi*, *Cyathodes empetrifolia*, and *Lomaria alpina*, probably attain their northern habitat in this singular locality. *Craspedia fimbriata* grows to a large size, and the charming terrestrial orchid *Corysanthes rotundifolia* is found sparingly. The luxuriant vegetation of the fissures contrasted forcibly with the dried grasses and stunted shrubs which marked the level of the plain, where the only plants worth notice are *Dracophyllum subulatum* and *Poa australis*, var. *lævis*, with tufts of *Celmisia longifolia*, which is known all through the district as "cotton-grass."

### OTUMAKOKORI.

At the foot of the Paeora range several tropical ferns exhibit the greatest vigour and luxuriance in an atmosphere of heated steam on the banks of the Otumakokori—the boiling river. Near the source of this remarkable stream are a number of boiling springs, some of which have their origin in cavern-like recesses, others in holes eight to fifteen feet in depth, boiling wells in fact, but most of them sufficiently large to allow of their investigation by anyone

disposed to incur the risk of descending their steep sides and slipping into water of a temperature much above 200° Fahr. Many of these springs yielded clear water, in others it was slightly turbid; but, unlike the springs of Rotomahana, there was no incrustation. All the springs discharge into the bed of the stream, which in the upper part is confined by rocky banks, between which the boiling river forces its way with great impetuosity, giving off clouds of vapour. A short distance below the springs the stream is crossed by a natural bridge, from which a charming view is obtained of the rushing torrent.

In no other locality in the district are the effects of a moist, warm atmosphere on vegetation so forcibly shown. The rocky banks of the stream and the sides of the boiling wells are abundantly clothed with a growth of *Lycopodium cernuum*, varying in luxuriance with the temperature to which it is exposed; flourishing where the temperature varies from 70° to 95° but forming dwarf compact masses covered with depauperated spikes at a higher degree. *Pteris scaberula* is abundant on the banks of the stream, but except in cool situations is excessively depauperated, forming a striking contrast with the luxuriant *P. incisa*, which flourishes in the heated steam. *Gymnostomum tortile* and other mosses exhibit a peculiar elongated and attenuated appearance, widely different from their normal forms, and do not produce fruit.

The tropical *Nephrodium molle* occurs sparingly in this, its only New Zealand habitat, evincing a decided preference for the sides of the deepest and least accessible boiling wells, but also growing in situations where it must experience a greatly reduced temperature, occasionally the pinnæ were singularly rounded and abbreviated, but covered with sori. The texture of its fronds is so extremely delicate that they are bruised by a light shower. *Nephrolepis cordifolia*, Baker, is found in great abundance chiefly amongst moss by the banks of the stream; in the excessively high temperature in the immediate vicinity of the boiling springs the fronds are not above six inches in length, and of a peculiar strict and rigid habit of growth, producing sori but sparingly; lower down the stream the fronds are more than two feet in length and of elegant habit, producing sori freely; the wiry, fibrous roots never produce tubers, as is the case in Mexico and Brazil.

*Gleichenia dichotoma*, Willd., is plentiful about the boiling wells in places where the roots have the advantage of a high temperature, but does not occur on the lower parts of the creek. *Nephrodium unitum*, Br., is found sparingly about the springs and in the swamp below, but in nothing like the profusion it exhibits at Rotomahana and other places.

*Fimbristylis dichotoma*, Vahl., occurs sparingly, but is probably of very recent introduction by travellers from Rotorua.

Otumakokori is the only known habitat in New Zealand, in which the tropical ferns here enumerated occur together. *Nephrodium molle* is not found elsewhere, and *Nephrolepis cordifolia*, although growing in another locality, is only found there in small quantity and in a depauperated condition. *Gleichenia dichotoma* and *Nephrodium unitum* are found in several localities, and exhibit a comparatively wide range when contrasted with the *Nephrolepis* and *Nephrodium molle.*

It is remarkable that Dr. Hochstetter, who first discovered *Nephrolepis cordifolia* and *Nephrodium molle* in the colony, does not mention the existence of *Nephrodium unitum*, or of *Gleichenia dichotoma*, one of the most striking ferns in the New Zealand flora.

About half a mile from its source the Otumakokori passes through a swamp; for some little distance along its margin *Nephrodium unitum* occurs sparingly, rarely accompanied by a solitary plant of *N. molle*, and more frequently by handsome specimens of *Nephrolepis cordifolia*, but neither of these plants is found beyond the influence of the warm water. Amongst the numerous uliginal plants which are found here *Gunnera prorepens* deserves special mention. The specimens observed were perfectly glabrous, possibly from growing in a much higher temperature than usual.

### PAEORA RANGE.

The forest which clothes portions of the Paeora range presents few plants of special interest and exhibits but little variety. The rata (*Metrosideros robusta*) is abundant, and in several localities, as at Waiwhakahihi, forms extensive groves, every tree being of purely terrestrial origin; specimens of epiphytic origin are only to be found in the dense lowland forest, and diminish in frequency as the tree approaches its southern limit.

Scattered plants of *Senecio lautus* are to be met with in the Paeora and Ratoreka vallies, and in other places in the Taupo district. It is of much more spreading and succulent habit than when growing on the sea shore, and might be mistaken for *S. odoratus* but for the smaller rays.

The pigmy *Isolepis aucklandica* is found sparingly in one or two localities, but is remarkably local; its northern boundary is probably attained at about a mile east from Otumakokori, at an estimated altitude of 1,500 feet.

### ORAKEIKORAKO.

At Orakeikorako the naturalized watercress is abundant on the margin of the Waikato River, and affords a welcome addition to the scanty supply of fodder to be procured in that locality. The banks on both sides of the river are marked by innumerable steam jets, ngawhas, fumaroles, and geysers to such an extent that the utmost vigilance is necessary on the part of the explorer to prevent accident. About the hot springs *Gleichenia dichotoma*

occurs in immense abundance, although from growing in exposed situations it does not exhibit the extreme luxuriance which it displays at Rotomahana, and produces sori but sparingly. *Schizæa dichotoma* and *Psilotum triquetrum* attain here their southern limit, their occurrence being due to the influence of the boiling springs in modifying temperature. In the north the *Schizæa* is usually found about the roots of the kauri. *Schizæa bifida* occurs sparingly and in a depauperated condition, apparently suffering from the increased temperature. *Juncus maritimus* grows in great abundance amongst the hot springs on both sides of the river, but I am not aware that this characteristic littoral plant has been found in any other inland habitat except Ohinemutu. *Lepidosperma concava* is found in great abundance and vigour on the right bank of the river, but appears to be confined to a solitary habitat, the only one known south of the Thames.

The famous alum cave at Orakeikorako is merely a deep hole sloping downwards from the face of the rock and containing a boiling spring which forms aluminous incrustations on the rocks within its influence, but the cave itself is chiefly remarkable for the richness and beauty of the plant-growth by which it is concealed. The face of the rock above the mouth of the cave is covered with a profusion of a slender climbing rata, *Metrosideros hypericifolia*, many of its sub-pendent branches supporting a growth of drooping mosses and scale mosses. The mouth of the cave is filled by striking specimens of the silver-tree fern (*Cyathea dealbata*) and the weki (*Dicksonia squarrosa*), their delicate tracery producing a most exquisite effect when viewed from the lower part of the cave. Several small ferns of great beauty cover portions of the mouth and detached rocks with a tapestry of the tenderest green, one of the most conspicuous being *Lindsæa trichomanoides*, which, although singularly local in the district, occurs here in profusion.

The Maoris have made sufficient progress in civilization to attach a money value to "show-places." At the time of my visit posts had been fixed for the erection of a gate which I was given to understand would be kept locked so as to prevent pakehas from visiting the cave until a payment of fifteen shillings had been extorted from each. It is to be desired that visitors on such terms may be few and far between!

### Oruanui.

At Oruanui is an extensive forest, chiefly remarkable for the large amount of totara which it contains. Many of the trees are of large dimensions and excellent quality. The contractors for the telegraph are said to have procured the chief part of the timber used in the district from this locality. The small patches of forest on the hill sides contain a large proportion of matai and miro, and less frequently kahikatea.

The open plains present but few plants of interest; patches of *Raoulia hectori* and *Muhlenbeckia axillaris* are found in one or two localities south of Oruanui and attain here their northern limit. *Carex inversa* occurs sparingly in dry sandy places, the culms being extremely slender. *Isolepis aucklandicus* and *Lomaria alpina* are found sparingly in moist, sheltered spots. *Dracophyllum subulatum* is common on plains throughout the district.

### WAIKATO RIVER.

Crossing the Waikato, near the northern extremity of Lake Taupo, much of the low scrub at a short distance from the river banks is seen to be stunted and depauperated; the cotton grass (*Celmisia longifolia*) forming large masses on the spots that appear too barren to allow the growth of *Poa lævis*. By the road side at Waipihi, and in other places on the margin of the lake, attention is at once arrested by the heavy growth of littoral plants, *Chenopodium ambiguum* and *Convolvolus soldanella*. The pohutukawa also is found on the Island of Motutaiko, and I believe in several places on the shores of the lake, but is nowhere so abundant or of such large dimensions as at Lake Tarawera.

### OPEPE.

About Opepe most of the hills are capped with patches of forest in which the totara, miro, matai and kahikatea are the most common trees. *Elæocarpus hookerianus* is also abundant, and attains a large size. *Griselinia lucida* is also common, and in this locality affords support to the larvæ of *Hepialus virescens*, the so-called vegetable caterpillar, which offers a nidus for the curious fungus, *Cordiceps robertsii*. Many rare ferns, as *Lomaria patersonii*, *Todea superba*, *Lomaria alpina*, *L. vulcanica*, *Dicksonia antarctica*, and *D. lanata* are found in great abundance. *Panax sinclairii*, *Gentiana montana*, and *Coriaria thymifolia*, the ground tute of Otago, attain here their northern limits. The small indigenous form of *Leontodon taraxacum* and *Viola filicaulis* are also found in abundance.

The exceptional position of the forest is doubtless the result of denudation.

The hills have been formed by successive pumiceous deposits, the more recent of which have been washed from the higher lands, so that the older submarine deposits, which are more or less decomposed, have been laid bare to a greater or lesser extent, and are now covered with a vegetation not only of luxuriant growth but comparatively rich in the number of species which it contains.

The low grounds are intersected by deep gullies and ravines, produced by sub-aerial denudation, which are often of great depth, and in some cases filled with a dense vegetation presenting but little variety. An inconspicuous *Haloragis*, new to science, occurs profusely in these situations.

MOTUKINO.

At Motukino I observed a few specimens of *Gaultheria fagifolia*, which was originally discovered by Mr. Colenso in this locality and has not been found elsewhere, so that it must be considered one of our rarest plants. Not more than five or six plants were observed, all of which were long past flowering; its fruited racemes were sometimes three inches in length, but the calyx was in all cases unchanged. Although remarkably different in appearance from *G. antipoda*, its habit and general aspect suggest the possibility of its being an hybrid between that species and some form of the protæan *G. rupestris*.

Other rare or interesting plants collected here, *Melicytus lanceolatus*, *Panax anomala*, *Santalum cunninghamii*, all of which occurred sparingly. *Gleichenia cunninghamii* was abundant in a solitary habitat. *Raoulia monroi*, and *R. hectori* were rare and local. *Asplenium colensoi* was found in a solitary habitat—the ditch of an ancient pa—but in a depauperated condition, the largest specimen not being more than two inches in height; the habit and colour of this plant contrasted forcibly with the associated *A. hookerianum*. *Lycopodium selago* was observed for the first time in the North Island, and with *Cassinia vauvilliersii*, attains here its northern limit.

The occurrence of littoral plants in the numerous inland localities stated in this paper, affords the strongest support to the theory of the submarine origin of the central portion of the island, so far at least as the lower lands are concerned. I had occasion to draw attention to this subject when treating on the botany of the Lower and Middle Waikato districts, and have pleasure in recurring to it, as it demonstrates most forcibly the importance of geological change as an agent in the distribution of vegetable life, a fact which has been almost lost sight of by phyto-geographical students.

The following littoral plants were collected :—

*Ranunculus acaulis*, Banks & Sol.—Rotorua, Tarawera Lake.

*Metrosideros tomentosa*, A. Cunn.—Tarawera Lake, abundant, and of large size; Lake Taupo.

*Convolvolus soldanella*, L.—Shores of Lake Taupo, abundant.

*Chenopodium glaucum*, L. var. *ambiguum*.—Rotorua, Tarawera Lake, Rotomahana, Lake Taupo.

*Astelia cunninghamii*, Hook. f.—Tarawera Lake.

*Juncus maritimus*, Lam.—Abundant amongst boiling springs, etc., on both sides of the Waikato, at Orakeikorako, and at Rotorua.

*Leptocarpus simplex*, A. Rich.—Rotorua.

*Scirpus maritimus*, L.—Rotoiti, Rotorua, Tarawera, Rotomahana, Orakeikorako, Lake Taupo.

*Carex pumila*, Thunb.—Rotorua.

*Zoysia pungens*, Willd.—Taupo plains, and about all the lakes.

*Bromus arenarius*, Lab.—Rotorua.

*Poa australis*, Br., var. *lævis*.—In all the low vallies from Te Ngae southwards, but nowhere found on the hills above 1,600 feet.

*Zoysia pungens* and *Poa lævis* are the only forms found over extensive areas; the propriety of considering the latter to be a littoral plant may possibly be questioned by those who are familiar with its distribution in the South Island only. In the North Island it occurs almost exclusively by the sea, or by tidal rivers, as at Port Waikato, except when under similar circumstances to those now under consideration, as at Cambridge in the Middle Waikato, from which locality it has been carried by the river to a recently formed island at Rangiriri, as I learn from a specimen given me by Captain F. W. Hutton. Mr. Buchanan informs me that in several instances in the South Island it distinctly marks the margins of ancient sea basins.

The examination of the southern and western parts of the district is necessary to the full consideration of this interesting subject.

It is worthy of remark that Rotokakahi and the Tikitapu Lake are the only lakes at which littoral plants were not collected. These are situate at an elevation of about 1,400 feet, or 300 feet higher than Lake Tarawera, and nearly 200 feet above Lake Taupo. This points to the greater age of the first-named lakes, and accounts for the absence of maritime plants on their shores.

The contrast between the arboreal vegetation of Rotokakahi and Rototarawera is most striking, and from the short distance that separates the two lakes is at once realized by the traveller. The most prominent trees on the banks of the former are terrestrial specimens of *Metrosideros robusta*, marked by small, compact, uniform, green-tinted foliage; on the latter, *M. tomentosa*, with spreading tortuous arms, and bold, grey, many-tinted foliage, changing with every breath of wind,—the one a plant specially characteristic of inland forests, the other equally characteristic of the northern cliffs and sea beaches.

## SUMMARY.

For convenience of reference, I have prepared the following brief summary of the additions to our phyto-geographical knowledge comprised in this paper:—

*Clematis colensoi*, Hook. f.—Sparingly in earthquake fissures in the Waihorepa valley, the most northern locality known to me.

*Montia fontana*, L.—Attains its northern limit at Kaitiriria; altitude 1,500 feet.

*Elatine americana*, Arnott.—Exhibits an extension of its known range eastward at Maketu, and southward at Rotorua.

*Pomaderris phylicifolia*, Lodd.—In abundance between Whakarewarewa and Kaitiriria; not observed further south.

*Coriaria thymifolia*, Humb.—Attains its northern limit at Opepe, where it is certainly perennial. Captain Gilbert Mair informs me that it has an outlying habitat at Matata, on the East Coast.

*Carmichœlia juncea*, Col., (identified in the absence of flowers) reaches its northern limit at Rotorua.

*Haloragis*, n.s.—Motukino.

*Myriophyllum*, n.s.—In habit much resembling *Crantzia lineata*; forms compact masses 2 to 3 inches in height in water from 1 to 5 feet deep; Rotokakahi; specimens imperfect.

*Myriophyllum*, n.s., habit of *M. integrifolia*.—Moist ground; Tikitapu Lake; specimens imperfect.

*Metrosideros hypericifolia*, A. Cunn.—Found on the summit of Tarawera mountain.

*Hydrocotyle heteromeria*, DC.—Rotokakahi; the most southern locality yet recorded for a plant which will probably prove to have a wide distribution although remarkably sparse.

? *Pozoa*, sp.—A minute plant, doubtfully referred to this genus in the absence of any trace of flower or fruit, was collected on the steep side of a deep ravine at Motukino.

*Alseuosmia macrophylla*, A. Cunn.—Crests of Ngongotaha and adjacent ranges, 2,300 feet, the most southern locality yet recorded.

*Corokia buddleoides*, A. Cunn.—Summit of Tarawera, the most southern habitat recorded; altitude, 3,600 feet.

*Coprosma lucida*, Forst.—Summit of Tarawera.

*Olearia furfuracea*, Hook. f.—Summit of Tarawera mountain, 3,600 feet.

*Craspedia fimbriata*, DC.—The most northern locality noted was at Kotukuroa Creek, but I believe the plant occurs at Maungarewa, twelve miles nearer Tauranga.

*Cassinia vauvilliersii*, Hook. f.—Attains its northern boundary at Motukino.

*Raoulia monroi*, Hook, f.—Summit of Tarawera; altitude, 3,600 feet, where it attains its northern limit; found also at Motukino, 1,500 feet. The first record of its discovery in the North Island, although specimens collected on the Kaimanawa mountains in 1870 by Dr. Hector are in the herbarium of the Colonial Museum.

*R. hectori*, Hook. f. (flowers not seen).—Attains its northern limit south of Oruanui, where it forms large patches on the plains; altitude, 1,600 feet.

*Gnaphalium filicaule*, Hook. f.—Northern boundary at Kotukuroa Creek, north of Rotorua.

*Gaultheria fagifolia*, Hook. f.—Motukino; not found elsewhere.

*G. oppositifolia*, Hook. f.—Attains its northern boundary at Kotukuroa creek, but cannot be compared in luxuriance with the splendid specimens at Rotokakahi and Lake Taupo; ascends to 3,200 feet on Tarawera mountain.

*Cyathodes empetrifolia*, Hook. f.—Attains its northern limit in a fissure in the Waihorepa valley, and on Tarawera mountain. In the valley the stems are diffuse, 2 to 6 feet long; on the mountain short and erect.

*Dracophyllum strictum*, Hook, f.—The common form in the district is var. *b.*, but the two forms pass insensibly into each other. *b.* occurs in the summit of Tarawera mountain, and reaches its northern limit at the Tamahere narrows, Middle Waikato; a most attractive plant.

*D. longifolium*, Br.—Attains its northern limit on the summit of Tarawera, altitude, 3,600 feet. Identified in the absence of flowers, but the habit of the plant can scarcely be mistaken.

*D. subulatum*, Hook. f.—The most characteristic plant of the Taupo district, attains its northern limit near the Kotukuroa Creek; summit of Tarawera, 3,600 feet.

*Gentiana montana*, Forst.—Attains the northern limit of the genus at Opepe.

*Gratiola sexdentata*, A. Cunn.—Ohinemutu, Rotomahana, etc. I have no note of a more southern habitat for this plant, although it probably occurs throughout the North Island.

*Glossostigma elatinoides*, Benth.—Common in the swamps and about the lakes, but has not been recorded from any locality further south.

*Utricularia*, n.s.—Amongst *Conferva*, Rotomahana; in appearance resembles *U. intermedia*, but the bladders are attached to the leaves.

*Avicennia officinalis*, L., attains its south-eastern limit in Tauranga harbour, northern part.

*Alternanthera sessilis*, Br.—Rotorua, the most southern locality yet recorded.

*Plantago coronopus*, L.—Native of Europe, naturalized on the beach at Tauranga; the first notice of its occurrence in the colony.

*Muhlenbeckia axillaris*, Hook. f.—Forms compact patches on the Taupo plains south of Oruanui, but is remarkably local, and attains here its northern boundary.

*Chiloglottis traversii*, F. von Muell. (*Caladenia bifolia*, Hook. f.)—Specimens long past flowering; occurs at Motukino, 1,500 feet, and amongst moss on the summit of Tarawera mountain, where it reaches its northern limit. Distinguished from all other New Zealand orchids by its glandular pubescence.

*Thelymitra longifolia*, Forst.—Summit of Tarawera mountain, 3,600 feet.

*Sparganium simplex*, Huds.—Rotoiti, Rotorua, Rotomahana, etc.

*Astelia trinervia*, Kirk.—Near the summit of Tarawera, 3,300 feet.

*Schœnus axillaris*, Br.—Ohinemutu, &c., the most southern locality yet recorded.

*Eleocharis sphacelata*, Br.—Rotorua, Rotomahana, etc.; the most southerly habitat yet recorded; Lyall's habitat of Bluff Island for this species is probably erroneous.

*Isolepis aucklandica*, Hook. f.—Attains its northern limit at about one mile east of Otumakokori; altitude, 1,500 feet.

*Fimbristylis dichotoma*, Vahl.—Attains its southern limit at Rotorua, in the modified temperature produced by the hot springs; with increased facilities for travel it will probably become established about all the hot springs in the Taupo country, as is already the case at Otumakokori.

*Cladium articulatum*, Br. — By Lake Taupo, the most southern locality observed; altitude, 1,200 feet.

*C. junceum*, Br.—Probably common throughout the North Island at least, but has not yet been recorded from any locality south of the lake district.

*Lepidosperma concava*, Br.—Attains its southern limit at Orakeikorako.

*Sporobolus elongatus*, Br.—Observed as far south as Lake Taupo.

*Deschampsia cæspitosa*, Palis.—Attains its northern limit at Rotorua.

*Gleichenia dichotoma*, Willd.—The accessory pinnæ are remarkably developed in some of the Rotomahana specimens; entirely confined to steaming, heated soil. This was first discovered at Rotomahana by Captain Gilbert Mair, who informed me that it grew sparingly about hot springs at Matata, on the East Coast; it occurs abundantly at Rotomahana and Otumakokori, in profusion about Orakeikorako, and again by some hot springs near Tapuaeharuru; also, I believe, sparingly about hot springs at Tokano, near the southern extremity of Lake Taupo; so that it has been found in scattered localities along the entire line of volcanic action, and is not so absolutely local as is commonly supposed.

*Dicksonia antarctica*, Br.—Common in forests between Maketu and Ngongotaha. Captain Mair informed me that he had seen specimens growing between Katikati and Ohinemuri, which doubtless mark its northern limit on the East Coast; and I learn from Mr. W. J. Palmer that a solitary specimen occurs about seven miles due west of Ngaruawahia, which will prove its northern boundary on the West Coast; where, however, its rarity is attested by the fact that the fern itself was quite unknown to Waikato natives who accompanied Mr. Palmer.

*Asplenium colensoi*, Moore, appears to find its northern limit at Motukino; altitude 1,500 feet.

*Nephrodium molle*, Desv.—Only found about the boiling wells and River Otumakokori. The Rotomahana habitat given in the "Handbook" is certainly an error, and I believe that Mr. Robert Mair's Whangarei plant must be referred to some other species.

*Nephrodium thelypteris*, Desv., var. *squamulosum*.—Rotomahana affords the most southern locality yet recorded.

*N. unitum*. Br.—Certainly the most abundant of the tropical ferns which owe their existence in New Zealand to the influence of hot springs; northern and eastern limit about hot springs at Maketu—on the authority of Captain Mair; Rotomahana, in immense profusion; Otumakokori, near Tapuaeharuru, and Waipihi, which is the most southern locality known to me, although it doubtless is found about the hot springs at the south of Lake Taupo.

*Nephrolepis cordifolia*, Baker.—Otumakokori, abundant. Captain Mair informed me that it had been found near Tapuaeharuru, but I failed to detect it in that locality.

*Polypodium rupestre*, Br.—Summit of Tarawera, 3,600 feet.

*Schizæa dichotoma*, Swartz.—Attains its southern limit at Orakeikorako, in the modified temperature of hot springs.

*Lycopodium selago*, L.—Attains its northern limit at Motukino; first recorded locality in the North Island.

*L. densum*, Lab.—Abundant near Kaitiriria; not observed further south.

*L. cernuum*, L.—Everywhere abundant about hot springs.

*L. clavatum*, L., var. *magellanicum*.—Attains its northern limit on the high land north of Rotorua.

*L. volubile*, Forst.—Ascends to 2,800 feet on Tarawera mountain.

*Tmesipteris forsteri*, Endl.—Summit of Tarawera mountain; epiphytic and terrestrial.

*Psilotum triquetrum*, Swartz.—Attains its southern limit at Orakeikorako.

*Isoëtes kirkii*, A. Braun.—Rotokakahi; the most southern habitat yet discovered.

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ART. XLIII.—*On the Specific Characters of* Dicksonia antarctica, *Br., and* Dicksonia lanata, *Col.* By T. KIRK, F.L.S.

[*Read before the Auckland Institute, 14th October*, 1872.]

THE characters presented by *Dicksonia antarctica* and *D. lanata* in these islands are so remarkably constant and so easily recognized, owing to the absence of intermediate forms, that it seems desirable to inquire if their union, under the name of *Dicksonia antarctica*, can be maintained. I must confess at the outset that it is with the greatest diffidence I venture to dissent from the opinion of so high an authority as the late Sir William Hooker, but after a careful examination of both forms in a recent condition, and in many localities, it appears to me that a student unacquainted with either would fail