Dracophyllum kirkii, Berggr.

Shrubby; leaves patent, fascicled, with a sheathing base, dilated from above, not auricled, narrowed, broadly concave, truncate or mucronate at the apex, glaucous above, striate below; flowers solitary, shortly pedicelled, 2–3-bracteate, bracts and sepals ovate, acuminate, ciliated on the margins, filaments longer than the anthers, fastened all the way below the middle.

I wrongly referred (*l.c.* tab. IV., fig. 1–11) this plant to *D. uniflorum*, Hook f. It is distinguished from all the other species of this genus with solitary flowers by the shape of the leaves, which are almost canaliculate, and like the leaves of those species which have compound inflorescence, especially *D. strictum*. The relative length of the anthers and filaments, as well as the point of insertion of the stamens, presents some difference in this species from both divisions of the genus.

Mount Torlesse, in Canterbury Alps.

Carex buchanani, Berggr.

Reddish-brown; culms cæspitose, graceful, strong, leaves subequal to the culm or longer, tenacious, semiterete, scabrid on the margin; bracts exceeding the culm, the lower sheathing, the upper not sheathing; spikes 5–6, oblong, the lowest distant from the others which are approximate, the terminal one cylindrical male, the rest female or male at the very base, scales obovate, at length hispido-cuspidate, pale, membraneous, torn at the margin, perigynia elliptical, plano-convex, beaked, beak bifid, and with its upper margin ciliated, serrate, purple-spotted, nerveless, glabrous, covered by the scale, stigmas 2. (*C. tenax*, Berggr., *l.c.* tab. VII., fig. 1–7—a name already used for another species).

Distinguished from *C. raoulii*, Boott, by the very tenacious semiterete leaves, the terminal spikelet without female flowers, and the nerveless glabrous utricle.

ART. XXXVI.—*On the Fertilization of* Thelymitra.

By T. F. CHEESEMAN, F.L.S.

[*Read before the Auckland Institute, 21st June*, 1880.]

THAT cross-fertilization is the almost universal rule in the great family of Orchids is a generalization first propounded and sustained by reliable evidence by Mr. Darwin, in his "Fertilization of Orchids." Many memoirs and short papers on the subject have appeared since the publication of the first edition of this work in 1862, but, taking them collectively, they only give additional confirmation to Mr. Darwin's views. It is true that, to the

two or three cases of self-fertilization given by Mr. Darwin himself, several other instances have since been added, but even then the total number is small, and bears no sensible proportion to the overwhelming majority depending on cross-fertilization for the production of seed.

Some of the most interesting exceptions to the rule yet recorded occur in the Australian and New Zealand genus *Thelymitra*. The Australian species have been ably investigated by Mr. Fitzgerald, who finds in the genus almost all the links between forms that are utterly sterile and barren without insect aid, and others that are regularly self-fertilized from one generation to another, and in which the flowers have almost become cleistogene. As nothing has been published about the New Zealand species, I propose to give a sketch of the fertilization of one of them—*T. longifolia*, pointing out some apparent differences between the method employed here and that which according to Mr. Fitzgerald is in use in Australia.

Thelymitra longifolia is probably the most abundant Orchid in the North Island. Its favourite station is on clay hills, but it can also be found in dry rocky places, on sand-hills, and even in wet swamps; in short, in all soils and situations, with the exception that it is rarely (if ever) seen in the *dense* forest, although often luxuriating in the shade of the "tea-tree scrub." As might be predicted of a plant having such a wide range of habitats, it is extremely variable. Small specimens are often seen barely two inches in height, with a narrow leaf and single small flower. Every intermediate can be traced between this and the large stout form eighteen inches, or even two feet, high, with a broad leaf, and a spike of from ten to twenty large flowers. The colour of the flowers is usually white, but pink and blue flowered varieties are common.

The perianth differs from that of most Orchids in being composed of six *nearly equal* leaflets, which spread on all sides when expanded; so that the flower has little of the irregular and often fantastic appearance of many of its allies, but rather resembles an *Ixia* or *Sisyrinchium*.

The column may be roughly described as hood-shaped, the upper part being produced over and above the anther into a broad three-lobed projection, the middle lobe (which is much the largest) being blunt and smooth, but the lateral ones densely fringed with cilia at their extremities. The anther is placed about half way up the face of the column. It is two-celled, each cell containing two granular plate-like pollen-masses. From each side of the base of the column a low wing-like expansion curves round towards the front of the flower, meeting opposite to the labellum. A small recess is thus enclosed, within which the stigma and rostellum are placed; both organs being detached from the column proper. The stigma is a broad shield-like body situated in front of and slightly below the anther.

At its base it is thick and fleshy, but it becomes thin and membranous towards the sides and two-lobed summit. The rostellum is lodged between the terminal forks of the stigma, in front of which it projects as a rounded boss. When mature, it consists entirely of viscid matter, covered with an extremely delicate membrane. At this stage its connection with the stigma is easily ruptured, so that it can be readily removed by a slight touch.

The anther attains its full size and development while the flower is yet in the bud, and long before expansion each cell splits down its outer face, exposing the pollinia. As these rest immediately behind the rostellum, and in contact, or nearly so, with its viscid posterior surface, they invariably become firmly attached to it. After this takes place, the column lengthens considerably, thus causing the anther to occupy a higher position relatively to the stigma and rostellum than before. As the pollinia have become affixed to the rostellum, they cannot accompany the anther in this movement, and the anther-case being dragged from them they remain hanging to the back of the rostellum in the narrow passage existing between the stigma and column; the upper part of the pollinia slightly overtopping the stigma. This is the state of things just before the expansion of the flower.

In fine sunshiny weather the flowers usually open about nine o'clock in the morning, neatly reclosing about four or five in the afternoon. There is, however, considerable irregularity as to this, some varieties only opening for a short time in the middle of the day, others remaining expanded for a much longer period. In cloudy or showery weather the flowers never expand so fully as on a clear day. In stormy or very wet weather they generally do not open at all. I have observed that when rain has obtained access into the flower the pollinia are frequently washed into a pulpy mass at the bottom of the recess behind the stigma; so that there can be no doubt that the closing of the flower acts primarily as a protection for the pollen against rain or dew; although in some of the varieties it certainly seems to be carried further than is required for this purpose. The flowers are quite scentless, and I have never observed that any nectar is secreted.

If a newly-expanded flower is taken and a blunt needle inserted in such a manner that the front of the rostellum is touched, the viscid matter composing this organ at once adheres to the needle, and if it is withdrawn, taking care to move the point in an upward and forward direction, the rostellum, with its attached pollinia, cannot fail to be brought away with it. This experiment should only be tried with flowers that have recently expanded, for, from reasons that will become apparent further on, the pollinia can only be removed with certainty immediately after the flower first opens.

So far, the whole structure of the flower seems designed to favour cross-

fertilization through the agency of insects; and there can be no doubt that if the flowers were regularly visited by suitable species this would inevitably take place. But, from some reason—probably from the want of sufficient attraction—insects seldom visit the flowers. For the last seven years, I have made it a practice to watch beds of this Orchid, and save on two occasions I have never seen winged insects enter the flowers; and in both these cases the pollinia were not removed. It should, however, be mentioned that a minute thrip-like insect is sometimes abundant on the pollen, on which it probably feeds; but it is much too small to be of any service in removing the pollen from flower to flower, although it may be useful in another way. But although insects have not been actually observed in the act of removing the pollen, I have yet been able to collect evidence proving that they occasionally, though very rarely, do this. Thus, in November, 1876, seventy-five flowers were examined, and two had lost their pollinia—evidently removed by some insect. In November, 1878, 103 flowers were examined, and two of these had their pollinia removed. Lastly, in November, 1879, out of forty flowers three had the pollen-masses missing. In three instances I have also found pollen scattered over the stigma, the pollinia being still intact in their places at the back of the rostellum. These facts are quite sufficient to show that cross-fertilization does occasionally, though very rarely, take place.

Few of our indigenous species mature seed so abundantly as *Thelymitra longifolia*, almost every flower producing a ripe capsule. Taking this in connection with the facts mentioned above, it is obvious that we have to do with a case of self-fertilization. The mode in which this is effected appears to be as follows:—The upper part of the stigma is thin and membranous, and has its margin slightly revolute, even when in the bud. After expansion this rolling back is carried to a greater extent, so that the edge of the stigma, and even a small portion of its anterior surface, comes into contact with the pollen-masses hanging directly behind it. Pollen-tubes are at once emitted into the substance of the stigma, usually so rapidly that before a flower has been expanded more than a single day the pollinia are glued so firmly to the margin of the stigma that they could not be removed by insects, even if they visited the flowers. Pollen-tubes are also frequently emitted into the upper part of the posterior surface of the stigma. Besides this, it often happens that the tops of the pollen-masses (which, as we have seen, slightly overtop the stigma) are broken down by some means, either by the shaking of the flowers by wind or by the minute thrip-like insect already mentioned, and the pollen scattered over the front of the stigma. By one of these methods, or by both combined, I believe that the flowers are regularly self-fertilized, and the perpetuation of the species secured.

Mr. Fitzgerald, in the introduction to his magnificent work on Australian Orchids, states that *T. longifolia* is fertilized in the bud in Australia. This, however, is certainly not the case in New Zealand, save when a long succession of wet weather has prevented the flowers from opening at their proper time. In ordinarily fine seasons I always find that the pollinia are intact and free from the stigma on the expansion of the flower, and come away with the rostellum on its removal. He also states that the flowers open for one hour only in the middle of the day. In New Zealand nearly all the varieties open for a much longer period than this, the chief exception being a blue-flowered form with very long and slender staminodia, apparently an intermediate between *T. longifolia* and *T. pulchella*. I cannot agree with Mr. Fitzgerald in considering the opening of the flowers "useless," for even admitting that the stigma had been penetrated by pollen-tubes prior to the expansion of the flower, yet if pollen should be brought from a different plant and placed on the stigma, it would probably have a prepotent influence, and destroy any effect produced by the plant's own pollen. To me it appears that the opening of the flowers is highly important, even if it takes place for only an hour, for it gives a chance of cross-fertilization being effected, and the great value of this is now well established. It is curious that Mr. Fitzgerald's researches should appear to go towards proving that *T. longifolia* is more exclusively self-fertilized, and the flowers more nearly cleistogene, in Australia than in New Zealand; for, considering the admitted paucity of insects in New Zealand, and the much damper and cooler climate, the exact converse of this might have been anticipated.

The whole case of *Thelymitra* is most interesting, and at the same time perplexing in the highest degree. On the one hand we find the flowers possessing a viscid rostellum, to which the pollen-masses become spontaneously attached, and with which they can be removed,—clearly an adaptation for cross-fertilization through insect agency. On the other hand we see that the form and position of the stigma is such that it early comes into contact with the pollen-masses, an end which is also encouraged by the margins of the stigma slightly bending back towards the pollinia; we also find that in some of the varieties the flowers remain closed for a large part of the day, thus absolutely preventing the access of insects. It is impossible to doubt that these circumstances favour self-fertilization. We are thus driven to the same conclusion that Mr. Darwin has arrived at in the case of the Bee Orchis:—that in the same flower there exist elaborate contrivances for directly opposed objects. To believers in the theory of evolution, the case is not without an explanation. If we could trace back the modifications through which the plant has passed, we should probably arrive at a

remote ancestor bearing flowers regularly cross-fertilized by insects, as is the case with most Orchids at the present day. We should probably find that from some reason—it might be from the flowers becoming less attractive, or from the proper insects becoming less plentiful—the flowers were not so regularly visited as before. It would then be an advantage to the plant to be occasionally self-fertilized, in order that a sufficiency of seed should be obtained to perpetuate the species. Varieties having a tendency to self-fertilization would then be rigorously selected. The process of modification having once commenced, I see no difficulty in its being carried on to any extent, provided that the visits of insects continued to decrease, and that consequently the necessity for self-fertilization became more pressing. In this way the species would become more and more self-dependent, until we find it, as it is at present, almost uniformly self-fertilized. At the same time, any structures existing in the flower for purposes of cross-fertilization would hardly be modified if they did not prevent self-fertilization from taking place, but would be retained in their original shape, although perhaps but seldom, or even never, performing their proper functions.

Most writers on the subject maintain that it is a positive disadvantage to a species to be self-fertilized for a long length of time. But here we have the case of a plant which is probably self-fertilized for many generations in succession, but which is yet a vigorous and predominant species, accommodating itself to a wide range of habitats, protecting itself against encroachment by other species, and highly successful in the battle of life.

Art. XXXVII.—*Description of a New Species of* Loranthus.

By T. F. Cheeseman, F.L.S.

[*Read before the Auckland Institute, 25th October*, 1880.]

Some time ago my friend, Mr. James Adams, the head master of the Thames High School, kindly forwarded to me specimens of a handsome new *Loranthus* discovered by him in the Thames district, and which differs widely from any of the known species inhabiting New Zealand. During a recent visit to the Thames I was able to examine the plant in a living state, and to obtain a good series of specimens, from which the following description has been drawn up. I have much pleasure in associating the name of the discoverer with the species.

Loranthus adamsii, n.sp.

A small perfectly glabrous bush, two to three feet in height. Branches terete. Leaves opposite, one and a half to two and a half inches long,