THE STRUCTURE OF THE ORCHID FLOWER

Mr. Butler has asked me to write a note on the structure of the orchid flower. It is difficult to be brief with a subject so complicated, but I shall try -

The orchid flower is peculiar because it is adapted for cross-pollination by specific insects. There are as many flower variations as there are insect types to pollinate them. Wasps, butterflies, bees ants moths, spiders and chewing beetles are all catered for. The attraction is centred in the middle petal (labellum), and may be perfume colour or nectar, or perhaps edible calli. Sometimes the labellum assumes the form of the insect concerned, and near-mechanical devices, traps and pitfalls are not uncommon. The pollinating mechanism of our native orchids has been largely evolved outside New Zealand and the local insect fauna is not sufficiently diverse to do it justice. Consequently there is a strong secondary tendency towards self-fertilisation or even cleistogamy (self-fertilisation within the unopened flower).

The flower of the orchid is basically liliaceous, but the relationship is often hard to trace. The ovary is inferior, i.e. below the flower; is ribbed, and opens by longitudinal slits. This is a useful point of identification. We may imagine the hypothetical orchid ancestor as having 3 petals, 6 stamens in 2 whorls, and a single style with a 3-fid stigma. The fusion of 4 of the stamens with the already confluent styles would seem to have developed in different ways to produce different groups of orchids, but in all of them it would appear to have preceded the specialised perianth. With the organs of reproduction in confluence, normal pollination became impossible, and the next logical step in the flower's development was the modification of the abaxial segment (in this case the middle sepal) to form a landing stage for insects. But the middle sepal, being an outer covering segment, could not lend itself to the delicate modifications which eventually took place, so the ovary became twisted through 180 degrees to bring the middle petal (labellum) into the abaxial position, where it could be more easily adapted to the formation of nectaries and calli and the finer shades of colour and form. At the same time the middle sepal came round into the dorsal position where by reason of its heavier texture and protective nature, it could serve as an awning over the anther. The modification of the labellum was completed by its fusion with the 2 remaining free stamens. Most orchids begin with the flower in its original position and the ovary twists during development. In Prasophyllum (and I notice in Gastrodia sesamoides too !) the flower is inverted with the labellum uppermost - actually the right way up ! Here is a point worth studying. Has the ovary in these species not twisted at all ? Or has it twisted through the whole 360 degrees and so come back to its starting point ?

All the New Zealand orchids belong to the subfamily Orchidoideae, which has but one fertile anther and 2 fertile stigmas. The structure of such a flower may be summarised as follows -

Theoretically there are 15 segments in 5 whorls of 3. In each whorl 2 of the segments are paired and the third usually different in form or function or both.

WHORL (1) - 3 styles, each capped by its stigma, confluent to form a single structure (Column) in the centre of the flower. 2 of the stigmas are paired and combine to form the stigmatic plate on the front of the column. The third stigma, or a portion of it, appears to be modified to form the rostellum at the top of the column. (The exact nature of the rostellum is causing much discussion at present and the question is far from settled. The above conclusion however, seems to be correct for the majority of the local species. This is another problem which would repay study).

WHORL (2) - 3 stamens, 2 of them paired and confluent with the sides of the column to form the column-wings (very prominent in Thelymitra, where they supersede the insect-attractive function of the labellum), the third stamen confluent with the front of the column (except in Petalochilus calyciformis where it appears as a basal appendage).

WHORL (3) - 3 stamens, 2 of them paired and confluent with the labellum to form the various labellar calli, the third (the only fertile stamen in the subfamily Orchidoideae) usually confluent (but not in Thelymitra) with the back of the column and carrying the 2-celled anther, which overtops and usually rests on the rostellum. (In Pterostylis the 2 paired stamens of this whorl do not enter the labellum proper but appear as the ciliate processes of the labellar appendage: In Thelymitra - but only in the subgenus Thelymitra - they are included in the front edges of the column-wings and finally extruded as the cilia of the secondary lobes).

WHORL (4) - 3 petals, 2 of them paired, the third (labellum) rarely similar (Thelymitra, Petalochilus), usually much modified to form an attractive landing-stage for insects.

WHORL (5) - 3 sepals, 2 of them paired, the third (dorsal) sometimes similar, usually much enlarged, its main purpose being to canopy the anther.

Most orchid genera are subject to reversion and odd ancestral features, free stamens, petaloid labella etc. may be found from time to time. Such are as a rule infertile and their peculiarities die with them. Once in a while however, these mutations do not interfere with the reproductive processes and we get forms like Petalochilus, which become quite abundant until man interferes with the habitat. Ordinary malformations are also common. Repressed or enlarged organs, twin labella, petals etc., double or multiple flowers. These are often due to insect or fungus diseases or to purely mechanical causes. E.D.H.