

successive layers of strata. That earthquakes are the result of movement amongst these gases and liquids there seems little reason to doubt.

We gather, from the various accounts to hand, that the characteristics of the recent typhoon were very similar to those of the event of 1871, viz., that it came from an easterly quarter, and, after sweeping over Hong Kong, reached Macao somewhat later, there culminating; and, describing a portion of a circle so as to present all the appearances of a whirlwind, eventually dissipated itself along the coast upon contact with the high land. This typhoon, as might have been expected, crossed the estuary of the Pearl River from Hong Kong to Macao in less than half the time occupied by the typhoon of 1871. The distance is almost forty-five miles, and the lowest readings of the barometer were as follows:—In Hong Kong at 2.15 A.M. and at Macao at 3.15 A.M. during 1874, against 11 P.M. and 1.30 A.M. during 1871. The rate of progression in the late instance was moreover twice as great as that of the West Indian hurricanes, which has been computed at twenty to twenty-five miles per hour.

Before we dismiss the subject it may not be out of place to dwell for a few moments upon the probable causes which give rise to these "freaks of nature." At Hong Kong the S.W. monsoon blows from April to September, and the N.E. monsoon from September to April. It is during the *change* from S.W. to N.E. that typhoons usually occur. The theory is this. When the cold N.E. monsoon sets in suddenly it strikes upon a vast tract of land in Southern China, and on a portion of the China Sea warmed by the mild breezes of the opposite monsoon, occasioning rapid precipitation or condensation of vapours, and, as a necessary consequence, an extensive vacuum where the rarefied air formerly was. Other air then rushes violently in to fill the vacuum, and strong breezes, sometimes developing into typhoons, are the result. The mingling and collision of the various currents at their point of contact also assists the disturbance of the atmosphere. The reason of the gale as a rule blowing from the east is apparent. Inland of the coast line is a towering range of mountains, extending down to Cochin China, and effectually arresting the rush of air from that quarter. The open sea, therefore, is the only free point of access. The prevailing direction of typhoons at Hong Kong is, in point of fact, very nearly that of the N.E. monsoon just commencing, but possibly slightly diverted by the remaining influence of the opposite monsoon. Hong Kong, Amoy, and Macao being just opposite to the opening between Formosa and Luzon, the full sweep of the wind rushes in unhindered towards them from the Pacific Ocean. Macao, however, fares worst, for it is situated precisely where the typhoon is arrested by the high land of the coast. The lowest readings of the barometer are invariably therefore recorded at Macao.

ENCKE'S COMET

I HAVE received this morning, from the Observatory of Pulkowa, copies of Dr. von Asten's ephemeris of this comet, in which the accurate effect of planetary perturbation to the approaching perihelion passage (about April 13^o Greenwich time) is included. His positions differ less than five minutes of arc from those I have already communicated. The comet arrives at its least distance from the earth on the night of May 3, about which time it may be a bright object for the observatories of the southern hemisphere. In these latitudes it will probably be observed, as in 1842, to the end of the first week in April. If not detected during the next period of absence of moonlight, as I believe to be probable, there can be no doubt of its visibility before the February moon interferes.

J. R. HIND

Mr. Bishop's Observatory, Twickenham, Dec. 22

FERTILISATION OF FLOWERS BY INSECTS¹

IX.

Alpine Orchids adapted to Cross-fertilisation by Butterflies

NO family of plants, as far as is known, offers more various adaptations of flowers to insects of different orders than the Orchids, which have called general attention to the relation between flowers and insects since the admirable description by Mr. Darwin.² Of thirty-four species of Orchids found up to the present time in Westphalia, five³ have been observed to be fertilised by humble-bees, and partly also by other Apidæ; two⁴ by Diptera; and one⁵ by species of Andrena; one⁶ by Vespa; one⁷ by Apidæ, Diptera, and Sphegidae; one⁸ principally by Ichneumonidæ; one⁹ exclusively by Diptera; two¹⁰ by minute insects of different orders; and four¹¹ by Lepidoptera. Although the fertilisers of the sixteen remaining species¹² have not yet been observed, still it may fairly be deduced from the structure of their flowers that none of them, except, perhaps, *Habenaria viridis*, is fertilised by butterflies. Of thirty-four species, then, growing in the plain and lower mountain region, four, or at the most five, that is to say 12 to 15 per cent., are fertilised by Lepidoptera; whereas of five species of Orchids growing in the higher Alpine region near the Ortler, three,¹³ or perhaps four,¹⁴ that is to say 60 to 80 per cent., are adapted to cross-fertilisation by butterflies, a proportion which strongly corroborates my view that the predominant frequency of butterflies in the Alpine region must have influenced the adaptations of Alpine flowers. As two of these five species of Alpine Orchids are not mentioned in Mr. Darwin's classical work, nor have yet been described with regard to their contrivances for fertilisation, I will give here a brief account of them.

Gymnaenia odoratissima (Figs. 58, 59) produces its honey in a nectary only 3₅ mm. in length, but the narrowness of its entrance (*n'* Fig. 59) proves it to be accessible only to butterflies. These, when inserting their proboscis into the nectary, cannot fail to attach to its upper side the two viscid discs (*d, d*) which lie close together immediately above the mouth of the nectary, and to which the pollinia are fixed by their caudicles. Hence a butterfly, when flying away from the flower first visited, bears a pair of pollinia upright on the upper side of its proboscis. When these are exposed to the air, the membranous discs to which their caudicles adhere contract (just as described and drawn by Mr. Darwin at p. 80 of his work), which causes the pollinia to move downwards and outwards in such a degree as exactly to strike the stigmatic surface when the butterfly inserts its proboscis into the nectary of a second flower.

Near the cataracts of the Adda, between the second and third Cantoniera, 2,200 to 2,400 metres above the sea-level, I found (July 14) plenty of these flowers, which, in accordance with their name, struck me by their highly attractive sweet smell; but although many butterflies were visiting a large number of the surrounding flowers, some of which were scentless, others but slightly scented,

¹ Continued from p. 112.

² "On the various contrivances by which British and Foreign Orchids are fertilised by insects." London, 1862.

³ *Orchis Merio*, *O. mascula*, *Epipogon Gmelini*, *Goodyera repens*, *Spiranthes autumnalis*.

⁴ *Orchis maculata*, *O. latifolia*.

⁵ *Cypripedium calceolus*.

⁶ *Epipactis latifolia*.

⁷ *Epipactis palustris*.

⁸ *Listera ovata*.

⁹ *Neottia nidus-avis*.

¹⁰ *Gymnadenia alba*, *Herminium monorchis*.

¹¹ *Orchis pyramidalis*, *Gymnadenis conopsea*, *Platanthera bifolia*, *P. chlorantha*.

¹² *Orchis laxiflora*, *oviphora*, *militaris*, *fusca*, and *variegata*; *Habenaria viridis*, *Ophrys muscifera* and *apifera*; *Cephalanthera pallens*, *ensifolia*, and *rubra*; *Epipactis atrorubens*, *viridiflora*, and *microphylla*; *Malaxis paludosa*, *Liparis Loeselii*.

¹³ *Nigritella angustifolia*, *Gymnadenia odoratissima*, *conopsea*, and *alba*; *Habenaria viridis*.

¹⁴ *Nigritella angustifolia*, *Gymnadenia odoratissima* and *conopsea*, and perhaps *Habenaria viridis*.

Gymnadenia odoratissima remained almost entirely overlooked, some specimens of *Crambus coulouellus*, Dup.,* being the only visitors I succeeded in observing during several hours. As the possibility of self-fertilisation has been lost by the flowers of this plant, it must be supposed that its cross-fertilisation by insects happens frequently enough to make self-fertilisation useless. Therefore, from

the rare diurnal visits and from the pale colour of the flowers, I am inclined to infer that *G. odoratissima* is more adapted to fertilisation by crepuscular and nocturnal than by diurnal Lepidoptera.

A curious observation on *G. odoratissima* remains to be noticed. In this species, as in most Orchids, the labellum (*n'*, Fig. 58), properly the upper petal, assumes

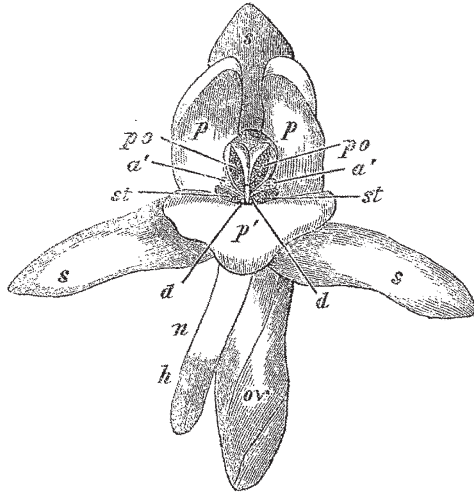


FIG. 58.—*Gymnadenia odoratissima*. Front view of the flower (7 : 1).

(*ov*, ovary; *s*, sepals; *p*, petals; *p'* labellum; *a*, developed anther; *d*, viscid discs; *a'*, rudimentary lateral anthers; *po*, pollinia; *st*, stigma; *n*, nectary; *n'*, orifice of the nectary; *h*, honey.)

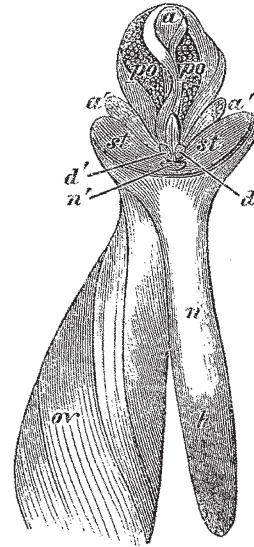


FIG. 59.—Front view of the same flower (14 : 1), with all the sepals and petals removed except the nectary.

(*ov*, ovary; *s*, sepals; *p*, petals; *p'* labellum; *a*, developed anther; *d*, viscid discs; *a'*, rudimentary lateral anthers; *po*, pollinia; *st*, stigma; *n*, nectary; *n'*, orifice of the nectary; *h*, honey.)

its position as the lower lip by the torsion of the ovary; but in some specimens which I found, the torsion of the ovary had stopped half way in all the flowers, so that they occupied a transverse position, directing the labellum and the nectary to the right hand, one of the sepals downwards, the other upwards. A slight approximation to this position is shown by Fig. 59 if compared with

Fig. 58. This exceptional imperfection of the torsion of the ovary of *G. odoratissima* seems to me to be of some interest, if we compare it with the normal condition of the flowers of *Nigritella angustifolia* (Figs. 60-62), in which the ovary is not at all twisted, so that the flowers occupy just the contrary position to what they do in other Orchids. In consequence of this also the function of the upper and

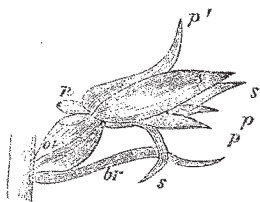


FIG. 60.—*Nigritella angustifolia*. Perfect flower viewed laterally, with the labellum (*p'*) in its natural position, upwards (3 : 1).

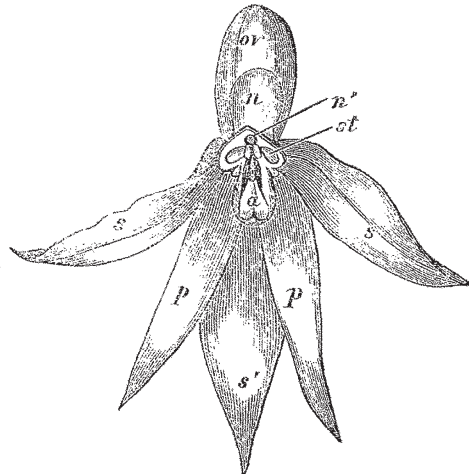


FIG. 61.—The same flower viewed in front, with the labellum removed (7 : 1).

All letters have the same significance in Figs. 60, 61, 62, as in Figs. 58, 59. By the dotted line in Fig. 62 the limit of the honey is marked.

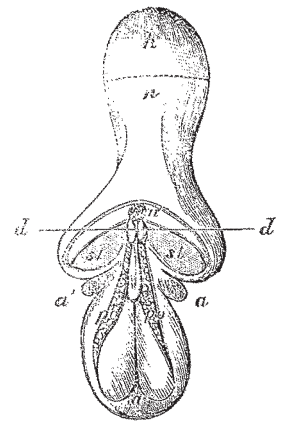


FIG. 62.—Sexual organs and nectary of same flower, in their natural position.

lower sepals and petals is inverted; the labellum (*p'*), being turned upwards, here protects the organs of fructification, and the sepals and petals opposite to the labellum (*s', p, p'*, Fig. 61) afford a landing-place for insects. When a butterfly inserts its proboscis into the narrow entrance

* According to Dr. Speyer's determination.

of the nectary (*n'* Figs. 61 and 62), it attaches the viscid discs (*d*, Fig. 62) to its under side; and when it flies away, the pollinia, in consequence of the drying up of the discs to which they are affixed, undergo an upward and outward movement so as to strike the stigmatic surface of the flower next visited. *Nigritella* has probably in-

herited the peculiar position of its flowers from the ancestors of the family of Orchids, which undoubtedly, like the most nearly allied families, possessed an untwisted ovary, and the imperfectly twisted condition of the ovaries of some individuals of *G. odoratissima* may be looked at as an effect of atavism.

Nigritella differs from *Gymnadenia odoratissima* in the position of its flowers, and in being fertilised in the daytime. Whilst the latter seems to be fertilised especially by crepuscular and nocturnal Lepidoptera, the former, on the contrary, is easily seen to be fertilised by diurnal butterflies. In contrast to the pale flowers of *G. odoratissima*, those of *Nigritella* are of a dark purple red colour, shining magnificently in the sunlight, whilst at the same time they exhale so remarkable a vanilla-like odour that I have more than once recognised this species sooner by smell than by sight. I have never met with any other flower which attracts diurnal Lepidoptera more efficaciously than this. When descending from the pass of Fluella, towards Zernetz (July 9), during about an hour I collected in a small locality the following species, having observed them all fertilising the flowers of *Nigritellas*. (a) Rhopalocera: (1) *Lycana semiargus* Rott., frequently; (2) *Melitæa Athalia* Rott.; (3) *Argynnis Euphrosyne* L.; (4) *Hesperia serratula* Ramb. var.? (b) Sphingidæ: (5) *Ino statices* L., Alpine varieties, in great number. (c) Noctuæ: (6) *Agrotis ocellina* W. V., several specimens; (7) *Prothymia ancea* W. V. (d) Crambina: (8) *Botys arealis* Hb., var. *opacalis* H.; (9) *Diasemia litterata* Scop., in great number; (10) *Crambus dumetellus* H. var., very frequently. (e) Tineina: (11) *Butalis* species.* In the subnival region round "Quarta Cantoniera," besides Nos. 3 and 5, I observed (12) *Melitæa Parthenie* Bkh., var. *varia*; (13) *Zygæna exulans* Reiner, both not only perseveringly seeking for the honey of *Nigritella* in the sunshine, but also lodging after sunset in the heads of their favourite flower, from which in the evening and morning numerous individuals could easily be taken off which had been killed or benumbed by the cold.

HERMANN MÜLLER

THE TRANSIT OF VENUS

DURING the past week a few additional telegrams have appeared in the *Times*; these, with the *Times*' notes upon them, in a condensed form, we give here.

From the Hague we learn that the Government has received advices from the Dutch expedition sent to Réunion for observing the Transit of Venus. The sky being cloudy, the expedition was only partially successful.

The Astronomer Royal has received the following telegram from the Sandwich Islands:—

"Transit of Venus well observed at Honolulu and Atooi; cloudy at Owhyhee. Sixty photographs; Janssen failed; internal contact uncertain several seconds; complete disc of Venus seen twelve minutes before; 120 micrometer measures."

From New York intelligence has been received that the observation of the Transit of Venus made by the British astronomical party at Honolulu has been successful, except as regards the photographs, which failed.

It will be seen that the bad news for the English plans from New Zealand is fortunately not followed up from the Sandwich Islands. There the ingress, at one end of a base line stretching to Kerguelen's Land, has been secured, and if the observations have been successful at the latter place, Delisle's method can be applied for the ingress.

The telegram from New York is enough to give rise to some uneasiness. The first telegram stated that the Transit was well observed at Honolulu and Atooi, while there were clouds at Owhyhee; and then followed

some statements which might have applied either to Owhyhee solely or to the whole attempt. From the last telegram we learn that the photographs failed at Honolulu, where in the telegram to the Astronomer Royal it was stated that the Transit had been well observed. There is, therefore, a distinct strengthening of the idea that the remarks "Janssen failed," "internal contact uncertain several seconds," apply to all the stations. We sincerely trust this may not be so, for, the whole value, to the English plans, of the occupation of Kerguelen's Land is that observations of ingress may be made there to correspond with those made in the Sandwich Islands,—the ingress being accelerated in these latter and retarded at Kerguelen. A long experience with transits of Mercury and solar eclipses has now convinced astronomers that corresponding observations mean observations made by similar instruments under similar conditions. For instance, it will be useless to compare an eye observation of a contact made at the Sandwich Islands with photographs of the contact made by Janssen's beautiful contrivance at Kerguelen, whence we are not afraid of hearing that "Janssen failed," for Father Perry, in whose charge the revolving apparatus is, is one of the very few men long practised with astronomical instruments who form part of the English staff.

Lord Lindsay telegraphs to Lady Lindsay from the Mauritius:—

"Transit observed; last half satisfactory. Good photographs, measures, and time determination. Altogether well satisfied."

The private expedition of Lord Lindsay to the Mauritius deserved to succeed. We regret that the degree of success obtained is not so high as that which Lord Lindsay's energy, skill, and care had merited. Had observations been secured here and at Réunion at the commencement of the Transit, both Mauritius and Réunion would have been Delislean stations for observations of ingress—almost, indeed, as good as Kerguelen's Land, where it is to be hoped the official astronomers have obtained observations to pair with those made at the Sandwich Islands. But, as Lord Lindsay saw nothing of the beginning (ingress), and as the sky was cloudy at Réunion, the parties at Kerguelen's Land are now the only hope of the Delisleans, and this makes one regret all the more that the Americans were foiled in their attempt to occupy the Crozets. But Lord Lindsay's hopeful telegram evidently means that he has obtained enough photographs and measures to employ with advantage the direct and heliometric methods of determining the least distance of centres; these methods being precisely those which the German parties, also in the Mauritius, were to employ, obtaining corresponding observations at Chefoo, in the north of China.

The *Times* Malta correspondent writes under date Valetta, Dec. 15:—"The Transit of Venus was distinctly witnessed at Malta on the 9th inst. The external egress of the planet from the sun occurred precisely at 7.26 A.M. local mean time."

"Melbourne, Dec. 29.—Intelligence from New Zealand announces that the American astronomer, Prof. Peters, was successful in his observation of the Transit of Venus. The German expedition to the Auckland Isles also achieved satisfactory results."

THE SPECTROSCOPE AND THE TRANSIT OF VENUS

A RECENT article in the *Times* (Dec. 24) speaks of the application of the spectroscope to the observations of transits; it is so much to the point that we reproduce a portion of it here:—

The news from Malta which we gave yesterday of the unhoped-for observation of external egress there under

* For all the names I am indebted to Dr. Speyer, of Rhoden.