

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.

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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 Diptera; 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*, *Hymenium 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*.