

gradations both between species, and between different ages and conditions of one and the same species.

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(To be continued.)

#### BEEs VISITING FLOWERS

ON the cliffs at Llwyngwrl, near Barmouth, *Lathyrus sylvestris* grows in large patches, and is freely visited by humble-bees. Where a plant grows in considerable masses, a great number of bees are naturally attracted, and the competition among them becomes severe. In this case the flowers are not sucked in the usual manner, but the bees bite holes through the corolla, and obtain in this way illegitimate access to the honey. Hermann Müller has shown that when flowers grow in any quantity, they are so diligently worked at by the bees that only comparatively a few contain any nectar; it is therefore important for the bees to find out as quickly as possible whether a flower is worth anything or not. These holes, bitten through the corolla, enable the bees to visit the flowers more quickly, and are thus a great saving of time. He also says that, although the bee which first gnaws the hole loses time in doing so, yet the advantage of being able to get the honey from the young and as yet unvisited flowers, fully makes up for the loss of time.

In *L. sylvestris*, as in many Leguminosæ, the honey is secreted within a nectary formed by the filaments of nine of the stamens soldered together. The trough-like cavity thus formed is covered in above and converted into a tube, by the tenth stamen. But at the base, where the trough enlarges into a bulb, the stamen is not wide enough to cover it, so that it leaves a pair of holes piercing the tube one on each side. It is through these "nectar-holes," as they are called, that the bee, after passing its proboscis down the tube of the corolla, or, as in the case already mentioned, through the holes bitten at its base, gains entrance to the staminal tube, in its search for nectar.

In *L. sylvestris* the hole is gnawed through the tube of the vexillum, close to the edge of the calyx, and exactly over the left nectar-hole. (Throughout this paper I mean the right and left of an observer looking at the front of the flower.) I think the reason of this constant choice of the left side of the corolla is that the left nectar-hole is usually somewhat larger than the right. I found this to be the case in sixteen out of twenty-four specimens of the wild *L. sylvestris*, and in eleven out of sixteen in the garden variety (the Everlasting Pea). It is difficult to say how the bees have acquired this habit. Whether they have discovered the inequality in the size of the nectar-holes in sucking the flowers in the proper way, and have then utilised this knowledge in determining where to gnaw the hole; or whether they have found out the best situation by biting through the vexillum at various points, and have afterwards remembered its situation in visiting other flowers. But in either case they show a remarkable power of making use of what they have learnt by experience.

The united filaments not only form the nectary, but also a sort of casing in which the ovary is enclosed; and out of which the growing pod has to break its way as it increases in size. In *Vicia cracca* it does so by lifting up the tenth stamen, but in most *Lathyræ* the filament is too stiff to allow of such a movement, and the growing pod was to squeeze its way between it and the edge of the trough formed by the nine united filaments. In doing this it enlarges and at last splits open one of the nectar-holes. In *L. sylvestris* the left nectar-hole, usually the larger of the two as I have before said, is almost always the one which is thus opened. In *L. pratensis*, on the other hand, where the nectar-holes are equal, the pod

emerges indifferently to the right or left of the tenth stamen.

I am inclined to believe that the want of symmetry in the growth of the pod and the inequality in the size of the nectar-holes are in some way correlated, and that both are connected with a third asymmetrical character in the flower of this species. In most *Lathyræ* the brush of hairs on the pistil is directed straight backwards towards the stalk of the flower. This is the case with *L. pratensis*, and also with the flower-buds of *L. sylvestris*, while very young; but, as they get older, the pistil rotates on its own axis, so that, in the adult flower, the brush is turned towards the left. I have often watched the bees sucking the flowers of the Everlasting Pea in the ordinary way, and have observed that the pistil, in consequence of being slightly bent as well as twisted on its own axis, emerges from the keel on the right side of the bee. The function of the brush is, as Mr. Farrer has shown (*NATURE*, vol. vi. p. 479, 1872), to sweep the pollen out of the keel, so that it may be transferred to the bees visiting the flower, and may be in this way subservient to the cross-fertilisation of the species. I believe that the twisting of the pistil helps to ensure this end, since in consequence of the brush being turned towards the left it rubs against the bee and smears it with pollen. Thus the mechanism for ensuring the cross-fertilisation of the plant is made more complete. At present the supposition that the asymmetrical character of the pistil is connected with the above described peculiarities and in the growth of the pod, is merely a conjecture.

These facts have a certain bearing on a peculiarity in the structure of the staminal tube in *Phaseolus multiflorus*, the Scarlet-runner. This flower, in common with many Leguminosæ, has a pair of nectar-holes at the base of its staminal tube; but the tenth stamen differs, as far as I know, from that of any other Leguminous plant, in possessing a little flap which projects from its upper surface just in front of the nectar-holes, and which almost completely blocks up the tube of the corolla. Mr. Farrer supposes (*loc. cit.* p. 480) that by pressing with its proboscis against this flap the bee levers up the tenth stamen, and in this way passes its trunk into the staminal tube. If this occurs at all, it must be like gnawing holes in the corolla, an illegitimate way of treating the flower, since it is impossible to believe that it should have well developed, but totally useless, nectar-holes. I believe the true function of this curious little flap to be as follows:—In many Papilionaceæ, *Lathyrus* for instance, the insect visiting the flower rests on a platform which is formed of the carina and the expanded alæ, but in the Scarlet-runner this platform is made up by the alæ alone, the carina being tightly coiled into a spiral close up to the entrance to the tube to the corolla. The alæ are attached, one on each side to the proximal part of the carina, so that when an insect rests on them, its weight bears on the carina, and causes the pistil which is contained in it as in a sheath to be forced out. The direction of movement of the pistil is downward and to the left, so that a bee resting on the expanded alæ and pushing in its head to the left of the coiled-up carina would come in contact with the pistil as it darted out of its sheath; but if the insect went to the right of the coil it would escape the pistil altogether. The end of the pistil is covered with hairs, and performs the same function as the brush in *Lathyrus* in smearing the bee with pollen. It is, therefore, of great importance for the cross-fertilisation of the plant that the bees should go to the left of the coil. As a matter of fact they all but invariably do go to the left; the very few bees that I have seen going to the right appear dissatisfied and unable to find their way into the corolla. Now to reach the nectar-holes the insect's proboscis has to pass down a tunnel formed above by the tube of the vexillum, below by the upper surface of the tenth stamen; the entrance into this tunnel is a narrow

archway leaning towards the left, *i.e.* having its highest point to the left of the middle point of its base. As before stated, the flap almost blocks up the tunnel, so that to get to the nectar-holes the proboscis must pass over the top of the flap, and must therefore travel along the highest part of the tunnel, but since at the entrance arch the highest point is to the left, the bee finds it necessary to go to the left of the coiled-up carina to reach the nectar-holes in the easiest way. If this view of the function of the flap, when considered in relation with the disposition of the pistil, carina, &c., be correct, it adds another instance to the long list of mechanisms for ensuring the cross-fertilisation of flowers by means of the visits of insects.

FRANCIS DARWIN

#### THE FRENCH MUSEUM OF PHYSICAL AND MECHANICAL SCIENCE

THE following official report of General Morin, the director of the Conservatoire des Arts-et-Métiers, Paris, to the Minister of Agriculture and Commerce, which we take from the *Journal of the Society of Arts*, furnishes some interesting details as to the present condition of this magnificent educational establishment, the like of which, dealing as it does with experimental and mechanical science, is entirely wanting in our country, although in the British Museum, the student of Natural History finds all he needs.

"The total number of persons who attended the lectures of the fourteen professors amounted in 1872 to 135,443, at 559 lectures, or in the proportion of 241 to each lecture. The smallest number of lessons given by any one professor was 40, from the opening in the commencement of November, until the last days of April. The total number of persons attending is smaller than in preceding years, which is explained by the decrease of the floating population of Paris. This year, as in all others, the decrease commenced when the days got longer, and work kept the people in the workshop.

"I would here limit this report if I did not think it necessary to add a few words upon the means of instruction which the Conservatoire offers to the public and the working-classes of all ranks.

"This establishment, as is known, owes its origin to the illustrious Vaucanson, inspector of factories, who, after having made at the Hotel du Montagne, Rue de Charonne, a collection of machines, instruments and tools, for the instruction of workmen, presented it to the Government, on the sole condition that its original purpose should be maintained. Louis XVI. accepted the gift by an act of council, and the illustrious Vandermonde, member of the Academy of Sciences, was named administrator and conservator of this first industrial museum. Later, by the decrees of the 15th and 18th of August, 1793, the Convention created a temporary commission of arts, to put a stop to the dispersion of objects of art, science, and industry. This commission succeeded in collecting a large number in a depot formed at the Hotel d'Aiquillon, Rue de l'Université. The value of these collections soon after determined the Convention, upon the report of Gregory, to make a decree, the 19 Vendémiaire, year 3, that there should be formed in Paris, under the name of Conservatoire des Arts-et-Métiers, a public collection of machines, models, tools, drawings, descriptions, and books of all kinds of arts and science, the use of which should be explained by three lecturers attached to the establishment.

"It may be well to mention that the title of 'demonstrateur' or lecturer, often corresponded to that of professor, and that the professors of the Jardin des Plantes remained long after they had commenced giving regular courses. However that may be, the organisation of the Conservatoire, which was checked by several circum-

stances, was again mooted by Alquier at the Council of the Ancients, on the 27th Nivose, year 7, which urged the great advantage of such an institution to workmen, by saying that it is of more use showing them articles than merely speaking of them. It was not, however, until the 12th Germinal, year 7, that the buildings of the priory of St. Nicholas of the Fields were put into the possession of the members of the Conservatoire, who were then composed of Le Roy, Conti, Molard, and Benvelot, designer. The names of these savants, and that of Montgolfier, who soon after replaced Le Roy, did not allow of any comparison being made between the functions of these lecturers and those who are differently named now-a-days.

"At length, in the year 8, all the models and machines belonging to the State were definitively removed to this building, and formed collections destined solely for the instruction at sight. The functions implied by the title of lecturer were never exercised, and this will easily be believed when it is said that the numerous visitors who are attracted by the rich collections sometimes amount to 200,000, which makes all verbal explanation on the spot impossible. But that which is not possible to do for the public has been for a long time afforded by the Conservatoire to persons who are really desirous of information. A complete and methodical catalogue has been made out and published, and to it are added, from time to time, all new acquisitions; this has already passed through four editions. The galleries have been systematically classified, a guide has been placed in each, who, if he cannot give any practical explanation, can at least show where such and such a model is to be found, each of which is ticketed and numbered, both in the catalogue and in the inventory. Should an engineer or a workman wish to examine separately a machine or machinery, a study card for the necessary time is given to him. Or should any more complete information or explanation be required, either the curator of the collections, the under-director, or the director, is always ready to furnish them, their office being freely open to all.

"The staff in charge of the collections consists of the conservator, an assistant conservator, and of fourteen chosen guardians, who, for the most part, are picked from old non-commissioned officers or soldiers. The wish to give explanations by these, even with the aid of written details for the 9,000 models or articles which are there, would lead to great errors and confusion by a zealous but a badly instructed staff. In asking that popular conferences, such as are held at the Polytechnic Institution of London, should be introduced here, account has not been taken of the great difficulties which stand in the way, and greatly exaggerated ideas exist as to their value.

"It is not by common and vulgar explanations that the principles of Science can be spread amongst our workmen, and the facts and experience which are so necessary; their minds and intelligence are developed enough, so no fear need be had to speak to them on difficult scientific questions, if it is done with wisdom.

"All the professors who have followed this mode of teaching have often been convinced, on meeting some of their old hearers in workshops, that what may be termed the knowledge of truth and scientific principle has more deeply entered into their minds than into that of scholars of more celebrated schools. Hence it was not without reason that, in 1819, a decree of the king, brought about by the respected Dean, M. le Baron Charles Dupin, added to the instructions at sight given by the collections, that of oral instruction in the amphitheatres, by professors chosen from among the ranks of science. The number of chairs, at first only three, is now fourteen, and the half of the professors are members of the Institute, who diffuse and popularise science, the progress of which they promote by their labours. This instruction, unique of its kind in Europe, only takes place during winter; it is free