THE PEA'S NECTARIES AND INSECT VISITORS

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As the pea has been commonly viewed to be a strictly autogamous plant genus, little attention has been given to the pea's nectaries and there are no reports on their anatomy and physiology. In fact, this topic has nearly fallen into oblivion.

That the pea produces nectar was described in the classical work of the Christian Konrad Sprengel, 1793 (5).

> Pisum sativum. Erbse. In dieser Blume habe ich den Saft oftmals vergebens gesucht, endlich aber doch gefunden. ...Sie wird von einer groBen Hummel besucht. Da dieselbe sich aber nicht auf das Schiffchen, sondern seitwarts setzt, und alsdann ihren Saugrussel zwischen den Nagel des einen Flugels und dem Nagel der Fahne steckt : so sehe ich nicht ein, wie sie dadurch die Befruchtung der Blume hervorbringen konne.

> Pisum sativum. Pea. I had often looked in vain lor nectar (literally; sap) in this flower, but after all I have found it. ...It is visited by a large humble bee. As this (bee) does not sit down on the keel, but sits down at the side and puts its proboscis between the ungula of one wing and the ungula of the sai1: I do not understand how it can by this procedure pollinate the flower.

Concerning the humble bees, Sprengel's observations are correct insofar as these bees often sit down at the side of the flowers and proceed as described by him, but he does not seem to have observed other types of behavior. The majority of bees I observed landed on the pea wings and subsequently went to the keel. There is another mention of the pea's nectar production by J. G. Kurr in 1832 (2). He points to Sprengel's description:

> 23. Pisum sativum ...secrete honey according to Conrad Sprengel.

The only other work I found mentioning the subject (excluding the Erie l comment by Myers and Gritton [4] made last year) is that of Makasheva (1973/1983) (3). She writes on page 109:

> Self-pollination occurs in a closed bud although its flower has zygomorphic structure and a sweet juice is discharged into the flower at the attachment of the filaments.

She asserts that especially the "larvae of thrips" are responsible lor cross-pollinations in pea as "honey bees or bumble bees (are) visiting already open flowers".

She is correct concerning honey bees (Apis mellifica) (Fig. 1) but not for humble bees which later visit both young and old flowers (compare photographs in PNL 16, p. 40). As for thrips, I have not yet made many observations but have repeatedly found them in the flowers. As the adult individuals of many species are able to fly, they may partake in cross-pollinations. Besides the humble bees, I have found also a soli-

tary bee (Osmia or Megachile with a layer of pollen on its lower abdomen) which was active on and in pea flowers (Fig. 2). It also inserted its proboscis to the bottom of the flowers.

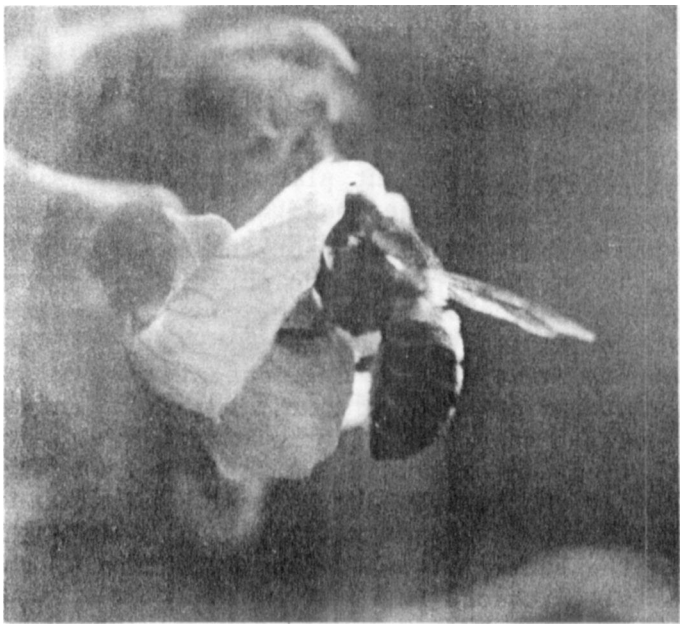
Concerning the "sweet juice discharged into the flower at the attachment of the filaments", I have made the same observation as quoted by Makasheva above. I also made a few simple tests: Reaction for $C_6H_{12}O$ by means of the Glucose-Test-Method (of Boehringer Mannheim) was positive. Sometimes I found little droplets at the base of the staminal tube, generally near the base of the carpel, i.e. in the tube. It appears important to point out that nectar production in pea seems to depend perhaps more than in many other species on the stage of development and there seem to be differences in different lines. In a few cases I found the carpel literally standing in sweet sap. Many pea lines obviously possess nectaries at the bottom of the staminal tube around the carpel. Although it is necessary to remove or disturb flower parts in order to observe the nectar, the nectar is not an artifact of injury. It is not too difficult for the insects with a long proboscis to reach this part of the flower since there are two apertures (left and right of the free anther rod) near the base under the two upper sepals.

Concerning evolutionary questions with regard to nectaries and allogamy, it is to be noted that some plant species have autogamous lines among allogamous ones, often all belonging taxonomically to one species (Mendelian factors being involved). The pea seems to make use of both possibilities. Dr. Blixt wrote me (1984) that he has observed "that pea lines from collections in warmer areas with larger bees are not lines but show every indication of being cross-pollinated...". I do not know whether these bees are necessarily large. Xy1ocopa, for instance, which was observed by Harland (1) on peas in Peru, is also found in Central Europe. If, however, the garden pea should have lost an original ability of being cross-pollinated to a higher percentage, then we would have a case of degenerat ion in such lines.

As I am leaving pea genetics (beginning work at another institute working with other species and probably will not have much time to work with peas), I would only hope that someone else will begin a careful investigation of the anatomy and physiology of the pea's nectaries.

1. Harland, S. C. 1948. Heredity 2:263-269.
2. Kurr, J. G. 1832. Untersuchnungen ubei die Bedeutung dei Nektarien in den Blumen aur eigene Booha< ht ungen und Verstic he gegrundet; PhD. thesis Stuttgart; above quotation p.. 67.
3. Makasheva, R. Kh. 1973/1983. The Pea. Leningrad, Washington and New Delhi. (Translated from the original Russian).
4. Myers, J. R. and E. T. Gritton. 1984. PNL, 16:62-63.
3. Sprengel, Ch. K. 1793. Das entdeckte Geheimnis dei Natur im Ban und in der Befruchtung der Blumen. (Reprint IS[1])4; ed P. Knuth; above quotation from the 3rd Vol., p. 65, - Leipzig).

Fig. 1. A honey bee (Apis mellifica) visiting an open flower and gathering pale pollen.



Fie. 2. A solitary bee. These bees were observed to insert their proboscises to the bottom of the pea flowers while slithering pollen (younger and older flowers).