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Notes on the Pollination of Flowers in India. Note No. 7 A few observations made in the Central Provinces and Berar

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The following observations were made on tours in the Central Provinces and Berar, in 1908 and 1909. The first of the tours comprised a visit to the hill of Asirgarh in Nimar (26-28. ix. 08) and a journey by road from Ellichpur over the Satpuras through the forests of the Melghat to Lewada where the Sipna valley opens towards the river Tapti, (3-19. x. 09): the second comprised a visit to Nagpur (14-22. ii. 09) and the third an excursion into the Melghat from Akot, along the Ban valley and to Jalgaon in the Buldana district (16-26. ix. 09). The weather during the last tour was unsettled.

The notes are fragmentary; but years may pass before an opportunity occurs for making them more complete. The chief point in them is connected with the cotton plant,—chief, because for those who are trying to breed out of our cottons improved races, it is essential to recognise the extent of that cross-pollination in the field which will level down what they are raising up.

The insects have been determined for me by Messrs. H. Maxwell-Lefroy, E. Brunetti and C. A. Paiva, to whom I offer my best thanks.

A Bee as a regular visitor to Cotton flowers, and some other visitors.

There is evidence that in the Ganges valley, the races of cotton, when grown mixed, are crossed naturally with some freedom. The literature is in three places. Firstly, in the Agricultural Ledger No. 8 of 1895, p. 10, Professor T. H. Middleton set forward his belief that seed of the Behar cottons—'Bhogila' and 'Deshi'—gave rise to hybrids in his experimental plot at Baroda. Secondly, in this journal for 1907, pp. 517-526, I called attention to the insects which visit cotton flowers in Behar in May and to the presence of apparent hybrids in the crops there. Thirdly, Mr. Martin Leake (this Journal, 1908, p. 18) felt himself justified in saying that indirect evidence exists in abundance for regarding the crossing of cottons in nature as of common occurrence: and he recorded a few observations made by himself on the variability of progeny from seed collected when precautions were not taken to prevent natural crossing.

Fyson (Memoirs Dept. Agric. ii, no. 6) has more recently
stated on similar grounds that in Madras at least some natural
crossing occurs.

All this evidence is opposed to Gammie's view, based on
observation at Poona, that cotton does not get cross-fertilised
in nature (Memoirs Dept. Agric. ii, no. 2). Certainly Gammie's
view cannot be made a generalisation for India as a whole.

In this connection it is now interesting to record, as an
apparently regular insect-visitor to cotton flowers in parts of
Berar, a bee, which by reason of its large hairy body is admirably
adapted for carrying pollen from flower to flower. This
insect is *Megachile albisfons*, Smith. It is, however, not very
active in moving from flower to flower. I first observed the bee
on the afternoon of September 22nd, 1909, sheltering in cotton
flowers during rain at Pingli, which is a village lying just under
the hills in the north-east corner of the Buldana district. By
a search through a field four more individuals were found. On
the next day between Pingli and Wasali, during the morning,
nine insects were seen, and in the afternoon at Wasali eight more.

No observations were made on September 24th owing to
rain; and on the 25th between showers no bees were seen on
the cotton flowers during a march from Jamod to Jalgao.; but on September 26th, four miles south of Jalgao, two more
individuals were seen on cotton flowers. This makes a total of
24 individuals seen on cotton flowers in six days. On the 26th
I left the district.

The common cotton of north-eastern Buldana is the yellow
flowered Jari (*Gossypium neglectum*, Tod., var. vera, Gammie).
Grown mixed with it, is a considerable quantity of white flowered
Jari (*G. neglectum*, Tod., var., rosea, Gammie) and a not inconsiderable amount of Dharwar American cotton (*G. hirsutum*,
Mill.). No individuals of *Megachile albisfons* were seen on *G.
eglectum*, var. rosea, and only one on *G. hirsutum*: all the
others were on *G. neglectum*, var. vera.

From the insects' point of view these three cottons may be
very unlike; for *G. neglectum*, var. vera, has larger yellow
flowers which nod as a rule and open rather widely; *G. neglectum*, var. rosea, has smaller rose-white flowers which generally
ascend slightly from the horizontal and open but little; *G.
hirsutum* has upright pale yellow flowers which open earlier
than the other two, and widely.

Bani (*G. indicum*) has flowers exactly as *G. neglectum*, var.
vera, but not a single plant was noticed in north-eastern Buldana,
where the Megachile was seen, whereby to prove (as might well be the case) that the bee would go from *G. neglectum*, var. vera, to it.

*G. neglectum*, var. vera,—Jari,—in north-eastern Buldana
spontaneously self-pollinates within an hour or two of opening;
and the flowers are fertile to their own pollen: so that the bolls
set whether insects go to the flowers or not.

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### The Pollination of Flowers in India

It is the habit of the Megachile to fly into the flowers and
at first to seek for honey at the base,—whether generally found
or not, I was unable to ascertain: that done the insect turns
round and with its head towards the light sits on the anthers
and eats pollen. When caught its hairy body is always abundantly
dusted with pollen; and it certainly carries it from one
flower to another, and probably produces the occasional cross
which seems to be the rule with so many plants.

Over the period during which the cotton was under
observation, a few butterflies were observed on the flowers. *Catopsilia
crocate*, Cramer, was seen at Wasali, and again to the south of
Jalgao on *G. neglectum*, var. rosea, generally going to the
extra-floral nectaries but sometimes to the intra-floral nectaries.
Its constancy to the white flowers was marked.

*Papilio polytes*, Linn., was seen on two days near Jalgaon
going both to extra- and intra-floral nectaries of *G. neglectum*,
var. vera, and *G. neglectum*, var. rosea.

A *Teras* visited flowers of *G. neglectum*, var. vera, between
Jamod and Jalgaon. Commoner still than any of these was
*Parnara colaca*, Moore. Seven individuals were seen going to the
intra-floral nectaries of *G. neglectum*, var. vera, between Pingli
and Wasali on September 23rd, eleven between Jamod and
Jalgao on September 25th, one on September 26th on the
south of Jalgao, and another at Nandura—making a total of
20. Further, on September 25th, between Jamod and Jalgao,
one went to the extra-floral nectaries of *G. neglectum*, var.
vera, and six to the intra-floral nectaries of *G. hirsutum*.

Thus there were seen:

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<tr>
<td><em>Megachile albisfons</em></td>
<td><em>G. neglectum</em> var. vera</td>
<td><em>G. neglectum</em> var. rosea</td>
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<td>23 individuals</td>
<td>1 individual in flowers</td>
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<td>entering the flowers</td>
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| *Catopsilia crocata*   | *G. neglectum* var. vera |
| 5 individuals          | generally at extrafloral nectaries |
| generally at extrafloral nectaries |

| *Papilio polytes*      | 1 individual |
| **Teras sp.**          | 1 individual entering flower |
| **Parnara colaca**     | 20 individuals, all but one entering the flowers: that one at extrafloral nectaries |
|                        | 6 individuals entering a flower |
Parnara and Papilio were also seen on yellow Cotton flowers between Nandurbâr and Tâloda in West Khandesh on September 29th, 1909; but flower-visiting insects, except the injurious beetle, *Glycyphana versicolor*, Fabr., were there exceedingly rare.

_Elaeodendron glaucum_, Pers.

The yellow-green somewhat massed flowers have a large disc, bearing a considerable amount of honey. They open widely, facing upwards or horizontally. At first they are male, the stamens standing up as in the upper figure: then they become female, the filaments, having bent as in *Rhamnus*, and the style elongated. The lower figure represents the flower in the second stage.

A few hours of leisure spent at Wasáli, Buldâna district, on September 23rd, while waiting for the carts that were bringing my camp-furniture, enabled me to collect the following visitors at honey on the flowers.


_Hardwickia binata*, Roxb.

_Hardwickia binata_ is an anemophilous Leguminosa, with the light foliage and flexible branchlets of a birch tree. On these thin flexible branchlets are produced in September the panicles of yellow green flowers. Apparently the flowers open chiefly at night. As the sepals part, the stigma is thrust out by the straightening of curves in the style: it straightens slowly, retaining a knee, by means of which the stigma is carried to a lateral position. After the stigma has thus been removed to a position and is no longer under the flower, the anthers emerge and dehiscence.

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*Fig. 2.*-On the left younger stages—ovary and style and stigma: on the right opening and wide open flower, x 2.
nor so late. A Pierid butterfly was also seen on the flowers in the broad sunlight.

A few further observations from Asirgarh and the Melghat.

The following observations are all, additional to the above, that I could make over twenty-six days spent almost entirely in the open. They show how few insect-visitors can be observed in the Satpura hills at the season of my tours: and they suggest that the scarcity of visitors to crops like cotton grown under the Melghat is due to the poverty of the country side in flower-visiting insects. At the time of my tours in the Melghat, few trees were in flower, but under the trees occurred sporadically the large blossoms of several species of Barleria, a Strobilanthes, other Acanthacere, Crotalearias, etc.; and in other places an abundance of Indigofera glandulosa, Tridax procumbens, Ageratum conyzoides, and Impatiens balsamina; while on the plateaux Linum, Tradescantia, Pimpinella, Senecio, etc., were in flower—flowers sufficiently conspicuous to attract many insects in Britain, during an equal period.

Xylocopa fenestrata, Bingham, was seen in Asirgarh (25–26. ix. 08) at honey on Celosia cristata, Linn., and Zinnia elegans, Jacq.; and X. aureipennis, Lepel., in the Sipna valley (10–13. x. 08) on Anisomeles ovata, R. Br., Crotalearia albida, Heyne, Sophobia delphinijfolia, G. Don, and Celosia cristata, Linn. (Megachile anthracina,) Smith, which is a somewhat similar insect, was seen in the Ban valley (19. ix. 09) in great numbers on Crotalearia juncea, Linn., and also freely on flowers of Sesbania aculeata, Pers. Anthophora zonata, Bingham, was seen abundantly on flowers of Leucas urticifolia just where the Ban river debouches on to the plains (22. ix. 09): the association of this insect with small labiates is noticed in Lefroy’s Indian Insect Life (Calcutta, 1909, p. 222). Apis florea, Fabr., on the pass near Ghátáng (10. x. 08) visited in great numbers for honey the flowers of Kydia calycina, Roxb., and in the Ban valley (19. ix. 09) it was seen in hundreds on the greenish-white flowers of Aspidopterys cordata, A. Juss., which smell like those of Sambucus nigra, Linn.

Apis dorsata, Fabr., was seen in the Sipna valley collecting pollen on the anthers of Andropogon contortus, Linn. (17. x. 08). No other Apiids were seen on flowers.

Of butterflies numbers were seen on the flowers of Celosia cristata, Linn., in all parts of the hills north of Ellichpur and in Asirgarh (25. ix—08. x. 18). They included species of Papilio, Danaids and Parnara.

Papilio ?polytes, Linn., was seen also on the flowers of Zinnia elegans in Asirgarh (25–26. ix. 08) and a Sphingid was seen on Ipomea coccinea, Linn., in the Sipna valley (17. x. 08).