Prof. T.Pullaiah,
Professor of Botany,
Sri Krishnadevaraya University,
Anantapur 515003, A.P.

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OBSERVATIONS IN SHORT-CUT TO NECTARY IN *CESTRUM FASCICULATUM*, MIRS.

BY

B. N. SINHA.

While spending a holiday in the Nainital Hills, one fair morning my attention was drawn to the visits of a large number of bees hovering round the crimson-coloured bunches of flowers of *Cestrum fasciculatum* growing in my garden. It is a well established observation that bees play a very important role in the pollination of flowers, so *prima facie*, no suspicion was held out with regard to their mischievous activities. But my curiosity was aroused when I saw them sitting at wrong spots namely at the base of the corolla-tube, instead of its open mouth. This fact along with the smallness of the flowers and the bigness of the bees was quite significant of their thievish behaviour. The whole thing thus appeared to be very interesting; so a careful study was made for a period of nearly two months.

During the last two decades or so, the observations in short-cut to nectary has been something of a neglected study. The literature that has accumulated in this direction is mainly due to the labours of Darwin (1), Hermann Müller (7), Fritz Müller Knuth (6) and a few others, based on their extensive work on pollination of flowers in both the hemispheres. Recently Otto Porsch (9) in his admirable work "Vogelblumenstundien" has collected up the literature with regard to the pollination and short-cut to nectaries by birds. Furtado (3) has recorded from Malay, Singapore, Malacca and other places instances of short-cut to nectary by carpenter-bees (*Xylocopa latipes* and *X. aestuans*). In India the observations of such a nature, have been described only in *Sesbania grandiflora* by Tiwary (12), and *Quisqualis indica* L. and *Delphinium sp.* by Iyengar (4). In *Sesbania grandiflora* and *Quisqualis indica*, the cuts are effected by birds while in *Delphinium* by the carpenter-bees (*Xylocopa sp.*). Therefore, from a short review of the available literature, it is apparent that nothing of the kind, has so far been reported with regard to *Cestrum fasciculatum* at least from any part of India.

The Solanaceous genus *Cestrum* is a large one comprising about 150 Species (13) belonging to the Tropical and Sub-Tropical America. The species growing in India, are all exotic ornamental plants cultivated in gardens. But, it is rather remarkable that

some of them have become so well adapted to the climate that they grow very luxuriantly in wild state e.g. *C. elegans, Schlech.* (2) (at Kodaikanal in South India at an elevation of 7,000 ft. above the sea level). *C. Parqui,* L'Herit. (8) (at Abbottabad in the Punjab) and a few others.

Cestrum fasciculatum is a choice beautiful plant of shrubby habit, quite common in Nainital gardens. Usually it flowers from May to December. The flowers in their bud condition, are erect but at maturity they attain something of a nodding position. This appears to be an adaptation to protection of the pollen grains from rain or dew. This fact is already known with certain differences of details in so many plants including even some species of *Cestrum* (5).

The flowers although of very beautiful colour are scentless. The calyx is tubular provided with five teeth and is 8 mm. (tube 5 mm. and teeth 3 mm.) long and 3 mm. in diameter. The corolla is also tubular but it widens out slightly from the base upwards and gets narrowed down again like a barrel before ending into five teeth (fig. 5). Seldom only four teeth are present. The diameter of the corolla-tube at the base is 2 mm. and in its broadest region is 6 mm. The circular opening of the corolla-tube is 3–4 mm. wide and the average length of the tube is 25 mm. The nectary disc which secretes honey, is situated just below the ovary (fig. 4). A fully mature nectary disc secretes so much of honey as to fill about 1/5 of the corolla-tube with the sweet fluid. Certainly is the description indicative of the fact that the plants in their natural habitat are visited by intelligent pollinating agents with long proboscis or small birds (like sun-birds or humming birds) provided with thin long beaks.

The bee which was observed cutting the corolla-tube is *Bombus haemorrhoidalis,* Smith. (Hymenoptera: Apidae). It measures 17 mm. long and 8 mm. broad (Photograph). It cuts holes on the corolla-tube by the help of its two strong jaws and drinks away the honey by inserting its tongue (about 7 mm. long) through the cut or cuts. In habit it is rather timid, as the very presence of man scares it to the extent that it takes to its wings. Due to this, it was found almost impossible to watch from a short distance, the process of cutting the hole in the corolla-tube. It was, however, thus made possible only from a fair distance by the help of a binocular. With great difficulty a few of them could be caught for identification.

These bees usually visit the flowers in the morning, only when it is bright and fair. They come flying about and after making a few rounds near the shrub they sit on one of the branches and select out only those flowers for their attack which are fully grown or nearly so. The young flowers or the buds are not bored at all because they do not find any honey there.

Judging from the description of the flowers and its size (mouth diameter 3–4 mm., length 27 mm.) and that of the *Bombus haemorrhoidalis* (broad 8 mm., long 17 mm.) it appears that these bees could never be expected to be of any use in pollinating the flowers. Being bigger in size they could not even enter the corolla-tube. However, in case of the cuts on the corolla-tube shown in figure 1, it may be possible for the bee to effect self-pollination or even cross-pollination if like-cuts existed on other flowers also, as in this case both the anther and the stigma were accessible to the insect; but in all probability it was only by chance that such cuts were made and that, these had nothing to do with the skill of the bees. The pollinating agents of these flowers must be some other insect or insects with long proboscis or small birds. Attempts to find out the real pollinators have, so far, been futile. Probably very few of these pollinators or perhaps none at all, visit the flowers, because of their being deprived of the honey by *Bombus haemorrhoidalis*. Thus the flowers suffer, and do not get pollinated, with the result that most of them dry up without producing any fruit.

Amongst the flowers examined most of the cuts were situated just above the calyx-tube i.e. at the nearest accessible region of the honey. The following data will give a clear idea about the situation of the cuts:—

Total number of the flowers (with cuts) examined .. 200

1. Flowers with cuts on the calyx-tube as well as on the corolla-tube near the cleft of the calyx teeth (fig. 3) .. .. 8 i.e. 4%
2. Flowers with one cut on the corolla-tube near the cleft of the calyx teeth (fig. 5) .. .. 80 i.e. 40%
3. Flowers with two cuts on the corolla-tube near the cleft of the calyx teeth .. .. .. 4 i.e. 2%
4. Flowers with long slit-like tortuous cuts beginning from the middle of the corolla-tube and ending in the neighbourhood of the cleft of the calyx teeth (fig. 2) .. .. .. 16 i.e. 8%

5. Flowers with one cut only in the middle of the corolla-tube (fig. 6)	4 i. e.	2%
6. Flowers with one cut in the middle of the corolla-tube and another near the cleft of the calyx teeth (fig. 7)	12 i. e.	6%
7. Flowers with one cut in the upper part of the corolla-tube and another near the cleft of the calyx teeth	4 i. e.	2%
8. Flowers with three cuts on the upper part of corolla-tube and a fourth near the cleft of the calyx teeth (fig. 1)	4 i. e.	2%

As already pointed out, about 1/5 of the corolla-tube is full of honey; and thus the insects which seem to be clever usually make punctures on the tube in a region near the cleft of the calyx-teeth. This process ensures their getting the honey with absolute certainty and also avoids the extra trouble of cutting the calyx as well as the corolla-tube. It will be seen from the data given above that only 4% of the flowers had cuts of the latter nature. For these, the inexperience of the insects is solely responsible. The most common cut was the one situated just in the neighbourhood of the cleft of calyx teeth. Amongst the flowers examined, almost all of them had such cuts with a few exceptions. It is from these that they get an easy supply of the honey. For the cuts in aberrant positions on the tube there can only be two possibilities: these may be due either to the inexperience of some of the foolish *Bombus* or may just be trial experimental searches after the honey before they could locate the right seat of nectar. Any way the fact remains that most of the cuts were very properly situated and that only such flowers which had enough of honey (in almost complete exclusion to the young ones) were the target of attack. This reflects very markedly on the cleverness and intelligence of the insect-thieves. The cuts, however, themselves are not of uniform shape and size (fig. 8). In form they have the outline of amoeba in different stages of its progress as seen under the microscope.

The natural effect of this stealing process of honey certainly has resulted in keeping away the real pollinators or in at least minimising the chances of attracting the right sort of pollinators to visit the newly acclimatised American *Cestrum*. As a consequence of this robbery, the plant is unable to set any seeds and if it is not aided by human agency to propagate on its species by cuttings, such a plant is indeed exposed to the perpetual danger of extinction in its adopted habitat.

Acknowledgement.

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BOTANY DEPARTMENT,
RAVENSHAW COLLEGE,
CUTTACK.

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Explanation of the Plate.

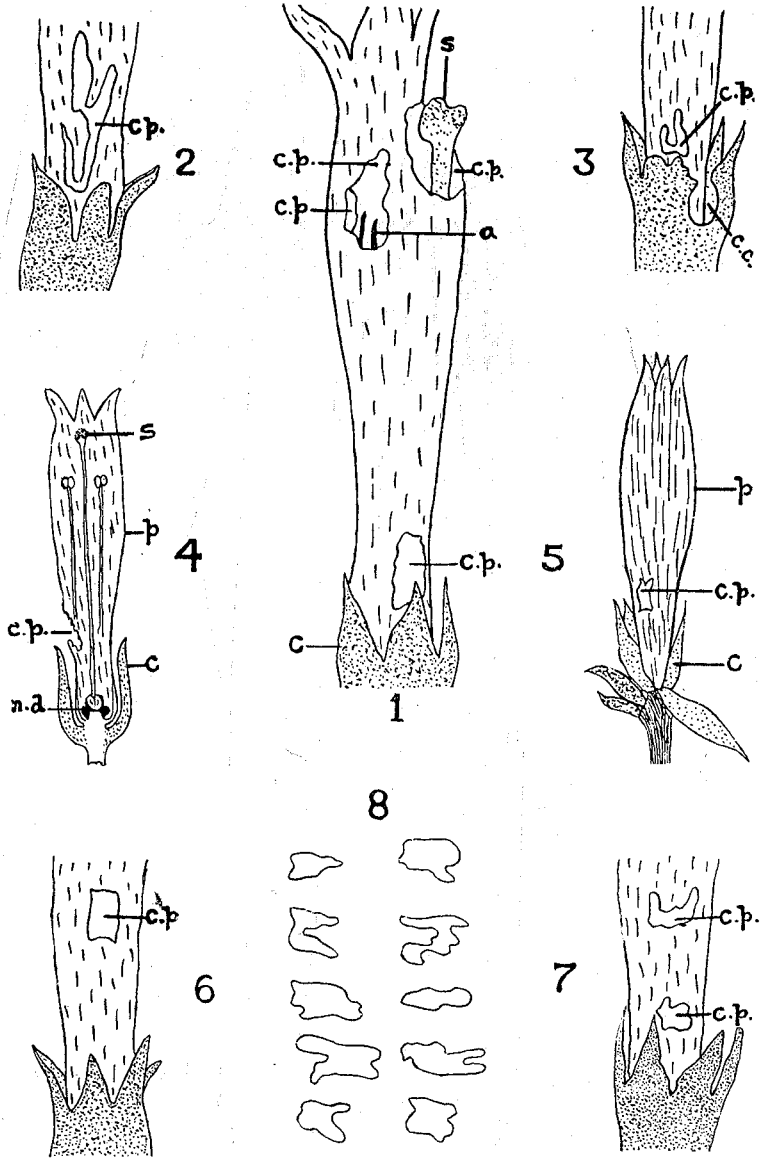
(c=calyx-tube, p=corolla-tube, a=anther, s=stigma, n.d.=nectary-disc, c. c.=cut on the calyx-tube, c. p.=cut on the corolla-tube)—The 'cuts' have all been drawn by the help of a Zeiss Camera lucida.

FIGURES 1–3 and 6–7: Portions of flowers showing the different positions of the cuts in relation to the calyx- and corolla-tube. × 4.

FIGURE 4: A longitudinal section of the flower. × 2.

FIGURE 5: A flower of *Cestrum fasciculatum*. Showing the commonest type of cut. × 2.

FIGURE 8: Ten different types of cuts on the corolla-tube. × 4.



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Bombus haemorrhoidalis, Smith. Showing the insect from three different views a = dorsal view, b = side view, and c = ventral view. 1½.