

BEHAVIOUR OF THE ROCK BEES, *APIS DORSATA* FABR., DURING A PARTIAL SOLAR ECLIPSE IN INDIA

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(Received December 8, 1956 ; read July 25, 1957)

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I. INTRODUCTION

Little information is available on the behaviour of insects during a solar eclipse. I have been able to find only two relevant references in the literature, viz. that of Newport (1837) on the honey bee in England and of Hokusima (1949) on a Chrysomelid beetle in Japan. Uvarov (1931, p. 103) in his comprehensive review on 'Insects and Climate' refers merely to Newport.

Newport (1837, pp. 306-307) observed that during an almost total solar eclipse in England on the 15th May, 1836, honey bees, *Apis mellifica* Linn., started flocking back to the hives at 2-15 p.m. when the eclipse began and the sunlight was sensibly diminished, and only few were leaving. At 3-15 p.m., when little light remained and the temperature dropped from 20°C. to 15°C., the hives were quiet as in the evenings and not a bee went abroad; also, cocks were crowing. At 4 p.m. when the eclipse was nearly over, full activity was resumed by the bees and they were going abroad in large numbers. He concluded (p. 306) as follows:—'. . . that in proportion to the diminution of light the hives became quiet, and the temperature of the hives decreased until after the eclipse had passed its maximum, when as the light began again to increase, the activity of the hives became restored, and with it a considerable increase of heat'.

The paper of Hokusima (1949) on the Chrysomelid beetle, *Phyllotreta vittata* Fabr., has not been accessible to me.

During the partial solar eclipse which occurred in India on the 20th June, 1955, I was able to observe the behaviour of the rock bees, *Apis dorsata* Fabricius, on a hive in New Forest near Dehra Dun (Uttar Pradesh, ca. 600 metres altitude). The hive (Text-fig. 1) whose flat surface measured about 50 × 60 cm. was situated at a height of about 12 metres from the ground, on a drain pipe on the southern face of a high quadrangle wall. The hive was so situated that the sun shone directly upon it in the mornings.

For the effect of solar eclipse on other animals, *vide* Appendix.

The eclipse at Dehra Dun lasted about 1 hr. 43 mins. (from about 07.37 hrs. to about 09.20 hrs.) in the morning, and was partial, the shadow covering about one-fourth of the sun at the maximum (Text-fig. 2).

Observations were taken with the aid of a field binocular from a distance of about 3 metres from the hive. As during the period of observation the bees were continually both leaving and returning to the hive, the total number of such bees was taken as a convenient and easily observable index of *bee activity* (Tables 1 and 2). For comparison, the bee activity was also recorded two days later on a 'normal' day.

I was assisted in making and recording the observations, particularly in making bee counts, by my children, Vimla, Sarla and Ganpat Singh, for whose enthusiasm and help I record my thanks.

II. OBSERVATIONS

The following is a record of the observations carried out first, during the eclipse (20th June) and, secondly, on a normal day (22nd June).

(a) ON 20TH JUNE, 1955 (DURING SOLAR ECLIPSE)

TABLE 1

Activity of bees Apis dorsata Fabr. (total number of bees leaving and returning to the hive per minute) before, during and after the partial solar eclipse on 20th June, 1955, at Dehra Dun (cf. Table 2)

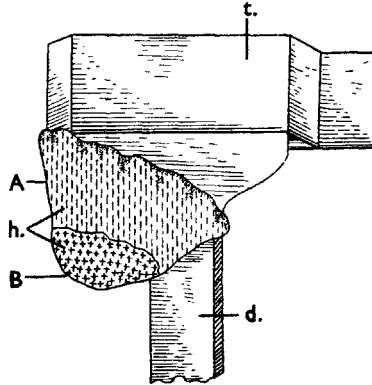
Note.—The individual observations were for 15–30 seconds and the figures so obtained were then calculated for one minute.

Time (hrs.)	Number of bees leaving and returning to hive per minute	Remarks
07.25	20	Cloudy.
07.37	20	Cloudy. Approximate announced time of beginning of eclipse.
08.05	28	Eclipse fairly advanced.
08.30	160	Eclipse advanced; about maximum.
08.45	172	
09.00	90	Eclipse declining.
09.15	28	Eclipse nearing end.
09.26	34	Eclipse over by now.
09.31	24	

(i) *Condition of bees just before the eclipse*

07.25 hrs.—The sun is under clouds. The bees are thickly packed on the hive and are generally quiet, but it is possible to divide the hive into two portions in this respect, thus: (i) The upper two-thirds (Text-fig. 1, *A*) in which the bees are very quiet and there is hardly a movement in the mass, except that occasionally a bee here and a bee there shows slight movements; hardly any bee leaves this part of the hive or returns to it. (ii) The lower one-third (Text-fig. 1, *B*) where the bees are distinctly more active. They move their bodies and legs as if for mutual adjustment. Occasionally, a bee leaves the hive or returns to it—this occurs at the rate of about 20 individuals (total of both categories)* per minute, the number of bees leaving and returning being about equal.

* Throughout this paper this figure represents the *total* of both categories, i.e. of those leaving and those returning to the hive.



TEXT-FIG. 1. The hive of the rock bee, *Apis dorsata* Fabr., which was kept under observation during the partial solar eclipse at New Forest, Dehra Dun, on the morning of 20th June, 1955.

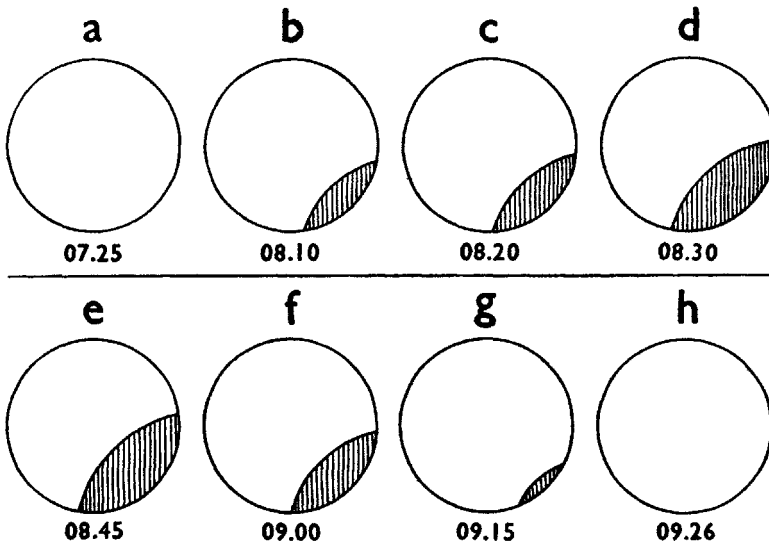
A—upper portion of hive (where the bees were comparatively inactive); B—lower portion of hive (where the bees were comparatively active); d.—drain pipe; h.—bee-hive; t.—drain tank.

(ii) Condition of bees during the eclipse

07.37 hrs.—The sun is under clouds. This is the approximate time of the beginning of the eclipse. The bees are behaving as at 07.25 hrs. The number of bees leaving and returning to the hive is about 20 per minute.

07.45 hrs.—It is still cloudy, but some sun rays are partly shining through. The bees are behaving as before.

07.50 hrs.—The sun is under heavy clouds. The bees are behaving as before.



TEXT-FIG. 2. The solar disc as seen at New Forest, Dehra Dun, on the morning (07.25 hrs. to 09.26 hrs.) of 20th June, 1955, during the partial solar eclipse. The shaded portion represents the approximate extent of the sun's disc covered by the moon. The time, in hours, is indicated.

08.05 hrs.—The sun is out of the clouds; the eclipse is fairly advanced. The bees appear to be a little restless in the lower part of the hive. The number of bees leaving and returning to hive is about 28 per minute. In the upper portion of hive the bees are quiet as before.

08.20 hrs.—The sun is visible; the eclipse is advancing. The bees are behaving as at 08.05 hrs.

08.30 hrs.—The sun is alternately in and out of the clouds; the eclipse is nearing the maximum. In the lower part of hive the bees are becoming much more restless than before; the number of bees leaving and returning to hive is about 160 per minute. In the upper part of the hive the bees are as inactive as before.

08.45 hrs.—The sun is alternately in and out of the clouds; the eclipse is almost at the maximum or perhaps a little past it (Text-fig. 2). In the lower part of hive the bees are restless as at 08.30 hrs.; the number of bees leaving and returning to hive is about 172 per minute. There is no change in the activity of bees when the sun goes in and out of the clouds.

09.00 hrs.—The sun is fully out of the clouds; the eclipse is declining. In the lower part of hive the bees are now less restless; the number of bees leaving and returning to hive is about 90 per minute. In the upper part of the hive the bees are comparatively inactive as before.

09.15 hrs.—The sun is now out of the clouds; the eclipse is nearing the end. In the lower part of hive the bees are much less restless than before; the number of bees leaving and returning to the hive is now only about 28 per minute. In the upper part of the hive the bees are inactive as before.

(iii) Condition of bees just after the eclipse

09.26 hrs.—The sun is visible; the eclipse is over by now. In the lower part of the hive the bees are behaving as at 09.15 hrs., i.e. they show only mild restlessness; the number of bees leaving and returning to the hive is about 34 per minute. In the upper part of hive, however, the bees, which had all along been very quiet, are now a little restless, and out of several hundred bees, all in the same vertical position and packed closely, a few (5 or 6) have now moved to a slanting position.

09.31 hrs.—The sun is free from clouds. In the lower part of the hive, the bees are behaving as at 09.26 hrs., i.e. are only mildly restless; the number of bees leaving and returning to hive is about 24 per minute. The upper part of the hive shows no change.

(b) ON 22ND JUNE, 1955 (NORMAL DAY)

TABLE 2

Activity of bees, Apis dorsata Fabr. (total number of bees leaving and returning to the hive per minute), on a normal, sunny day (22nd June, 1955) at New Forest, Dehra Dun. (Same hive as in Table 1)

Note.—The individual observations were for 30 seconds and the figures so obtained were calculated for one minute.

Time (hrs.)	Number of bees leaving and returning to hive per minute	Remarks
08.00	50	Sun shining directly on hive.
08.15	50	Ditto.
08.30	56	Ditto.
08.45	62	Sun not shining directly on hive.
09.00	64	Ditto.
09.30	50	Ditto.

For comparison with observations during the eclipse, the behaviour of the bees in the same hive was observed two days later, on the 22nd June, 1955, with the following results. The number of bees leaving and returning to the hive is given in Table 2, the number leaving and returning being about equal.

08.00 hrs.—The sun is *out* and shining directly on the hive; there are no clouds. As on the 20th June, the bees are more active in the lower part of hive than in the upper. The upper portion is distinctly more active than on the 20th June, although still less active than the lower one.

08.15 and 08.30 hrs.—There is no change.

08.45 hrs.—The sun is as before but is not now shining directly on the hive. The bees all over the hive are more active than before.

09.00 hrs.—The condition of bees is generally as at 08.45 hrs.

09.30 hrs.—The condition of bees is generally as before, but the number of bees leaving and returning to the hive is rather fewer.

(c) CONCLUSIONS

It would appear that during the partial solar eclipse on the 20th June, the rock bees became distinctly restless and more active. This was evident both by general visual observation as well as by counting the number of bees leaving and returning to the hive. The total of such individuals (both leaving and returning) rose from 20 per minute at the beginning of the eclipse to 160–172 at the maximum eclipse, and then gradually fell with the decline of the eclipse, the count being about 24–34 at the end. Comparison on a normal sunny day two days later (22nd June) during roughly the same period gave this count as 50–64; no marked rise or fall was noticeable.

III. SUMMARY

1. The behaviour of the rock bees, *Apis dorsata* Fabr., was observed in a hive at New Forest, Dehra Dun (Uttar Pradesh), during a partial (about one-fourth) solar eclipse, on the 20th June, 1955, which lasted for about 1 hr. 43 mins. (from about 07.37 hrs. to 09.20 hrs.). For comparison, the behaviour of the bees in the same hive was observed two days later (on the 22nd June).

2. It was noted that during the eclipse the bees became distinctly restless and more active. The number of bees leaving and returning to the hive rose from about 20 at the beginning of the eclipse to 160–172 at the maximum eclipse, and then gradually fell to about 24–34 with the decline of the eclipse. No such marked rise and fall was noticed on the 22nd June, the figures being 50–64.

IV. REFERENCES

- Hukusima, S. (1949). On the activity of the adult of *Phyllotreta vittata* Fabricius in the case of a solar eclipse. [In Japanese.] *Matsumushi*, Sapporo, 3, 81–84. (Not seen in original.)
 Newport, G. (1837). On the temperature of insects, and its connection with the functions of respiration and circulation in the class of invertebrated animals. *Philos. Trans. R. Soc. Lond.*, London, 127 (1), 259–338, 16 tables.
 Uvarov, B. P. (1931). Insects and climate. *Trans. ent. Soc. Lond.*, London, 79 (1), 1–247.

V. ADDENDUM

After this paper was ready for the press, two recent observations on the effect of solar eclipse on animal behaviour came to my notice and deserve mention.

Pillai (1956) made some observations during a partial solar eclipse* at Trivandrum (southern India) on the 14th December, 1955, which commenced at

* Pillai did not mention the extent of the eclipse. On an enquiry from the Officer-in-Charge, The Observatory, Trivandrum, the latter informed me (in his letter dated 25th March, 1957) that the solar eclipse observed at Trivandrum on the 14th December, 1955, was 'a partial one and the maximum extent of it was about 80%'; and further that the 'total time of duration was 4 hrs. 21 mins.'; and 'it was maximum at 12.55 p.m.'

10.37 a.m. and lasted 4 hrs. 21 mins. At 12.35 p.m. it was so dark that lights had to be put on inside the rooms. The temperature fell from 82.6°F. (ca. 28.1°C.) at 12.00 hrs. to 80.6°F. (ca. 27°C.) at 13.00 hrs. and 80.4°F. (ca. 26.8°C.) at 14.00 hrs.; there was also a slight fall of atmospheric pressure and a rise in humidity by 9 per cent. He observed several birds and mammals in the zoological garden during the eclipse and concluded that 'contrary to popular notion, animals either captive or free display little or no responsive behaviour during a solar eclipse'.

Marsden (1956) observed during the solar eclipse in 1936, in Japan, that until the eclipse was total such birds and domestic animals as came to his notice behaved in no way out of the common, but as soon as the eclipse was total (about 1 p.m. local time), it was as dark as in a clear moonlight night in India, and 'all animal noise and movement ceased forthwith'. Fifty-five seconds later when the moon's shadow on the earth passed away equally suddenly, 'the usual animal noises of early dawn were heard on all sides—cocks crowing, etc.—and normal movement was resumed'.

- Marsden, G. H. (1956). Solar eclipse and animal behaviour. *J. Bombay nat. Hist. Soc., Bombay*, 54 (1), 194-195.
Pillai, N. G. (1956). Solar eclipse and animal behaviour. *J. Bombay nat. Hist. Soc., Bombay*, 53 (4), 708-710.

Issued September 23, 1957.



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