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THE ECONOMIC ROLE OF HORN WORMS (*Sphingidae*) WITH SPECIAL REFERENCE TO S. INDIA*

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As all entomologists are aware, horn worms are the larvae of moths belonging to the family *Sphingidae* known popularly as hawk moths. Though these insects are not so very important from an economic stand-point compared with the caterpillars of such groups of moths as the Noctuidae (cut worms etc.), Pyralidae, (leaf caterpillars) Arctiidae (Hairy caterpillars), etc.; some horn worms occasionally come to some prominence not only as pests of cultivated crops, but also in some other respects. This paper is an attempt to bring together our knowledge of the general bionomics of Indian Sphingids which possess some economic importance with special reference to S. India. We have so far records only of three sphingids of economic importance from South India *vide* Fletcher's book published in 1914 though Hampson, Lefroy and latterly Fletcher refer to about a dozen forms from all over India. In view of the fact that our knowledge of these insects has considerably increased since then, and since we have no connected or upto-date account of these insects from S. India, this paper is an attempt in that direction; as far as the writer is aware—the only recorded publication on any sphingid from S. India since 1914 is the one by the present writer on the bionomics of *Polyptychus dentatus*, Cr. In the present paper brief notes on all the Indian forms so far noted to have any economic importance are added with special reference to forms noted in S. India. In all fifteen species are included; a few remarks on the striking features of sphingids in general are also added to make the paper somewhat comprehensive of the whole family.

General Bionomics of Sphingids. Among moths (Heterocera) including numerous families the Sphingidae (hawk moths) include insects which are some of the biggest stout built and beautiful moths known. They are found chiefly in the tropical regions. Their stout body and quick dashing flights have gained them the name of "hawk moths". The life histories and habits of almost all the members of the family are similar—the larvae feeding and developing on plants only. The fairly large oval eggs are laid singly on the specific food plant and the caterpillars that emerge are generally stout and cylindrical and in some cases grow to a length of four or five inches by the time they pupate. The special characteristic of hawk moth caterpillars, not found in most other caterpillars, is the possession of a dorsal horn on the apical abdominal segment hence known as hornworms. It is median in position and may be curved or straight, smooth or tuberculated

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and long or reduced in different species. In one case however, *Polyptychus dentatus*, L. the writer noted a horn like process on the head also during the earlier larval stages—a character quite uncommon and unique in the family. Hawk moth caterpillars often assume frightening attitudes by raising their front part and assuming the form of the sphinx; hence they are known also as sphinx caterpillars. Some of them also possess in addition to the anal horn bright ocellar spots on the thorax which appear like eyes and these evidently act as protective adaptations. The full grown larvae generally pupate under the soil, often under a cocoon of soil. The pupa is generally of large size and two types of them are found among the members of the family; one similar in form to that of all moths—a compact chitinous object; the other type, which is peculiar to some hawk moths only, is known as the jug handle pupa—since in this type the proboscis sheath of the chrysalis is separated from the main body and attached to it, this modification appearing like the handle of a water jug. The adult moths, as already noted above, are stout built creatures, active fliers and generally crepescular and nocturnal in habits, though a few are sometimes found flying during day time. Similar to other caterpillars horn worms are also often subject to the attacks of parasites and other natural enemies. The writer has once reared from a single larva of the nerium hawk moth (*Deilephila nerii*) as many as sixty eight individuals of a parasitic wasp (*Megarhogas theretrae*, V). From the egg of the cardia sphingid (*Polyptychus dentatus*, C) he also got a minute chalcid parasite (*Anastatus coimbatorensis*, G). From another sphingid larva that of (*Macroglossum vialis*) a braconid wasp *Microplitis sp.* was also reared. Parasitic flies also have been found to attack these caterpillars. The tachinid fly *Sturmia atropivoria*, RD, has been reared in numbers on the gingelly sphinx—*Acherontia styx*. Outside India a bacterial disease of horn worms has been noted on the tomato and tobacco worms (*Protoparce* spp.—insects close to our sweet potato hawk moth *H. convolvuli*); this disease gradually turns the caterpillar watery and before dying it clings on to the plant by means of the proleg hooks. We have not noted such a thing on sphingids so far in S. India though such a case has been noted by the writer affecting the paddy arm worm (*Spodoptera*) more than once.

In South India the following species have been noted to possess some economic importance:—

1. *Acherontia styx*, W. Known as the death's head moth on account of the peculiar skull mark on its thorax. The moth is stoutbuilt and has a dark brown general color with marks of blue and yellow especially on the abdomen. The caterpillar of this moth is a pest of some importance attacking cultivated crops like Sesamum, Lab-lab and Brinjal all over India. It is green with golden stripes along the sides of the body. There are records of the insect on potato in N. India. The insect has wide distribution all over India.

2. *Acherontia lachesis*, FB. This insect is very similar to *A. styx* in general form and color but has a stronger build and darker color. The

larva is more or less similar to *A. styx* and is found in company with the latter but is not so common. Has been noted by the author feeding on Nyctanthus plant in Malabar. Sometimes this moth is noted hiding under roof of houses. The moths of these species make a screeching noise when disturbed.

3. *Ambulyx pagana*, F. A large moth with pinkish brown wings. The stout greenish larva has the abdominal spine short and reduced. It has been sometimes found feeding on the foliage of *Pongamia glabra* in Coimbatore.

4. *Acosmeryx anceа*, Cr. The larva of this insect has been found by the writer on Daincha *(Sesbania aegyptiaca)*.

5. *Hippotion celerio*, L. A dark grey moth with a whitish streak along fore wings and pink and dark patches on hind wings. The caterpillar is not as stout as those of *Acherontia* or *Ambulyx* and the color varies; it may be a shade of green or sometimes with a mixture of violet and brownish red. There are conspicuous many colored eye spots (generally two pairs) on either side of the body behind the third thoracic segment. The abdominal horn is long and straight. In S. India this caterpillar feeds on the foliage of about half a dozen common plants including Grape vine, Elephant yam, *Colocasia* and garden Balsam. A common wild shrub it feeds on is *Boerhavia*. It has a wide distribution all over India. Is recorded on *Beta* and *Rumex* in N. India and on cotton in Egypt.

6. *Theretra Oldenlandiae*, Fabr. The moth is in general form and appearance similar to *H. celerio* with a dark and white streak along upper wing. The green caterpillar is commonly found on *Colocasia*, both wild and cultivated. Recorded on sweet potato and Balsam in N. India.

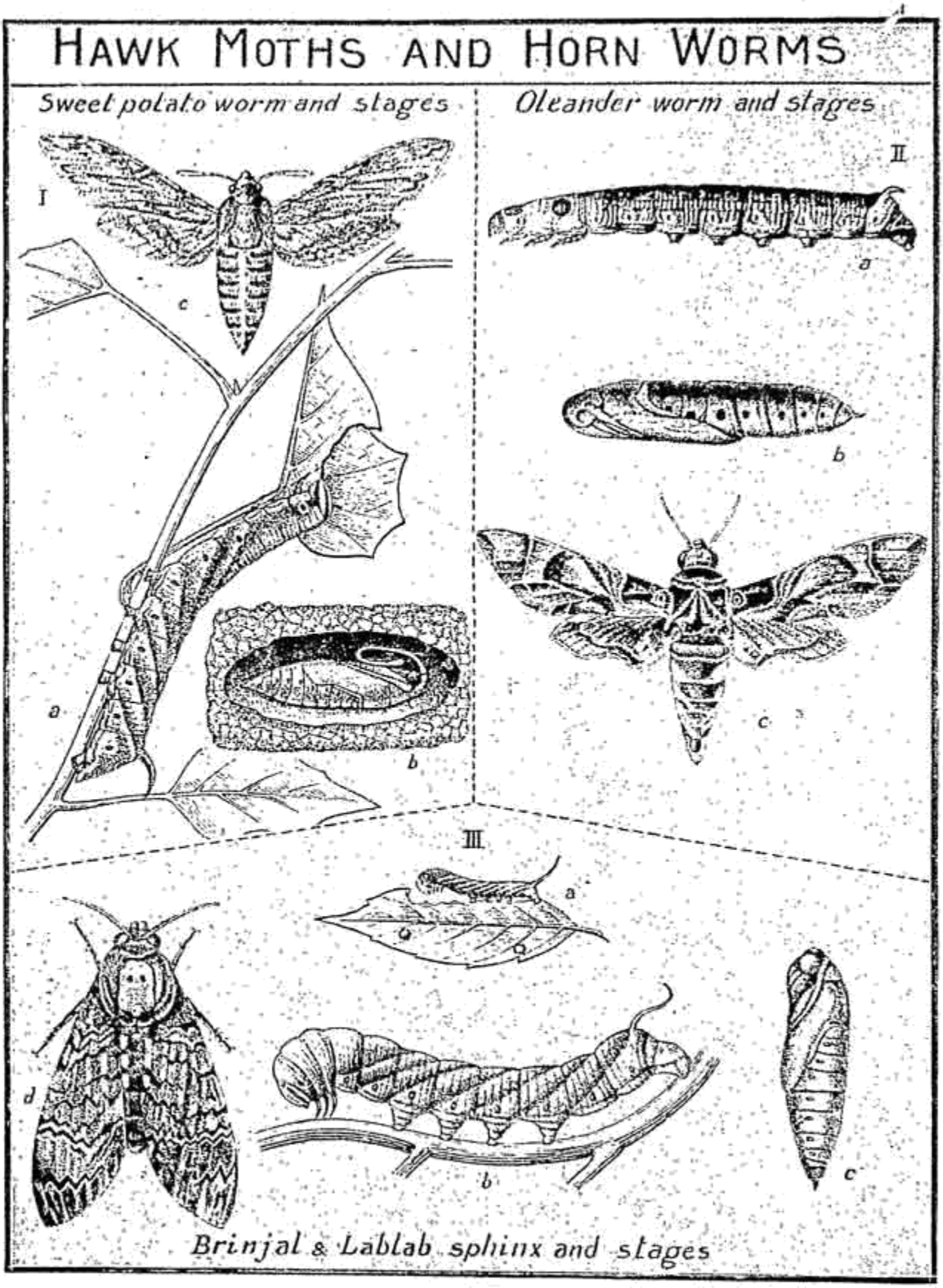
7. *T. butus (gnoma)*, Wlk. Is a closely allied species also found occasionally on grape vine with *H. celerio*, L.

8. *Rhyncholaba* actens, Cr. A grey medium sized moth with bright green patches on the wing. The larva which is beautifully adorned in colors is occasionally found on *Colocasia* with *Theretra* spp. It has several eye spots on the body; of these the thoracic ones are bigger and many colored. Life history notes on this insect (with figures) reared in Pusa on *Pythonessa wallichii* plants are given in Bulletin 89 (1919).

9. *Deilephila nerii*, L. A large stout olive green moth, one of the most beautiful insects known. This is known as the Oleander hawk moth after its common food plant the garden oleander (nerium). The large sized stout larva is green or yellowish green with conspicuous large eye spots behind the thorax and a long yellow rough abdominal horn. It is common all over India and confines its activities almost entirely to this plant. It is noted by Fletcher to have been bred to on *Jasminum* and *Tabernimontana* in N. India.

10. *Herse (Protoparce) convolvuli*, L. Among sphingids of economic importance in S. India this insect occupies a very important position since his caterpillar often causes wholesale damage in fields of pulses and sweet

HAWK MOTHS AND HORN WORMS



potato, and has been also noted on sunflower and ground nut in N. India. The writer once noted a whole field of green gram in the Godavari district completely defoliated by caterpillars of this moth. The moth is pale whitish grey with pale violet bands on the abdominal segments. The caterpillar is pale green with yellowish or reddish brown stripes along the side of the abdomen. The genus *Protparce* has a very wide distribution all over the tropics. In California, Australia, etc. the species of this genus attack Tabacco and Tomato badly and those species appear to be very much allied to our *H. convolvuli*, L.

11. *Thamnoecha uniformis*, B. A stout dark grey moth with the thorax bordered with black, especially around the posterior margin and sides. The caterpillar at a glance may be mistaken for that of *Acherontia styx* but slight differences in color and in the build of the thorax and the anal horn are clear. It has been recorded by the writer on the Parijath (*Nyctanthus arbor-tristis*), plant in Malabar where it occasionally defoliates this valuable and sacred flower plant.

12. *Nephle didyma*, F. A medium sized olive greenish moth often with 2 or 3 silvery spots on the fore wings. The caterpillar is green with a faint brownish band along the middorsal line and white lateral striae on the abdomen; the thoracic region is swollen. The caterpillar occasionally pupates inside leaf folds in the food plant itself which is generally *Carissa carandα* in Coimbatore (a local fruit which is pickled). It has also been noted on the same plant in Calcutta.

13. *Rhophalopsyche bifasciata*, B. A small dark grey moth with a yellow patch on hind wing with dentate margins. The caterpillar is greenish or greenish brown in color with the abdominal horn, long and stout. The caterpillar is in many respects similar to that of *Macroglossum spp.* noted below and breeds on *Morinda tinctoria* leaves.

14. *Macroglossum spp.* These are what are known as humming bird hawk months due to their close general resemblance to humming birds. Some of them even mimic those birds (see fig.). Two or three species are common in South India and these are generally found to breed chiefly on *Morinda tinctoria* leaves; these include *M. gyrans*, W. and *M. vialis*, B. small moths with abdominal tufts. These are occasionally found flying during daytime also. The larvae are green with the horn edged with black; variations are frequently found in the form and coloration of these larvae. *M. vialis* has also been recorded as having been reared on *nux-vomica* leaves on the Nilgiris by Fellowes Mason in 1921.

15. *Cephanodes picus* Cr. This is a beautiful small stout built moth with hyaline wings, yellow and red colored abdomen and with a conspicuous hair tuft at the anal end. It is also a humming bird hawk moth and is often found flying during day time visiting flowers of sorts. This has not been noted as a pest but is found to act as an efficient pollinator of many flowers.

The above are the species so far known from S. India having an economic importance. Most of them in their larval stages are plant feeders

and some of them such as *Acherontia, Herse, Hippotion, Theretra* and *Deilephila* are plant pests of some importance. As adult moths most of the sphingids are either harmless or helpful. The harm done has been noted chiefly with the death's head moth *Acherontia styx*, which has been often reported to rob honey from bee hives. The writer doubts whether this moth causes any appreciable loss in honey in the case of artificial hives where it is impossible for it with its stout body to enter a hive through the small bee hole. As regards beneficial work done it may be added that several species of hawk moths, especially the crepescular and diurnal species like *Macroglossa, Cephanodes* etc. carry on good work as pollinators; their long tongue helps them in reaching some of the deep flowers like those of the Convolvulaceae.

It is quite possible that further studies might add a good deal to our present knowledge of Indian hawk moths and their economic importance.

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THE CHEMICAL COMPOSITION AND ENZYME CONTENT OF INDIAN HONEY

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Figures for the composition of honey commonly used in other countries are known, but there is no information available regarding the composition of Indian honeys. The present investigation was, therefore, undertaken as a preliminary step towards the analysis of Indian honey samples, for the purpose of purity determinations in order to set standards by which the purity of honey could readily be ascertained.

The study of the analysis of the honey samples has now been made by the most reliable methods which can be obtained. Sucrose, levulose and glucose have each been determined separately. Since these are the only carbohydrates which are absorbed as sugars from the gut, their sum constitutes the available carbohydrates of honey.

Materials and Methods. All the honey samples were obtained through the courtesy of Messrs. The Coorg Honey and Wax Producers' Co-operative Society, Ltd. They were collected from three different places and were known therefore to have been collected by bees under different floral conditions