

PRELIMINARY OBSERVATIONS ON A SKIN-PIERCING BLOOD-SUCKING
MOTH (*CALYPTRA EUSTRIGATA* (HMPS.) (LEP., NOCTUIDAE))
IN MALAYA

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(Plates IX & X)

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By examining the stomach contents of the eye-frequenting Noctuid moths *Lobocraspis griseifusa* Hmps. and *Arcyophora sylvatica* Büttiker, Büttiker (1959*a*, *b*, and unpublished records) showed that these species occasionally ingest blood. However, the details of this peculiar feeding habit of eye-frequenting Lepidoptera have so far remained unknown and no information on the mode of uptake has been published.

The first direct observations on blood-sucking moths were made in the course of entomological work in the field¹ in Thailand and Malaya between 1965 and 1967, when it was established that there are two groups of these moths: those which pierce the skin and suck blood and those which "lick" the skin and suck blood. This paper is concerned with the behaviour of *Calyptra eustrigata* (Hmps.), a Noctuid which is a member of the first group, and which has a strong proboscis that enables it to pierce the skin of a number of mammalian hosts.

The moths of the second group, upon which it is intended to report elsewhere at a later date, are unable to pierce the skin, apparently because the proboscis is too weak. They either suck blood from open wounds, or imbibe the tiny droplets of blood that are sometimes present in large numbers on the body of bovines. These droplets are shed by mosquitos which excrete part of the blood that they themselves have ingested. Some of these skin-licking blood-imbibing Lepidoptera are also eye-frequenting, that is, members of a group of moths which take up lachrymal secretions from Ungulata and elephants (Büttiker, 1962*b*, 1964, 1967) and occasionally from human beings (Bänziger, 1966).

Related species of the genus *Calyptra*, including *C. emarginata* (F.), *C. provocans* (Wlk.), and *C. minuticornis* (Gn.) (Kalshoven, 1951; Neubecker, 1960), are well-known in Africa and South Asia as fruit-piercing moths. Moreover, in Cambodia the last species has once been captured from the eye of a water buffalo (Büttiker, 1962*b*) and would therefore appear to be an occasional eye-frequenting as well.

Observations in the field

Records of the behaviour of *Calyptra eustrigata* were made in March and April 1967 in the course of nocturnal observations made while investigating eye-frequenting moths in Malaya. The observation sites, which were on a number of farms at Sungei-tua (approximately 15 km. north of Kuala Lumpur) and also in the

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TABLE I. *Field observations on feeding behaviour of Calyptra eustrigata (Hmps.) near Kuala Lumpur, Malaya, 1967*

Hosts and place	Date (1967)	Weather conditions	Behaviour observed
Nilgai (Zoo)	10.iii	Slight rains in the afternoon	Moth flying for long period around the host, which was too agitated to allow it to alight.
Sambar (Zoo)	16.iii	No rain	Moth sucking blood on the legs.
"	17.iii	Shower in the late afternoon	Moth sucking blood at least 6 min. at a healed up wound on the throat; after a long interval a second attack followed.
"	2.iv	No records	Moth repeating attacks on wound several times at long intervals; also sucking blood on legs and flanks up to 10 minutes.
Tapir (Zoo)	18.iii	Shower in the evening	Moth attacking twice at an interval of 30 min., sucking blood for at least 5 min.
Water buffalo	9.iii	Strong shower in the afternoon	Moth flying amid the herd for long period; not seen feeding.
(Sungei-tua)	29.iii	Night very sultry	2 moths flying amid the herd, probably sucking blood.
"	30.iii	No rain	Moth flying amid the herd, not seen feeding.
"	31.iii	No rain	2 moths flying amid the herd, sucking blood several times for short periods.
"	1.iv	Rain	Moth flying amid the herd and alighting on legs and flanks, very probably sucking blood for short periods.
"	3.iv	Rains in the afternoon, night cool and windy	Moth attacking the herd five times at long intervals, landing once on the back, probably sucking blood.
"	6.iv	No records	Moth flying several times around the mouth, the nose and the body, not seen feeding.
"	9.iv	No rains, hot	Moth flying amid the herd, not seen feeding.
"	10.iv	Slight rains	Moth flying amid the herd, landing on different places and sucking blood for short periods.

No moths were observed during a further 11 inspections at Sungei-tua and the Zoo. Sungei-tua (15 km N of Kuala Lumpur) and the Zoo (15 km NE of Kuala Lumpur) are situated on small hills bordering evergreen rain-forests.

Zoological Gardens of Kuala Lumpur, were in a region of undulating hills covered with primary and secondary rain-forest and rubber plantations.

Adults of *C. eustrigata* were seen on 14 occasions on hosts that included the following: water buffalo (*Bubalus bubalis*), sambar deer (*Cervus unicolor*), Malayan tapir (*Tapirus indicus*) and nilgai antelope (*Boselaphus tragocamelus*), and details of the observations are presented in Table I. The moths rapidly approached the animals at a height of six metres or more above ground, a flight path relatively high in comparison with those of other blood-sucking moths. When near their hosts they dived and circled around them in a faltering flight, apparently locating an attractive spot. On the whole, all parts of the body were visited equally often.

On two nights a healed wound on a sambar deer was attacked by a moth repeatedly, and notwithstanding the fact that the moth was dislodged several times by the host, it invariably returned to the same place. One specimen was observed imbibing blood on the flank of a sleeping tapir for fully five minutes, after which the host became aware of our presence and ran away.

Observations on caged moths

The observations made in the field led to experiments on a human subject using caged adults of *C. eustrigata* in order to obtain more detailed information on their feeding behaviour. By breathing upon the moths, their attention was drawn to moistened fingers held inside the cages. As soon as a moth encountered the fingers, it settled on one of them and began to palpate the skin with its proboscis, and shortly thereafter thrust the proboscis vertically against the skin and tried to pierce it. The spots most commonly pierced appeared to be the pores of the hairs. The dagger-shaped sclerotised tip of the proboscis was pressed against the skin so that the whole proboscis became curved. At the same time, the moth's head began to oscillate rather like the balance wheel of a watch. This movement induced the middle part of the proboscis to vibrate so rapidly that the whole resembled a spindle. Whenever the skin proved impenetrable, the moth tried again at another point near by. As soon as the proboscis successfully perforated the skin, the subject felt strong burning pains which were described as being like those caused by a hot needle. Thereafter the rate of penetration was more rapid, probably because the tissue encountered was softer and the sawing mechanism worked more efficiently as the barbs of the proboscis gripped the tissues. Once inserted, the proboscis remained straight whilst the oscillating movements of the head continued. It was possible to study the working of the mouth parts with a magnifying glass. When they were in operation, the two halves of the proboscis moved rapidly along their longer axis in opposite directions. This mechanism was effective, provided that at the outset sufficient force could be brought to bear to thrust the proboscis into the tissues, because one half of the proboscis could then anchor itself within the tissues, whilst the other penetrated more deeply. The oscillating motion of the head seemed to assist this movement. In addition to its boring action, the whole proboscis was moved up and down at irregular intervals within the hole in the skin. This upward and downward movement was made with so little difficulty as to suggest that a wide shaft had been rasped out. Quite often droplets of saliva, originating below the palps, were seen to run down the outer side of the proboscis; sometimes saliva appeared at the base of the proboscis even before the skin had been pierced. Frequently, some of the ingested blood was regurgitated, and a drop would appear at the aperture of the shaft, but as a rule it was quickly re-ingested. In the meanwhile, the sawing motion of the proboscis continued. After a while, a whitish swelling appeared on the skin around the point of entry of the proboscis. The greatest depth of penetration was about six millimetres. After 10 to 30 minutes had elapsed, dark-red drops of blood were excreted by the moth but the sawing motion

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continued. Blood-sucking occupied from 10 to 60 minutes and blood continued to flow out of the wound for a few minutes after its cessation. Hours and sometimes even days later, the wound was still itching. The skin around the site of the puncture became hardened and this could be felt for at least five weeks. The wound itself, however, remained painful for only a short time.

The experiments were repeated 26 times. In 16 instances the moths pierced the skin and sucked blood; in four they sucked blood from open and superficial wounds on a finger that had been made by means of a knife, and in six they were not able to pierce the skin or made no attempt to do so.

On several occasions, peaches, grapes, oranges and plums were offered to individual adults of *C. eustrigata*, but only peaches were attacked, and it was only some of the moths that attacked these.

Discussion

The foregoing observations made of the skin-piercing and blood-sucking habit of *Calyptra eustrigata* in Malaya are the first to be recorded. In Thailand, we were unable to obtain any evidence of the occurrence of this moth although for 20 months we there investigated eye-frequenting moths that live under similar biological circumstances as *C. eustrigata*. From our own experience and from references in literature it would seem that this species occurs mainly in Malaya, India and Ceylon. This Noctuid was not common at the time of our visit as we found only 25 specimens in the course of four weeks' field work.

According to the preliminary observations made in the neighbourhood of Kuala Lumpur, the usual hosts of the moth were members of the families Bovidae and Cervidae. In one instance even a tapir was attacked. The preferred hosts of the eye-frequenting moths also belong to the Bovidae and Cervidae.

This feeding habit of *C. eustrigata* suggests the possibility that the moth may play a rôle as a vector of diseases of man and animals. The ability to pierce the skin may open a way for pathogens, as the bore of the feeding track is comparatively large, as is shown by the sustained flow of blood after the proboscis has been withdrawn. The secretion of saliva during sucking may also be important, since vectors of disease, such as mosquitos, can transmit pathogens with their saliva. The strong itching suggests that extraneous fluid, such as saliva, enters the wound and gives rise to local inflammation. The subsequent hardening of the skin may be the result of haemorrhage in the damaged tissues accompanied by slight infection or else may be a reaction of the tissue to wounding. However, notwithstanding the observations made under experimental conditions, we have not so far seen any attempt by *C. eustrigata* to attack man in the field.

Some laboratory experiments have shown that *C. eustrigata* pierces fruit. The fruit-piercing behaviour is well-known in other species of the genus and has been reported from many countries. Possibly *C. eustrigata* was formerly a typical fruit-piercing moth; but it would now seem to be evolving into a blood-sucker. Such a change would render it largely independent of the presence of ripe fruit, as blood-feeding is possible throughout the year. The evolutionary path that this behaviour seems to foreshadow parallels that which has already been taken in mosquitos.

Further investigations are being carried out on the economic status, biology and distribution of this Noctuid.

Summary

In the course of entomological investigations in Malaya between 1965 and 1967, it was found that *Calyptra eustrigata* (Hmps.) (Noctuidae) frequently pierces the skin of mammals to feed on blood, and in this respect differs from those

Noctuids that merely imbibe blood from an open wound. Other species of *Calyptra* are known as fruit-piercing moths, and *C. minuticornis* (Gn.) which was taken in Cambodia on one occasion at the eye of a buffalo, is also one of the eye-frequenting moths, which imbibe lachrymal secretions of Ungulata, Proboscidea and occasionally of man. *C. eustrigata* has been observed imbibing blood after piercing the skin of buffalo, Sambar deer, Malayan tapir and nilgai antelope. Caged adults in the laboratory were observed piercing the skin of human fingers offered to them; and imbibition of blood continued for up to an hour. The proboscis, which ends in a sclerotised and strongly barbed point, can penetrate about six millimetres below the surface. The two halves of the proboscis work like two paralalled saws moving alternately. While feeding is in progress, droplets of saliva exude at the base of the proboscis and run down the outside. Often some blood is regurgitated, then reabsorbed. The puncture causes itching, which can last for up to an hour, and local hardening of the tissue, which can persist for five weeks. By reason of its mode of feeding, *C. eustrigata* would appear to be a potential vector of disease, as the saliva and regurgitated fluids might transmit pathogenic agents.

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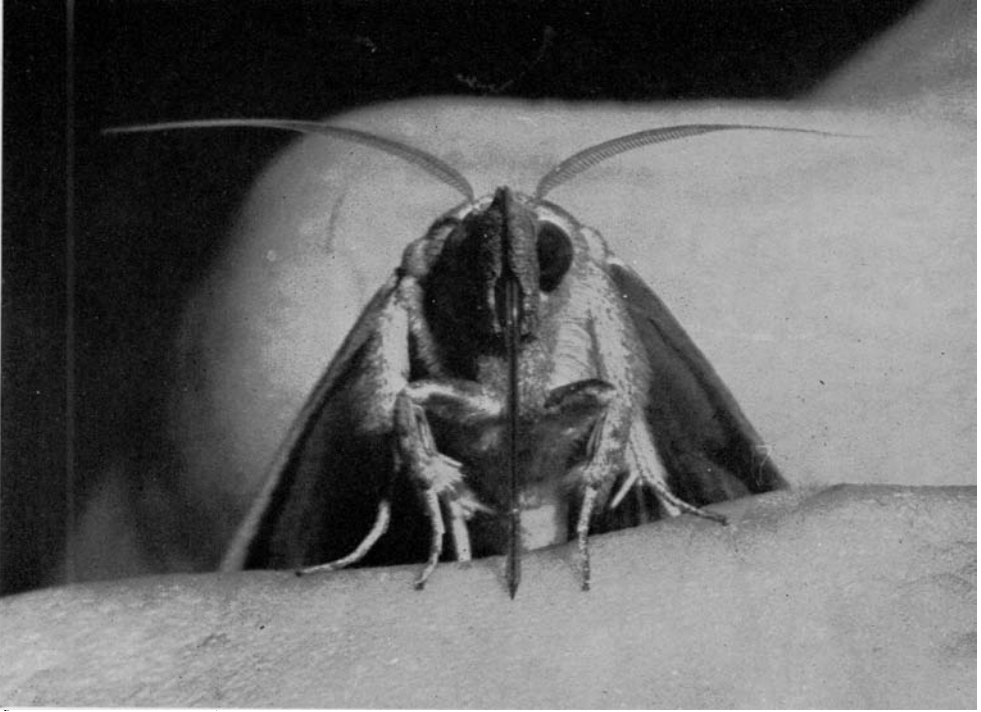


FIG. 1. *C. eustrigata* attempting to pierce the skin of the author's finger. The point of the proboscis is being pressed against the skin, as is indicated by the stretched position of the protarsi. About 3.5×nat. size. (Photo Bänziger.)



FIG. 2. *C. eustrigata* piercing the skin. Part of the saw-tooth armature of the proboscis still visible. (Photo Bänziger.)

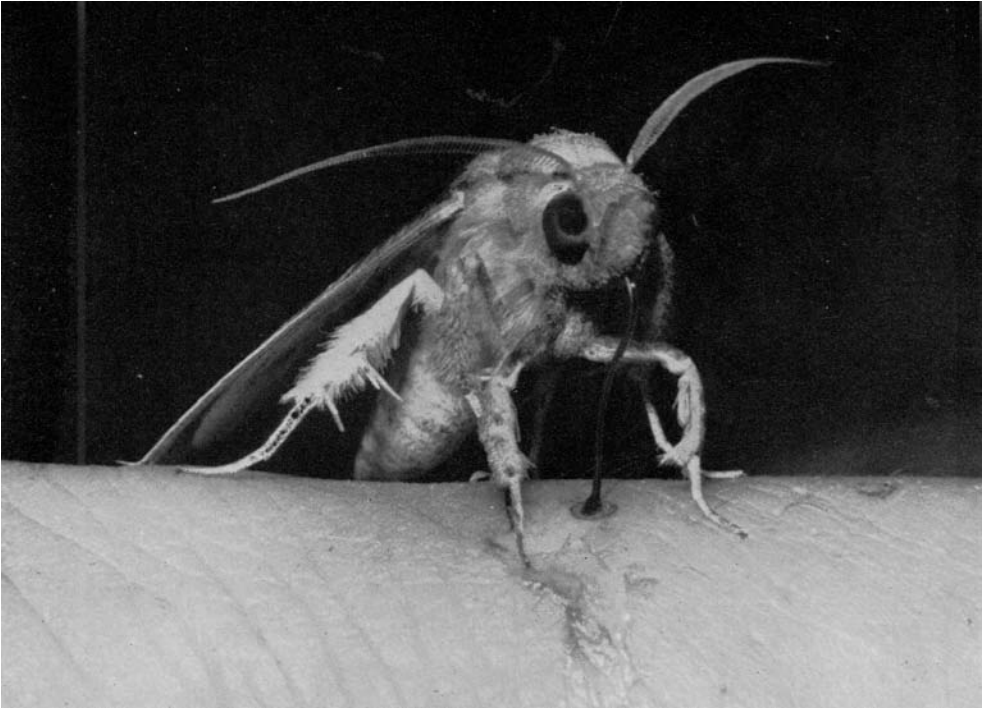


FIG. 1. *C. eustrigata* re-ingesting blood that has been regurgitated a few seconds earlier. The proboscis still remains in the wound. (Photo Bänziger.)



FIG. 2. *C. eustrigata*, with abdomen distended, about to finish sucking, as indicated by the laying of the antennae against the body. (Photo Bänziger.)