1. THE HEAD

(i) External features of the head capsule
(Figs. 1, 2, 3 & 4).

The head capsule of *Spodoptera mauritia* Boisduval is of hypognathous type. It is subglobular in shape and densely covered with dark brown scales. Greater part of the cranial area is occupied by large and suboval eyes (E). The two ocelli (O) borne by the vertex are mesal to and closely lying near the ocular sutures (os). The antennae are confined to the frontoclypeus (FrClp), while the gnathal appendages hang from the ventral margin of the cranium. The long proboscis, when not in use, remains closely coiled underneath the head, flanked laterally by the labial palps (LbPlp). The foramen magnum (For) is fairly wide and secondarily divided into upper (For₁) and lower (For₂) portions by incomplete fusion of the tentorial bridge (TB) with the lateral portions of its rim. The latter possesses concavity (ArcPoc) for the articulation of the cervical sclerite of its side. Below the foramen magnum is the spacious oral fossa with gnathal appendages lodged in it.

(ii) Sutures of the head capsule
(Figs. 1, 2, 5, 6 & 14)

The cranium possesses some sutures which form the limits of its various sclerotic plates.

Laterofacial suture (Ifs).—The laterofacial suture is fairly long and connects the lower rim of the antennal socket (Asoc) with the
anterior tentorial pit (at). It runs almost parallel to the ocular suture (os), except the two extremities which are bent mesally. The suture is internally represented by a very strong ridge (1fr) whose lower end is secondarily fused with the root of the anterior tentorial arm (AT). This suture has been differently named by various workers. Snodgrass (1935) calls it 'subantennal suture'. Duncan (1939) in Vespula pennsylvanica and Carbonell (1959) in Marellia remipes, Uvarov, also take it as 'subantennal suture'. The present writer is in agreement with DuPorte (1956) regarding the nomenclature, as well as, the course of this suture. In insects where separate entities of the frons and clypeus are retained, the laterofacial suture is shown to consists of two parts called 'frontogenal' and 'clypeogenal' sutures (DuPorte, 1960, 1965). These form the limits between the clypeus and frons on one side and the gena on the other side. DuPorte & Bigelow (1952) in hymenoptera have put the anterior tentorial pit as landmark between the 'frontogenal' and 'clypeogenal' sutures.

Vasudeva (1956) in Papilio demoleus L., has labelled an almost identical suture as 'lateral arm of the epistomal suture', further she has shown a faint 'median arm of the epistomal suture', connecting the two antennal sockets. The present writer is not prepared to accept either of her interpretations due to obvious reasons. First, the so called median arm of the epistomal suture is nothing but depigmented line; secondly, the epistomal suture when present usually connects the two anterior tentorial pits across the lower region of the face (Snodgrass, 1935, 1960). Lastly, if at all the two antennae are connected by a suture, it is normally the 'transfrontal suture' (DuPorte, 1965). Srivastava
while working on the same insect (P. demoleus) differs from Vasudeva. He has labelled the 'lateral arm' of the so-called epistomal suture of Vasudeva (1956) as 'subantennal sulcus' which according to him consists of two parts; the first part is short and starts from the anterior tentorial pit whereas the second part is long and fuses with the 'ocular sulcus' to form a composite 'oculo-subantennal sulcus', ending at the base of the antennal socket. The so-called 'oculo-subantennal sulcus' and the 'free' subantennal sulcus' of Srivastava may combinely be compared with 'laterofacial' suture of S. mauritia. Zaka-ur-Rab (1961) while working on the sucking pump of P. demoleus shows 'subantennal sulcus' as independent suture which does not merge with the 'ocular sulcus'. This is a clear contradiction of the findings of Srivastava in P. demoleus. Mathur (1965; Ph.D. thesis) has also pointed out differences in the findings of Vasudeva (1956) and Srivastava (1957), and has rightly suggested these workers to come to an agreed conclusion after consultation and re-examination of P. demoleus.

Postocippital suture (pos). The postocippital suture runs submarginal to the dorsal and lateral margins of the foramen magnum (For). The suture is internally represented by a distinct horse-shoe shaped ridge, which forms an important place for the attachment of various neck muscles responsible for the movement of the head. The suture ends very close to the posterior tentorial pits (pt) having faint continuity with them. Alam (1951) in Stenobracon deesae Cam., attributes almost the same course to the postocippital suture whose ends have been shown to be distinctly continuous with the hypostomal suture through the intervention of the
posterior tentorial pits.

**Trans-Parietal suture (TrPrtls).** The trans-parietal suture starts from the top of the ocular suture (os) in close proximity of the ocellus (O). The suture ascending over the dorsal area of the head descends obliquely on its posterior surface to end/postoccipital suture (pos). It is internally represented by a distinct ridge. The two trans-parietal sutures divide the extensive parietal area into a centrally placed vertex (Vx) and two side plates, the genae (Ge). A suture taking almost the same course but arising from the antennal socket has been labelled as 'postgenal suture' by Madden (1944) in *Protoparce sexta* J. In *P. demoleus*, Srivastava (1957) has named it as 'occipito-postgenal sulcus', separating the occiput from the postgena. However, it may be noted that in these insects the occipital suture is wanting. Naturally, the occiput and postgenal area of these two insects cannot claim separate entities from the parietals. The suture running across this area, therefore, can appropriately be named as trans-parietal suture.

Vasudeva (1956) in *P. demoleus* names a similar suture as 'postgenal suture' and considers the postgenal area engulfing the conventional occiput, a portion of vertex and the upper portion of the facial sclerite upto the antennal socket, a condition not conveniently adjustable in cranial morphology. In *Amblycorpyha oblongifolia* DeGeer, Krammer (1944) has shown an incomplete 'temporal' suture. Ehrlich (1958) in *Danaus plexippus* L., has recorded a suture, more or less, of the same course as that of the trans-parietal suture of *S. mauritia*, and calls it 'paratemporal suture'. He describes another suture as 'temporal suture' which runs
parallel but mesal to the former. The area enclosed between these two sutures is taken by him as 'temporal area'. The course of the 'temporal suture' as shown by Ehrlich (1958) appears to be peculiar. If the 'temporal' and 'paratemporal' sutures of *D. plexippus* as such are accepted, then the 'temporal fossa' in that insect automatically occupies an area which definitely becomes a portion of the mandibular segment of insects as shown by Ferris (1942), whereas, Ferris' interpretation logically confines the temporal area to the ocular-antennal segment.

**Ocular suture (os).** The ocular suture surrounds the eye externally in the form of a circular groove. The suture is internally represented by a weak ridge. It may, however, be noted that a considerably broad ocular diaphragm (oph) is secondarily attached to the margin of the ridge and serves to strengthen the latter. Zaka-ur-Rab (1961) considers the ocular diaphragm (oph) as representing the ocular ridge. The fact that the diaphragm can be detached from the margin of the ridge, shows that it is not a part of the ocular ridge. In the region of the ocellus, the ocular suture receives the trans-parietal suture (TrPrtls). In *P. sexta* (Madden, 1944) the course of the 'ocular suture' is shown to be the same as adopted by the laterofacial suture (Ifs) of *S. mauritia*. It seems, the ocular suture is actually absent in *P. sexta* and Madden has confused the laterofacial suture with the ocular suture. It is interesting to note that Vasudeva (1956) and Srivastava (1957) working on the same species have attributed different courses to the 'ocular suture'. This is likely to complicate rather than clarify the understanding of the ocular suture in insects.
Areas of the head capsule.

(Figs. 1, 2, 3 & 8)

Frontoclypeus (FrClp). The central area of the face is occupied by a large subquadranular and protuberant fronto-clypeus sclerite. The latter is bounded from above by the vertex (Vx) while its lower limit is formed by the labrum (Lm). Laterally the sclerite is flanked by the paired laterofacial sutures (Jfs). The frons and clypeus are not differentiated since the frontoclypeal suture separating the two sclerites is absent. Efforts have been made by Vasudeva (1956) to separate a narrow frons from a large clypeus by the so called 'median arm of the epistomal suture'. The validity of the latter as a true suture has been earlier regarded as doubtful. Further, Vasudeva herself is not sure when she describes it as a "faint line" which also has been shown in her drawing by dots. Similar transverse line connecting the two antennal sockets has been considered differently by Madden (1944), Short (1951), DuPorte (1956, 1965) and Ehrlich (1958) in their respective insects. DuPorte as well as, Ehrlich take it as 'transfrontal suture'; whereas, Short, and Madden call it as 'median arm of the epistomal suture' and the 'frontal' suture respectively. The present writer regards it as a mere line of depigmentation with no morphological significance in *S. mauritia*. As such the facial area becomes a composite sclerite and is named as frontoclypeus. This is in confirmation with the findings of Snodgrass (1947), Hinton (1948), Chiswell (1955) and Zaka-ur-Rab (1964). Srivastava (1957) has gone a step further to include the labrum with frons and clypeus and calls the
composite structure as the 'epistoma'. This idea, seems to have been put forwarded on the basis of the absence of a clypeo-labral suture.

The absence of an external demarcation between the frons and clypeus, results in the loss of their separate identities. Snodgrass (1935) suggests that the clypeus normally gives origin to the cibarial muscles; whereas the frons serves as an area for the origin of the pharyngeal muscles. 'True mouth', which defines the boundary between the cibarium and the pharynx thus becomes quite important. DuPorte (1946) emphasises the importance of anterior tentorial pits which according to him denotes the position of the true mouth and therefore, he distinguishes the frons as the area lying above the anterior tentorial pits and the clypeus lying below. Snodgrass (1947), while reaffirming his previous view, bases the definite entities of the frons and the clypeus on the origin of cibarial and pharyngeal muscles. He, further holds that the true mouth always coincides with the position of the frontal ganglion. The latter unlike the tentorial pits (DuPorte & Bigelow, 1952) retains its position irrespective of any changes in the structure of the head.

DuPorte while agreeing with Snodgrass (1947) on the position of the true mouth in respect to the frontal ganglion, maintains that the frontal ganglion and the anterior tentorial pits are approximately at the same level. In other words he upholds his previous view in defining frons and clypeus with a modification that an imaginary line connecting the anterior tentorial pits shall always pass across the frontal ganglion.

The present writer refrains from supporting DuPorte in considering
the anterior tentorial pits as stable border between the frons and the clypeus. In other words the anterior tentorial pits cannot be accepted as a better basis than the origin of the cibarial and pharyngeal muscles in assigning separate entities to the clypeus and the frons. Snodgrass (1947, 1960) and Zaka-ur-Rab (1964) have convincingly proved that the extra oral 'mouth cavity' (cibarium) lying anterior to the frontal ganglion always receives muscles from the clypeus, whereas the stomodaeum (pharyngeal region) which is posterior to the frontal ganglion receives muscles from the frons. In insects, where the clypeus and frons are separated from each other by fronto-clypeal suture the cibarial and pharyngeal muscles invariably maintain this arrangement (Akbar, 1957; Dhillon, 1966). DuPorte's (1946) contention that the anterior tentorial pits denote the position of the true mouth is not without exception. He himself in a later work with Bigelow (1952) admits that in some insects the anterior tentorial pits do migrate forward so as to lie much ahead of the true mouth. The present writer feels that once the anterior tentorial pits have been found to migrate forward, these can no more be regarded as dependable criterion in demarcating the frons from the clypeus. DuPorte (1956, 1965) while reaffirming his previous view maintains that irrespective of the distance between the anterior tentorial pits and the true mouth, both these structures retain approximately the same level. The present writer doubts its validity because in S. mauritia the true mouth lies much above the level of the anterior tentorial pits.

It is now clear that none of the criteria of DuPorte is without exception, therefore, it is not always possible to determine the boundary
between the postoral frons and the preoral clypeus on the basis of anterior tentorial pits. If at all we are to accept the latter forming any basis, it will have to be with several modifications or even exceptions. This will certainly minimise the value which DuPorte has assigned to the anterior tentorial pits.

Further, DuPorte (1965) in his rejoinder to Zaka-ur-Rab (1964) argues, that the cranium undergoes considerable structural changes and therefore, the muscles may not always retain their origin on the same sclerite. He says "In many insects the frons is very narrow or is greatly shortened, or even obliterated as it is in some Coleoptera, (DuPorte, 1960), one of two things must happen: either the muscle disappears and, perhaps a new one develops, or the muscle shifts its origin to the parietal region in order to maintain its efficiency. Regions of the head therefore, should not be defined solely on the evidence of muscle origin". The present writer however, feels that the presence of the muscles rather than their absence should be considered important from morphological point of view. As such, it has been recorded that in spite of topographic changes in the cranium, the preoral cibarial and postoral pharyngeal muscles do not shift their origin to some other sclerite. DuPorte (1956; Fig. 5; No. 3a) has shown a pair of dorsal dilator muscles of cibarium arising from 'frons', and considers this condition as exception to Snodgrass' (1947) generalization. This argument is apparently based on the recognition of the so-called 'transfrontal suture'. The question is, should this line of secondary depigmentation be given the morphological status of the 'transfrontal suture'? An almost identical line in
S. mauritia has been denied the sutural status.

The cibarial dilators of S. mauritia arise from a large portion of the facial area. As such the clypeus is regarded to have ascended thereby enlarging itself at the cost of the frons. In P. demoleus, Srivastava (1957) has shown a small clypeus and a large frons which is a contradiction to this accepting the fact that the distribution of muscles forms the basis for separating the frons from the clypeus. Perhaps, he would have assigned just the reverse conditions to the clypeus and the frons i.e., what has been shown in S. mauritia, if he had not ignored the importance of frontal ganglion (FrGng).

Parietals. The lateral area of the cranium bearing the eyes and the ocelli is the parietal region. The parietal is ventrally extended up to the lower region of the head due to the absence of distinct pleurostoma. It is mesally separated from the facial area by the paired laterofacial structures (lfs). The absence of the occipital suture enables the parietals to run over the generalized occiput, thereby, extending up to the postoccipital suture (pos). The parietal is subdivided by the paired trans-parietal sutures (TrPrtls). These subdivisions are a central area known as vertex (Vx) and the two lateral areas known as genae (Ge).

Vertex (Vx). The vertex constituting the dorsal surface of the cranium and containing the two ocelli (0) is anteriorly confluent with the frontoclypeus (FrClp) and laterally limited by the distinct trans-parietal (TrPrtls) sutures. Ehrlich (1958) in D. plexippus shows the anterior (ventral) limit of the vertex at the 'transfrontal' suture.
This appears to be in contradiction with the very purpose of the 'trans-frontal suture'.

**Gena (Ge).** The lateral areas of the parietal containing the eyes (E) contribute to the genae of the cranium. The narrow anterior portion of the gena is limited by the laterofacial suture (IFS). The posterior portion of the gena is conspicuously broad. This unusual extension of the gena on the posterior surface of the cranium is due to the absence of the occipital arch. In *P. demoleus*, Srivastava (1957), restricts the gena to a small triangular area in the vicinity of the anterior tentorial pits. Ehrlich (1958) in *D. plexippus*, labels the area enclosed between the ocular sclerite (OSc) and the laterofacial suture as 'paraocular area' which appears as analogous to the anterior portion of the gena of *S. mauritia*. He has not given any reason for using the term 'paraocular area'. Snodgrass (1956), and Ehrlich (1958), regard the major portion of the posterior surface of head as 'occipital area', in spite of the fact that the occipital suture is not recorded by them.

**Postocciput (Poc).** The well developed postoccipital suture (POS) cuts off a narrow submarginal sclerite known as postocciput (Poc) which provide attachment to the cervical membrane. The postocciput forms an incomplete ring around the upper half of the foramen magnum (Forj). The dorsal portion of the sclerite is broad and looks like a flap, hanging obliquely downwards. Therefrom the postocciput descends as narrow strip of sclerite. The lower ends of the postocciput form two broad protuberances which fail to meet each other. Thus an incomplete transverse septum is formed which is responsible for the subdivision of
the foramen magnum into an upper and a lower portion. The upper one (For$_1$) provides passage for the alimentary canal and the heart, while the lower (For$_2$) is traversed by the salivary duct and the ventral nerve cord.

Each protuberance of the postocciput bears a concavity to provide ball and socket like articulation to the cervical sclerite. Such articular concavities have been shown by Alam (1951) in S. deesae. Akbar (1957) is of the opinion that the postocciput develops a condyle instead of a concavity which would mean that the articulation of the cervical sclerite with the cranium should be of 'dicondylic type'.

(iv) **Tentorium**

(Figs.8 & 14)

The tentorium forms the endoskeleton of the head capsule. It is represented by a pair of well sclerotized bars extending from the ventrolateral ends of the postoccipital ridge to the lower extremities of the laterofacial ridges. Each bar is formed by the ingrowth and union of two apodemal arms known as anterior (AT) and posterior (PT) tentorial arms. The root of the anterior tentorial arm is externally represented by a distinct anterior tentorial pit (at) at the lower end of the laterofacial suture (IFS). The posterior tentorial pits (pt) functioning likewise, as point of invagination of the posterior tentorial arm (PT) are located at the end of the postoccipital suture (POS). The arms extending in opposite directions fuse by their apices to form one continuous tentorial bar.
The posterior tentorial arm (PT) after leaving the pit, flattens considerably to function as seat of origin for the antennal extrinsic muscles. The ventro-lateral surface however, gives attachment to the tentorial adductor muscles of the stipes. The posterior tentorial arm in its basal region unites with the counterpart of the other side to form a narrow but distinct tentorial bridge (TB). The latter fuses with the incomplete transverse septa of the postocciput.

The anterior tentorial arm (AT) is elongated and somewhat laterally compressed. The arms are uniformly broad and diverge laterally to accommodate the huge sucking pump. In the basal region just above the anterior tentorial pit (at), the arm fuses with the broad ridge (lfr) of the laterofacial suture so as to brace the lower edges of the cranial wall. The anterior tentorial arm functions as seat of origin for some of the stipital adductor muscles.

(v) Antennae with their muscles
(Figs. 9, 10, 11, 12 & 13)

The antennae are lodged in the frontal area of the cranium. The long, slender and many jointed antennae are suspended from the antennal sockets (Asoc) and can move in all direction.

The antennal socket is suboval and lies close to the ocular suture (os). The antennal suture is wanting and so is the antennal sclerite. The lateral portion of the rim of antennal socket is conspicuous and fairly thickened. In its middle a knob like antennifer (af) is developed to provide articulation to the antennal base.
The antenna is broadly divided into a basal stalk and a distal shaft.

**Basal stalk.** The first antennal joint is the scape (Sep). It is the largest of all the antennal joints. The scape is narrow at the two ends whereas, in the middle it is broadest. The proximal end is lodged in the antennal socket to which it is attached by narrow and flexible 'antacorium'. The lateral portion of the proximal rim of the scape develops a subtriangular shelf-like articular process of the scape (s). The inner surface (d) of this process is markedly concave to provide articulation for the antennifer. Such 'ball-and-socket' type of antennal articulation with antacorium is a confirmation of the findings of Mathur (1961) in *Utetheisa pulchella* L.

The distal rim of the scape develops a pair of articular knobs (e₁, e₂). These are borne on the anterior and posterior halves of the rim. The anterior half of the distal rim is considerably extended to form a fairly developed articular knob (e₁) whereas, the posterior half of the rim bears a stumpy articular knob (e₂). These knobs are of conical shape with broad base. The present writer does not find any 'cup-like depression' on the apices of the knobs as has been shown by Mathur (1961) in *U. pulchella* and thus holds that the scape-pedicellar articulation is of dicondylic type.

**Distal Shaft.** The distal shaft consists of 72-74 joints in males and 75-78 in females. The proximal most annulus which is the largest, is known as pedicel (Pdc). The latter is broader than long. It is narrow at the two ends and swollen in the middle. The anterior and posterior
halves of the proximal rim of the pedicel extend out to form a pair of knob ($f_1^1, f_2^1$). Unlike the distal rim of the scape, the knob borne on the posterior half is well developed ($f_2^1$). The knobs in association with the articular knobs of the scape provide 'dicondylic' articulation between the scape and the pedicel.

The distal end of the pedicel allows the following annulus to fit into it. Each joint is convex proximally and concave distally. Such an arrangement gives the idea of one joint partly telescoped into the other with the result that joints become immovable individually. The lack of mobility in the joints is further attributed to the absence of intrinsic muscles in them.

**Muscles of the antenna** (Fig. 14). The muscles controlling the movements of the antenna, consist of both extrinsic and intrinsic types. The extrinsic set of muscles consists of five separate muscles inserted on the proximal rim of the scape. Similarly, intrinsic set is represented by two muscles only.

**First levator of the antenna** (No. 1). It is a large muscle originating from the dorsolateral surface of the corresponding posterior tentorial arm and is inserted by a short tendon on the proximal rim of the scape just anterior to the articular concavity ($d_2$). It functions as strong levator of the antenna and may be compared with the 'first tentorio-antennal muscle' of *P. demoleus* (Srivastava, 1957).

**Second levator of the antenna** (No. 2). It is also a large muscle arising from the dorsal surface of the posterior tentorial arm,
mesal to the first levator and is inserted by a long tendon on the anterior half of the proximal rim of scape. It is an important levator muscle of antenna. This muscle may be compared with the 'outer levator of antenna' of *P. demoleus* (Vasudeva, 1956).

**First depressor of the antenna (No. 3).** This is the largest muscle of the antenna and originates from the dorsal surface of the posterior tentorial arm mesal and slightly posterior to the first levator. It is inserted by a short tendon on the posterior half of the proximal rim of scape just posterior to its concavity. The pull on this muscle depresses the antenna in a dorso-ventral direction.

**Second depressor of the antenna (No. 4).** It is a slender muscle arising from the dorsal surface of the posterior tentorial arm close to the first depressor muscle. It is attached by a long tendon to the postero-mesal angle of the proximal rim of the scape and serves as a strong depressor of the antenna. This muscle may be compared with 'fourth tentorio-antennal muscle' of *P. demoleus* (Srivastava, 1957).

**Third depressor of the antenna (No. 5).** It is a very slender muscle with origin on the dorsal surface of the posterior tentorial arm mesal and anterior to the second depressor. The muscle ends by long tendon on the posterior half of the proximal rim of the scape.

**Levator of the flagellum (No. 6).** The levator muscle of the flagellum arises by a broad base on the inner surface of the anterior (dorsal) wall of the scape. The fibres of this unpaired muscle are grouped into three bundles which converge on a small tendon inserted on the anterior
half of the proximal rim of the pedicel very close to the anterior articular knob \( (f_1) \). On contraction this muscle raises the flagellum.

**Depressor of the flagellum (No. 7).** The depressor muscle of the flagellum originates on the inner surface of the posterior wall of scape. It is inserted on the posterior half of the proximal rim of the pedicel close to the posterior articular knob \( (f_2) \). The muscle is made of two incomplete bundles which form a single tendon. The depressor muscle lowers the flagellum in dorso-ventral direction.

**(vi) Labrum and epipharynx**

**(Figs. 1,5,6,7,8 and 14)**

The labrum in *S. mauritiana* is a narrow sclerite attached to the ventral margin of the clypeus along a line of flexion. Just after leaving the facial sclerite it curves backwards and then swings forwards. This makes basal portion of the labrum concealed underneath the clypeus. The remaining portion is exposed and directed forwards. Such form of the labrum has not so far been described in Lepidoptera. The present writer attributes this modification to the special function which the labrum has to perform in such insects. The folds in the labrum act like spring and help in forming a tight lid over the otherwise open food canal lying below.

The labrum contains a pair of prominent pilifers (Pf). The latter are well sclerotized, curved and hollow sac-like structures which are covered with thick coat of long hairs. The labrum also bears a central
conical lobe (LMH). The pilifers conceal the proboscis in general, while the central lobe specially covers the basal portion of the food canal. The undersurface of the labrum functions as epipharynx (Ephy). The unpaired dilator muscle of the food meatus originates on the labrum.

(vii) Maxillae with their muscles
(Figs. 3, 4, 7, 14, 15, 16, 18, 19, & 20)

The greatly modified paired maxillae flank the labium from sides. Lying in the oral fossa, these are in membranous suspension from the ventral margin of the posterior surface of the head capsule. Their mesal margins are in membranous connection with the lateral margins of the labium. Each maxilla consists of cardo, stipes and galea. The lacinia is absent while the maxillary palp (MxPlp) is highly reduced and mono-segmented.

Cardo (Cd.) The cardo is a small, oval sclerotic piece. The antero-lateral margin of the cardo has a centrally located socket (ArcCd) which receives the articular knob (ArkGe) formed by the corresponding genal margin of the cranium. Madden (1944) in P. sexta, assigns the articular process to the sclerotized portion of the labium. The cardines in S. mauritia no doubt lie very close to the lateral margins of the labium, yet a close study reveals that these have no articulations with the labium. Srivastava (1957) in P. demoleus shows the proximal end of the cardo having contact with the 'hypostomal projection' but neither from the description nor from the drawings it is clear that the latter provides articulation to the cardo.

Distally the cardo is in continuity with the proximal portion of
stipes along a narrow line of flexion (CdStf). Previous workers on Lepidoptera (Madden, 1944; Eastham & Eassa, 1955; Ehrlich, 1958; Vasudeva, 1956 and Srivastava, 1957), do not record any such hinge line between the stipes and the cardo.

**Stipes (St).** The stipes is an incomplete tubular structure. Mesally it is in membranous connection with the labium and laterally in membranous suspension from the ventral margin of the cranium. The stipes can longitudinally be demarcated into a membranous mesal portion (Stm) and a sclerotic lateral one (Stt). The latter assumes tubular form enclosing a space known as stipital lumen. Srivastava (1957) has divided the sclerotic part of the stipes into three regions, viz., the flat 'juxtastipes', strongly sclerotic tubular 'verastipes' and tapering 'palpifer'. These have been separated by 'stipital sulcus' and 'groove', respectively by him. The so-called stipital sulcus has been shown to have a ridge which is actually the stipital apodeme (StAp) on which the stipital muscles are inserted. Further, such subdivisions can be supported if these help in functional utility of the structure. But to base them on sutural demarcation would not be easily acceptable to morphologists. The present writer, therefore, is not prepared to accept the subdivisions of the stipes.

In *S. mauritia*, the tubular part of the stipes is capable of rolling its outer margin (lateral margin of stipes) inward into the stipital lumen (lumSt). It can take a reverse course to return to its normal position. Such changeable conditions of the stipital lateral margin earn it the status of a valve, which is recently named as 'stipital valve' in *P. brassicae* (Eastham and Eassa, 1955). Thus the longitudinal stipital
valve (StVJw) of *S. mauritia* can connect the stipital lumen with the cephalic lumen through a conspicuous slit. The two lumina can be shut off as well. The flow of blood into and from the stipital lumen is controlled by the actions of the stipital muscles which are inserted on the stipital apodeme. Further, the wall of the stipes possesses a longitudinal line of flexion (Sttf). The elasticity so provided to the wall helps in perfect working of the stipital valve and also saves the sclerotic portion of the stipes from rupture when the adductor muscles undergo contraction. The theory on stipital valve recently proposed by Eastham and Eassa (1955) in *P. brassicae* is thus confirmed. So far all workers on the mechanism of feeding in Lepidoptera appear to have paid no attention to Eastham and Eassa's theory. It is only very recently that an elaborate attempt has been made by Mathur (1965; Ph.D. thesis) towards the justification of the theory.

The two galeae are drawn out with outer convex and inner concave surfaces. The concave surfaces of the elongated galeae run opposed to each other and thus together form the long proboscis. Their inner concavities become confluent to form a longitudinal passage enclosed within the proboscis. This passage can correctly be named as 'food canal' (fc). The basal portion of the food canal is incomplete dorsally where it is overhung by the labrum.

Each galea (Ga) encloses a haemocoel limited by its two walls. The galeal haemocoel is in communication with the lumen of the tubular stipes. The proximal region of the galea (basal part of proboscis) is broad but very short and does not take part in the process of coiling. It is strongly sclerotized and lacks in surface annulations. It may be
differentiated from the distal coilable region along deep latero-dorsally oblique cuticular inflection (R₂). This inclination serves as an apodeme for the insertion of elevator muscles of the galeal base.

The distal coilable portion of the galea, gradually tapers towards the tip which bears several rows of long sensory setae (oSet). The convex outer wall of the galea consists of alternating highly sclerotized (exc) and feebly sclerotized (end) incomplete rings homologous to the exocuticular and endocuticular ribs of P. brassicae. The inner wall of the galea is made of mostly exocuticle, and therefore, is more rigid.

The two galeae are held together through interlocking mechanisms called 'dorsal' and 'ventral' linkage. These interlockings are effective due to indentations all along the mid-dorsal and mid-ventral longitudinal lines of the proboscis. The ventral linkage is formed by curved and toothed hooks which lock into each other from the two sides. Each hook is borne on the inner galea wall. These are of exocuticular in nature and very hard. The ventral hooks form very firm linkage and are actually responsible for holding the two galeae together.

The dorsal linkage is comparatively less thick than the ventral linkage. It is brought about by a series of overlapping lance-shaped plates (dp1). These overlap each other like the tiles on a roof from the base of the proboscis to the tip. The dorsal linkage mechanism is much loose in comparison to the ventral linkage. Probably its main function is to serve as a roof for the food canal besides providing linkage for the two galeae. The inner wall in the region of the dorsal linkage bears a
pair of fairly broad elastic rods (db) which run throughout the whole length of the proboscis. On the basis of location and elastic nature, these may be taken homologous to the 'dorsal bars' of *P. brassicae*.

The internal lumen of the galea is partitioned into three chambers of varying dimensions by the appearance of two oblique septa (dsm, vsm). The septa starting from the base of the coilable portion of the galea end a little before its tip. The septa are identical to the 'dorsal longitudinal' and 'ventral longitudinal' septa of *P. brassicae* (Eastham and Eassa, 1955). The tracheae (tr) of the proboscis lies in the dorsal septum. The dorsal chamber (dch) is devoid of muscles excepting a little of its proximal portion where the elevators of the galea are present. The median chamber (mch) is the largest containing the galeal nerve (nv) and a set of 7-8 primary oblique muscles. The ventral chamber (vch) is the smallest with a set of about two secondary oblique muscles lodged in it. These muscles are present only in a very small portion of the galea called the 'knee bend'. The latter is situated at about one third of the length of the proboscis from the base. It is this place where in extended condition the proboscis shows a sharp ventrally directed bend. However, in coiled condition this point cannot be detected from outside. This confirms the findings of Eastham and Eassa (1955) in *P. brassicae*.

Since the dorsal and ventral longitudinal septa are absent in the tip of the proboscis, its haemocoel becomes unpartitioned. It is almost filled with oblique muscles. The septa which are probably excuticular in nature, help in maintaining the shape of the galea when under the impress of the contraction of its intrinsic muscles.
Sensory structures of the proboscis. In addition to innumerable spines (S) which occur on the outer surface of the proboscis, the present writer has discovered two special types of sensory structures. One of them is on the outer surface of the galea while the other one is on the inner wall of the galea.

(1) **Inner trichoid sensillum** (Fig. 19; iSet). There is a pair of trichoid sensilla on the inner wall of the galea a little distal to the knee bend and projecting into the food canal. The exact situation of the sensillum is the junction of the two longitudinal septa with the inner wall of the galea. The wall providing a base for the sensillum and the latter is in communication through it with the sensory cell (SCI). Taking into consideration the location of the sensillum and their direct contact with the food, it would be proper to consider them as gustatory in function. This will find support when mode of feeding will be described.

(2) **Outer trichoid sensillum** (Fig. 20; oSet). The outer wall of the apical portion of proboscis bears four rows of very long blade like sensory structures arranged dorsolaterally and ventrolaterally on it. These sensilla, though uniform in their structures are not so in their length. Those away from the distal tip of the proboscis are short in comparison to those lying close to the tip. Each sensillum is narrow at the base and gradually broadens towards the apex. The apical tip is constricted to form a small knob which bears a sensory hair. The basal portion of the sensory hair is embedded in a pit borne by the wall. The attachment of the sensillum with the pit is not as firm as that of the inner sensillum. These are probably sensory structures, reported for the
first time in Lepidoptera and are taken to be gustatory sensillia.

**Gland cells of the proboscis** (Fig. 20; gc). The apical one third portion of the haemocoel possesses a series of large unicellular gland. Each cell is roughly globular in shape with narrow duct directed towards the base of the dorsal linkage and opens there. The cell possesses a large nucleus (nu) and granulated cytoplasm. The gland cells possess oily fluid which are discharged onto the outer surface of the dorsal plates. Eastham and Eassa (1955) in *P. brassicae*, record the gland cells in the entire proboscis. They attribute double functions to them. First, it serves to lubricate the dorsal plates for their smooth movements and secondly it seals the gap between the two dorsal plates. The present writer assigning the functions to the gland cells of *S. mauritia* is of opinion that the gland cells are meant for lubrications purposes only.

**Muscles of the maxilla** (Figs. 14, 16 & 17). There are three extrinsic muscles to control the flow of blood from and into the stipital lumen. Srivastava (1957) has recorded five extrinsic muscles for the stipes. This is in contradiction to the finding of Vasudeva (1956) on the same insect who found only three such muscles.

**Cranial adductor muscle** (No. 8). This largest muscle of the stipes is shaped like a fan. Its fibres originate on the genal area occupying practically the entire surface between the ocular diaphragm and the laterofacial inflection. Running downwards and laterally flanking the anterior tentorial arm these end on the broad stipital apodeme just anterior to the cardo. Eastham and Eassa (1955) have shown this muscle
arising on the gena and clypeus. Vasudeva (1956) reports it to arise from the clypeus. These workers are of the opinion that the course of the muscle is mesal to the tentorial arm.

**First tentorial adductor muscle (No. 9).** It is a comparatively small muscle originating on the ventral surface of the tentorium (Tnt) covering a portion each of the anterior and posterior tentorial arm. Its fibres running parallel and mesal to the cranial adductor and just adjacent end to the latter/on the stipes. The identical course and insertion suggest that the two muscles work combiningly to effect complete working of the stipital valve which shuts off the connection between the cranial lumen and the lumen of the stipes. The muscle corresponds with the 'anterior tentorial stipital adductor muscle' of *P. brassicae*.

**Second tentorial adductor muscle (No. 10).** It is the smallest muscle of the stipes. The muscle takes origin from the ventro-lateral surface of the anterior tentorial arm (AT) and is inserted by a short tendon on the distal region of the stipital apodema (StAp). The muscle is similar to that described by Eastham and Eassa (1955) and Vasudeva (1956). It controls the anterior portion of the stipital valve.

**Muscles of the Galea (Figs. 17, 18, 19 & 20).** The galea has both intrinsic and extrinsic muscles which govern its movements.

**Elevator of the galea (No. 11a, b).** There are two such muscles for each galea. These arise on the cuticular inflection separating the stipes and galea (*R*₁) and running obliquely in antero-dorsal region end on the cuticular inflexion of the galea (*R*₂). Eastham and Eassa (1955) show
similar galea elevators but they have separated them into proximal and
distal muscles. The muscles are so arranged that on contraction the
basal region of the proboscis is raised towards the labrum, so that the
latter may temporarily cover the open portion of the food canal.

Retractor of the Galea (No. 12).__ It is a moderately large
muscle arising from the ventral surface of the tentorium to become inserted
on the junction of the stipes with the galea. The contraction of this
muscle draws the base of the proboscis in the region of the cibarium. A
similar muscle has been recorded by Eastham and Essa (1955) and Vasudeva
(1956).

Primary oblique muscles of the galea (No. 13).__ The distal
coilable portion of the galea is provided with sets of 7-8 muscles each;
obliquely arranged throughout the length of the median chamber. Each muscle
is obliquely stretched between the dorso-lateral and ventral portions of
the outer wall of the galea traversing across the median chamber disto-
proximally. In coiled state these muscles are relaxed and take the
curvature of the proboscis. In the extreme distal region, where the longi-
tudinal septa are wanting, the muscles are shorter and stronger and adopt
a transverse course in latero-mesal direction. The space in this region
is almost filled up by these muscles. The primary oblique muscles are
very important as their contraction draws the outer and inner walls of the
galea towards each other, thus uncoiling the proboscis.

Secondary oblique muscles (No. 14).__ Reference has already been
made regarding the knee bend, which is noticeable in the extended proboscis
at about one third of its length from the base. It is here that few sets of 2-3 muscles are observed. These correspond to the 'secondary oblique muscles' of *P. brassicae*. Each muscle arises from the ventral portion of the outer wall at the latter's junction with the inner wall. The fibres traversing the ventral chamber disto-proximally, take a laterally oblique course to end on the ventral portion of the outer wall of the galea close to the ventral longitudinal septum. These muscles act as antagonistic to primaries.

(viii) Labium with its muscle

(Figs. 3, 4, 21, 22 & 23)

The labium in *S. mauritiana* is highly reduced, more or less triangular with feebly sclerotized broad proximal portion and strongly sclerotized narrow distal portion. The basal margin of the labium is continuous with the neck membrane (cvx) in the manner described by Vasudeva (1956) in *P. demoleus*. Madden (1944) in *P. sexta* shows the basal portion of the labium as wholly membranous. The labium in *S. mauritiana* all along the basal portion of its lateral margins is suspended from the cranium excepting a small portion which is soldered with the latter in the vicinity of the maxillary articulation with the cranium. In Lepidoptera Madden (1944), Vasudeva (1956), Srivastava (1957) and Ehrlich (1958) fail to record any sclerotic contiguity between labium and cranium. The posterolateral margins of the labium is in membranous continuity with the maxillae. The apical portion of the labium is subtriangular and
bears internally a median carina (mR). The latter provides attachment to the terminal portion of the median salivary duct.

The sockets for the labial palps are borne on the labial plate about half of its length from the base and close to the lateral margins. The labial palp simply fits into the corresponding socket (Lbsoc) and is attached to its rim by a narrow stretch of membrane. The palpi are flexed upwards with long scales borne on it. It is three segmented; the first being largest. The last segment of the palp is shortest bearing a distinct pit on the distal surface. Hsü (1938) is perhaps the first to record and describe an identical pit in the labial palp of Pieris rapae and took it for "olfactory pit". Since then it is not reported in Lepidoptera. The inner wall of the sensory pit (Sapt) bears numerous bristle like 'sensilla coeloconica (ScPlp). Hsü (1938), shows pegs instead of bristle. The nerve (Nv) for labial palp when reaches the pit, dilates to enclose the latter. Here it gives origin to bipolar cells, whose apical ends enter the bristles. The sensilla coeloconica probably functions as chaemoreceptors.

There is no extrinsic muscle for the labium, which means that its movements are controlled by maxillary muscles. However, the basal segment of the labial palp is provided with a levator muscle (Fig. 23; No. 15). It is a very small muscle taking origin on the labial plate and is inserted on the proximal rim (rLbPlp) of the basal segment of the palp. In _P. demoleus_, Vasudeva (1956), does not record any muscle for the labial palp; whereas, Srivastava (1957) describes it from the same insect.
© (ix) Sucking pump with its muscles
(Figs. 5, 6, 7 & 24)

The sucking pump in *S. mauritia* is a composite structure consisting of the entire cibarium and a portion of the pharynx. The fusion is so complete that there is no differentiation between the two components. The frontal ganglion (*FrGng*) is the only separating landmark. When distended with food it gives the appearance of a bulb, occupying a considerable area of the head lumen. It is a highly muscular structure resting on the diverging anterior tentorial bars. The anterior end is continuous with the food meatus (*fm*) which is dorsally united with the epipharynx (*Ephy*). In *P. brassicae*, Eastham and Eassa (1955) do not show any food meatus whereas a similar structure is taken as 'narrow neck' by Vasudeva (1956) in *P. demoleus*. The food meatus in turn opens into the food canal (*fc*) of the proboscis. Posteriorly the sucking pump communicates with the pharynx (*Phy*).

The floor of the sucking pump (*Hyph*) is bowl-shaped, and highly sclerotized. In *P. demoleus*, Vasudeva (1956) assigns a porous nature to it. The present writer fails to understand, how a porous object can produce a suction force enough to lift the fluid through the lengthy passage of the proboscis into the cibarium. It appears that she has based her observation on a pair of small semisclerotized spots which the present writer has discovered in *S. mauritia*. These spots bear minute sensory pits, working as sensilla coeloconica (*ScSP*). Frings and Frings (1949), have described similar chaemoreceptors from the preoral food
cavity of many insects. However, the presence of sensilla coeloconica in the floor of the sucking pump of *S. mauritia* is perhaps the first record in Lepidoptera.

The floor of the sucking pump of *S. mauritia* appears to be the adoral surface of the hypopharynx (Hyph). The latter has lost its separate identity. The antero-lateral angles of the floor protrude out as strong sclerotic bars (HR) which run forward to fuse with the corresponding genae. Thus the sucking pump is actually supported on the genal area of the head. These bars are identical to the 'hypopharyngeal ridges' of *P. brassicae* (Eastham and Eassa, 1955). The roof of the sucking pump is membranous, concave and flexible. It receives the dilator muscles of the pump which arises from the frontoclypeal area of the cranium. The membranous nature of the roof in comparison with the sclerotic floor responds to the action of dilators as well as, compressor muscles of the pump.

**Muscles of the sucking pump** (Figs. 5, 6 & 7). The musculature of the sucking pump of *S. mauritia* is highly complex. This includes both intrinsic and extrinsic muscles and are categorised as 'dilators' and 'compressors'.

**Dilator of the food meatus** (No. 16). It is an unpaired small muscle which is extraordinarily broad and arises from the inner surface of the labrum (Lm). It is inserted on the dorsal wall of the food meatus (fm). This muscle on contraction converts the food meatus into a wide passage for easy ascent of food into the cibarium. Srivastava (1957)
in *P. demoleus*, names similar muscle as 'anterior clypeal cibarial muscle'. This labelling seems to be based on interpreting as clypeus the area which actually belongs to the labrum and considering the food meatus as part of cibarium.

**Compressor of the food meatus** (No. 17). The fibres of this unpaired muscle transversely wrap the proximal portion of the food meatus near its junction with the cibarial portion of the sucking pump. This muscle being of sphinctor nature normally keeps the communicating passage between the food meatus and the sucking pump closed. It is only under the food pressure synchronized with the relaxation of the dilator of the food meatus that the compressor of food meatus yields and the food consequently moves from the food meatus to sucking pump. A similar muscle, 'transverse sphinctor of cibarium', round the narrow anterior region of the cibarium has been described by Eastham & Eassa (1955). Srivastava (1957) also, labels an identical muscle as 'cibarial compressor', in *P. demoleus*. Perhaps these authors have taken the food meatus as cibarial derivative. This interpretation is difficult to accept specially when cibarium and food meatus are distinctly two independent structures in insect morphology.

**Anterior cibarial dilator** (No. 18). This muscle appears to consist of three bundles originating separately on the anterior one third of the frontoclypeus. Running in dorso-ventral direction these fibres end on the dorsal wall of the sucking pump very near the food meatus. The median bundle is largest while the two laterals are small.
In *P. brassicae* Eastham and Eassa (1955) have shown this muscle represented by a single bundle. Vasudeva (1956) and Srivastava (1957) in *P. demoleus* have taken it to be monobundled and paired muscle respectively. Zaka-ur-Rab (1961) in the same butterfly (*P. demoleus*) records two pairs of 'anteromedian dilator of cibarium'. It can, therefore, be concluded that the anterior portion of the cibarium is provided with dilators in varying numbers in Lepidoptera.

**Lateral cibarial dilator** (No. 19). This pair of muscles is largest among the muscles of the sucking pump. It arises on greater part of the protoclypeus along the laterofacial inflection. Its fibres descending obliquely end in a line on the latero-dorsal surface of the pump. Functionally this muscle becomes a strong dilator of the cibarium. Eastham and Eassa (1955) have labelled a similar muscle as 'lateral cibarial dilator' in *P. brassicae*. Srivastava (1957) shows this muscle originating on the frons. This is based on interpreting the area of origin of the muscle as frons which actually belongs to clypeus. In *Argina cribraria* C., Zaka-ur-Rab (1963) has shown three pairs of such muscles.

**Pharyngeal dilator** (No. 20). It consists of a pair of large and stout muscles. Each muscle arises from the posterior most portion of the frontoclypeus close to the antennal socket (obviously the area becomes the frons). It ends on the dorsal wall of the sucking pump (stomodaeal region) just posterior to the frontal ganglion (FrGng) and its connectives. The contraction of this muscle dilates the
stomodaeal region of the sucking pump. Eastham and Eassa (1955) have shown an unpaired 'pharyngeal dilator muscle' ending on the postero-lateral surface of the sucking pump posterior to the frontal ganglion. How they have shown this muscle arising on the clypeus is difficult to understand.

**Transverse compressor of the sucking pump (No. 21).** It is an unpaired muscle wrapping transversely the entire posterior half of the dorsal surface of sucking pump. It covers both the stomodaeal as well as, cibarial areas of the pump. It is the broadest compressor muscle whose contraction exerts considerable pressure on the dorsal wall of the sucking pump.

**Cruciform compressor of the sucking pump (No. 22).** It is a pair of large muscles encircling almost the entire sucking pump. The fibres of each muscle run diagonally along the length of the pump, and the two muscles consequently cross each other in the form of a 'chiasma'. The present writer calls them as principal compressor of the sucking pump having homology with the 'cruciform compressor' of *P. brassicae*.

(x) **Salivarium with its muscle**

(Figs. 7 & 17)

The common salivary duct dilates slightly at the apex. Though it does not form a reservoir yet is capable of holding a small quantity of saliva within its lumen. Therefore, it may be appropriate to call this region of the salivary duct as salivarium (Slw). The latter may
be compared with that of S. deesae (Alam, 1951). A salivarium has not been so far recorded in Lepidoptera. The salivarium of S. mauritia opens at the junction of the food meatus with the food canal and is secondarily attached to the median carina of the labium. It is lying ventral to the floor of the sucking pump. The roof of the salivarium is membranous while the floor is distinctly sclerotized.

The paired salivary dilators (No. 23) descending obliquely from the hypopharyngeal ridges end on the roof of the salivarium. This corresponds to the 'salivary dilator muscles' of P. brassicae. However, other workers on Lepidoptera do not report any muscle for salivary duct. Alam (1951) has recorded muscle for the salivarium. The ejection of saliva into the food canal is controlled by these muscles.

(xi) Mode of feeding

One of the most interesting features in the anatomy of the Lepidoptera is the mode of coiling and uncoiling of the proboscis. Reumer (1734) was perhaps the first to study the mechanism in some details. Since then, considerable efforts have been made to solve this mystery by different workers in their own ways. These literatures ending with Bourgogne (1951), do not present any thing definite about the actual mode of coiling and uncoiling. For convenience, these works may be divided into three categories.

(1) Intrinsic muscles are directly responsible for coiling, whereas extension is due to blood pressure from the head, or elasticity of the proboscis or both (Burgess, 1880; Eltringham, 1923; Snodgrass, 1935;
Lameere, 1938; Schmitt, 1938; Imms, 1942; Bourgogne, 1951, etc.).

(2) Muscles responsible only for extension and elastic properties of the cuticular wall of proboscis for coiling, (Savigny, 1816; Kirbach, 1884; Hering, 1926; Weber, 1933; Pradhan and Aren, 1941, etc.).

(3) Muscles responsible for both coiling and extension, (Reaumer, 1734; Burmeister, 1832; Portier, 1949, etc.).

Eastham and Eassa (1955) have put forwarded the convincing theory well supported with facts on the mechanism of coiling and uncoiling of proboscis in *P. brassicae*. According to them, the extension of the proboscis is brought about by indirect muscle action under conditions of haemocoelic turgidity. Similarly, coiling is attributed to a special type of elastic 'dorsal bar' present in the proboscis. The present studies in *S. mauritia* mostly support their findings.

The coiling of the proboscis may be considered as a prelude to the feeding. The adductor muscles of stipes are in actual control of the stipital valve which in turn disconnects the stipital lumen from the cranial lumen. Consequently the blood contained in the stipital lumen is not allowed to escape into the cranial lumen. This is considered as a pre-requisite to uncoiling of the proboscis.

In an experiment other than performed by Eastham and Eassa (1955) the present writer severed the apical end of one galea. The galea whose tip was cut remained loosely coiled, showing very little
jerking action. The undamaged galea however, uncoiled in normal manner. When the cut end of the galea was sealed with celloidin, it resumed normal uncoiling. Thus it can be concluded that a closed galea lumen is an essential factor for the uncoiling of the proboscis.

The haemocoel of the galea being closed, the retractor muscles of the galea contract. This draws the proboscis closer to the region of cibarium. It is followed by the contraction of elevator muscles of the galeal base, to pull the latter just underneath the labrum. The structure of the labrum is such that it fits perfectly on the raised basal portion of the proboscis, thereby, effecting temporarily dorsal closure.

Under raised condition the luminae of proboscis and stipes become continuous and the blood from the stipes flows into the basal portion of the galeae. Simultaneously, the primary oblique muscles in the galeal wall undertake proximo-distally directed contraction, thereby, permitting flow of stipital blood into the entire length of galeae and also effecting full extension of the latter.

As has already been reported, the extension of the proboscis beyond a particular limit is resisted at the 'knee bend' which is situated at about one third length from the base. It is here that a set of secondary oblique muscles are present. The long distal portion of the proboscis under extended condition maintains an angle of 80° - 120°, with the knee bend. This curvature in the proboscis is very helpful for the moth which can explore from one spot, several small flowers lying within its reach. The secondary oblique muscles combine with primary oblique muscles to form overlapping 'V's. Due to the curvature of the
proboscis in this region, the latero-ventral contraction of the primary oblique muscles tend to coil the proboscis instead of uncoiling it. The secondary oblique muscles which are antagonistic to primaries check the proboscis from coiling.

The extented proboscis is introduced into the reservoir of the food. The outer trichoid sensilla present on the apical portion of the proboscis helps the moth in selecting the proper food. Such pre-selection is regarded essential for ensuring entry of right type of food into the sucking pump. It is interesting to note that food enters the food canal not only through the open tip of the proboscis; but also through dorsal linkage which are loose and allow the liquid food to enter the food canal from any place beyond the knee bend. This has been discovered by the present writer through an experiment in which the apical tip of the proboscis was sealed by celloiden, yet the moth continued to feed without much difficulty. The outer trichoid sensilla are present on the apical portion of the proboscis for food testing before it enters through the tip. Besides, there are inner trichoid sensilla in the lumen of the food canal beyond the knee bend which perform test on the food entering through the dorsal linkage.

The present writer on the strength of this experiment suggests that the dorsal wall of the food canal is not perfectly air tight. Eastham and Eassa (1955) also basically accept this fact; nevertheless they think that the gland cells opening at the base of the dorsal linkages besides lubricating them may also function to seal the gaps between them
and thereby, make the dorsal wall 'airtight'. The present writer has found these glands only in the apical region of the galeae and therefore, is reluctant to accept that the entire dorsal wall can be regarded air tight with the secretion of the galeal glands. The question arises whether, in the absence of an airtight channel, the suction force created in the sucking pump is capable of lifting the food through such a long passage and against the gravitational force? The feat seems difficult if not impossible. If the source of the food is big enough so as to permit emersion into it a considerable portion of the proboscis, then the feeding can conveniently be done. But the fact that the moth can consume even a small drop of liquid placed at the tip of the proboscis, apparently nullifies the theory of the present writer. The latter attempting to justify his theory suggests ascent of food in the food canal on the basis of capillary mechanism. It is a well known fact that in a capillary tube, liquid rises to a particular height without any extrinsic pressure. The food canal of the moth is sufficiently narrow, and as it is not air tight it can function very well in the manner of a capillary tube. As soon as the tip of the proboscis comes in contact with the food, the latter automatically ascends into the food canal to a particular height. This rise of food without any extrinsic pressure brings the food within the field of action of the sucking pump. To test the validity of the capillary theory, the tip of the proboscis of the moth which was under anaesthesia was introduced into a small drop of glucose water. The latter started ascending into the food canal upto a particular level though the insect was under perfect anaesthesia.
After the food has been raised into the food canal for some height, the dilator muscle of the food meatus contracts so as to put the food meatus in communication with the food canal and, thereby, enabling ascent of the food towards the sucking pump without difficulty. At this stage the dilator muscles of the sucking pump undergo contraction in antero-posterior direction. This creates marked low pressure inside the sucking pump and consequently, the food is dropped into it. After the sucking pump is filled with food, the compressor of the food meatus contracts to cut the passage between cibarium and food meatus so that any backward flow of the food is checked. The dilators of the sucking pump relax in antero-posterior direction and simultaneously the compressors of the sucking pump return to their normal position. The combined action of the dilators and the compressors of the sucking pump compels the food to move in antero-posterior direction within the lumen of the sucking pump. Synchronizing with this movement in the food, the dilators of the pharynx undergo contraction to provide passage for its flow into the pharynx.

The coiling of the proboscis was attributed either to muscle action (Burgess, 1880; Eltringham, 1923; Snodgrass, 1935; Lameere, 1938; Schmitt, 1938; Imms, 1942; Bourgogne, 1951), or to the elasticity of the proboscis as a whole (Kirbach, 1884; Hering, 1926; Weber, 1933; Pradhan and Aren, 1941). Eastham and Eassa (1955) studying in detail the cuticular structure of the proboscis discovered a pair of elastic 'dorsal bars' in each galea "in the upper wall of the food tube".
They assigned the main responsibility of coiling the proboscis to these longitudinal bars. In order to test this, the present writer carried out an experiment on the proboscis of *S. mauritia*. In this experiment the galeae were separated and uncoiled. A few incisions were made in the left galea with a knife along the dorsal bar. After recovery from anaesthesia the moth coiled back the right galea to its normal position; while that of the left side hanged loosely. This confirms that coiling is brought about by elasticity of the dorsal longitudinal bars. The present writer suggests that, though coiling of the proboscis is due mainly to the elastic bars, it is initiated by the relaxation of the primary oblique muscles of the galeae. Secondly, the role of the bar is perhaps made easy and more effective due to the relaxation of the adductor muscles of the stipes which provides unhindered return of excess blood from galeal lumina to the stipital lumina.