The Morphology & Biology of Stenobracon deesæ Cameron.,
(Braconidae, Hymenoptera)
An Ecto parasite of Sugar-cane and Juar Borers of
Northern India.

A DISSERTATION SUBMITTED FOR
THE DEGREE OF Ph.D.
OF
THE ALIGARH MUSLIM UNIVERSITY,
ALIGARH.
1947.

By
Shah Mashhood Alam,
Zoological Laboratories,
Aligarh Muslim University,
Aligarh, U. P.,
India.
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Introduction.

The study of the morphology and biology of *Steno-brason deesea* (Cam.) was taken up by the present writer for the Ph.D. Degree of the Aligarh Muslim University, Aligarh. This insect is noteworthy in many ways: Firstly, it is abundantly found in Aligarh, the neighbouring districts, as well as many parts of India; hence it is easily available for carrying on research work both in the field and the laboratory. Secondly, this parasite, because of its wide spread distribution in every part of India, can conveniently be chosen as a type of parasitic wasp by the students of Universities and Colleges in the country. Finally, it can be bred conveniently throughout the year.

The present paper includes observations on the structure (Internal & External), Life-history and Habits of *Steno-brason deesea* which is an important Braconid ectoparasite of nearly all the borers of sugar-cane and juar plants in India. The present writer has aimed at making a comprehensive study of this insect.

There are, so far, very few detailed accounts on the morphology of various Hymenoptera. Important among them are:

(i) A contribution to the Biology of north American Vespine wasp by Carl D. Duncan (1939).

(ii) Anatomy and Physiology of the honey-bee by R.E. Snodgrass (1925).


(iv) Studio morfologicoe biologico della Blastophaga psenes (L.) by G. Grandi (1929).

(v) On the Anatomy of ants by H. Lubbock (1879).

In view of these it was deemed essential to make a detailed study of a Braconid wasp which has not yet been done else-where.

The group "Ichneumonidea", too, has not received adequate attention. There is no thorough work on the Structure particularly Internal Anatomy of this group. All that has been available is in the form of few fragments of work.

In India the study of Morphology of Hymenopterous parasites has proportionately been far more neglected than the study of the Life-history and Habits. The idea of developing "Biological Control" methods has over-shadowed all the other aspects of these insects.

The present work comprises a study of the adult stage laying chief stress on the Skeleto-Muscular mechanisms of the entire body of this insect. Further more, it also incorporates Anatomical and Functional studies of the Internal viscera.

As regards Biology of the parasite the present writer has touched only the broad features of it because of the limited scope of the problem set for his dissertation. Nevertheless, he has always taken care that the Biological portion of his studies should not be too much restricted so as to lose its own value.

Efforts have been made to refer to all the important Researches on the subject; but it is quite probable that some valuable material might have been omitted. If so, it may be due to the lack of availability of foreign literatures due to the World War (1939-1945), during which this work was started and brought to completion.
Material and Technique.

The adult insect both entire and in parts has been thoroughly studied with the help of dissection under binocular. The well-sclerotized external structure was softened down by 5-10% KOH. It was invariably subject to decolorisation by treating it with Potassium dichromate and hydrochloric acid. The process of decolorisation was always followed by staining with Carbol aniline, and, later on Carbol xylol was used to remove every possibility of incomplete dehydration before the structure could be brought to microscopic studies.

The Myology of the adult was studied under binocular with the help of Borax-Carmine and Mallory fluid. It may be noted here that the second stain proved to be a most successful one for the study of Musculature. The Mallory fluid (stain) is most useful in preparing permanent slides of muscles, which are kept intact at their two ends, with the maximum amount of differentiation for detailed microscopic studies. Besides, this stain served the purpose of providing a temporary bright coloration to the region of the insect under observation. This temporary phase of coloration of the medium, with a good deal of temporary differentiation helps immensely in tracing out the exact points of origin and insertion and the right course of action of the various muscles.

The insects were kept in Picro-chloracetic fixative for 12 hours and then transferred to 70% alcohol for several wash. The specimen fixed in it were found to be quite suitable for section-cutting and dissections for a considerably longer period.
For cutting sections of the Internal anatomy the fixed specimen was passed through ascending alcoholic grades till absolute alcohol was reached. Thence it was put into Benzene which proved to be a most suitable substitute for oil of Cedar wood. From Benzene instead of taking the specimen direct into paraffin it was kept in a mixture of Benzene and paraffin. Therefrom the specimen was subject to pure paraffin of 54-56°C melting point. It was given 2-3 bath of paraffin before embedded in it finally.

The sections were cut with the help of Cambridge Rockery at 4-6 microns thick and were stained in Heidenhain's Iron Haematoxylin.

The alcoholic solution of Eosin in 90% alcohol was used for counter staining of the sections. After the sections had picked up Eosin stain satisfactorily, they were brought up to absolute alcohol in the usual manner. Thence they were transferred to Xylol for few hours. After the Xylol had done its bit the sections were mounted in Canada balsam for microscopic studies.

The respiratory system was studied both in fresh and fixed specimen. Besides, the process of temporary Mallory stain was used for searching out small tracheae in the midst of various Internal viscera and the muscles of the insect.

The study of the chitinous structures of the Pre-imaginal stages had been done exactly in the manner described in connection with the "External structure" of the adult; while the Internal anatomy was studied with the help of Borax-Carmine. The breeding of the parasite was done in the Laboratory. A detailed account of the breeding technique has been given in the chapter dealing with the Biology of the parasite.
(v)

It is regretted very much that the figures could not be drawn at a desired large scale as good drawing paper was not available in sufficient number, due to the World War (1939-1945) during which the problem was started and brought to completion. As regards lettering of the figures the writer had to do it in his own handwriting because of the inavailability of printed letter booklet in India during the period the problem was in hand.

Acknowledgement.

The writer considers his foremost duty to express his heartfelt indebtedness to Dr. M.A.H. Qadri for the most valuable and indispensable help and guidance, he has given during the period the problem was under observation, and also for the trouble he has taken in correcting the manuscript before it could be submitted. He is also thankful to Prof. M.B. Mirza for permission to use his well-equipped laboratory and for financial and other facilities. Besides, he extends thanks to the Indian Agricultural Research Institute, New Delhi for the correct identification of the parasite.
THE HEAD

External features of the head capsule:

The head capsule of Steno-branch doesae (can) is of hypognathous type. In facial view (Fig. 1) it appears triangular in outline. The dorsal area of the head capsule constitutes the base; while the anterior end of the labrum forms the apex of this triangle. The two sides of the triangle are represented by the two big compound eyes. (Figs 1, 2, 3 & 8, E). The base of the triangle or the "vertex" is arched and bears 3 ocelli located approximately in its middle (Figs 1, 2, 3, 87-Vx and 0). The ocelli are arranged in a triangular manner. Two of them lateral to the middle line while the 3rd is anterior to these two. The foramen magnum (Figs 3 & 6; For) is a small "Y" shaped aperture with its arms diverging wide apart, and is located almost in the centre of the posterior surface of head. The area of the posterior surface immediately surrounding the foramen magnum is distinctly depressed laterally and dorsally. The posterior surface gradually gets levelled up while approaching the eyes and the vertex. In the opinion of the present writer this depression increases the mobility of the head capsule. The oral fossa is located ventral to the foramen magnum. (Figs. 2 & 6, OF)

Sutures of the head capsule:

The following sutures are evident in the head capsule. These sutures, form the lines of demarcation of the various component sclerites of the cranium.
1. **Epicranial Suture** (Fig. 1.cs)

The epicranial suture is obliterated to such an extent that it is nothing but a small faint line starting from the anterior ocellus running down the middle of the face upto a point midway between the antennae. It has no corresponding internal ridge, and is also devoid of the two bifurcations vis., the "Frontal sutures". Duncan shows the same fact in the wasp.

**Occipital Suture** (Figs. 3 cs)

The occipital suture is fairly evident. It does not form a horse-shoe. Each of its arms starting from a point slightly anterior to the posterior articulation of the mandible of the side traverses in the cranial wall in ventro-dorsal direction posterior to the respective cheek or Gena. On reaching near the vertex it gets obliterated. This suture serves as the only line of demarcation between the lateral and posterior, or, occipital, regions of the head. There is no trace of the corresponding internal occipital ridge.

**Post Occipital Suture** (Fig. 2.cs)

The post occipital suture is a distinct suture running round the dorsal and lateral margins of the foramen. Each end of this suture on reaching the ventral region of foramen unites with the corresponding hypostomal suture which is an extension of the subgenal suture. Before ending into the hypostomal suture each post occipital suture traverses an invagination called the "Posterior tentorial pit" (Figs. 2 & 6 pt). The post occipital ridge is present surrounding the foramen dorsally and laterally.
Submental suture:

The sub-mental suture runs from the posterior tentorial pit to the anterior articulation of the mandible of each side. It runs downward and inward from the posterior tentorial pit till it descends considerably below the ventral margin of the foramen. On reaching a level well below the margin of foramen it turns outwards with the result that a small lobe is formed. As this lobe possesses the extent of the post-mental area hence it is called post-mental lobe (Figs. 2 & 6. PgZ). Henceforth this suture runs almost vertically to the ventral margin of the head capsule. On reaching near this margin the sub-mental suture turns towards the facial region and runs, close to, and along the line of articulation of the corresponding mandible. The sub-mental suture has been differentiated into two parts. The first part which starts from the posterior tentorial pit and ends near the ventral margin of head is called "Hypostomal suture." The hypostomal suture (Figs. 2 & 6. hs) demarcates the ventral half of the occipital region (post-mental) (Fig 2 & 3 Pgs) from the ventro-median area of the posterior surface of the head, or the area below the foramen magnum. This area being surrounded on either side by the hypostomal suture may be called hypostomal region and is formed of a single horse-shoe shaped selerite with its two ends directed ventrally. This selerite (Figs 2 & 6. Sst) is known as hypostomal selerite. In the middle the hypostomal selerite forms a bridge (hypostomal bridge) below the ventral margin of the foramen. The hypostomal bridge (Figs. 2, 5a, & 6. HB) near its union with the ventral margin of the foramen (Figs 2 & 6 Vmar) gets narrowly constricted due to the intrusion of the two post-mental lobes. Dunjan in the
wasp shows that the two hypostomal sutures unite to form a post-
genital bridge just below the foramen. This post-genital bridge not
only engulfs the post-genital lobes but it also extends over the
hypostomal bridge of Steno bracon deeseae. In this way the greater
part of the bridge becomes post-genital in position. The present
writer in Steno bracon deeseae and Smidgrass in honey bee show
that the two hypostomal sutures run separately and form the post-
genital lobes which are held apart by the hypostomal bridge running
in between them (Figs 2 & 6 HB). The hypostomal suture of Steno-
bracon deeseae is a faint line without an internal ridge. Duncan
holds that in the wasp a hypostomal carina is formed easily to
the hypostomal suture. Smidgrass does not throw any light on
this point though he had not overlooked the formation of oral
fossa and calls it "the fossa of the proboscis". The oral fossa
(Figs 2 & 6 GF) is an inverted "U" bounded by the inner margin of
hypostomal selerite. It is covered by a membranous floor which
serves as suspensorium for labio-maxillary complex. The hypos-
 tromal selerite at its apex protrudes into the fossa in the form
of a small rod which ends into 2 knobs (Figs 5a and 6 BH). These
knobs form the points of articulation of the two sardines of
maxillae.

The second part of the sub-genital suture which is running
parallel to the ventral margin of the cranium and above the
lines of articulation of mandibles is called "pleurostomal
suture" (Figs 1 & 3 ps). Its posterior end joins the corresponding
hypostomal sutures while its anterior end turns upward near the
anterior articulation of the mandible and meets the "epistomal
suture" below the corresponding eye. The pleurostomal suture
has an internal ridge (Figs. 7 & 29 Fr). It also sets off a small submarginal pleurostomal area (apart of sub-genal area)(Figs. 1, 3, 7 & 29, Plst).

Epistomal Suture(Fig. 1, cs)

The epistomal suture is a distinct semicircular groove connecting the ends of the 2 pleurostomal sutures across the lower part of the face. It has a similarly semicircular ridge on the inner face of its wall (Figs 7 & 29 Fr).

Ocular sutures(Figs. 1, 3 & 8 03)

Each eye is externally surrounded by a distinct circular groove. Ventrally it reaches close to the pleurostomal suture but does not fuses with it. It also passes near the epistomal suture, but there too maintains its identity and does not merge into it. There is a distinct ocular ridge and a circular ocular selerite (Figs. 1 & 3. 03e) around the ocular socket.

Areas of the head capsule: Frons:- (Figs 1, 3 & 27 Fr).

It has already been noted that frons has no actual boundaries laterally and dorsally due to the absence of frontal sutures and the atrophy of the epicanal suture. On its ventral margin there is the epistomal suture which demarcates it from theclypeus. Hence the area of the face extending downward from the bases of the antennae and reaching the epistomal suture on n be claimed as "Frons". The whole of the frons is prominently convex. A more-or-less similar view is taken up by Pratt in his paper "Studies of the Ichneumonidae of New England, 1940" when he says "The frons is a median unpaired selerite extending from the two anterior tentorial pits to, and including, the median ocellus". It appears that median ocellus is in the frons region. This is a view which the
present writer does not regard essential, and this objection has been upheld by Crompton (1921) in his paper, "The sclerites of the head and the mouth parts of certain immature and adult insects" where he says "The frons usually includes the area bearing the median ocellus, but this is absent in many insects".

**clypeus** (Figs 1, 7, 27 & 28 Cyl).

It is a small but distinct convex, semicircular plate. Posteriorly it is bounded by the episetalal suture and anteriorly by the labral suture. The latter is not easily observable, for two reasons. Firstly, it is situated very close to the anterior margin of the cranium; and secondly the upper margin of the labrum is so thick and raised as to conceal the suture altogether.

**vertex** (Figs, 1, 2, 3 & 27 Vx)

The vertex is generally called the top of the head. This is as a matter of fact not limited by any sutures. It lies between the frons and the occiput in between the posterior borders of the two genae. The small triangular area of the vertex including the three ocelli is called "Ocellar triangle" by Duncan in wasp.

**genae** (Figs 3 Go)

The area of each of the genae is a narrow elongated area lying in between the occipital suture and the posterior half of the ocellar suture. Ventrally it is demarcated by pleu-rostomal suture, while dorsally it extends upto vertex.

The whole posterior wall of the cranium with a central opening (foramen magnum) consists of four major parts: (1) occiput, (2) postocellar region, (3) hypostomal region (described above), and (4) the post-occiput.

**occiput** (Figs 2, 3, & 27 OC). The occipital area occupies the
space between the occipital and post occipital sutures referred to above.

**Postoccipital** (Figs. 2, 3 Pgs) The post genal areas are the ventral extensions of the occipital region. Each post gena lies between the hypostomal and the occipital sutures of its side. It starts behind the posterior articulation of the respective mandible as a narrow space and becomes broader and broader while approaching the occiput near the foramen. There is no suture between the occiput and the post genas. Duncan in wasp has named the whole area, that is occiput plus post gena as "Occipital arch". Each post gena protrudes over the hypostomal bridge to form a post genal lobe (Figs 2 & 6 Pgl).

**Postoccipitalis** (Figs. 2 & 6 Pgs). The post occipital region is an incomplete ring of sclerite all round the foramen magnum and serves as buffer area between the foramen and the occipital arch. Duncan in wasp believes in the formation of a complete ring of post occiput. The present writer has already discussed the differences of opinion while dealing with the hypostomal region.

The dorsal part of this sclerite is a bit broader as compared to its lateral region. It is caused by the unusual thickening of its margin which spreads over it. The margin near each lateral angle bends outward, and overlaps the post-occipital suture, with a concavity within it. Thus two concavities (Figs 2 & 6 Artesm) are formed to provide articulation to the two articular knobs of the pleurites of the prothorax.

**Tentorium** (Fig 5a).

The tentorium is represented by a single pair of well sclerotized bars extending from the ventro-lateral regions of the post
occipital ridge up to the two extremities of the epistomal ridge; each bar comes in contact with the head capsule at 2 points which are marked externally as the anterior (Figs 1, 7 & 20 at) and posterior (Figs 2 & 6 pt) tentorial pits. If the head capsule is opened so as to allow an unhindered dorsal view of the tentorium, when the latter has all its four points of union with the head wall intact, it is seen that its anterior and posterior regions are dissimilar in shape as stated below. Each bar on leaving the posterior tentorial pit bends slightly inward and later on, adopts more-or-less parallel course with that of the other side up to the middle of its length (Figs 5a Pt). These bars before adopting the parallel course are connected with one another by a small and broad transverse bar which can be nothing but extension of their mesal surfaces to provide contact in between them (Fig 5a, 5b, tb). The dorsal surface of the connecting bar develops a weak and flexible loop which ends in a long spine (Figs 5a & 5b T.3.S.) The transverse bar which is so distinct, has not been mentioned by Snodgrass and Duncan in honey bee and wasp respectively. They have only made a mention of the loop referred to above and have named it as tentorial bridge.

The ventral surface of each tentorial bar throughout its posterior half is fused with the inner surface of the hypostomal bridge. They are never fused directly with one another with the result that the part of hypostomal bridge in between them is distinctly visible in dorsal view. Duncan holds a reverse view. According to him both bars have lost their separate identity by fusing with one another in their posterior half. On emerging from the hypostomal bridge these bars diverge slightly until they
reach the epistomal ridge. This portion of the bar can be regarded as the anterior tentorial arm (Figs 5a & 27 AT) which is sclerotised in the middle (Fig 5a ep) and has semi-ciliated flaps on the sides (Fig 5a. mfl. 1f). These features of the anterior tentorial arm have not been described by Snodgrass in honey bee. From Duncan's account on wasp it is not clear whether the "mesally and laterally" directed flanges of the tentorium are really parts of the anterior tentorial arms.

Each anterior tentorial arm dorsally at its root gives insertion to a fairly stout and long sclerotic rod called "dorsal tentorial arm" (Fig 5a. DT). Each dorsal arm starts from the ocular ridge close to the corresponding antennae. Its point of origin, unlike anterior tentorial pit, is not visible externally. Duncan is half-willing to accept the presence of a pair of dorsal tentorial bars in wasp; while Snodgrass in honey bee has found it occasionally.

Antennae:-

The antennae are situated slightly in the upper half and very close to the middle of the facial wall of cranium. Each antenna is a long slender many jointed, movable, appendage of the head wall. Its colour is black and is divided into two main parts, the basal stalk and the distal shaft.

Basal stalk: - It is composed of one segment called "Scape" which is longest in all the antennal joints. The scape is tapering at its proximal end and broad at the distal end (Fig. 1, 3, 11, 12, 14 & 15, Se). The ventral wall of scape at its distal end is deeply emarginated to provide space for the projected portion of the ventral wall of pedicel to fit in it. There are two articular
knobs in the form of internal projections of the distal region of scape at its dorso-lateral angles (Figs 12 & 14, ArkSc). These articulate with the pedicle. The proximal rim of the scape has a deep concavity (Figs 9 & 10, Aco) and is completely placed within the antennal socket encircled by a membrane which keeps it in the socket (Figs 1, 3, 8 & 29, ASc). The rim of the socket close to eye-develops a knob like projection called "Antennafer" which articulates like the concavity of the scape (Fig 8, af). This articulation is of "Socket and ball" type.

The distal shaft consists of about eighty-five joints. The proximal most annulus of the distal shaft is called "Pedicel" (Figs. 11, 12, 13, 14 & 15, Pe) whose basal rim is distended on the ventral side (Figs 11, 12, 13 & 15, VprPe). Further on each dorso-lateral angle of the pedical there is an out growth called "Articular knob" (Figs. 11, 12, 13, 14 & 15, ArkPe). These knobs are articulate with the respective articular knob of the scape which are in the form of inward projections from the dorso-lateral regions of the distal part of a scape (Figs 12 & 14, ArkSc). Such articulation has been termed "DISONDFLIE" articulation by Snedgrass. It may also be mentioned here that close to the left side of the dorsal part of the proximal rim of pedicel there is a prominent internal epodeme whose function has not yet been discovered (Figs. 13, 14 & 15, apd). The distal end of the pedicel allows the preceding annulus to fit into it. Each joint after pedicel has developed a convexity on its proximal and a concavity in its distal ends respectively. The convexity of one joint fits into the concavity of the other behind it. It is thus clear that with the exception of pedicel the remaining joints of
the distal arm are not movably articulated. Nor are they supplied with intrinsic muscles. This supports the finding of Qadri in Blatta and other orthopteroid insects.

Masculature of Antennae—The muscles of the antenna are of two types, extrinsic and intrinsic.

Extrinsic muscles—The extrinsic muscles consist of 4 separate muscles inserted on the proximal rim of the scape. They are:

(i) External levator (Fig. 10, No. 6).

The external levator muscle originates from the dorsal surface of the central as well as lateral regions of the corresponding anterior tentorial arm, and is inserted by means of a tendon on the latero-dorsal angle of the scape's rim very close to the articular concavity. It serves as the levator of antenna and may be compared with the "External levator of antenna" in Camnodae lubbocki described by Imms.

(ii) External Depressor Muscles (Fig. 10, No. 7).

The depressor muscle is stout and originates partly from the lateral region of the corresponding anterior tentorial arm and partly from the inner surface of the lateral elyseal region close to the rim of the optic socket. It is the largest muscles and is inserted through a tendon on the ventro-lateral angle of the rim of scape very close to articular concavity. It is the chief depressor of the antenna and can be compared with the "depressor of antenna" in Camnodae lubbocki described by Imms.

(iii) Internal levator Muscles (Fig. 10, No. 5).

The internal levator is a slender muscle which originates from the dorsal surface of the central region of corresponding anterior tentorial arm. It is inserted by a tendon on the meso-
dorsal angle of the rim of the scape away from the articular concavity. It is described as internal levator by Lums.

(iv) **Internal depressor muscle** (Fig. 10. No. 8a, 8b).

The internal depressor muscle is a large muscle, with fibres originating in two bundles from the dorsal surface of mesal region of the corresponding anterior tentorial arm. It ends on the meso-ventral angle of the rim of scape away from articular concavity and serves as depressor muscle. A more or less similar muscle in Caspoda rubrosci has been considered as extensor muscle by Lums.

Snodgrass has also described four extrinsic external muscles in honey-bee. He has not gone in detail about their points of origin and insertion and does not also deal with their separate functions.

**Intrinsic Muscles:** There are two intrinsic muscles in the antenna, which control the movements of the flagellum:

1. **Levator of the Flagellum** (Fig. 14. No. 9).

   The levator muscle arises from the whole inner surface of the dorsal wall of scape. It runs through the scape converging on the dorsal half of the proximal rim of pedicel. This muscle does not form any distinct tendon as described by Snodgrass with the result that its fibres are separately on the rim of the pedicel.

2. **Depressor of the Flagellum** (Fig. 15. No. 10).

   The depressor muscle originates from the inner surface of ventral wall of scape and ends, as in the case of levator on the ventral aspect of the proximal rim of pedicel. Here again unlike honey-bee no distinct tendon is present.
13.

Labrum (Figs. 1, 7, & 27. La).

The labrum is a triangular plate with its vertex tapering directed downward. In dorsal view it appears slightly depressed or conave and is connected to the clypeus with the help of a membrane. This conjunctival membrane extends on either side of the labrum in order to connect it with clypeus (Figs. 1, & 7. Conj). The labrum is pulled away from the mouth, to open it, with a pair of abductor muscles (Fig. 7. No. 1). These muscles originate from the middle of clypeus and end near the central part of labrum.

The abductors of the labrum in Gryllus described by Duporte and the musculus levator labri described by Morison in honey-bee functionally resemble the abductors of the labrum of Steno-daem. Though in their origin and insertion they differ from the latter.

Epipharynx (Figs. 27 & 28. Ephy).

The epipharynx is a membranous fold having its dorsal wall ending with a broad posterior base on the internal surface of the clypeal anterior region. Its ventral wall fuses at its posterior end by the anterior margin of the dorsal wall of the pharynx just above the mouth. The whole of the epipharynx becomes tapering in anterior direction and lies ventral to the labrum.

Its anterior apex almost reaches the tip of the labrum. The ventral surface of the epipharynx in its middle area develops a pair of weakly sclerotised rods called "Epipharyngeal bars" (Fig. 28. Eb). Each bar gives insertion to a distinct muscle (Fig. 7 & 28. No. 2) originating from the middle of clypeus slightly posterior to the origin of labral abductor of its side. These muscles run almost parallel and ventral to the labral
abductors and appear to act as retractor muscles of the epipharynx. Snodgrass is doubtful if they are two distinct muscles in honey-bee. DuMezin in wasp does not make any mention of these muscles. 

**Mandibles** (Figs. 1, 3, & 4, H4).

The mandibles are highly sclerotised triangular structures articulating with the cranial wall with the help of posterior condyles developed at their outer basal angles (Fig. 4 H3). The entire base of each mandible has membranous connections with the corresponding part of the cranial wall. The apex of the mandible which is coloured black is tapering and pointed. There are very few teeth in the anterior part of incisor area of the inner surface, while the hinder part or molar area is plain.

There are two muscles inserted on each mandible. The fibres of one originate on the lower part of the side wall of head behind the eye. These fibres converge on a single stout apodeme which ends on the outer basal angle of the mandible slightly internal to its condyle. It may be called "abductor muscle of the mandible" (Fig. 4, H0,3). The second muscle which is much stouter and larger are known as "abductor muscle" (Fig. 4, H0,4).

It consists of 2 distinct groups of muscle fibres, one originating on the back of the head below the level of the foramen magnum and the other arising behind the eye and also from the top of the head. Both these groups of muscle fibres and on a well developed apodeme which ends at the inner basal angle of the mandible.

**Maxillo-labial complex:-**

The very name of this complex indicates that the labium and maxillae have developed a complex organ capable of functioning
The present writer has proposed to accept that view and would

The distinction between super-mutation and the actual construction.

Any case with no trace of super-mutation, be this defined to an extent

Part 1 (490) in The Mechanism, has shown that the majority to

The important possession all the parts, except the "passage-mutation".

separate between the maxillae and the labium in the honey bee.

propagation decrease. Similarly has also made no mention of such

members, there is, however, no such separate in the case of

membrane. This is, however, no such separate in the case of

this section both on the right and the left of the point is divided to

named this separate as "inter-axillitary junction", associated to the

of the whole median of the maxillary tergum at the edge of the

the dorsal part of one arm of the junction base with the dorsal part

because has suggested the presence of a small separate connective

of with the maxillae except through this membraneous connection.

than the only mode of attachment together with the examination

structural part and means of a broad membrane(Fig. 16, Comp.),

coated on the upper and lower edges of the broad base of the junction on the

maxillary tergum. Each maxilla is, therefore, connected with the

shaped as well as the shape of the inner region of the

hypo-axillaray cuticle. It is surrounded at the base which is

the junction halves posteriorly downwar. From the margin of

[Lit. 5-18].

which was described by Stengel and W. W.

not the junction halves to use the term "maxillo-tergal complex"

maxillae which involve direct adaptations with the flower and

prominent, the present writer on the ground that it is only

maxillary complex for the simple reason that it is more directly

located as a single organ. Dunham prefers to call it "hinge".
like to suggest Pratt to reexamine his insects. The pre-mentum (Figs. 1, 31, 32, & 34. Prnt) is very well developed and occupies the whole area of the labium. It has acquired the shape of a grocer's sugar-scoop. The lower and the lateral walls of the pre-mentum are sclerotised; while its upper wall is membraneous. The "U" shaped base of the labium, that is, the proximal margin of the pre-mentum is dorsally placed with a wide space in between its two arms which provides a passage for the various muscles of labium (Figs. 1, 4, 18, 21, 22, 23, & 34. Prnt). Each arm of "U" at its anterior tip gets broadened into a triangular form. This region of the arm is appropriately termed as broad "spatulate process" by Duncan (Figs. 4, 18, 21, 22, 23, & 34. Prnt).

**Hypopharynx** (Fig. 4. Hyp).

The hypopharynx is found stretched over the dorsal surface of the middle region of the prementum in between the "lingua" and the two spatulate processes. It is composed of two lateral walls, and a roof. These walls (Figs. 21, 22, 23, 24, 29 & 31. Wphy).

Hypopharynx anteriorly converge and meet each other slightly posterior to the base of the lingua while posteriorly they are held apart. The roof joins them dorsally throughout their whole length (Fig. 4, 23, 30, & 31 ry). Basally "posteriorly" the walls being held apart coupled with the roof being stretched over them, provide a passage for the salivary duct to enter into the hypopharynx. Each wall of the hypopharynx possesses a longitudinal selerite starting from the anteriorly placed basal angle of the spatulate process of its side. The selerite is rod like and moderately sclerotised in its proximal half, while its distal half becomes gradually broader. The observation of the present
writer tallies with that of Duncan. Snodgrass shows the presence of such a selerite in each wall of the hypopharynx but he describes it as a slender and feebly sclerotised rod with no differentiation in its two halves on the basis of sclerotisation. Every part of the hypopharynx externally is covered over with hairs. The distal half has the thickest growth of hairs, while the proximal half has the thinnest outgrowth. Duncan shows the presence of hairs or setae on the hypopharynx and considers them arranged in a row in the region of demarcation between the distal and proximal halves of the sclerotised rod of each wall and calls it "hypopharyngeal tent in".

The labial palpi emerge from the distal region of prementum on its latero-ventral angles (Figs. 1, 2, 4 & 22. LbFly). Each palpus is distinctly three jointed and hangs downward from the labium. The area of prementum distal to the palpi is called "ligula". The ligula has two distinct membranous walls: (i) ventral wall which is an undivided distal prolongation of the posterior sclerotised wall of prementum.

(ii) Dorsal wall constitutes the entire anterior membranous surface of the distal region of prementum, that is, area placed distally to the hypopharynx. It is differentiated into a single centrally placed big lobe and a pair of dorso-laterally placed small conical appendages called "lingua" and "paraglossae" respectively.

Lingua: (Figs. 1, 2, 4, 23, 24 & 26. Lin).

It is a broad structure consisting of an upper and a lower membranous flap which are fused on their latero-anterior margins. Posteriorly the upper flap ends in a pair of basal selerites called "anterior lingual plates" (Figs. 23 & 26. ALiP). Each basal
selerite is broadest in the centre and narrowest at its lateral region. These selerites are held apart due to the prolongation of the anterior flap in between them which bears the orifice of saliverium (Figs. 23 & 26, or). Duncan in wasp has described only one anterior lingual plate in this region. In between the lower flap and the lower surface of prementum there is a transversely placed cork-shapped selerite similar to the "posterior lingual plate" of wasp shown by Duncan (Fig. 24, Pl.4P). These basal selerites meet each other at the two lateral angles of linguo. It may safely be said that the proximal region of linguo has a more or less, complete selerotised ring which is broken in the middle of its anterior basal region where the two anterior lingual plates are held at a distance. Duncan has observed a well developed selerotised ring proximal to the ring formed by upper and lower lingual plates. He has named it "ligular-hinge-plate". Neither Smedgass nor the present writer has succeeded in finding out this ring in the insects studied by them. Duncan further more thinks it advisable to accept the presence of two glossae which unite to constitute the median lobe i.e. linguo. He based his opinion on the presence of a notch in the middle of the distal margin of linguo. In the case of Stenchonason descries the distal margin of its linguo is absolutely unbroken and is devoid of any notch in it. The present writer is of opinion that the mere appearance of a notch in the lingual distal margin is not a sufficient proof of the presence of two glossae. The latter should either be distinctly apart from each other or an almost complete longitudinal groove may be present in the linguo if at all the presence of two glossae is to be accepted in it.
Para-glossae (Figs. 1 & 4 Pfg).

There is a pair of para-glossae situated on dorso-lateral regions of the prementum slightly distal to the hypopharynx and proximal to lingua. In natural condition each para-glossa overlaps the anterior lingual plate of its side. There are two distinct parts of a para-glossa viz: Basal selerite; and the body of para-glossa. The basal selerite is a small selerite lying transversally in between the hypopharynx and the corresponding anterior lingual plate. Its nasal end unites with the meso-posterior angle of the anterior lingual plate of its side (Figs. 21, 22, 23 & 26 Bpg2). The body of para-glossa is more or less irregular structure originating from the basal selerite and is covered over with hairs (Figs. 2, 22, 24 Bpg1).

Maxillae: The two maxillae are placed on either side of the labium with which the anterior margins of the inner stipital regions are connected through membrane as described before (Fig. 19 Conj). Each maxilla has all the parts of a generalised maxilla. Its outer cardo-stipital margin suspends from the corresponding margin of the hypostomal selerite (Figs. 8, 6d & St). The various parts of the maxilla are described below:

Cardo (Figs. 8, 4, 3a & 19. Cd). The cardo is an elongated selerite narrowest at its proximal and broadest at the distal end. There seems to be a uniformity in the increase of width of the cardo. The proximal end of the cardo has a socket (Fig. 4, 3co) which receives the articular knob of the corresponding rod of hypostomal selerite (Figs. 3a & 6, XHB). It may be noted here that the two articular knobs are the tips of rod like extensions of the hypostomal bridge. Snodgrass in honey-bee and Dunsan in wasp
regard articulation as lateral while the present writer in Ste- 
romedon deucee has found it to be centro-dorsal. In the former 
the case the cardines should converge towards the centre of the oral 
fozen as shown by Snodgrass (1942) figure 21; while in the latter 
the case cardines run parallel to one another with their thin nasal 
margins touching each other throughout their longitudinal courses. 
In the natural condition the cardines hang vertically from the 
points of their articulation which fact seems rather, impossible 
if their articulations are lateral.

The cardo can be differentiated into two longitudinal parts 
on the basis of the density of sclerotisation, one of them is 
less sclerotised, broadest and nasally/(Figs. 19, Med). The other 
is markedly sclerotised, narrower and is placed laterally(Figs. 
19 & 20 Med). This feature has not been mentioned both by Snodgrass 
and Duncan in honey-bee and wasp respectively. These nasal and 
outer parts of the cardo may resemble the junta-cardo and vera-
cardo respectively of Schistocerca gregaria described by Karnadik- 
kar. But the present writer does not find further characteristic 
features of these parts in Steornedon deucee, as mentioned by 
Karnadikar to confirm their resemblance.

The cards at its distal end abruptly bends upwards and forms 
an elbow-like "cardo-stipital hinges"(Figs. 2, 4, 19 & 26 h). As 
there is no line of demarcation or suture in between the distal 
part of cardo and proximal part of stipes, hence this hinges may 
be considered as the only boundary-line between them.
Stipes (Figs. 1, 2, 3, 4, 19 & 20, St).

The stipes is the largest part of maxilla. It can be easily differentiated into three longitudinal parts viz. (i) inner region, (ii) outer region, (iii) middle region. The inner region (Figs. 16, 17, 18 Dseg) is totally membranous and extends in a sigmoid manner throughout the length of the stipes. It is narrowest in the proximal region, broader in the distal region and broadest in its centre. Its anterior (distal) margin is moderately sclerotised (Figs. 16, 18, 19 & 25, AMarl). The outer region is less membranous in nature (Figs. 17 & 25 OSeg). It is narrower in the proximal and broader in the distal region. The five jointed maxillary palpus originates from the distal half of the outer membranous region. The middle region of the stipes is the broadest and highly sclerotised part of the stipes (Figs. 16 & 17 OSeg).

Its outer and inner margins (Figs. 16 & 17 IMar, OMar) serve as lines of demarcation for the outer and inner regions of stipes respectively. There is a distinct carina in the middle region of stipes starting slightly proximal to its centre and ending as a broad surface in the distal area of the maxilla. The carina is feebly developed in the beginning but goes on becoming prominent gradually till the distal region is reached where it is so wide that almost the whole of this region is transformed into a raised surface or a bulge. Thus the carina is very prominent near the bases of the distal lobes of maxilla (Figs. 16 & 17 CSt). Duncan has described carina in wasp which does not appear to be similar to that of Stenobracon dooceae.

Lacinia: (Figs. 4, 16, 17 & 19, Le).

The lacinia is a moderately sclerotised structure placed
mainly to the galae. It is composed of two walls fused by their
margins all along except its basal region. The inner wall of the
lacinia possesses a conical shaped selerite at its base which joins
it with the distal margin of the inner region of stipes. Besides,
this selerite joins with the distal part of the carina as well
(Figs. 16 & 18 P5Le). It is similar to the "pivotal selerite" of
wasp described by Duncan with the only difference that here it has
membranous connection with the spatulate process of labium
instead of articulating through the labio-maxillary jugum as
suggested by him. The outer wall of lacinia also possesses a
selerite at its base whose outer end is fused with the inner margin
of galae, while its basal end is in continuation with the distal
margin of the outer membranous region of the stipes. A more or
less similar selerite has been described as "basal selerite" by
Duncan in wasp(Figs. 17 P5Le).
Gala (Figs. 2, 3, 4, & 17, 6a).

The galae is situated lateral to the lacinia. It has two
walls as witnessed in lacinia. The ventral wall of galae unites
with the distal margin of the stipital carina.

Musculature of maxillae: In order to study and understand the
plan of musculature the present writer has adopted Smedgrass
scheme and has divided the muscles into two groups, extrinsic and
intrinsic.

Extrinsic Muscles of the maxillae: There are four distinct muscles
which can rightly be grouped as extrinsic muscles of the maxilla.

They are as follows:-

First Protractor of the maxilla (Figs. 19 & 25, No. 22)

It is a stout short muscle originating from the corresponding
post-genal area and very close to the post-genal lobe of its side. It converges slightly over the outer margin of cardo. The exact point of its insertion is the outer margin of cardo close to its articulation with the hypostomal rod. On contraction this muscle pulls the cardo up which by $p$ rotating over its point of articulation becomes horizontal instead of being vertical to it. Thus the maxilla is produced forward. This muscle has been labelled as "cardinal protractor of the proboscs" by Snodgrass in honey-bee. Duncan has also shown a similar muscle in the wasp. Both of the above authors have described it ending on the proximal tip of cardo above its articular point. Besides it may resemble "Abductor of maxilla" in gryllus described by Duportes.

**Second Protractor of maxilla** (Figs. 19 & 20, No. 23). It is a long stout muscle originating on the ventral surface of the corresponding anterior tentorium arm close to the anterior tentorial pit. It runs backward to end on the proximal tip of the middle region of stipes slightly anterior to the cardo-stipital hinge line. This corresponds to No. 11 of honey-bee described by Snodgrass. It has been regarded as "extensor" of maxilla by Duncan. He holds that it originates from the clypeus and ends on a tooth like process of stipes at its proximal end. This fact should not, however, be forgotten that the pull of this muscle affects the position the cardo-stipital hinge and in this way protrudes the stipes forward. Inns (1944) has described a more-or-less similar muscle in diptera as "Protractor of the stipes".
Flower of maxilla: (Figs. 19 & 25, No. 26).

It is a small muscle originating on the mid-ventral surface of the corresponding anterior tentorial arm slightly in front of the origin of the dorsal tentorial arm. It ends by means of a tendon, on the distal half, of this anterior margin of the inner region of the stipes. It passes across the protractor of maxilla at its outer face almost at right angle to it. In natural position it appears to run almost vertically from its point of insertion. It may resemble flower of the maxilla described by Duponte in gryllus. Duncan has shown it originating from clypeus. This is doubtful. The view of the present writer has been supported by Snodgrass in honey-bee. As regards the function the author disagrees with Snodgrass who considers it to be a protractor muscle, for the simple reason that it ends vertically on the stipes and therefore its pull will always make it to bend over the cardo stipital hinge line. Snodgrass (Figure 4A, No. 13, p.15).

Second flower of lacinia: (Figs. 19 & 25, No. 26).

It is a thin long muscle originating from the genal area near the ocular suture and close to the posterior articular point of the corresponding mandible. It forms a common tendon with the first lacinial flexor which is an intrinsic muscle. So naturally it becomes second flexor of lacinia. This muscle has not been described both by Duncan and Snodgrass in 'wasp and honey bee respectively. It may resemble "Cranial flexor of lacinia" described by Walker in Grylloblatta. Formerly the writer regarded it as muscle No. 12. of honey-bee described by Snodgrass but repeated dissection made him to drop this view. Muscle No.12 of honey-bee is absent in Stenobracon deeseae. Duncan is silent on
this point. All these extrinsic muscles have their respective
effect on the labium as well, of course through maxilla, as these
structures (labium and maxillae) are not independent of each
other as in case of the generalised insect like orthoptera.

Intrinsic muscles: The intrinsic muscles consist of a group of
the muscles originating and ending within the maxilla. These
muscles naturally arise from the inner face of the middle region
of the maxilla and have their insertion on its palpus or in
distal-lobes. They are as follows:

First flexor of labium (Fig. 20, No. 26).

This muscle originates from the proximal region of middle
region of stipes near the membranous outer region. It runs dorsal
to all the intrinsic muscles and ends by a tendon in the region
of the pivotal sclerite which is fused with the membranous region
of stipes. Its tendon receives the tendon of the 2nd flexor of
labium coming from the cranium as described already.

Flexor of galea (Fig. 20, No. 27).

This muscle originates from the proximal portion of the
middle region of stipes near its inner region. It runs ventral
to the flexor of labium and ends on the ventro-proximal part
of the galea. It corresponds to the flexor of galea of honey-bee
described by Snedgrass.

Repressors of the palpus (Fig. 20, Nos. 28's 29).

These are two muscles which control the movements of the
palpus. One of them (NO.28), is long slender muscle originating
on the proximal end of the middle region of the stipes in between
the points of origin of the iflexors of labium and galea. It runs
ventral to those flexors and ends by a small tendon on the inner
(anterior) region of the base of palpus. The second palpal muscle (No.29) is a short weak muscle originating on the distal half of the middle region of the stipes near the latter's outer surface and ends slightly ventral to the large muscle. In natural condition it is completely covered over by its fellow muscle and hence there is a likelihood of its being overlooked. The present writer agrees with Duncan to regard them as two separate depressors of maxillary palpus.

Each of the first three segments of palpus has a thin diagonally placed muscle originating on the proximal part of its ventral wall. The fibres of each muscle converge to form a tendon which ends at the base of a segment anterior to it. These are flexors of segments on which they are inserted (Fig. 20. No. a, b and c). These muscles are not described by Sandgrass in honeybee and by Duncan in wasp.

Musculature of the Labium: The musculature of the labium also consists of extrinsic and intrinsic muscles. There are three pairs of extrinsic muscles viz. (i) anterior adductor, (ii) posterior adductor, and (iii) levator of labium.

Anterior adductors: (Fig. 21. No. 13).

The anterior adductor muscles are the longest pair of muscles of labium originating from the stipes, on their way while converging over the labium they pass through almost all the extrinsic muscles of maxillo-labial complex and also the whole length of labium until they reach the paraglossae. There each of the anterior adductors ends on the basal sclerite of the corresponding paraglossa by the side of the point of insertion of the flexor of paraglossa.
Posterior adductors (Figs. 21, 22 & 25, No. 14).

The posterior adductor muscles also consist of 1 pair of muscles. They originate from the ventral surface of the corresponding anterior tentorial arm close to the origin of the flange of maxilla of their side. Both the latter and these muscles after their origin cross the protractors of the maxilla of their side externally and internally respectively. The two posterior adductors converge towards each other and form a common small tendon which ends at the middle of the proximal margin of prementum. Duncan describes a definite notch at the point where these muscles end. This notch has neither been observed by Snodgrass nor by the present writer. The latter thinks that the posterior adductors also retract the maxillae due to the presence of maxillo-labial complex.

Lowers of labium (Figs. 21 & 25, No. 15).

Each lower muscle arises on the ventral surface of the corresponding anterior tentorial arm close to the origin of the second protractor of the maxilla of its side. It darts towards the labium almost vertically and ends in the middle of the corresponding arm of the base of prementum. This pair of muscles serves as levator of maxillo-labial complex. It has not been described either by Duncan or by Snodgrass in their respective insects.

Intrinsic muscles of labium

Linguval flanges: (Fig. 24, No. 16).

These consist of a pair of muscles originating from the middle of the inner surface of prementum ventral to almost all intrinsic muscles. They run parallel and end independently on
the posterior lingual plate. This pair of muscle is definitely
the actual flexor of lingua. It is homologous to the paired
flexors of glossae in generalised insects. Duncan has shown only
two broad muscles as their representative in honey-bee. Snodgrass
observed two such muscles with their insertion on the axial rod
of the tongue.

**Ligular flexor** (Figs. 21 & 24, No. 17).

These muscles consist of a pair of muscles originating in
the proximal region of the prementum but on either side of all
muscles originating from it. Each one is a long muscle and ends,
mesial to the point of insertion of the corresponding anterior
adductor, on the basal selerite of the paraglossae. Duncan has
shown its insertion on the anterior lingual plate while Snodgrass
describes it ending on the corresponding ligular arm. As each
basal selerite of the paraglossae is articulated by its mesal
tip with the corresponding anterior lingual plate, already
described, therefore any pull on the mesal region of the basal
selerite will naturally affect the lingua. Hence the present
writer agrees with Duncan in calling this pair of muscles "Flexor
of the ligula" rather than "Flexor of the paraglossae". The above
pair of muscles coupled with the two anterior adductors bring
about complete flexion or retraction of the whole of the ligula.

**Palpares of palpus** (Fig. 22, No. 19).

Each palp receives a flexor muscle at its base which
originates from the proximal half of the selerite of the premen-
tum. Duncan regards it originating from the spatulate process of
its side. Apart from it there are two small muscles, one (Fig. 22,
No. 19) originating within the basal segment of palpus and
ending at the base of the succeeding segment, and the other (Fig. 22, No. 20) originating within the second segment and ending at the base of the third or the terminal segment. Duncan does not describe these muscles in wasp; while Snodgrass in honey-bee shows only one such muscle originating in the basal segment of the palpus and ending at the base of the succeeding segment. According to the observations of Snodgrass the remaining three segments of bee's labial palpi cannot enjoy independent movements. The present writer holds that each segment barring the basal is flexed by its own flexor muscle while the whole labial palpus is controlled by its flexor described above.

**Dilators of Salivarium**

The salivary duct on entering below the hypopharynx gets dilated into a more or less flattened oval shape reservoir called "salivarium" which becomes tubular anteriorly to open in between the two anterior lingual selerites. It is supplied with two pairs of muscles which act as dilators. They are termed as anterior and posterior dilators of the salivarium.

**Anterior dilators** (Fig. 22, No. 12).

There are two anterior dilator muscles, each arising from the anterior region of the corresponding spatulate process. These converge towards the centre of the anterior (dorsal) wall of salivarium where they form a common longitudinal insertion, that is their fibres do not end on any tendon, but as a matter of fact end directly on the wall of salivarium independently. Duncan in wasp, has described a similar pair of muscles but he is not sure about the nature of their insertions. Snodgrass in honey-bee has described a similar pair of muscles which according to him
originates from the anterior edge of the salerite of the prementum. 

**Posterior dilatators** (Fig. 26, No. 11).

There are two broad muscles originating from the proximal area of prementum. These run dorsal to the two lingual flaps and converge towards the centre of the posterior (ventral) wall of the salivarium where they form similar longitudinal insertion as described in the case of anterior dilators. Snodgrass has also shown a similar pair of muscles in honey-bee but he regards them as compressors of the salivarium perhaps for the simple reason that these end on the respective sides of the salivarium. Morison's account of the musculus dilator ampullae salivae posterior supports the view of the present writer.

**Compressors of salivarium** (Fig. 21, No. 21).

These muscles consist of a pair of muscles. Each of these muscles originates from the prementum close to and proximal to the base of the corresponding palpus. Their fibres run dorsal to the flexor of the palpus and form a tendon which ends on the margin of the corresponding arm of prementum slightly behind the spatulate process. On contraction of these muscles pull down the two spatulate process which in turn pull down the lateral walls of the hypopharynx. Consequently the roof is pulled downward to exert pressure on the salivarium. This preserve on the salivarium coupled with the relaxation of dilator muscles brings reduction in its volume. In this way the latter is compressed and the saliva is ejected out. The present writer regards them as the "indirect compressors" of the salivarium.
THE THORAX.

The thoracic region of stenopteron deeseae, like other hymenopterous insects consists of four distinct segments, viz. prothorax, mesothorax, metathorax and propodeum. Each of these four segments are distinctly marked off from the preceding one by the presence of narrow inter-segmental grooves which are traversed by thin intersegmental membranes (Fig. 32. Conj). The various thoracic plates are sclerotized to a great extent with the exception of propodeal sternum which is entirely membranous.

The thorax is broad and oval in shape with arched dorsal surface (Fig. 34). This characteristic outline of the thorax coupled with a high degree of sclerotization of its plates, withstands the pressure brought upon the thorax by the activity moving wings and by muscles. The rigidity of the thorax is further increased by the approximation of the pronotum and mesonotum, (Figs. 32 & 34) as well as a close apposition of pronotum with mesopleuron (Figs. 33, 34 & 35). The posterior margin of mesosterna with the anterior margin of metasternum (Figs. 32 & 34) of the metatergal posterior margin with the anterior margin of propodeal tergum (Figs. 32, 34, 97, & 101) and of the mesopleural descending dorsal margin with metapleural anterior margin, (Fig. 34 & 96). This condition brings about a great reduction in the intersegmental spaces which along with the intersegmental membranous are covered over externally by the margins of the corresponding thoracic plates; and are therefore hidden from outside. The presence of broad marginal ridges along the anterior margins of mesopleuron, metapleuron and propodeal tergum; and the marginal inflections along the posterior, anterior and dorsal margins of
protergum combiningly bring perfection to the thoracic armour of insect.

Dunstan's claim of the presence of a structure best suited to withstand stress and strain only in vespine wasps is a bit of exaggeration. The present writer also finds in his insect a structure equally if not better suited than that of the wasp.

Prothorax:

Unlike other thoracic segments the prothorax fails to become a separate structural unit for two simple reasons, one being in a close association of protergum with the pterothorax and the other the dissociation of propsectus from the remaining parts of the thorax which turns it into a suspensorium for prothoracic legs and a support for the head.

The protergum is a collar like sclerite stretching from one forecoxa to the other in between the meso-thorax and the head. It can roughly be differentiated into two broad side lobes and a central narrow strip forming a median bridge which connects the two lobes (Figs. 32 & 34). Each side lobe is more or less triangular in shape with its base directed behind and its vertex merging into the median bridge (Figs. 34 & 35. L). The base of the triangle is the postero-ventral margin of the lobe; (Fig. 34. L0va) while its two sides become the antero-ventral (Fig. 34 & 35. L0va) and dorsal margins (Fig. 35. L0d) which subsequently merge into the anterior and posterior margins of the above said median bridge respectively.

The anterior margin of the median bridge (Figs. 32, 34. L0an) conceals within it the greater part of the marginal inflection which passes over the dorsolateral region of the propleuron. This
marginal inflection stretches over the anterio-ventral margins of the side lobes. This entire inflection is called "Anterior pronotal inflection" of protargum (Fig. 35, BsmI + Lam I). From Duncan's statement it appears that this inflection is restricted to the anterio-ventral margin of each lateral lobe and the anterior margin of the bridge is free from it. Snodgrass makes no mention of this fact. Each half of the anterior marginal inflection overlaps a greater part of the dorso-lateral region, starting from esonl articulation onwards, of the respective pleuronae. A broad membrane concealed beneath the anterior region of the protargum keeps the anterior margin of the latter in communication with the two dorsal longitudinal margins of the two pleuronae. A forward extension of the same membrane becomes the dorsal membranous part of the meso neck as it connects the central part of the anterior pronotal inflection with the dorsal (upper) half of the rim of the foramen magnum. A similar marginal inflection (Fig. 35, 49 & 53, Bsm I) is developed from the posterior margin of the bridge and is found stretched over the dorsal margins of the side lobes in the form of submarginal inflection (Fig. IqsmI). This inflection as a whole is appropriately called "posterior marginal inflection" by Snodgrass. It fits dorsally against the whole anterior margin of prescutum of the mesotergum (Fig. 32 & 34). The prothorax lies below the inflection having no direct articulation with it.

Each side lobe has a marginal inflection along its postero-ventral margin (Fig. 35, type I). It is well-developed in its upper half and less in the lower half. The upper half at its junction with the lower portion of the posterior pronotal
inflection (Dorsal angle of pronotum) forms a labular structure which contains the spiracular opening. Across the base of the spiracular lobe a distinct ridge connects the marginal inflection of the postero-ventral margin of the pronotal side-lobe with the dorsal sub-marginal inflection of the same lobe, (Fig. 35, r3).

The lower half of the marginal inflection of postero-ventral margin of the side lobe meets the lower tip of the marginal inflection of the anterior margin of pronotum at an acute angle. These two lower tips of the two side lobes do not meet each other and are connected by a membrane in between them. Their postero-ventral margins develop small raised surfaces close to each of the lower ends. The whole of the postero-ventral inflection coupled with its raised surface abut against the anterior marginal inflection (apodeme) of the mesopleuron. The lower raised surface of one side-lobe is put in communication with a similar raised surface of the other by a connecting internal ridge. This ridge is externally represented by a long groove which is deepest in the dorsal region of pronotum. Thus the latter is split up into an anterior and posterior unequal parts. The postero-ventral margin close to it's angle forms a small movable apodeme which gives origin to the esculator muscle of the spiracle. This apodeme is named as "Attachment peg for esculator of first thoracic spiracle" by Duncan in Wasp (Fig. 35, Osp²). The anterior part of the bridge on its dorsal region is markedly elevated as compared to it's remaining parts due to the presence of the deepest part of the groove there. This small piece of pronotum may be called "Anterior pronotal bulge".
Properites

The combined structure of propleuron and protergum may be called as "Propectus". This structure has no articulation with any part of the insect's body save the head. It is kept in communication with the protergum and the head through membranous connections (Figs. 33, 36, 37, 38, 49, 50 Conj); and may be considered as "suspensorium" for the prothoracic legs.

There is a pair of elongate triangular sclerites called 'Propleuron' (Figs. 33, 36, 37, 38, 41, 44, 48, 49, & 50, pl 1). Each propleuron has a broad ventral plate (Duncan's antero-ventral plate)(Figs. 33, 36, 37, 48, 49, & 50 Vpl) and a small dorso-lateral plate (Duncan's lateral plate)(Figs. 48, 49, 50 & 51, Dpl). Both plates are fused with one another longitudinally by their lateral margins in such a manner that the dorso-lateral plate appears to be a dorso lateral extension of the broad ventral plate. Due to the bending of the dorso-lateral plate in order to meet the ventral one a convexity is developed along the course of the bend. This convexity has been regarded as a definite carina in wasp by Duncan. The present writer does not agree with him on this point and regards it as a bulge and not a carina due to the absence of a definite ridge (Figs. 35, 37, 48, 49, & 50, Pl 1b). The mesal longitudinal margins of the ventral plates are free and face each other (Figs. 33, 36, 37, 38, 40, 41, 44, 45, 48, 49, & 50, b). Anteriorly both abruptly leave their parallel course and diverge to their respective sides leaving more-or-less, a semi circular space in between their divergent arms (Figs. 33, 36, 37, 49 & 50 b ). Similar divergence of the mesal margins occur in the posterior region of the ventral plate (Figs. 33, 36, 37, 38, 40, 41, 44, 45, 48, 49, & 50 b ).
Each posteriorly divergent arm throughout its entire length has a weak marginal inflection and ends at the posterior tip of the line of bending of the dorso-lateral plate where the procoxa articulates with the corresponding pleuron. Each side margin of the triangular basisternum is overlapped ventrally by the lower portion (posterior) and the posteriorly divergent arm of corresponding mesal margin (Figs. 36, 37, 38 & 50 BSm).

Throughout the entire length of the mesal margin of each ventral plate there is a distinct internal sub-marginal ridge which externally is represented by a longitudinal groove (Figs. 33, 36, 37, a). This ridge (Figs. 38, 40, 41, 44, 45, 46 & 50, ar) follows the course of the anteriorly divergent arm, and later on, projects as an articular process in a latero-dorsal direction; thereby ensconcing the semi-circular space on its sides and finally articulating with the respective concavity present in the rim of femur magnum (Figs. 33, 36, 37, 38, 40, 41, 44, 45, 46, 49, 50, & 53, op). Duncan does not speak of such a submarginal ridge; and consequently, does not in believe in the origin of the occipital process as an extension of the former in wasp. He suggests its origin from the antero-dorsal angle of the pleuron. In other words according to him, though he does not make any such definite mention, the occipital process develops from the anterior region of the dorso-lateral plate (Duncan's lateral plate) of the pleuron. Snedgrass does not go in the detail and hence confines himself to hold the whole anterior apical region responsible for the origin of the occipital process. These two occipital processes function as two lateral seleretic walls of the cervical region.
Each occipital process from its midmesal area projects internally in a dorso-posterior direction. This free internal projection is appropriately called "Cervical apodeme", by Snodgrass, a name more appropriate than "Posterior ramus of the occipital process" of other workers for the reasons already given by him (Figs. 35, 40, 41, 44, 45, 49, 50 & 55, Cor Ap). Snodgrass holds that the cervical apodeme is a mesal expansion in the anterior region of the horizontal apodeme. Neither Duncan nor the present writer agrees to his view. A membrane starts from the ventral rim of foramen magnum upto the vertex of the basisternum. It occupies the semi circular space described above and the narrow longitudinal space in between the mesal margins of the ventral plates. The anterior most part of this membrane serves as ventral membraeous part of the neck. On reaching the vertex of the basisternum it branches into two. Each branch extends upto the eoma of its side after traversing the side of the basisternum and the posteriorly divergent arm of the ventral plate.

The dorso-lateral plate has a sub-marginal groove on it's outer surface along its longitudinal free mesal margin which is internally represented by a broad submarginal horizontal apodeme (Figs. 35, 40, 41, 44, & 45, horip). Duncan calls it marginal apodeme while Snodgrass's view is in support of that of the present writer. This apodeme anteriorly ends close to the cervical apodeme as a narrow ridge. Posteriorly it terminates as a narrow ridge at the postero-dorsal angle of the dorso-lateral plate (the region in which the endosternum articulates with the pleuro-uron). Extending from the postero-dorsal angle upto the osmal articulation is the region of the posterior margin of dorso-
lateral plate. This margin is considerably thickened. The postero-
dorsal angle of the dorsolateral plate has developed a knob like
structure due to the union of the horizontal apodeme with the
upper end of the thickened posterior margin. This knob articu-
lates with the corresponding side of the endosternum (Figs. 38, 40,41,44,45,46,49,50 & 51 Endstar). From the thick posterior
margin of the dorso-lateral plate there projects a small apodemal
structure which runs dorsal to the endosternal-propleural articu-
lation. This process is found lying free by the side of the
outer margin of the supranotral bridge and is called "propleural
arm" by Duncan in wasp who calims it to arise from the posterior
portion of the horizontal apodeme (Duncan's marginal apodeme). The
propleural arm (Figs. 40, Pl. A) has no ligamentous connection
with the supranotral bridge as suggested by Duncan. It has been
shown as an internal apodeme by Snodgrass who has named it as
"Plural apophysis".

Each propleuron is a complete episternum. No trace of
epimeron or pleural suture is found which serves as a line of
demarcation between it and the episternum. Snodgrass in honey-
bees is definite in demarcating the posterior region of the
dorso-lateral plate as "Epimeron". Further more he confirms this
view by describing a distinct "Pleural sulcus" running between
the epimeron and the episternum. Duncan is doubtful as regards
the presence of epimeron and the pleural sulcus.

The prosternum is a small sclerite lying posterior to the
propleura and in front of the middle part of the mesopleural
anterior margin. The precocma flank it on either side and to a
great extent cover it on the ventral side. It is roughly divisible
into an anterior triangular part called "Basistermum" (Figs. 33, 36, 37, 39, 48, 49, 50, 56) and a large, and, more-or-less, a square posterior part known as "Fureastermum" (Figs. 33, 37. P31, P32). The former is bent inwards. It is overlapped by pleural plates as described above. The fureastermum is described by Snodgrass as a narrow strip of plate; but it has not been mentioned by Duncan. These two plates are demarcated by the presence of a transverse groove in between them which serves as the base of the triangular basistermum (Figs. 33, 36, & 37 Antg). Duncan lays stress on 3 processes of prostermum; out of which two are lateral and one anterior. The present writer considers the tapering vertex of the triangle equivalent to the anterior process(Figs. 33, 36, 37, 39, 48, 49 & 50. d2) and the pointed base-angles as lateral processes (Figs. 33, 36, 37 & 39, d3). Snodgrass has nothing to say on this point. There are two pits in the posterior margin of fureastermum close to its lateral angles (Figs. 33, 37 Fsp). From each of these pits, starts a groove running towards the middle line forming an acute angle with the posterior margin of the fureastermum (Figs. 33, 37. Postg). Thus two distinct grooves called "Posterior grooves" are formed which meet in the centre of the fureastermum; and split up the latter into a small posterior triangular plate (Figs. 33, 37, 39, 48, 49, 50, & 51 P32) and a large pentagonal plate (Figs. 33, 36, 37 P31). The central point of the anterior transverse groove is brought in communication with the point of union of the two posterior grooves by the presence of median longitudinal groove called the "Median groove" (Figs. 33, 37. mg). The anterior transverse, internally forms a short ridge (Figs. 39, 48, 49, & 50 Autr); while the posterior
and median grooves possess septa like vertically placed internal ridges (Figs. 38,48,49,50 & 51,Posbr & mvr). Thus a prominent inverted "Y" shaped structure is formed internally by the furcasternum, which marks the roots of the postternal apophysis.

The prothoracic endosternum consists of (i) a supporting base on the furcasternum, (ii) a pair of divergent wing plates and (iii) a pair of neural bridges. The supporting base is the inverted "Y" shaped structure mentioned above whose median vertical ridge corresponds with the vertical median plate; while its 2 arms represent the "two lateral thickenings" of honey-bee stretching over the anterior, posterior, and median ridges is a broad horizontal plate (Figs. 39,48,49,50 & 51,Sn1) which as a matter of fact, is composed of two distinct plates corresponding to the wing plates of honey-bee fused by their mesal margins along the median vertical ridge. These are regarded as a single plate by Duncan and named as "Horizontal plate of the postternal apophysis". The posterior margin of each wing plate (Figs. 39, 48,49, & 51,Westmar) is produced into latero-posterior direction to meet the posterior tip of its free outer margin. The outer margin of each wing plate is considerably more sclerotized than its remaining parts (Figs. 39,48,49, & 51,Westmar).

There are two, almost, square shaped supranueal bridges corresponding to the furcal arms of the wasp described by Duncan (Figs. 39,48,49,50 & 51). Each neural bridge stands at an obtuse angle by its anterior margin with the postero-laterally extended part of the posterior margin of the corresponding wing plate. In this region complete fusion of the two parts takes place with the result that the supa neural bridge if viewed
dorsally appears to lie in a dorso-posterior direction. Each bridge has a concave posterior surface. This condition is made further prominent by the well-developed marginal inflections along its entire margin (Figs. 39, 44, 49, 50, & 51. m, mar I; D. mar I, Lmar I). Both Duncan and Snodgrass point out the presence of such a condition and call this concavity as "Median trough". The region of the endosternum which is commonly shared by the wing plate and its corresponding neural bridge along the line of the fusion of the two, has a distinct oblong concavity at its lateral end. This concavity provides the point of articulation for the prepleural articular knob present at the dorso-posterior angle of the dorso-lateral plate (Figs. 39, 43, & 51. EndstCon). In between the inner margins of the two supra neural bridges is a large space called "Neural foramen" (Figs. 39, 44, 49, 50, & 51. mf). It is bounded anteriorly by the arms of the inverted "T"

Musculature of the Prethorax

The musculature of the prethorax can be divided into four main groups viz. (i) muscles directly responsible for the movements of the head (ii) Intersegmental muscles running between pro and meso thorax, (iii) muscles which control the movements of the propscutus and may share in an indirect way in the movement of the head (iv) muscles mainly responsible for the movements of the fore-legs. These muscles are dealt with below.

The direct muscles of the head are inserted on the under surface of the inflected margin of the foramen magnum. They consist of the following (Figs. 50, 52, No. 40a & 40b).

First Pair of Levators of the Head: These are stout muscles with two distinct bundles; one originating from the latero-median
region of the anterior surface of the supra-mesural bridge (No. 40b) and the other from the lateral region of the dorsal surface of the wing plate of its side (No. 40a). Both these muscles unite at a long broad tendon which passes by the side of the corresponding occipital process and end on the under surface of the lateral articular concavity present on the lateral angle of the margin of the foramen magnum. It is termed as "Fuscal elevator of the head" by Duncan in wasp and the fourth pair of "Levators of head" by Snodgrass in honey-bee. Besides, this pair of muscles can be compared with the "2nd Levators of the head" in Ant (Lasius flavus) described by Lubbeck (1879).

2nd pair of Levators of the Head: (Figs. 40, 52, No. 41a, 41b).

These are also stout muscles consisting of two distinct bundles; one running longitudinally along the horizontal apodeme which serves as the region of its origin (No. 41a), while the second bundles originates from the inner surface of the ventro-lateral area of the propleuron (No. 41b). The two bundles unite to form a thin common tendon which ends on the under surface of the dorsal half of the inflected margin slightly median to the 1st pair. This pair of muscles has been shown to have common point of insertion with the first pair of levators of the honey-bee. This muscle has probably been overlooked by Duncan in wasp. It may be noted here that Duncan's pleural levator of the head (Ois 1) should not be confused with it.

3rd pair of Levators of the Head: (Figs. 40, 52, No. 42a, 42b).

These muscles also consist of large and stout bundles. The region of the origin of the one comprise of the whole inner space of the ventral plate (No. 42a), while that of the other occupies
the inner surface of latero-ventral region of propleuron below
the horizontal apodeme (No. 42b). The latter bundle is ventrally
placed to the bundle of the 2nd pair of levator present in this
region. These two bundles unite to form a thick long tendon which
ends on the under surface of the dorsal half of the margin slightly
lateral to it's middle and mesally to the 2nd pair of levator.
This pair of muscles has not been described by Snodgrass. It may

correspond to the "Pleural elevator of the head" of the wasp
described by Duncan; but the union of its tendon with that of the
1st levator according to Duncan make it's homology a doubtful fact.
Accessory levators of the head (Figs. 49, 52, No. 43, 44).

There are two pairs of such muscles, one of them is composed
of 2 muscles originating close to, and on either side of the
middle of the anterior margin of the pronotum. Each muscle dives
down into the corresponding propleuron and ends with the tendon
of the 3rd levator of its side in the region of the occipital
process (No. 43). The second muscle also consists of two muscles
originating slightly lateral to the first. These muscles also
dive down and end with the tendons of the respective 1st levators
of head (No. 44).

The separate identities of these accessory muscles are
undisputable and they cannot be regarded merely as the bundles of
the 1st and the 3rd pair of levators due to their different
origin. Meanwhile they cannot be compared with other levators in
their function which is indeed accessory to the latter. Therefore
the present writer regards them as "Accessory levator muscles"
instead of additional levator muscles. These muscles may be compa-
red with the first levators of the head of ant (Lasiusflavus)
described by Lybbecke.
**Depressors of head** (Fig. 49, No. 45).

These consist of a pair of depressor muscles. Each of them is a stout muscle with a broad tendon whose fibres originate from the whole of the inner surface of the wing plate of its side. It runs ventral to the sternopleural muscle and the 1st levator of its side. The two tendons run parallel in between the occipital processes and end on the under surface of the ventral half of the foramen magnum very close to and on either side of its Central notch. Snodgrass in honey-bee regards each one of them to be composed of two bundles originating from the corresponding side of the supraesophageal bridge. These muscles correspond to "Second depressor of head" of the wasp described by Duncan and first pair of depressor muscles of the head described by Lubbock in ants. Snodgrass in honey-bee is justified in refuting the presence of two pairs of such depressor muscles as claimed by Duncan.

**Ist. Depressors of pronotum** (Fig. 53, No. 46).

These consist of a pair of small muscles arising very close to each other from the dorso-posterior area of the pronotum. Each has its fibres close and parallel to the posterior marginal inflection. They run parallel in ventro-posterior direction and end in a line along the margin of the prephragma by their slightly tapering ends. They correspond to "Intertegal" of the honey bee described by Snodgrass; and the "Inner provotal retractors of the scutum" of the wasp described by Duncan.

**2nd depressors of pronotum** (Fig. 53, No. 47).

These muscles resemble the 1st pair. They originate close to and on either side of the latter, and end on the respective
lateral areas of the prothorax. This pair of muscles is named as "Outer prenotal retractor of the scutum" by Duncan in wasp; while they are regarded as being absent in honey-bee by Snodgrass.

Retractors of the Pronotum (Fig. 51. No. 48).

These consist of a pair of long muscles with numerous fibres. Both of them arise from the anteriorly directed free margins of the supra neural bridge of pterothorax. Their fibres run towards the prothoracic endosternum. Each muscle ends on the whole posterior surface of the supra neural bridge of its side. It corresponds to the ventral intersegmental muscles of honey-bee described by Snodgrass; and the "First mesofurcal retractors of the propectus" of wasp described by Duncan. The present writer does not find them to develop tendons and end on the curved posterior vertical plate of the prosternal apophysis as suggested by Duncan. Hence he is inclined to reject Duncan's view regarding the insertion of this muscle on the basis of his own observations as well as that of Snodgrass. This muscle serves as intersternal, while the two pairs of prenotal depressors are intertergal muscles.

Ist Protractor of the Pronotum (Figs. 41, 49. No. 49).

There are two large and stout protractor muscles, each arising from the anterior half of the pronotum near its anterior marginal inflection. They run in a postero-ventral direction and end on the posterior end of the corresponding horizontal apodeme of the propleuron. These muscles correspond to the "Intermediate notal protractors of the propleuron" of wasp described by Duncan. Snodgrass calls them targo-episternal of the prothorax and has shown them to arise from the posterior inflection of pronotum ending on the anterior extremity of the horizontal apodeme.
Elevators of propodeum (Fig. 41, No. 50).

It is a small pair of muscles, each of which originates on propodeum close to the pleural protractor of its side and ends on the dorsal surface of the cervical apodeme near its posterior end. It serves indirectly as the elevator of the head. It is similar to the "Anterior notal elevator of the propodeum and head" of wasp described by Duncan. Snodgrass regards it a branch of tergo-episternal of the prothorax and hence does not regard it as a separate muscle. It is No. "47" of honey-bee described by Snodgrass.

Retractors-elevators of propodeum (Figs. 41, 49, 83, No. 51).

There are a pair of broad muscles originating from the anterior median region of the mesoscutum. They run, more-or-less, parallel to each other with a slight bending in the antero-ventral direction during their course. Each develops a small tendon which ends on the dorso-posterior end of the corresponding cervical apodeme. Snodgrass calls them "Phragmopleural muscle of the prothorax" (No. 46 of honey-bee) and regards them to originate him the prophragma. If his account of origin is taken to be correct even then his claim to call them as purely protractors of the propodeum is untenable because the course of the muscles does not support this view.

End protractors of the propodeum (Fig. 49, No. 82).

They consist of a pair of broad muscles, each of which originates from the ventral-anterior region of protergal median bridge and after running a short distance in a postero-medial direction ends on the propodeum arm of its side slightly above the insertion of the 3rd protractor of propodeus. It is described
as the "1st posterior mental protractor of the propleuron" by Duncan in wasp. The present writer regards it as "Protractor of propsectus". His view has also been upheld by Snodgrass who calls it "Protractor of the propsectus". Duncan has in reality limited the field of its activity by regarding it merely a "Protractor of propleuron".

**3rd protractors of propsectus (Fig. 49, No. 53).**

These consist also, of a pair of stout muscles. Each of which originates from the ventro-anterior region of the corresponding side lebe of the protargum. Their course is slightly posterior but similar to that of the 1st protractors. The point of insertion of this muscle is the free end of the propleural arm of its side.

**Adductors of propleuron (Figs. 41, 42, No. 54).**

They consist of a long and slender pair of muscles. Each of which starts from the antero-nasal area of the supra neural bridge and ends on the nasal surface of the corresponding cervical apodeme very close to its posterior free tip. This pair of muscles runs parallel to the 1st of levators and dorsal to the pair of depressors of the head. Snodgrass in honey-bee regards these muscles as "Adductors of the propleuron". But this view does not hold good if it is based on the direction of their course and the levels of their points of origin and insertion. Therefore, the present writer regards them as "Retractors of propleuron".

**Fore-legs (Fig. 54A).**

The fore-legs are slender and weak. They are mainly the protractors of the body in walking and climbing and are the
shortest and weakest of all legs. The osmal articulation is mainly responsible for the movement of the leg as a whole. If an imaginary axis is allowed to run vertical to the osmal articulation it will split up osma into its two longitudinal anterior and posterior halves. Keeping this line of axis in mind, if the movements of the fore-osma are watched they would appear to swing forward and backward almost at right angle to it. In order to decide the nature of the muscles influencing the movements of the leg it is advisable to find out their insertions on osmal rim in relation to the axis. This study might reveal that these muscles are inserted anterior and posterior to the latter. Hence it is evident that they are promoters and removers rather than extensors and flexors as suggested by Morison.

Fore-osma (Figs. 36, 44, 45, 46, 54 A, cmJ).

The fore-osma is a small subspherical and flattened structure. Its dorsal surface has developed an almost oblong mesally directed rim (Figs. 35, 38, 43, 44, 45, 46, 47, 54 A, cmJS). The entire margin of the rim has an inward inflection which surrounds the oblong lumen of the osmal base (Figs. 43, 47, cmJAI). The inflected margin of the osma has developed a small concavity at its end which provides articulation to the pleural osmal process of the propleuron and with the sternum by conjunctival membrane (Figs. 44, 45, ConJ). A "U" shaped weak submarginal suture called basioestal suture runs slightly posterior to the margin of the rim with its two free extremities merged into the inflection at the articular point (Figs. 42, 43, 47, box). The suture has a freshly developed internal ridge called "Basiocosta". On the distal end of the osma there is an oval space in its walls (Figs. 36, 44, 45
40. 

46. ex1 DL). This space keeps both dorsal (Fig. 78A, ex2 DVR) and ventral (Figs. 56, ex2 DVR and Fig. 79, ex2 DVR) walls at a distance and is itself filled with conjunctival membrane. The anterior and posterior walls of the exa develop a small Conical knob in each (Fig. 56, ex1 Artk and Fig. 79, ex2 Artk) which are directed into the space and provide articulations to the corresponding articular knobs present at the lateral angles on the proximal end of the trochanter (Figs. 55, 66, 78D, 82, 108, 110. ArtkT). Hence it is clear that the articulation is of "Dicondylic" type; and the movements of trochanter on the exa will be "Up and down" along an approximately antero-posterior axis. Apart from the dicondylic articulations whole of the proximal (anterior) rim of trochanter is kept in communication with the circular distal rim of the exa by the presence of conjunctival membrane in between them (Fig. 55, Conj).

Trochanter(Fig. 54A, Tr).

The trochanter is the smallest part in a leg. Its proximal region is tapering as compared to its broad distal region. If viewed from above the whole structure appears to be slightly concave. In other words its real dorsal surface is a little concave while the real ventral surface is a bit convexed (Fig. 54A, Tr). Snodgrass calls them anterior and posterior surfaces respectively. The ventral half of the proximal rim is distinctly conical (Fig. 55, TpvR) while the dorsal half is normal (Figs. 55, 56, TpvR) with a small central elevation to receive the muscles (Figs. 55, 56. Mr). Besides, this portion of the proximal rim has internal inflection (Fig. 62, 79, TpvRI). At the distal end the dorsal wall gets prolonged towards the femur (Figs. 57, 76A, Tm).
while the ventral wall falls short in length (Figs. 57, 76A, 76V). A reverse condition is exhibited by the dorsal and ventral walls of the femur at its proximal end (Figs. 57, 76A, 107B, h) with the result that they appear to meet each other along an oblique hinge line with an articular point at the upper end (Figs. 57, 76A, 107A, h). At the distal end of the ventral wall of trochanter a small articular knob projects in its lumen (Fig. 57, 76ArtP). It articulates with the corresponding concavity developed at the proximal end of the ventral wall of the femur (Fig. 57, FemCon). This articulation is not shown by Snodgrass in the fore-leg of the honey-bee; but has been mentioned in the hind leg as an specially developed structure (Snodgrass Fig. 142, F, 1). There is a strip of conjunctival membrane which connects trochanter with the femur (Fig. 76A, Conj). The movements of the femur on the hinge line with the trochanter are those of production and reduction and controlled by a single adductor muscle while the femur also moves as whole with the trochanter at the line of articulation of the latter with the coxa.

FEMUR (Fig. 54A, Fn).

The femur is an elongated joint with its distal part broader than the proximal. It has a collar like constriction (Figs. 54, 76, 107B, cs) which splits it into a small proximal and a long distal parts (Figs. 76, 107B, FemAdd). The former should not be regarded as the 2nd trochanter because the adductor muscle of femur neither originates from it nor does it end on the collar. This muscle coming from trochanter as a matter of fact, ends on the internal apodeme, projecting into the lumen from the ventral margin of the femur (Figs. 57, 62, 76B, h 107, FemAdd). The ventral
The wall of the femur (Fig. 107B, VRFa) has a bell-shaped marginal
ation at its distal end (Fig. 107B, VEFa). Besides, there are two
inner articular projections at its lateral angles (Fig. 107C, 
FmArtk). These knobs are connected with one another by the presence
of semi-circular internal ridge running parallel to the dorsal
half of the distal rim (Figs. 107C&D, DmP). The bell-shaped
prolongation of the dorsal half of the proximal rim of tibia
rests on it. Besides, during movements it keeps a constant contact
with the ridge. Hence it appears that the ridge reduces the
possibility of dislocation of femoro-tibial joint. The knobs
articulate with the corresponding lateral projections present in
the proximal end of the tibia. This is a clear discondylyic arti-
culation horizontal to the general plan of the leg. Hence the
movement of tibia will be those of extension and flexion subject
to the actions of tibial muscles. The space in the articular area
provides conjunctival connexion between the femur and tibia.

**Tibia** (Fig. 54, Tb).

The tibia is cylindrical and approximately equal to femur
in size. Its proximal region is narrowest. The tibia gets broader
and broader if viewed in a proximodistal direction. The dorsal
half of the proximal rim is produced into a bell-shaped structure
(Figs. 107C, 109, 115, 116, TbPRE), while the ventral half has
the normal course (Figs. 107C, 109, 115, 116, TbPRE). There are two
external articular knobs at lateral angles (Figs. 107C, 109, 115,
116, TbArtk). The proximal lumen (Figs. 107C, 109, 115, 116, Lun) is
highly reduced due to internal apodeme developed along the whole
of the margin (Figs. 109, 115, 116, TbRi).
At the distal end there is a cup shaped elevation (Figs 66,66,TbE) in the ventral wall of the tibia(Figs.65,66,67,TbDR). The central lip of the elevated margin projects out a structure called the "Spur" of the antennae-cleaner(Figs.56,67,68,3). The dorsal wall (Fig.58,TbDR) near its distal rim develops an internal ridge postero-cesally directed (Figs. 58,69,64,DRv) which possesses a distinct crescent shape concavity facing the tarsus (Figs. 58,59,ComIr). The median knob present on the proximal rim of the dorsal wall of tarsus fits into the concavity(Figs 59,64,Tarh) thereby producing a clear ball and socket like tibio-tarsal articulation. Slightly proximal to the point of articulation there is an internal ridge running parallel to the dorsal half of the distal rim of tibia which probably plays some part in controlling the movements of the tarsus(Fig.59,TbDR).

**Tarsus:** (Fig. 54, Tar).

The tarsus is longest amongst all the joints of the leg. It is divided into five sub-joints called "Tarsomeres". The proximal tarsomere is the biggest one and provides the tibio-tarsal articulation. It is called basitarsus (Fig. 64,65,67, Tar). The proximal rim of the dorsal wall of basitarsus possesses three closely placed knobs; out of which the central one articulates with the tibia (Figs. 59,64,Tarh). The remaining two receive tendons of anterior and posterior tarsal muscles respectively, (Figs. 59,64, Tarl). All the three knobs are borne on three internal longitudinal ridges in the basitarsus called central and lateral tarsal ridges (Figs. 59,64, TarDr & TarIr). The second and the fifth tarsomeres are sub-equal in size with the difference that the latter has a slightly concave ventral face while
the former is a straight tube similar to the rest. The third one is about half of the size of the second, and the fourth is smallest amongst all. Each tarsomere except the first one has a tapering narrow proximal and which is telescoped into the comparatively broader distal end of the preceding one. Their internal longitudinal cavities are continuous with one another.

Prosternum (Figs. 60, 61).

The distal margin of the dorsal wall of the last tarsomere develops a crescent shaped amargination (Fig. 61, TarDis). From the centre of which diverge out the sclerites in either direction and parallel to its margin. These are called "unguifera" (Fig. 61, UrP). The narrow bases of the unguifers first fuse with one another and later on, this common structure fuses with the basal area of the margin (Fig. 61, Urb). The narrow space in between the unguifers and the margin is traversed by conjunctive which keeps each unguifer hanging from the margin (Fig. 61, Conj).

As the unguifers run along the margin therefore naturally the two combine and form a, more-or-less, concave structure in the middle of which the basal part of the manubrium is placed (Fig. 61, Mub). The manubrium is a well sclerotized elongated structure broadest in the middle region (Fig. 61, ma). Both of its basal and distal parts are narrow. The latter is so narrow that the manubrium in that region becomes a tapering structure (Fig. 61, Dmm).

The Arolium is a ball like distal lobe (Figs. 60, 61, Ar) with a deep invagination in its surface facing the manubrium (Fig. 61, InvAr). This invagination accommodates the conical structure of the latter. A space thus enveloped in between the arolium and the
conical structure is traversed by conjunctiva which keeps them in communication with one another. The arolium as a whole is a heart shaped fleshy structure with a distinct collar-like sclerite band in its basal region which dorsally covers the distal part of the maxilipod. It is called "Arcaus" (Figs. 60, 61, aca).

There is a pair of hollow claws with broad basal and pointed distal ends (Figs. 60, 61, aca). At the base of each claw a concavity is present (Figs. 60, 61, concala) which provides articulation to the knob-like free end of the corresponding unguis (Figs. 61, Utr) in a "Ball and socket" like manner.

The ventral wall of the pretarsus is shorter than the dorsal with the result that the dorsalward pressure of the leg exerted on the arolium through the maxilipod works to its greatest extent. Close to the ventral rim (Fig. 60, TarDV) is a bottle-shaped sclerite called "Unguicurator" (Fig. 60, Utrv). It has a median longitudinal ridge running on its dorsal surface (Fig. 60, Utrv). At its base there is a small groove which appears to be continuous with the ridge and receives the tendon of the muscle (Fig. 60, Utrv). The ridge has a membranous connection with the ventral surface of the maxilipod. The ventro-posterior margin of each claw is so close to the unguicurator that it is equally affected by the muscles of the latter. Due to this reason the muscle is called "Flexor of the claw". The distal end of the unguicurator lies close to the base of arolium and has conjunctival connection with it.

This insect can walk on a smooth surface but not so efficiently and swiftly as the house fly due to the presence of a weak clinging mechanism.
Antenna Cleaner (Figs. 66, 67, 68.)

The antenna cleaner consists of a leaf-like spur and a ridge-like brush. The spur (Figs. 66, 67, 68, 8) fits into a notch (Figs. 67, 68, Tm) present at the distal end of the ventral wall of tibia (Fig. 67, TrW) by its proximal knob (Figs. 67, 68, 8k). The notch-margin is well sclerotized (Fig. 68, Thmar). The articulation is "Ball and Socket" like. The free end of the spur is tapering and its entire body is longitudinally concave with the concavity directed towards the basitarsus (Fig. 68, ccaon). The two outer i.e. lateral margins (Figs. 67, 68, 8lar) and the median rib of the spur (Figs. 67, 68, 8mr) are covered over with a thick growth of bristles (Figs. 67, 68, b). All these structures combiningly work as "Scrapers" (Figs. 67, 68, 8). The brush facing the scraper is a short convexity equal in size to the scraper. It is located in the proximal part of the ventral wall of basitarsus (Figs. 67, 8). The sides (lateral margins) of the brush (Fig. 67, 8lar) are fused with the ventral wall of the basitarsus; while its median part is beset with bristles (Fig. 67, 8m and b).

The antenna is held in between the scraper and the brush. The latter slowly bends down to grip the antenna thoroughly. The antenna is then slowly drawn through the cleaner which collects all foreign matters from it with the help of bristles; and thereby renders the antennal surface free of foreign matters.

Musculature of the Fore-limb:

Para-somatic

Duncan in the wasp, does not deal with the plan to which the coxal movements are confined. Hence the musculatures used by him appear to be more of speculative nature rather than an
exact account of the actual facts.

**Int. mesal prosectori (Figs. 44, 46, 47, No. 55).**

The fibres of the first mesal prosector arise from the posterior region of the ventral plate beneath the horizontal apodeme. These are arranged in 2 distinct bundles (58a, 58b) which form a common small tendon to end on the outer surface of the anterior rim of the soma close to its articulation. Snedgrass confines himself to describing episternum as its seat of origin. This is muscle No. "53" of honey bee described by Snedgrass and is comparable with the "pleural prosector of the fore-soma" in wasp described by Duncan.

**2nd prosector of soma (Figs. 37, 46, 47, No. 56).**

This is a big muscle with its fibres spread over the entire dorsal surface of furcasternalum below the wing plate. Some of its fibres appear to start from the furcasternal ridge as well. They converge to form a long tendon which ends on the distal end of the outer surface of anterior mesal rim far away from mesal articulation. This is muscle No. "56" of honey bee described by Snedgrass. Here again Snedgrass's account of the origin is insufficient. Duncan shows its origin only from the furcasternal ridge of the wasp. He probably does not trace every group of fibres which could have revealed a certain number of groups placed ventrally to this muscle and originating from the furcasternalum. This muscle has been named as "Sternal rotator of the fore-soma" in the wasp by Duncan.

**Int. rotator of soma (Figs. 46, 47, 48, No. 57).**

It is a big muscle originating from the posterior margin of pronotum close to spiracular lobe. Its insertion is on the middle
of the outer surface of the posterior esomal rim. Duncan calls it "Pronotal adductor of the fore-esoma". It is muscle No. "56" of Snodgrass in honey bee. Both the above authors confine it's origin on the ventro-posterior margin of pronotum. This means that it cannot be a strong retractor unless it originates from the region shown by the present writer, which will indicate the direction of the pull of the muscle.

**2nd retractor of esoma (Figs. 46, 47, 51, No. 56)**

This is the stoutest muscle of the esoma. It originates from the posterior i.e. ventral surface of the corresponding supra-neural bridge and ends by a small tendon behind the 1st retractor of its side. This muscle corresponds to muscle No. "56" of Snodgrass in honey bee. It is named as "Furcal rotator of the fore esoma", by Duncan in the wasp.

**3rd retractor of esoma (Figs. 46, 47, No. 59).**

This muscle originates from the lower surface of the horizontal apodeme of its side and has its insertion on the outer surface of the mesal rim of esoma just opposite to the esomal articulation. Its insertion is mesal to the 2nd retractor and hence should not be confused with it. It corresponds to muscle no. "57" of honey-bee as described by Snodgrass. It has been described as "Secondary adductor of the fore esoma" in the wasp by Duncan.

**Retractor of Coma (Figs. 46, 47, No. 60).**

This muscle originates from the side of the anterior part of the median meso-sternal ridge which supports the pterothoracic endosternum. It runs ventral to the retractor of proposties of its side and ends on the outer surface of the posterior rim of
the corresponding corna far away from the articular point and close to the insertion of the 3rd cornal remotor. It is, undoubt-
edly, a direct retractor of the fore corna; but a more or less similar influence of this muscle on the entire propodius cannot be left unnoticed. It can, therefore, be called "Indirect retractor of propodius". Duncan is justified in regarding it as the "Mesosternal retractor of the propodius". Horsem has incorrectly used the term "Extensor" for this muscle which corresponds to muscle No. "58" of Snodgrass in honey-bee.

**Anterior levator of trochantari** (Fig. 56, No. 30).

This muscle arises from the dorso-posterior region of the fore-cornu and ends by a tendon on the central raised portion of the dorsal half of the proximal rim of the 2nd trochantari.

**Posterior levator of trochantari** (Fig. 56, No. 31).

This muscle arises from the dorso-posterior region of the fore-cornu and ends by a tendon slightly posterior to the anterior levator.

**Pleural depressor of trochantari** (Figs. 48, 46, 63, No. 61).

This muscle arises from the under surface of the horizontal apodeme. It runs dorsal to the 1st promotor of the cornu. On entering the lumen of the cornu it forms a long tendon (Figs. 45, 46, 63, Plast) which ends on one side of the depressor's apodermal plate. The latter (Figs. 46, 55, 63, Dappl) lies very close to the ventral half of the proximal rim of the trochantari and has a conjunctival connection with it.

**Cornal depressors of the trochantari** (Fig. 63, No. 97).

This muscle consists of three bundles of fibres arising from the ventral wall of the cornu. All these bundles (a, b, c) and
on ventro-lateral area of the apodemal plate by their convergent fibres. As the regions of the origin and insertion of these fibres are common and that they do not form separate tendons therefore an exact interpretation would be to regard them as bundles of the same muscle. This muscle corresponds to muscle "63" of honey bee described by Snodgrass.

**Femoral reductor:** (Fig. 62, No. 100).

It is a thick muscle with its fibres arising underneath the posterior half of the proximal marginal inflection of trochanter (Fig. 62, 703, 103B, TFWI). The fibres run parallel over the posterior wall of the trochanter and end singly on the internal apodeme of the posterior half of the proximal margin of femur (Fig. 62, Fm1Ap). It resembles muscle "63" of Snodgrass in honey-bee. He is however silent on the exact place of its origin. Besides, he has shown convergent nature of its fibres instead of parallel nature as shown by the present writer.

**Extensor of Tibia:** (Fig. 116, No. 101).

It is a pinnate muscle whose fibres arise along the dorsal wall of femur. It's axial apodeme ends on a small triangular solerite placed just above the apex of the dorsal rim of the tibia (EApl).

**Depressor of Tibia:** (Fig. 115, No. 102).

The depressor of the tibia is similar to the extensor and originates along the ventral wall of femur. The axial apodeme (Fig. 115, Ap) of this muscle ends on a large triangular plate called "Hamulotrochanter plate" (Fig. 115, gf) which is placed on the ventral rim of tibia. This muscle corresponds to No."91" in honey bee as described by Snodgrass. Besides this, two bundles
of small muscles are found ending by their fibres on either side of the genufleexor plate. Each of these bundles arises from the dorsal wall of femur in its distal region as a very weak muscle. Snodgrass has described them in Dissasteira Carolina. The present writer, however, does not regard them as important depressor muscles; and hence calls them as "Accessory depressor muscles" (Fig. 118, 103, 104).

A tendon like thread is inserted on the proximal dorsal rim of the tibia. The function of this thread is obscure and it may be a part of some chordotonal organ originating some where in the middle of the femur (Fig. 118,q).

Productor and Reductor of the tarsus: (Fig. 64, No.105 & 106)

One of the three knobs present on the dorsal proximal rim of the basitarsus the central one serves as a point of articulation (Figs. 59, 64, Tarlk). The remaining lateral knobs give insertion to the two muscles coming from the tibia (Figs. 59, 64, Tarlk). These two muscles arise as pinnate muscles from the anterior and posterior walls of the latter. As the three knobs are placed very close to each other hence these muscles are automatically drawn by their insertions very close to the central knob. The muscle originating from anterior wall functions as "Productor" (Fig. 64, No.105) while that coming from the posterior wall becomes "Reductor" (Fig. 64, No.106).

Depressor of the tarsus: (Fig. 65, No.107).

This muscle is also a pinnate muscle occupying about three fourth of the ventral wall of tibia. Its axial tendon gets lost in the conjunctival membrane just above the ventral half of the proximal rim of the basitarsus.
Flower of the claw (Figs. 65, No. 108t; 109, 110).

This muscle originates from the femur and its fibres are found placed in between the extensors and depressors of tibia. It is a small muscle with a very long and thin tenden which is developed in the posterior region of the femur (Figs. 65, No. 108t). This tenden while passing through tibia receives at least two bundles of muscle fibres one in the proximal (Fig. 65, No. 109) and the other in the central regions of the latter (Fig. 65, No. 110). These proximal and central muscles have their origin on the ventral wall of the tibia and may be analogous to the second and third flexors of the claw in Bisectotena Carolina described by Snodgrass. Unlike honey-bee the tenden is throughout single and unbranched. It receives no muscles in the tarsal region and ends on a small rectangular sclerite in the second half of the last tarsomere (Fig. 60, Spl). This sclerite is connected with the groove (Fig. 60, Utrg) of the unguicurator by means of a small connecting tendon (Fig. 60, Utr). According to the present writer the function of this sclerite is to strengthen the pull of the muscle on the unguicurator which is being exercised through a long tenden. Snodgrass does make no mention of this point.

Mesothorax.

The mesothorax covers about two third of the whole thoracic region. Its various parts are well developed and are highly sclerotized. There is a marginal inflextion running along the entire length of the anterior margin of the mesopterous (Figs. 35, 72, 36, 88, & 87, Fig. 1). This condition enables the posterior margins of the two side lobes of pronotum to abut on the
mesopleuron. The posterior half of each dorsal margin of mesopleuron possesses a distinct sub-marginal ridge (Figs. 71, 72, 85, 86, & 57, Pl. III). It is the posterior extension of the ridge of pleural suture which overlaps and abuts on the corresponding portion of the anterior margin of the mesopleuron of its side. The mesepisternum along its mid-ventral region has a weakly developed longitudinal ridge which supports the meso-endosternum. All these specializations coupled with the arched nature of the mesonotum corroborate that the mesothorax is best fitted to withstand the tremendous amount of strains brought upon it by the powerful leg and wing muscles present within it.

Mesonotum

The mesonotum is an oval shaped convexed sclerite. A pair of semi sclerotized lobes called "Prephragma" hangs from its antero-dorsal margin (Figs. 63, 69, 70, 82, 83, & 84, A 169A, Pl. II). These lobes are held apart from one another by the presence of marked slit in between them, E.ek (Figs. 69, 82, 83, & 84, Pl. III). This slit is traversed by the aorta when the latter is at the point of entering into the prothoracic region (1942). Snodgrass shows an unpaired crescent shaped prephragma solidly united with the mesonotum.

Prescutum (Figs. 32, 34, 53, 69, 70, 81, 82, 83, 84, 169A, Pl. II).

The prescutum is separated from the scutum as a narrow marginal strip by the presence of a distinct suture in between them. This suture running sub-marginal to the entire lateral and anterior parts of the mesonotal margin ends by its two extremities in the lateral regions of the line of fissure of the mesonotum. It is called "Prescutal suture" (Figs. 32, 34, 53, 69, 70,
71, 81, 92, 83, 84, & 93, t c). The course of this suture is although parallel to the margin except in its postero-lateral regions where each of its extremities before ending on the line of mid fissure becomes markedly nasal. This change in the course of prescutal suture makes the prescutum expand in its postero-lateral region called "Postero-lateral expansion" of the prescutum (Figs. 32, 69, 70, 71, 81, 82, 83, 84, & 93. Prece). In the region of deviation of the prescutal suture the mesonotal margin gives out an off-shoot which runs in a meso-posterior direction slightly lateral to the corresponding prescutal suture (Figs. 70, 71, 82, 83, & 94. MNsb). This off-shoot does not reach the line of fissure and gets lost some where in the lateral expansion of the prescutum; and serves as the base of origin of the tegula which is definitely an external out-growth of prescutum (Figs. 32, 34, 69, 70, 71, 82, 83, 84, & 93. Tg). At the postero-lateral angle the prescutum develops a "Y" shaped sclerite black in colour and concealed by the tegula. The two external ends of this sclerite form the anterior metal process (Figs. 32, 34, 69, 70, 71, 72, 82, 83, 84, & 93. ANP).

Snodgrass (1949) in honey-bee does not show any trace of prescutal area in honey bee. The same writer in his paper "Theran of Hymenoptera 1916" regards the two parapsidal sutures as parts of "Prescutal suture" in Enatrogenos penetrator (Braconid). The present writer rejects this assumption on the ground that the prescutal suture and parapsidal sutures are different sutures with different courses in Stone-bracoon species.

Duncan has shown an inflected scutal margin which is probably analogous to the prescutum of the present writer.
According to Duncan the apodemal fold borne on the down turned scutal margin develops the tegula. Snodgrass regards it originating direct from the scutum. Snodgrass holds scutum responsible for the origin of the anterior notal process, while Duncan gives a confusing account of this structure. The present writer thinks that all the above mentioned differences with Snodgrass and Duncan had disappeared if these writers would have succeeded in finding out the prescutum in the mesonotum of their respective insects.

**Scutum** (Figs. 32, 34, 53, 69, 71, 169A, Set2).

The whole of the mesonotum is split up by a transverse fissure into a small posterior basal part (scutellum) (Figs. 32, 34, 69, 71, 82, 83, 84, 85, Set2) and a large anterior part (Scutum) (Figs. 32, 34, 53, 69, 71, 169A, Set2). This fissure on either side opens into the corresponding wide marginal margination and is itself traversed by a thin strip of membrane (Figs. 32, 34, 69, 71, 81, 82, 83, 84, 85, Set5). Thus these lateral marginal marginations formed just below the anterior notal process of each side of the mesonotum enter into communication with one another through the fissure. This line of division does not conform with the true scutescutellar suture of a generalised insect and hence can rightly be called "Pseudoscuto-scutellar" suture. The real scutescutellar suture is present in the form of a crescentic groove which is merged at its apex with the central part of the pseudo scuto-scutellar suture (Figs. 32, 34, 71, vs). The arms of the true suture run in a postero-lateral direction till they end into the respective postero-lateral angles of the mesonotum. Internally the true suture is represented by a well developed
ridge with its mesal part inflected backwards. It is called "Notal ridge" by Snodgrass (Figs. 69, 82, 83, 84, & 93, HR). Thus the basal part is further split up into a central almost semi-circular area the "true scutellum". (Figs. 32, 34, 69, 71, 82, 83, 84, & 93. Selg) and two antero-lateral quadrilateral areas which are definitely included into the scutum. These individually may be called "postero-lateral lobes of the scutum" (Figs. 32, 34, 69. Sel1).

From Duncan's account it is evident that the "Transscutal suture" and the true scuto-scutellar suture in wasp are coincident throughout excepting in the small lateral areas where the divergence in their course causes the formation of two small triangular areas. These triangular areas are called "Axillae" by Duncan. The two axillae in every respect are analogous with the two postero-lateral lobes of the scutum in Steno-brachus deceae. Duncan is mistaken in including axillae into the scutellum. Firstly because he himself holds the validity of the true scuto-scutellar suture; and secondly because he himself admits that the course of the latter is posterior to that of the transscutal suture beyond any shadow of doubt. Each postero-lateral lobe of the scutum bears on the external side a longitudinal carina which splits the former into an outer and an inner, more-or-less triangular bodies (Figs. 32, 34, 69, 71, 82, 83, & 93. c). The outer triangle has its vertex directed towards the lateral emargination, and and receives the axillary cord of the respective fore-wing (Figs. 32, 34, 69, 71, 82, 83, 84, & 93. et). It can rightly be called "Posterior notal process" (Figs. 69, 71, 81, 82, 83, 84, & 93. PNPg). Duncan refuses to accept the
presence of a true posterior mental process, while Snodgrass' observations support the present writer.

The part of the mesotergum in between the fissure and the proscute-scuteal suture is called the "Scutum". It contains the anterior portion only of the median suture in the form of an impression (Figs. 32 & 69, mns). A pair of lateral sutures (parapsidal sutures) are present (Figs. 32, 34, 69, & 71, mns). Each starting from the respective lateral portion of the proscute-scuteal suture after leaving one third of the anterior region of the mesonotum. Both lateral sutures after traversing a little distance medially bend downwards and run parallel to each other till they end separately on the fissure. Thus the whole surface is split up into three longitudinal parts. Out of these the median one is longest (Figs. 32, 34, 69, 71, & 93, mn); while the two laterals are equal in size (Figs. 32, 34, 69, 71, 92, 93, 94, & 95 Par). Duncan has described a pair of parapsidal furrows in wasp. But from his figure "Ko, 41" it is evident that they are incomplete and have become obsolete to a certain extent. Snodgrass does not describe them in the honey-bee.

Scutellum (Figs. 32, 34, 69, 71, 92, 93, 94, & 95, Sc1g). The scutellum appears externally like a semicircular hump in the posterior region of the mesotergum. Apart from the arched mental ridge it has a distinct submarginal ridge across its posterior margin (Figs. 92, Sc1g,mf) which cuts off a narrow highly sclerotised plate called "Flange" by Duncan (Figs. 32, 34, & 93, Pf). This flange abuts dorsally against the anterior margin of the metanotum with a thin infolding of the membrane in between them.
Mesopteracrinus (Figs. 69, 71, 82, 83, & 84, Sph).

The post-phragma is a "Y" shaped structure. The area between the tips of its 2 limbs i.e. anterior margin is fused with the internal free surface of the posteriorly placed submarginal ridge of the meso scutellum. Duncan believes that the post phragma is fixed with the mesoscutellar region only in its latero-anterior parts and its mid-anterior margin is free from having any fusion with the meso-scutellum.

It extends up to the posterior part of the propodeum. There is a small notch at its posterior tip through which dorsal aorta passes (Figs. 69, 71, 82, 83, 84. Sph). Due to a small emargination in the centre of its anterior margin it remains separate from the mesoscutellum in this region (Figs. 69, 71, 82, & 83, Sph). The posterior notch has been mentioned both by Duncan and Snodgrass in wasp and honey-bee respectively; but the anterior emargination has not been described by them. These two notches are connected with one another by a weak longitudinal impression which splits up the whole post-phragma into a right and a left arms, (Figs. 69, 71 & 84. Sphs). Snodgrass has made a mention of the word "Arm". His account of the arm points out the region described above by the present writer; but he has failed to show any suture demarcating these arms.

Each arm can be differentiated into an anterior oblong part and a posterior long tapering region called anterior and posterior lamellæs respectively. The former is more densely (Figs. 69, 71, 82, 83, & 84, AL) sclerotised and its anterior margin is the true anterior margin of the post-phragma (Figs. 69, 71, 82, 83, & 84, Sph). It is comparable to the "Inner lamella" of
Snedgrass in honey-bee. The present writer doubts if the anterior lamella is exactly what Duncan calls as "lateral maxae". The posterior lamella is an elongated posteriorly tappering part of the post-phragma (Figs. 69, 71, 82, 83, & 84, PL). It is weakly sclerotised and extends upto the propodeal region. This condition gives the post-phragma an intersegmental position. The posterior lamella has been described as "Outer lamella" by Snedgrass. Duncan does not mention this point. Each anterior lamella tappers out laterally in the form of a projection. This projection is directly united with the dorsal face of the mesal inflection of the descending margin of the corresponding epinera (Fig. 72). Both Duncan and Snedgrass had shown an independent coxite to articulate with the post-phragma. This coxite according to them is epineral in origin and rests on the epineral margin just below its mesal inflection. Snedgrass had named it as "supporting plate of subalaro". Weber regards it as fourth axillary coxite.

From the ventral surface of the lateral half of each anterior lamella a small conical projection comes out in a postero-mesal direction (Figs. 69, 82, & 83, P). The tip of this process provides a point of insertion to a muscle which will be described later on. It is exactly homologous to what has been described as "Muscle bearing process of second phragma" by Snedgrass in "Nagarkhosa inuator" (Ichneumonidae). Weber has called it as "Pointed anterior process of the mesophragma". Duncan is correct in regarding such a condition as "Generalised condition" as compared to what is present in the honey-bee. The latter is unquestionably a case of specialisation.
Mesonotum

The mesoscutum is formed by complete fusion of mesoscutum into the mesopleura and thereby occupies the whole ventro-pleural regions of the mesothoracic segment. It possesses a median sternal groove which divides it into a right and a left halves (Figs. 33,74,75,76, & 96, mssg). These are called right and left mesopleura. James in "Harmolita graminicola" has shown a distinct sterno-pleural suture. Both Duncan and Snodgrass regard such a line of demarcation between mesosternum and mesopleurum as absent. This does not mean that the mesosternal area should be considered absent all together. It is present and it's lateral extent can be observed by the areas occupied by the ventral ends of the fibres of dorse-ventral muscles on either sides of the mid-longitudinal groove.

The mesopleuron is narrowed at its dorsal end to form a dorse-posteriorly directed articular process called "Plleural wing process (Figs. 35,71,72,85,96, & 67.FlMP). Ventrally the mesopleuron is broad with its posterior margin forming the anterior rim of the corresponding mesocoimal socket for the meso-coxa to fit in (Figs. 33,34,85,96,103, & 104 mccoar). The posterior margin at the point of its union with the dorsal margin develops an articular knob to articulate with the outer part of the corresponding meso-coxal rim (Figs. 34,73, & 96. Akma). From the tip of the pleural wing process upto a point in the anterior margin, the latter is shaped such so as to allow the whole ventral surface of the basalar to fit over it. The base of the basalar (Figs. 35,37,Bayk) is placed into a small emargination possessed by the anterior margin of the
mesopleuron (Figs. 25, & 27, g). Slightly downwards to the basalare articulation is a depression on the outer surface of the anterior margin which is covered over by the spiracular lobe of the prothorax. Starting from this depression downwards the shape of the anterior margin conforms with the base of the corresponding triangular side lobe of the prothorax in order to facilitate the latter to abut with the former. The anterior margin in between the two ventro-posterior angles of the prothorax is left uncovered and has extended out towards the pleural region (Fig. 33, Pl.92a). This extended portion is demarcated from the remaining mesopleuron by two oblique sutures which join the anterior tip of the median sternal groove with the anterior margin (Figs. 33, Pl.92a). Internally these sutures develop two weak ridges which appear like bifurcations of the median sternal ridge (Figs. 72, 74, 85, 96, & 57, Pl.10). This area may be called "Mesopropostus" (Figs. 33, 72, 74, 85, 96, & 57, Pl10). If James in Harmolita had held a similar view, while Duncan in weasp had regarded it a carina.

The descending dorsal margin (Figs. 34, 35, 71, 72, 85, 96, 57, & 96, plgma) immediately on leaving the dorsal tip of the pleural wing process makes a small semi-circular and inward bend (Figs. 34, 35, 71, 72, 85, 96, & 57, 5b). After emerging from this bend the margin undergoes a nasal inflection in the form of a wide plate (Figs. 34, 35, 71, 72, 85, 96, & 57, Plgma). The inflection is followed by an outward lobe like expansion of the margin (Figs. 34, 35, 71, 72, 85, 96, & 57, Plgma) which carriess the 2nd thoracic spiracle and may be called the "Spiracular lobe of the 2nd thoracic spiracle. Thence it runs downwards unaided
until it joins the outer tip of the posterior margin of mesopleuron.

The course of the semi circular bend of the descending dorsal margin is internally followed by a distinct ridge which extends from the tip of the pleural wing process up to the medial inflection. It may be compared with the "Subalar-mesopleural ridge" of wasp described by Duncan (Figs. 35, 71, 72, 85, 86 & 87, 622). The area thus enclosed, in between the so called subalar-mesopleural ridge and the semi circular bend of the descending dorsal margin, may be regarded as "Fossa of the third axillary" as shown by Duncan in the wasp (Figs. 35, 71, 72, 85, 86 & 87, 7). The lower tip of the subalar-mesopleural ridge is joined with the anterior margin of the mesopleuron near the articulation of the basalar through a second ridge which runs across the mesopleuron in a ventro-anterior direction (Figs. 35, 71, 72, 85, 86 & 87, 7). In this way a triangular area is marked off in the dorso-anterior part of the mesopleuron (Figs. 34, 35, 71, 72, 85, 86, & 87, Fig.7). This triangle has definitely a more highly raised platform as compared to the remaining part of the mesopleuron. This platform has been represented by "Posteriorly large reflected plate" i.e. "g" in honey-bee by Snodgrass.

The mesopleuron is traversed in the dorsal region by a groove. This groove starting close to the triangular platform traverses the dorsal part of the mesopleuron obliquely until it reaches the medial inflection of the descending dorsal margin. Then it bends downwards and running almost parallel to the descending dorsal margin gets merged into the axial articulation. This groove is the true pleural suture (Fig. 34, 71, Fig.7).
Internally it forms a strong pleural ridge (Figs. 72, 73, 85, 86, & 87, Pl. 2) and divides the whole of the mesopleuron into a small and narrow dorsal area and a large spacious ventral area called episternon (Figs. 34, 72, 73, 85, 86, & 87, Ep. 2) and episternum respectively. The episternon starts from the coxal articulation in the form of a narrow strip running in between the descending dorsal margin and the pleural ridge. It expands over the dorsal region of the mesopleuron and engulfs in it the triangular dorso-anterior platform of the meso pleuron, fossa of the third axillary, the mesal inflection and the outward lobe like expansion of the descending margin. There is another suture which starts from the anterior margin of the mesopleuron. This suture passes across the dorsal region of the episternum and bends downwards near the downward bend of the pleural suture. The former after running a certain distance very near and parallel to the latter gets merged in it. The first half of this suture i.e. the part extending from the anterior margin of mesopleuron up to its downward bend possesses an internal ridge, while the remaining part is internally represented by a very faint line. This suture may be called "Secondary pleural suture" (Figs. 34, 72, 85, 86, & 87, Ep. 2). The latter divides the episternum into a small dorsally placed "Anepisternum" (Figs. 34, 72, 85, 86, & 87, An. Ep. 2) and a big ventral "Kantepisternum" (Figs. 33, 34, 72, 73, 85, 86, 87, & 1884, Kt. Ep. 2) and can be compared with the transpleural suture of the wasp described by Dunsen.

The course of this secondary pleural suture is almost similar to that adopted by the pleural suture described by Sandgras in honey-bee in his book "Anatomy and Physiology of
the honey-bee, 1925. Later on, the same author in his recent publication "The Skeletal Muscular mechanism of the honey-bee 1942" has however abandoned this view on the following grounds:

It does not possess a conspicuous pit which would internally form a small pleural apophysis and which in its turn would be intimately associated with the arm of the mesothoracic enosternum.

If the above be the only distinctive features of the true pleural suture then the present writer considers himself justified in sticking firm to his view. The true pleural suture has a conspicuous pit (Figs. 34 & 72 P1g 2) which internally forms a small pleural apophysis in the region where it receives the secondary pleural suture (Figs. 72, 73, 85, 83, 82, 87, Plg 1). This apophysis is in communication with the corresponding arm of the mesothoracic enosternum.

Neuromesosternum

The prominent "median sternal groove" (Figs. 33, 74, 75 & 76 mg 3) runs between two pits, one located in the anterior region, the mesosternal pit, (Figs. 33, 74, 75 & 85 fp 2) while the other lies in the posterior region (Furcal pit) of the mesosternum (Figs. 33 & 85, fp). The median sternal ridge gets gradually elevated in the antero-posterior direction until it reaches the furcal pit where it attains maximum elevation (Figs. 72, 73, 74, 75, 76, 85, 87, 92, 102, 104, 105, 162A msf 2).

The anterior margin of the median sternal ridge in its posterior half becomes a little flattened and joins the ventral surface of the horizontal plate. This flattened part probably corresponds to the two laminae of the median sternal ridge in wasp (Figs. 5, 74, 76, 76, LamSg 2).
The horizontal plate is "Y" shaped (Figs. 74, 75, 76, 85, 86, 87, 87 & 91. Hf_3). Its stalk starts very near the furcal pit and passes in an antero-dorsal direction above the posterior surface of the median sternal ridge (Figs. 74, 75, 76 Hf_3). On emerging from the ridge it bifurcates into two small rod-like structures. Each of these rods (Figs. 74, 75, 76, 77 Hf_3) gives rise to the respective furcal arm from the outer surface of its distal end. The latter is narrow at its proximal end and broad and fan shaped at the free distal end (Figs. 74, 75, 76, 85, 86, 87, & 91. Af_2). These furcal arms run towards their respective pleural apophysis.

The mesofurcal bridge originates as a broad flat plate from the inner surfaces and at the distal ends of the two rods of the horizontal plate (Figs. 51, 74, 75, 85, 86, 87, & 91. ArF_2). It is horizontal in position and connects the furcal arms when they are turning towards their corresponding pleural apophysis. The anterior surface of the bridge is drawn out in the form of a narrow process called anterior spine from either side of which originate the fibres of the two mesofurcal muscles which are the retractors of propodius (15% of Duncan) (Figs. 51, 74, 75, 85, 86, 87, & 91. ArF_2). The anterior spine should not be confused with any of the two lobe-like anterior processes of the wasp as described by Duncan. The posterior margin of the bridge develops a pair of lobe-like projections. These posterior lobes being directed inwards overlap each other by their free distal ends (Figs. 74, 75, 76, 85, 86, 87, & 91. ArF_2). This condition divides the foramen situated in between the distal part of the horizontal plate and the posterior margin of the bridge into
two unequal lumina. The smaller of the two lies dorsal to the posterior lobes (Figs. 51, 74, 75, 85, 86, 87, & 91. mfgs), while the larger one is ventral to them (Figs. 74, 75, 76, 85, 86, 87, & 91. mfgs).

The two posterior rims of the mesosomal sockets are joined to one another by the presence of a transverse groove in between them (Figs. 33, 96, 98, 102, 104, exagur). This groove has been named as "Intersegmental groove" by Duncan; which demarcates the mesepisternum from the metepisternum (Figs. 33, 96, 98, 102, 103, & 104. Leg). Somewhere from the middle of each anterior rim of mesosomal socket there starts another distinct suture running inwards. This suture subsequently turns upwards and meets its corresponding suture of the other side just below the furcal pit. The combined suture is known as the "Transsternal suture" (Figs. 33, 96, 98, 102, 103, 104, & 105. stst). A small posterior part of mesosternum which is marked off by it can appropriately be called "Precoxal area" (Figs. 33, 96, 98, 102, 104, & 105. Prex). Duncan has shown two separate precoxal sclerites in the wasp. James in Hymenoptera and Snodgrass in honey-bee have made no observation having a bearing on this point.

Hymenoptera Legs (Fig. 54B).

A detailed description of the legs and of their different parts and articulations has already been given before in the case of the forelegs. The author will therefore confine himself to the specialisations which has occurred in the pterygosternae legs.

The meso-coxa is almost similar to the prococx in shape but is bigger in size (Figs. 54B, 85, 86, 90, & 108A. Zoom). The
proximal elongation present in the process is reduced in the
case of neso eom with the result that the neso-eomal rim and
its nusen have become more or less circular (Figs. 73,77,86,
86,92, & 90. enxR). The basicosta of the nesoecom is comparat-
ively well developed (Figs. 77, & 90. Be); and its basi osnute is
more spacious (Figs. 54B,77, & 90. Ben). A prominent concavity
is found on the outer (ventro-lateral) part of the inner infla-
tion of its rim to provide articulation for the pleural articu-
lar process (Figs. 73,77B,86,89, & 90. A.eom). The latter is
episternal in origin and situated at the distal end of the
pleural ridge (Figs. 54,73,86. Ahmu). Snodgrass has shown a
several articulation in addition to the above. The present
writer has failed to trace out this additional articulation.
Duncan also does not show the latter in the wasp. The whole of
the eomai rim (Figs. 73,77,86,89, & 90. enxR) is in membre-
neous connection (Figs. 73, & 86. enxR) with the rim of the
respective eomai socket (Figs. 73, & 86. enxR). The nesoecom at
its distal end has discondylic articulations with the trochanter
exactly, as described in the ease of process (Figs. 79,emxArth,
ArxM).

The neso trochanter is more or less similar to that of the
foreleg (Figs. 54B, 57,92&. Tr). It differs from the latter
firstly in being greater in size; and secondly in having the
anterior sx leovater muscle (Figs. 90 & 92,So,92) much stouter
than the posterior leovater (Figs. 90 & 92, No,92). The anterior
leovater of the neso-trochanter have some of their fibres origi-
inating from the basicosta. The trochantere-femoral joint is exactly
as seen in the foreleg.
The femur of the mesothorax has its proximal lumen a bit elongated. The posterior half of its proximal rim has a much prominent internal apodeme. Besides, the size of both the proximal and the distal halves of the femur are comparatively greater than the corresponding parts of the forelegs. The size of tibia of the mesothorax is longer than the tibia of the foreleg. The femorotibial joint is dicondylic like that of the foreleg. The internal inflection of the proximal rim of tibia is greater as compared to that of the foreleg. The cup-shaped emargination at the distal end of the ventral wall of tibia is less prominent. From either side of the emargination a small process projects out which may erroneously be taken as the "spur" (Figs. 63B, S). This assumption is incorrect for the simple reason that each process is merely a cylindrical structure without any longitudinal groove on its surface facing the basitarsi.

The tibia-tarsal joint is monocondylic as described already in the foreleg. The basi tarsus and the preceding segments of the tarsus are comparatively bigger in size than the corresponding segments of the forelegs.
Indirect and principal depressors of the fore-wings:

These muscles are the longest pair of muscles in the body. They originate from the entire ventral aspect of the post-phragma, and run longitudinal to the mesosternum in between the two "Indirect and principal elevators" of the forewings. Anteriorly their fibres end on the anterior most part of the mesosternum including prophragmatal surface. Snodgrass in honey-bee calls them "Dorsal longitudinal muscles".

A close study of these muscles reveals that each dorsal muscle consists of three distinct set of muscle fibres.

(i) One of them starts from the posterior region of the post-phragma and ends on the posterior surface of the corresponding prophragmal lobe. It runs ventral to the rest. (Fig. 62, No. 62a).

(ii) The second set of fibres originates in the middle region of the post-phragma. The anterior most part of the pre-scutum serves as the region of its insertion. It runs in between the First and the Third set (Fig. 63, No. 62b).

(iii) The fibres of the 3rd set originate from the anterior region of the post-phragma and running dorsal to the rest are inserted on the anterior part of the scutum (Figs. 96, No. 62c).

At the very first sight, this arrangement of muscle fibres leads an observer to divide the dorsal longitudinal muscles into three distinct pairs. The present writer is opposed to such an assumption on the following grounds. Firstly all the three set originate from one common part of the mesosternum. Secondly their regions of insertion, broadly speaking, constitute the
anterior part of mesosternum and finally their function is
similar and they act in coordination and simultaneously. Further,
none of them is individually capable to work as an independent
muscle. These muscles on contraction bend the mesosternum upwards
which ultimately brings about the depression of the forewings.
Indirect and principal elevators of the forewings (Fig. 108A, No. 111)
These muscles are also paired and are the second largest
muscles in the insect body. The fibres of each muscle originate
from the side of the median sternal ridge and almost parallel
to it thereby demarcating a portion of the meso-episternum as
the true sternal region. These fibres run obliquely upwards and
are inserted on the entire surface of the corresponding lateral
area of the mesocoxa. In the region of its origin each of
these muscles lies mesally to the direct muscles of the corre-
sponding wings; while it is inserted lateral to the corresponding
sets of the indirect and principal depressor muscles. The con-
traction of these muscles pull the mesosternum downwards which
gives an upturned motion to the forewings.
Secondary indirect depressors of the fore-wings (Figs. 63, 67, No. 69)
This is a pair of small muscles. Each of these muscles
originates from the antero-dorsal surface of the mesofurcal arm
of its side. Running latero-dorsally it terminates on a small
tendon at the free end of the corresponding auxiliary lever of
the post-phragma.
From Duncan's account it appears that this pair of muscles
counter-acts the pressure exerted on the post-phragma by the
contraction of the indirect depressors and thereby helps the
post-phragma to regain its former position. Snodgrass regards
this muscle to be responsible for the backward jerk of the forewings. The present writer thinks that the contraction of this pair of muscles, unlike Duncan's assumption, synchronizes with the contraction of the indirect and principal depressors of the forewings with the result that the post-phragma is not allowed to be pulled or leave its position of rest. Instead of it, these muscles are made to bring about a complete depression of the forewings. Therefore, these muscles may be treated as a pair of secondary indirect depressor muscles instead of "Furcal retractors of the meso-post-phragma" as described by Duncan in wasp.

**Principal extensors of the forewings:** (Figs. 35, 37, No. 64).

The concave surface of the basalar apodeme receives numerous parallel running muscle fibres. These fibres originate from the posterior half of the corresponding mesepisternal plate and traverse the latter obliquely above the pleuronotal and axillary muscles. The contraction of this muscle pulls down the basalar. This downward movement of the basalar draws the membranous connection, between it and the humeral complex, downward with the result that the wing is drawn forward and is extended.

**Secondary extensors of the forewings:** (Figs. 35, 35, No. 66).

Each forewing has a secondary extensor muscle arising from the attachment peg for extensor of 1st thoracic spiracle of the corresponding pleural side-plate and ends by a small broad tendon on the lower end of the apodemal plate of the basalar. Due to the peculiar arrangement of the side lobe of the pronotum and the mesepisternal the secondary extensor muscle becomes almost parallel to the corresponding principal extensor muscle.
The contraction of this muscle helps the principal extensor muscles to bring a maximum forward swing of the forewing. It has been named as a secondary extensor muscle for the simple reason that its pull has no effect on the wing. This muscle has been described neither by Duncan nor by Snodgrass. The present writer on the basis of function regards it analogous to the "Accessory wing extensor", of Snodgrass in honey-bee.

1st flexor of the forewings (Figs. 36, 50 & 67, No. 66).

The first flexor muscles of the forewings are small muscles, originating ventral to the principal extensors, from the anterior region of the katepisternum and are inserted on the proximal inner elevation of the corresponding 3rd axillary sclerite (3 Ax). It may be taken as "76b" of honey-bee described by Snodgrass.

2nd flexor of the forewings (Figs. 36, 50 & 67, No. 67).

These muscles originate behind the point of origin of the 1st flexor, and slightly overlap the latter. The course of these muscles is almost parallel to the 1st flexor; while their point of insertion is a bit proximal to that of the latter. The 2nd flexor of the forewing is analogous to (Muscle No. 76c) of honey-bee described by Snodgrass. These two flexors work together. They pull their common region of insertion on contraction with the result that the distal region of the 3rd axillary sclerite is made to swing in an antero-mesal direction. This swing of the sclerite pulls the axial card and the conjunctiva near it in an upward direction, which in their turn draw the wings back-wards.
Pleural elevators of the forewings (Figs. 21, 2 87, No. 82).

The pleural elevator muscle of the forewings consists of stout fibres arising from the posterior region of the metepisternum. These muscles adopt antero-dorsal course running ventral to the principal extensors of the forewings and dorsal to the area of insertion of mesothoracic furco-pleural muscles of their sides. Each ends by a tendon on the ventral surface of the posterior notal process. The contraction of these muscles depresses the posterior notal processes which being in articulation with the posterior end of the 1st axillary sclerites raise the wings upwards. This pair of muscles in conjunction with the two indirect and principal elevator muscles enables the whole of the scutum to elevate the forewings. The pleural elevator muscles have been labelled as "Pleurenental muscles (No. 75 in honey-bee) by Snodgrass. The present writer is of opinion that the pleural depressors of the scutellum of the wasp may be regarded as comparable to these muscles though they differ in their insertion.

Mesothoracic furco-pleural muscles (Figs. 83, 86, 2 87, No. 83).

There is a pair of furco-pleural muscles, each connects the free outer (lateral) margin of the mesofurcal arm with the inner surface of the corresponding meso-pleural ridge in between its point of bending and the pleural apophysis. Some of its fibres end on the pleural apophysis while others on the adjacent metepisternal area. On leaving the mesofurcal arm the fibres bend downwards instead of running straight to meet the pleural ridge, As these fibres run straight from one region to another without forming any tendon hence the differentiation of the
insertion and origin of this muscle can only be done on the basis of function discharged by it. Duncan is justified in regarding it responsible for protecting the mesofurcal arm from undergoing any deformation. Keeping this view in mind the present writer regards the mesofurcal arm as the region of its insertion; the pleural apophysis, pleural ridge and the katepisternal region form the area of its origin.

Auxiliary elevators of the fore-wings (Fig. 23, No. 70).

The fibres of this pair of muscles are attached on the posterior surface of the real scuto-scutellar ridge. These converge to form two thin tendons which run parallel through a space left in between the posterior margin of the scutellum and its sub-marginal ridge to end on the middle of the anterior margin of metatergum. These muscles appear to act as auxiliary to the targo-tergal muscles of the mesothorax in restoring the mesonotum after the action of the dorsal longitudinal muscles. Marison in honey-bee has described a similar pair of muscles, viz., musculus retractor tergi meta-thoracis, responsible for retracting the metatergum. This view seems to be impracticable because such movements of meta-tergum cannot assist any of the so many muscles of flight. Duncan's view, in wasp, to regard them as retractors of the mesoscutellum appears to be reasonable.

Intersternal muscles between meso and meta sternae (Fig. 81, No. 72).

These are two in number. Each connects the posterior lobe of the mesofurcal bridge with the base of the corresponding metafurcal arm. These muscles appear to compensate the weakness of the muscular movement caused by the mobility of the mesofurcal bridge, by providing stable points of muscular attachment on the metaendosternal plate.
Subalar muscles of the Mesothorax (Figs. 50, 56, 65, & 80, No. 73).

These are spindle shaped muscles. Each runs dorsally to the lateral promotor muscle of 2nd com and connects the posterior tip of the subalar with the posterior half of the corresponding coxal rim very close to the pleural articulation. It forms a long tendon at the anterior end before ending at the subalar. Snodgrass has shown its origin in honey-bee on the coxal rim in the form of a broad base; while according to Dunean it originates from the lower part of the pleural wall.

As the subalar is connected with the posterior tapering process of the 2nd axillary sclerite hence it definitely becomes a flazor of the forewing. The present writer does not agree with Snodgrass in regarding it as the coxal promotor.

Lateral promotor of the middle com (Figs. 50, & 56, No. 73).

The fibres of this muscle originate from the inner surface of the posterior half of the pleural ridge in between the pleural apophysis and the coxal process; its point of insertion lies on the anterior half of the coxal rim very close to the pleural articulation. Snodgrass regards it as a cylinder muscle with its origin only on the small pleural apophysis. It means that the muscle cannot be so strong in function (as a promotor) as that of Steno-brason daceae where a wide area of origin is provided. Dunean does not show the presence of this muscle in the wasp.

Mesal promotor of the middle com (Figs. 50, 56, & 59, No. 74).

The mesal promotor muscle is the second largest muscle of the com. The fibres of this muscle originate from the corves-
pending lateral surface of the highly elevated part of the median sternal ridge and from the adjacent sternal surface as well. These converge to form a broad tendon which is inserted on the nasal end of anterior half of the esophagus. This muscle may be compared with the "Protractor of the middle esophagus" of wasp described by Duncan and Muscle "No. 31" of Snodgrass in honey-bee.

Reseater of the middle esophagus (Figs. 88, 89, & 91, No. 78).

This is the largest and the stoutest muscle of the esophagus arising from the entire lateral surface of the highly elevated part of the median sternal ridge. It attaches the nasal promotor laterally both in the region of its origin, as well as, along its way to the esophagus. It is inserted by a broad tendon on the nasal end of the posterior rim of esophagus. This muscle is equivalent to the "Inner reductor of the middle esophagus" of wasp described by Duncan and "Muscle No. 23" of Snodgrass in honey-bee.

Unseveral depressors of the trochanter of the middle leg.

(Figs. 89, 90, & 92, No. 78).

The depressor muscle of the trochanter arises from the horizontal plate of mesoendosternum, including a part of its rod and the proximal part of the metatrochanteral arm of the corresponding side. Running in a posterior-ventral direction it enters the lumen of the esophagus. Here it ends on a long tendon (Figs. 78, Dhest) which is continuous with the depressor apodeme of the trochanter (Figs. 79, 90, & 92, Dap). This apodeme forms a broad plate called "Depressors apodemal plate" which has conjunctival connection with the middle of the posterior rim of trochanter and transmits the effect of the muscle to the trochanter (Figs. 79, & 92, Dappl).
Sperm depressor of the trochanters (Figs. 90, & 92, No. 92).

The sperm depressor muscle consists of 3 bundles all arising from the ventral wall of the soma. The central one, is pinnate type (No. 92b) with its apodemum (Figs. 90, & 92, Bap) ending into a plate apodemal plate. The remaining two (No. 92b'd) which are comparatively lateral end on the apodemal plate (Fig. 92, Bapl).

The remaining muscles of the mesothoracic legs are more or less similar to what have been described in the case of protethoracic legs.

Metathoracic:

The metathorax is smallest among all the thoracic segments and consists of a small dorsal plate or meta-notum; two lateral plates or meta-pleura and a distinct but small quadrilateral sclerite the "metasternum".

Metanotum (Figs. 93, 94, 96, 97, 98, 102, & 103a, Mg)

The metanotum is a narrow transverse sclerite extending across the dorsal region of the thorax in between the mesotergum and the propodeum. It should not be regarded to be divided into a scutum, scutella, etc., inspite of the presence of incomplete internal ridges (Figs. 94, 96, 101, & 102, M3, S). Its anterior margin has a marked concave emargination just to allow the posteriorly produced central part of the marginal flange of mesotergum to fit in (Figs. 32, 34, M3am). The posterior margin is almost straight like the anterior margin of the propodeum and the narrow space in between the two is traversed by a thin membrane (Figs. 32, 34, & 97, M3m). Both the anterior and posterior margins have undergone inflections called anterior and posterior
metanotal inflections (Figs. 94, 96, 101, & 102, N\textsubscript{g}amI and N\textsubscript{g}amII). The anterior margin in its concave region exhibits a high degree of inflection which on either side becomes smaller and smaller till the two angles are reached where the inflection becomes totally obliterated.

The meta notum is composed of a large central and two small outer (lateral) regions. The lateral regions are marked off from the central one by distinct oblique carinae starting from the anterior margin and ending on the corresponding part of the posterior margin. These carinae are called "transmetanotal carinae" by Duncan (Figs. 94, 96, 101, & 102, G\textsubscript{C3}), and each of the lateral region thus demarcated may be termed as "Metanotal rami" (Figs. 94, 96, 101, & 102, K\textsubscript{g}). The two metanotal rami are translucent, unpigmented and less sclerotized as compared to the central region. The metanotal rami may be taken to be the semi-detached sclerite (E\textsubscript{g}) of honey-bee described by Snodgrass. The postero-lateral tip of the rami is slightly directed upwards and is clearly placed posterior to the base of the 1st axillary sclerite of the hind wing. As this tip is in communication with the medial end of the 3rd axillary sclerite of the hind wing hence the present writer regards it as "Posterior metanotal process" (Figs. 94, 96, 97, 98, & 102, P\textsubscript{g}P\textsubscript{g}). The ventral aspect of the rami, close to its posterior metanotal process, develops a lever like projection called "Lever of the metanotal rami" (Figs. 94, 96, 97, 98, 101, & 102, N\textsubscript{g}amII). The posterior metanotal process is described as a flexible syphon like process by Duncan (P\textsubscript{g}) in the wasp.
The humeral selerite of the meta notum in wasp described by Duncan is present in the form of a loop like selerite (Figs. 94& 97.hst); whose tapering mesal (inner) end is joined with the dorsal surface of the mesal part of the respective anterior lamella of the meso-post-phragma (Figs. 94.hetm). This selerite arches across the whole length of the anterior lamella without having a second connection whatever with the latter till it enters the base of the corresponding hind wing. On reaching the wing base this selerite becomes a little broader and forms two processes one at its anterior tip and the other at the posterior. The anterior process has conjunctival connection with the body of the 1st axillary selerite and may, therefore, be regarded as "Anterior metal process" (Figs. 94, 97.hetp). The posterior process of the humeral selerite of the metanotum and a part of its posterior margin (Figs. 94, 97. hstpm) are united with the lateral margin of the metanotal ramus slightly anterior to the posterior metal process (Figs. 94, 97. hstp).

Metanotum (Figs. 33, 34, 35, 36, 97, 98, 101, 102, 103, 104, 105, & 106. Flg).

The propodeum is bounded on either side by a distinct selerite called "metapleuron" extending from the wing base of the corresponding hind wing above, to the hind cone below. Each lateral margin of the propodeum is fused with the posterior part of the dorsal margin of the corresponding metapleuron. This line of fusion may easily be split up into an upper (anterior) and a lower (posterior) half. The upper half extends from the antero-lateral angle of the propodeum to the propodeal spiracle of its side (Figs. 34, 97. Ulmsr); while the lower half starts by
latterly bounding the spiracle and ends on the metapleuro-
propodal terminal sclerite (Figs. 34, 96, 101, 102, 103, 104, 105, 
& 106. 11figs). Externally both halves are represented by a 
continuous groove; and the upper half has developed a well-
marked internal ridge (Figs. 96, 102, 103, 104, 105, & 106. 11figs).
The anterior extremity of this ridge is fused with the prephragma 
of the propodenum (Figs. 96, 101, 102, 103, 104, 105, 106, 11figs) 
while its posterior extremity ends near the spiracle. This 
fused condition apparently leads one to regard this ridge as a 
part of the prephragma as suggested by Duncan. The present 
writer is opposed to this view for the simple reason that there 
is present a distinct lateral margin of the propodenum in its 
two parts (upper and lower halves) with the ridge in question 
developed in its upper half. Had the lower half been not conti-
uous with the upper half then of course the present writer 
would have accepted Duncan's claim. Duncan has made two referen-
ces of the above. They are (1) "Below the first metapleural 
pit the meta-pleuron is bounded posteriorly by an obscurestent 
suture that takes the form of a slight Carina; and (ii)"Laterally 
the phragma continues down the lateral propodal margins as 
far as the first metapleural pit, where it joins the second 
metapleural apodeme". These references impress upon the present 
writer that Duncan was not unaware of the presence of lateral 
margin of the propodenum. Nevertheless he has knowingly avoided 
to regard the ridge as counter indication of its upper half.

Each metapleuron is traversed by an oblique groove extending 
between the wing process and the pleural articulation of the 
hind coxa (Figs. 34, 96, 101, 102, 103, 104, & 106. 11figs). This groove
is called "Meta pleural suture", which divides the metapleuron into a smaller upper Epimeron and a larger lower Episternum (Figs. 34, 36, 102, 103, 104, & 105, Figs. 3 and 5). The metapleural suture possesses a conspicuous pit in its upper half called "Meta pleural pit" (Figs. 34, 35, 36) which internally forms a broad metapleural apophysis (Figs. 34, 36, 37, 38, & 39, Figs. A).

Duncan has described another metapleural suture called "Meta pleural secondary suture" which is exactly what Snodgrass calls a groove dividing the metapleuron into its upper (Figs. 34) and lower (Figs. 35) parts. On the other hand the latter author's conception of meta-pleural suture (34, 35) is nothing more than lateral margin of the propodeum of the present writer. Neither of these two views is satisfactory. The present writer regards Snodgrass's view to be more closer to his own view; and expects that a thorough re-examination of honey-bee's meta thorax may reveal the true metapleural suture so far shown missing.

The upper half of the anterior margin (Figs. 34, 36, 37, & 39, Figs. A) of metaepisternum has a marked marginal inflection which shows reduction in its lower half. This whole length of inflection abuts against the postero-dorsal margin of the corresponding mesopleuron (Figs. 36, 102, 103, 104, & 105, Figs. A). Dorsally the union of the dorsal and anterior margins of the metapleuron forms the wing process of the hind wing (Figs. 34, 36, 37, 38, 39, 102, 103, 104, & 105, Figs. W). The dorsal margin from the wing process until it fuses with the lateral margin of the propodeum acquires a some what concave shape and thus provides a space for articulations of the various wing sclerites (Figs. 34, 36, 37, 38, 39, 102, 103, 104, & 105, Figs. A). The posterior mar
of the episternum forms the lateral part of the rim of the
equal socket (Figs. 36,102,4 105. sm. 1r) with an articular inset
in it, which provides a definite pleural articulation to the
hind exam.(Figs. 36,96,101,102,103,104,4 105. Aten). The upper
end of this margin ends with the posterior margin of the propo-
den; while its lower end unites with the posterior tip of the
sternum-pleural suture of the meta thorax.

**Meta-sternum**

The meta-sternum is a small quadrilateral sclerite situated
below the propodeum, instead of being located beneath the meta-
notum. Laterally it is limited by an oblique groove (meta-
sternopleural suture)(Figs. 33,96,6 1g) which has developed a
clear, internal ridge (meta sternopleural ridge)(Figs.96,102,103,
104,4 105. gil). Duncan, Snodgrass, and James all are opposed
to the presence of this suture; and their accounts lead one to
regard the meta sternal as a continuation of the two metapleural
sclerites in the ventral aspect of the meta thorax. Anteriorly
it is marked off from the combined procoanal area of the mesothe-
rax by a faint transverse intersegmental groove connecting the
bases of the mesosternum (Figs. 33,96,96,102,103,4 104. Isg).
Slightly posterior to the intersegmental groove there is a
feebly incomplete groove called "Meta sternal anterior sub-
marginal groove"(Figs. 33,4 96. asg). This groove internally
develops a weak ridge called "Meta sternal anterior submarginal
ridge" which mesally gets merged with the anterior tip of the
longitudinal vertical ridge of the meta endosternum (Figs.96,
102,103, & 104. asgr). The area thus bounded in between the
intersegmental groove and the meta sternal anterior submarginal
groove becomes the "Basisternum" (Figs. 33, 83, 96, 102, 103, & 104, Fg. 3); while the remaining large posterior part of the meta sternum is the "Fureasternum" (Figs. 33, 83, 96, 102, 103, 104, & 105, Fg. 3). The basisternum bears the posterior half of both the pairs of mesocoxal sockets (Figs. 33, 83, 96, 103, & 104, split). The posterior margin of the meta sternum (Fureasternum) which forms the anterior part of the rim of mesocoxal sockets (Figs. 33, 83, 96, 103, & 104, split) meets the posterior margin of the corresponding meta episternum at the point of latter's union with the lower tip of the meta sternopleural ridge.

**Meta episternum.**

The meta sternum is externally traversed by a groove called "Median sternal groove" (Figs. 33, & 96, split) which internally forms the broad vertical longitudinal ridge (Figs. 96, & 103, split). This ridge can be split up into an anterior (Figs. 76, 102, & 104, Fg. 3) and a posterior half (Figs. 76, 102, 104, & 105, Fg. 3) lying respectively in front and behind the conspicuous metasternal pit situated in the middle of the meta sternal groove (Figs. 33, 76, 96, 96, 103, & 104, Fg. 3). The meta sternal pit gives rise to the posterior narrow part of the "Horizontal plate", i.e., stalk which ascends obliquely between the posterior and anterior halves of the vertical longitudinal ridge (Fig. 76, Fg. 3). This horizontal plate on emerging from the ridge runs over the dorsal margin of the anterior half of the vertical longitudinal ridge in the form of a furrow instead of being stretched like a plate (Figs. 76, 91, 102, 128 & 131, Fg. 3). On reaching the anterior tip of the vertical longitudinal ridge the lateral walls of the furrow fuse with the bases of the corresponding furcal arms of the meta episternum.
The furrow in between the lateral walls of the horizontal plate may be regarded as the anterior part of the open "passage way" of the wasp described by Duncan. The present writer is unable to find the posterior extension of this passage-way over the posterior region of the horizontal plate upto the meta-ternal pit. It appears that the upper surface of the posterior part of the horizontal plate which could have served the purpose of the posterior extension of the "passage way" is already pressed with the posterior half of the vertical longitudinal ridge.

Each furcal arm is narrow at the base with a broad free end (Figs.76,91,106,130, & 131,AF). It runs upwards and then bends towards the corresponding meta-pleural apophysis. On reaching underneath the metapleural apophysis its upper surface gets loosely united with the under surface of the latter and the two can easily be separated without causing damage to either. The apophysis and the arm are in no case fused with one another as claimed by Duncan in wasp. Nor are they united as expressed by Snodgrass in honey-bee. Both the meso and meta endosternae are distinctly two separate endoskeletal structures. Unlike, honey-bee they have no direct union or fusion of any of their parts.

Hind legs (Fig.54C).

The hind legs can be distinguished from the rest by their larger size. They are also used for cleaning the abdominal terga and the wings in both the sexes, and for the clearing of the ovipositor in case of female.

The structure of the hind leg, articulation of its various parts and its movements and musculature resembles those of the
middle leg. The few modifications which exist are dealt below.

Unlike honey-bee the proximal part of the exca possesses
a definite small basiconcave (Figs. 54C, 112, Bex) marked off from
the rest by a basiconcave suture(Figs. 54C, 112, bex). The articular
concavity (Figs. 103, 104, 105, 113, & 114, Acca) developed on the
lateral part of the conal rim provides articulation to the
pleural process (Figs. 34, 96, 101, 102, 103, 104, 105, 113, 114, Anex). There
is no sternal articulation as mentioned by Snodgrass in
honey bee. The hind exca is similar to the middle exca in shape
but almost double of it in size. The dorsal half of the proximal
rim of the hind trochanter is almost concave with no central
raised platform as shown in the middle trochanter (Figs. 99, 109,
110, 111, FTER). The internal inflection of the proximal rim of
trochanter is shared by the dorsal half of the rim as well and
hence it is no more dependent on the ventral half of the
 trochantal rim only as found in the other two legs (Fig. 108B, THi).
This modification has further reduced the lumen of the trochanter
at its proximal end (Fig. 108B, Lus). Besides, the usual two
levator muscles of the trochanter (Figs. 108A, 111, No. 94, 95, 96t)
there is a small 3rd levator muscle as well (Figs. 108, 111, No. 96).
It originates from the exca and ends by a broad tendon very
close to the point of insertion of the posterior levator. The
base of the bell-shaped emargination in the distal end of the
ventral wall of tibia gives rise to two spurs (Figs. 54C, S) which
press the esipositor against the ventral surface of basitarsus
which has a long row of bristles almost covering the entire
length of the basitarsus similar to the brush of the antenna
cleaner. This unusual length of the brush shows that the two
basitarsi brush the terga of abdomen like a pair of brushes moving over them simultaneously in an antero-posterior direction.

THE WINGS.

The wings of Steno-bracoidea resemble typical braconid wings. They are held flat along the back in repose.

The wings are yellowish hyaline and are covered over by microscopic hairs. The forewing possesses a stigma (Fig.168B, st) and has fuscos fusca extending from the base of the stigma up to the anal vein. It covers almost the whole area of the first and the second discoidal cells. Another cloudy spot starts from the apex of the stigma and ends in the second cubital cell close to media 1/2. The apex of the wing is thinly cloudy. This cloudiness stretches across the major portion of the third cubital cell, the apical region of the fused third discoidal and second apicalecell, and the apical portion of the anal cell.

The hind wing is smaller than the forewing. The wing venation and the wing cells are also less in number. The apex of the hind wing and a part of anal margin up to the middle of the wing is smoky. At the junction of the costa of the hind wing with its anterior margin there are four hooks with their apices directed upwards. These may be called "Frenulum" (Fig.168C, f).

The region of the posterior margin of fore-wing corresponding to frenulum is slightly curved downward. This curved portion is thickened and ridge-like and may be called "Frenal fold" (Fig. 168B, x). The frenal fold provides a firm hold for the...
formulas which together serve the purpose of "wing coupling apparatus" in Steno bracon deesse.

**Wing Venation (Fig. 163BAC).**

The wing venation in Steno bracon deesse is of specialized type. It has undergone reduction in the number of distinct veins by coalescence of adjacent veins. The most prominent type of coalescence is the formation of a distinct and thick anterior margin "C" of the fore-wing (Fig. 163B), between its base and the stigma, by the union of costa, subcosta, radius and media. The second distinct vein is the cubitus "Cu". This cubitus runs from the wing-base up to the posterior end of medio-cubitus cross vein, thence cubitus, "Cu_1" is formed which runs hindward to meet anal vein. The third distinct vein is anal "A" running from wing base up to media_3. The fourth vein is media "M" which starts from the posterior limit of stigma and runs in postero-mesal direction in order to meet the upper end of the medio-cubitus cross vein "m-cu". Thence it turns outward and bifurcates into two branches which are (i) Fused media "M_142", and (ii) Fused media third and fourth "M_344". At the point of division the media meets the lower end of the medio-medial cross vein "r-m". The fused media first and second runs towards the apex almost parallel to the anterior margin and ends by meeting the lower end of radius_4. Thence only media_1 "M_1" runs towards the apex but terminates far from reaching it. The media_2 running in postero-mesal direction subsequently divides in M_3 and M_4. The media_3 "M_3" on separation runs in postero-lateral direction until it meets the distal end of the anal. Thence it runs completely in lateral direction, almost parallel to the
posterior margin, to end close to the outer margin. The media_3 "m_3" runs inwardly to end at the point of union of subitus_1 with the medio-subitus cross vein "n-cu".

Along the anterior margin from stigmas up to the apex runs the radius_1 "R_1". It gives out a branch called radius_3 "R_3" which runs inward to meet the outer end of the radius sector "R_3". The inner end of the radius sector ends at the point of union of the radio-medial cross vein "r-m" with the radial cross vein "r".

From the point of the union of radius-sector with radius_3 a vein comes out which runs in posterior direction and meets the fused media_1,2. It be called radius_4 "R_4".

Nomenclature of the cells of the forewing (Fig. 166B).

Median cell: "a".

It is bounded anteriorly by the anterior margin, posteriorly by the subitus vein and laterally (outward) by a combination of the medio-subitus cross vein and a part of the media.

Sub-Marginal cell: "b".

It is bounded by subitus and a part of anal veins on the anterior and posterior margins respectively and by the subitus laterally.

Anal cell: "c".

It is anteriorly bounded by the anal and a part of media_3 veins and posteriorly by the posterior margin.

First discoidal cell: "e".

It has medio-subitus cross vein as its inner limit while anteriorly, posteriorly, and outwardly, it is guarded by a part of media_3, media_4, and media_3 respectively.

2nd discoidal cell: "f".

It is bounded by media_4 and a part of anal veins anteriorly
and posteriorly respectively. Besides it the cubitus₁ serves as its inner limit and a part of media₃ as its outer limit.

Confluent 3rd discoidal and 2nd apical cells:“a”.

It has media₃₋₄ and a part of media₃ at its inner margin while the larger part of the media₃ and the combined media₁₋₂ and media₁ serve respectively as its posterior and anterior boundaries. Laterally it is bounded by the apical margin.

First cubital cell:“b”.

The media forms its inner and posterior borders; while radio-medial cross vein and radial cross vein form respectively the lateral and anterior borders.

Second cubitus cell:“c”.

The radius sector and media₁₋₂ are respectively the anterior and posterior boundaries of the 2nd cubitus cell. Besides, the inner border is formed by the radio-medial cross veins while the radius₃ forms its lateral border.

Third cubital cell:“d”.

Its anterior and inner limits are the radius₃ and radius₄ respectively. Posteriorly there is no complete line of demarcation for the third cubital cell; while laterally the apical margin serves as its border.

Radial cell:“k”.

It is anteriorly and inwardly limited by radius₁₋₃ and radial cross veins respectively; while radius₃ and radius sector together form its latero-posterior margin.

Venation of the hind wings: (Fig.168C).

The venation in the hind wings is more reduced as compared to the fore-wings. The anterior most vein is the costa formed
by the fusion of costa, subcosta and radius veins "C". On entering the distal half of the wing it turns upwards to end into the anterior margin. Near its bend the radius vein "R" separates from it and after running more-or-less parallel to the anterior margin of the wing ends close to its apical margin. The media "M" starts from the base and on reaching half the length of the wing turns upwards to terminate close to the separation of the radius. The subitus "Cu" starts from the bend of the media and after running in postero-outer direction ends close to the lower portion of the apical margin of the wings. The anal "A" vein originates from the base and after running in anterior direction ends into the media close to its origin.

Homology of the cells of the hind wing (Fig. 168 C).

Costal cell: "C".

It is bounded postero-laterally by the costa and anteriorly by the anterior margin of the wing.

Radial cell: "R".

The media serves as the postero-lateral boundary of the medial cell; while the costa becomes its anterior limit.

Radial cell: "M".

The posterior boundary of the radial cell is marked by the radius; while anteriorly it is bounded by the anterior margin of the wing. The curved part of the costa becomes the inner border of the radial cell.

Cubital cell: "C".

The cubital cell is laterally bounded by the apical margin of the wing; while the curved part of the media becomes its inner border. Anteriorly and posteriorly the cubital cell is
bounded by radius and cubitus respectively; these veins however do not form complete boundaries of it.

Submedial cell:"a".

The anal serves as postero-lateral limits for the submedial cell; while the basal part of the media becomes its anterior border.

Fused anal and discoidal cell:"b".

This cell is anteriorly bounded by a larger part of media and the whole of cubitus combined; while posteriorly it is limited by the posterior margin of the wing. The inner boundary of this cell is formed by the anal vein.

The articulation of the wing:

The wings are attached to the lateral margins of the notum of the wing bearing segments by membranous basal area called "Axillary membrane". In axillary membrane (Figs. 81, 97, 98, 99, 101, & 102.Axa) are embedded several articular sclerites having functional similarity but structural diversity in the two wings.

The wings are supported by two notal and one pleural processes:"Anterior and posterior notal processes" (Figs. 81, 82, 83, 84, 97, 98, & 102.ANP2 or ANP3 and PNP2 or PNP3), "Pleural wing process" (Figs. 35, 36, 97, 98, 101, 102, & 103. PlgMP or PlgWP). Slightly behind the posterior notal process is the attachment of the nasal extension of the posterior margin of the wing. This extension is cord-like and is termed as "Axillary Cord" (Figs. 81, 97, & 98.Axa).

In the fore-wings the following articular sclerites are present:—
First axillary selerite (Figs. 30, & 81.14x).

The first axillary selerite is an elongated selerite with a laterally curved neck bearing a distinct large head (Fig. 30.b). The middle portion of the selerite has formed a broad lateral projection (Fig. 30.p); while the mesal surface of the same region possesses a small emargination (Fig. 30.2a). The attachment of this selerite is such that its neck rests on the anterior lobe of the anterior notal process, while the posterior lobe of the process fits into the mesal emargination. The lateral projection serves as region of attachment for the second axillary selerite. The posterior tapering end of the first axillary selerite ends well above the posterior notal process. The lateral surface of the head region forms attachment with the costal selerite.

Second axillary selerite (Fig. 30, & 81.24x).

The second axillary selerite is a curved selerite with its mesal surface attached to the first axillary selerite. Besides, ventrally it articulated with the pleural notal process, and thereby stands out among all axillary selerites as a selerite having direct articulation with the pleural region. Furthermore, the posterior end of the second axillary selerite has a cord like connection with the subalar selerite.

Third axillary selerite (Figs. 30, 61, 67, & 162.34x).

The third axillary selerite is boat shaped lying close along the axillary cord and having outer end broader than the inner one. The outer end articulates with the basal part of the anal vein (Fig. 81.1b); while the inner articulates with the posterior notal process. Proximally the third axillary selerite
forms an elevation (Fig.30, a 37.3 Ave) which provides the point of insertion of the flexor muscles of the fore-wing.

**Humeral plate (Figs.31, a 168. Cx).**

The humeral plate is a more-or-less oval shaped sclerite lying along the anterior margin of the axillary membrane and anterior to the first axillary sclerite. Laterally it is in direct communication with the base of the costa. The base of the costa just posterior to it's communication with the costal sclerite is prolonged into the axillary membrane to lie in between the costal sclerite and the median plate(Fig.31.Cbp).

**Median plate (Fig.31.m).**

The median plate lies in between the basal part of the costa and the third axillary sclerite. Medially it ends in close proximity with the second axillary sclerite while laterally it is associated with the cubitus.

**Basalare sclerite(Figs.35,35, a 37.3a).**

The basalare sclerite is a long sclerite with both ends bend towards the mesopleuren. It lies along the anterior margin of mesopleuren extending from the pleural wing process upto an emargination in it. This emargination (Fig.35, a 37. g) provides articulation to the lower bend end of the basalare sclerite (Figs.35, a 37.3avh); while the upper bend-end of the latter (Figs.35, a 37.3avh) lies near the humeral plate. From the ventral surface of the basalare close to its articulation with the mesopleuren there hangs a semi-circular concave plate called "Basalare apodeme" which provides insertion to the fibres of the principal extensor muscle of the fore-wing(Figs.35, 35, 357. BaAp).
Subalar Selerites (Fig. 90, 8a).

The subalar selerite is a small oval selerite resting on the mesal inflection of the mesopleural dorsal margin. Externally it is connected by means of a cord with the posterior end of the second axillary selerite; while internally it receives the tendon of the corresponding subalar muscle of the mesothorax.

In the hind wings the articular selerites are less in number than the mesothoracic wings; and are dealt here one after the other.

First axillary selerite (Figs. 97, 98, & 100, lax).

The first axillary selerite consists of a broad base (Fig. 100, b) with an elongate body over it. The free end of the body is curved outward to articulate with the humeral plate. In between the basal part and the curved end of the first axillary selerite a fossa is developed (Figs. 97, 98, & 100, f) where the second axillary selerite associates with the body of the first axillary selerite. Further more the mesal surface of the latter is in communication with the anterior notal process.

Second axillary selerite (Figs. 97, 98, 100, 101, & 103, 2ax).

The second axillary is an irregular selerite with broad anterior and narrow posterior region. Ventrally it articulates with the pleural wing process. The posterior region of the second axillary selerite lies in close proximity with the third axillary selerite and has cord like connection with the subalar selerite (Figs. 98, 99, & 100, 3at). Mesal to the second axillary selerite is the basal selerite of the anal vein (Figs. 97, 98, & 99, Abp).
Third Axillary Sclerite (Figs. 97, 98, 99, 100, 101, 102, & 102, 3A).

The third axillary sclerite is an elongate sclerite lying close along the axillary cord—usually it communicates with the posterior notal process; while laterally it is connected with the anal vein in the vicinity of the formation of basal sclerite of this vein. The proximal region of the third axillary sclerite provides insertion to the flexor muscles of the hind wing (Fig. 102, 3A).

Basalare Sclerite (Figs. 99, 100, & 102, Ba).

The basalare is a small sclerite resting on the anterior margin of the metapleuren close to the pleural wing process. Its upper narrow end is in communication with the costal sclerite, while the lower broad end receives the tendon of the extensor muscles of the hind wing (Figs. 100, & 102, Mst).

Subalare Sclerite (Figs. 99, 100, & 103, Sa).

It is a small oval shaped sclerite resting on the dorsal margin of the metapleuren. Externally it is in connection with the second axillary sclerite by means of a cord; while internally it receives the tendon of the two subalare muscles.

Propodeum (Figs. 32, 34, 96, 101, 102, 103, 104, 105, 134, & 135, Pr).

The tergum of the propodeum is a convex and well sclerotized plate (Figs. 32, 34, 96, 101, 102, 103, 104, 105, 134, & 135, Pr). Except the mesotergum no thoracic terga is as long as the propodeum. Lateral and already mentioned it keeps the two metapleurae apart by interpolating in between them. The anterior margin of the propodeum is straight (Fig. 32, pram), and has internally developed a broad inflection which becomes the "Prephragma" of the propodeum (Figs. 96, 101, 102, 103, 104, 105, 106, 135).
incomplete circular emargination called "Propodeal notch" (Figs. 32, 96, 101, 102, 103, 104, 105, 134, 135, 136, & 137, pre), which is guarded at its gate by two processes named as "Propodeal teeth" (Figs. 32, 96, 101, 102, 103, 104, 105, 106, 134, 135, & 137, pre).

From each meta coxal articular knob (Figs. 34, 96, 101, 102, 103, 104, 105, & 106, Ahz2) an oblique suture runs upwards till it joins the corresponding margin of the propodeal notch. This suture may be called "metapleuro-propodeal terminal suture" (Figs. 32, 96, 101, 102, 103, 104, 105, & 106, AhzPre) and the selerite thus set off naturally becomes "Meta pleuro-propodeal terminal plate" (Figs. 32, 96, 101, 102, 103, 104, 105, & 106, AhzPre2). The course of the suture reveals that the meta pleuro propodeal terminal selerite is a combination of the posterior parts of both the propodeum and the metapleuron. Hence evidently it would be a mistake to regard it as a sole part of any of these two. This selerite develops at its margin a small knob which fits into a conavity present at the antero-lateral angle of the 1st abdominal tergum, the (true 2nd abdominal tergum). This knob may be termed as "Articular knob for the pediscal" (Figs. 32, 96, 101, 102, 103, 104, 105, & 106, AhzFd) which functionally inhibits the bending of the abdomen on the sides.

**Pediscal:**

The pediscal is a small flat tube with its length and breadth almost equal. On the dorsal side it consists of the acrotergite of the second abdominal tergum (Figs. 117, 132, 133, 134, 135, 136, 136A, & 142, atg); while the 2nd abdominal sternum constitutes its ventral wall (Figs. 124, 125, 126A, 126A, 130,
The inner surface of each lateral margin of the aero-tergite (Figs. 134, 135, & 136. III2mar) unites with the inner surface of the corresponding lateral margin of the sternum (Figs. 136, & 137. pdEmar). The aero-tergal region develops a small inverted "Y" shaped ridge stretched from the middle of it's anterior margin (Figs. 117, 133, 134, 135, 136, & 138A. II Ham-mer) unto the middle of the anticostral ridge. It may be called the "vertical plate of the pedical" (Figs. 134, & 138A. vpl). It's dorsal surface receives the posterior extension of conjunctival membrane which connects the abdomen with the propodeum. This membraneous covering is also shown by Snodgrass in honey bee. The ridge like stem of the "Y" shaped vertical plate (Figs. 117, 133, 134, 135, 136, & 137. vpl) swells at its base to form a triangle with its base facing the propodeal notch (Figs. 117, 133, 134, 135, & 137. vplB). The two knobs of the propodeal notch rest on the corresponding faces of the stem (Figs. 133, 134, 135, 136, & 137. Prt). The forward and backward movements of the abdomen are followed by the backwards (Fig. 137. Prt1) and forwards (Fig. 137. Prt) gliding of the knobs of the propodeal notch on the stem of the "Y" shaped ridge. The base of the stem and the point of bifurcation of its two arms (Figs. 117, 132, 133, 134, 135, 136, & 137. vplA) serve as anterior and posterior points of limitation for the knobs from slipping off their tract. Besides it, a flattening of the dorsal margin of the stem wipes off the possibility of slipping the knobs in dorsal direction away from their path of movements.

The propodeal sternum is a feebly sclerotized transverse-band running in between the metasternum and the 1st abdominal
sternum (true 2nd abdominal sternum) (Figs. 130 & 131, pret). The outer regions of its anterior margin become the corresponding posterior half of the two rims of the meta coxal sockets.

Musculature of metathorax and the mesoderm:

Lateral adductor of the hind coxa (Figs. 103, 104, 106, 113 & 114, No. 77.)

The lateral adductor muscle consists of two distinct bundles. The broad one originates from the anterior marginal inflection of the meta episternum (77a). The thin bundle of muscle fibres arises from the under surface of the metapleural apophysis and runs dorsally as if in the lap of the broad one (77b). United by their tendons both of them end in the lateral part of the anterior rim of the coxa close to the pleural articular point.

Mesal adductor of the hind coxa (Figs. 103, 113, 114, No. 78).

The mesal adductor muscle has two clear bundles one of them arises from the posterior half (78a) while the other starts from the anterior half of the vertical longitudinal ridge (78b). These converge on the hind coxa and run ventrally to the mesal reductor of hind coxa, and end in the mesal part of its anterior rim slightly away from the insertion of the lateral adductor. This is exactly what Smagorinsky described as mesal promoter(106) in honey-bee. Probably the same muscle has been named as pleural protractor of the hind coxa by Duncan in the wasp. If it is so then it's region of origin as shown by Duncan seems to be disputable.
Lateral reductor of the hind femur (Figs. 105, 112, & 114, No. 79).

The fibres of the lateral reductor muscle originate from the under surface of the meta-furcal arm (79a) and from the anterior half of the vertical longitudinal ridge (79b). These fibres run dorsally to the thoracic depressor of hind trochanter in a convergent manner to form a common tendon. This tendon has its insertion on the posterior half of the coxal rim close to the pleural articulation. These muscles have not been described by Snodgrass in honey-bee.

Nasal reductor of the hind femur (Figs. 104, & 114, No. 80).

This muscle originates from the vertical longitudinal ridge. Its lower (posterior) fibres (80b) run dorsal to the nasal adductor muscle; while the upper (anterior) fibres (80a) run ventral to the lateral reductor muscle. These fibres end by a common tendon in the nasal region of the posterior coxal rim away from the point of pleural articulation. Snodgrass has called it "Nasal retractor, No. 106" of the hind femur in honey-bee.

1st subalar muscle of metathorax (Figs. 103, & 113, No. 81).

This is a spindle shaped muscle having its posterior end inserted on the internal inflection of the coxal rim just before the articular concavity. On its way to meta-thoracic subalar sclerite (Figs. 93, 99, & 103, sa) it converges into a tendon (Figs. 98 & 99, sa) which ends on the lower end of the subalar. Functionally it is regarded as a flexor of the hind wing.

2nd subalar muscle of the metathorax (Fig. 103, No. 82).

This muscle consists of few small fibres originating from epimeron close to the base of the metapleural apophysis and dorsal to the origin of the 3rd elevator of the hind wing. These
fibres converge to form a tendon which runs parallel to the
tendon of the 1st subalar muscle and, later on, ends on the
lower end of the subalar. This muscle is similar to the 1st
subalar muscle in function. Duncan’s pleural muscle of the
subalar in wasp (III p.93) is similar to it on the basis of
insertion and function though its point of origin differs
widely.

Thoracic depressor of the hind trochanter (Fig. 110, No. 89).

The thoracic depressor has a well developed long tendon
going down into the soma (Figs. 108, 110, 112, Dist). This tendon
before entering the soma appears to have been formed by the
union of two tendons. Each of these tendons receives a pair of
bundles, one originating from the under surface of the metaple-
ural apophysis while the other from the under surface of the
corresponding furcal arm. Thus four clear bundles (ap³bb³b³)
combine to constitute the thoracic depressor of the trochanter.
Duncan has mentioned only two branches constituting his so
called "Depressor of the trochanter and abductor of the hind
leg" of the wasp. The present writer thinks that a minute observ-
ancy vation in future by Duncan may reveal the presence of four
instead of two bundles.

Coxal depressors of trochanter (Fig. 110, No. 89).

The long tendon of the thoracic depressor of the hind
trochanter ends on a long apodeme called "Depressor's apodeme"
which ends by a plate on the posterior half of the trochantal
proximal rim (Figs. 108a, 110, Map & Mapl). This apodeme has
conjunctival connection with the centre of the posterior half
of the proximal rim of the trochanter (108a, 110, coa). The stalk
of the apodeme receives fibres of a pinnate muscle called "Coxal medial depressor of the trochanter" (No. 90a). It can be compared with coxal depressor of Snodgrass (110) in honey-bee. The apodermal plate receives two muscles, one on either side. As these also derive their origin from the coxa hence they can appropriately be named as "Lateral Coxal depressors of the trochanter" (No. 99b, c).

First elevator of the hind wing (Fig. 101, No. 34).

The first elevator muscle of the hind wing is considerably long whose fibres originate from the meta-episternum by the side of the entire upper half of the anterior marginal inflection. These fibres form a long tenden which end directly on the posterior surface of the posterior notal process of the hind wing. It may be compared with muscle "97" described by Snodgrass in honey-bee.

Second elevator of the hind wing (Fig. 101, No. 86).

The second elevator muscle of the hind wing arises from the upper surface of the meta-pleural apophysis. It is smallest among all the three elevators. Its tendon ends on the mesally directed lever of the metanotal ramus. It may be compared with muscle "93" of Snodgrass in honey-bee.

Third elevator of the hind wing (Fig. 101, No. 86).

The third elevator muscle originates from epimeron lying by the side of the metapleural apophysis. They are bigger than the 2nd elevator and end by their tendon on the lever of the metapleural ramus slightly mesal to the insertion of the former. These muscles have not been described by Snodgrass in honey-bee.

All the three muscles exert a combined ventro-posteriorly
directed pull on the posterior metapleural process. This pull is transmitted to the 1st axillary sclerite through the connecting membrane which in its turn elevates the wing.

**Extensor of the hind wing (Fig. 102, No. 87).**

The extensor muscles of the hind wing originate from the meta-sterno pleural ridge and the part of the episternum close to it. The fibres of this muscle meet to form a long stout, cylindrical tendon which runs parallel to the anterior marginal inflection of the episternum and ultimately ends on the posterior broad end of the basalar. The conjunctival connection of basalar with the hind wing transmits the pull of this muscle to the latter which gets extended. In result, this muscle is similar to "101" of Snodgrass in honey-bee which has been shown to originate on a lobe of the ridge in the metasternal area.

**1st flexor of the hind wing (Figs. 100, & 102, No. 89).**

The 1st flexor muscle originates as a narrow muscle from the meta-episternal region close to the pleural apophysis. It runs dorsally to the 1st elevator of the hind wing and, later on, ends by a tendon in the proximal region of the 3rd axillary sclerite.

**2nd flexor of the hind wing (Figs. 100, & 102, No. 89).**

The 2nd flexor muscle is a broad muscle but smaller to the 1st flexor in size. Its fibres originate from the meta-episternal region close to the base of the pleural apophysis and, later on, converge to form a small tendon which unites with that of the 1st flexor.

Snodgrass has described only one muscle with three distinctly separate bundles (No. 100), in honey-bee. According to him these
bundles converge on a small selerite which, later on, put them in communication with the 3rd axillary selerite. This shows that the muscle cannot render direct effect on the 3rd axillary selerite. The present writer understands that the intervention by this selerite does not serve any good purpose.

Duncan has not come out with a definite reasoning to regard "III p.n.2a"; and "III p.n.2b" as two separate muscles. There is no definite regional difference in their origin as has been pointed out by the present writer. Therefore, it would be appropriate to agree with Snodgrass and consider "III p.n.2a"; and "III p.n.2b" as two bundles of one muscle. This muscle may be compared with the present writer's Ist flexor muscle of the hind wing which is exactly similar to "No.100" of Snodgrass in honey-bee. The 2nd flexor of the hind wing is a muscle not shown by Duncan and Snodgrass. These two flexor muscles exert pressure on the hind wing in a manner already dealt with in the fore-wings.

Ist levator of the abdomen (Figs. 132 & 133, No. 155).

These muscles are two in number. Each of them is a long stout muscle with its fibres originating partly from prephragm and partly from the entire length of the upper internal ridge of the corresponding lateral margin of the propodeum ventral to the propodeal torsion muscle of its side. The fibres of each muscle converge to form a long conspicuous tendon which ends laterally on the posterior tip of the corresponding arm of the vertical plate of the petiole.
2nd levators of the abdomen (Figs. 132, 133, 134, & 135, No. 188).

These muscles consist of a pair of levator muscles of the abdomen. Each then is a thin long muscle originating from the prothorax of the propodeum. Their long tendons end mesally on the posterior tip of the corresponding arm of the vertical plate of the pediole.

The "levator muscles of abdomen" described by Snodgrass in honey-bee and the "propodeal elevators of the abdomen" of the wasp shown by Duncan are exactly what the present writer calls as "1st levators of the abdomen". Both these authors have failed to find out any other pair of levator muscles comparable with the 2nd levators of the abdomen. The musculus propodei retractor lateralis inter-tergalis post-abdomenis described by Marison in bee should not be confused with 2nd levator of the abdomen. These differ from one another in origin, insertion and function.

These two pairs of muscles by their contraction, at first, pull the abdomen forward with the result that the articular knobs of the propodeal notch glide to the posterior locks of the vertical plate of the pediole. This forward movement is, later on, followed by an upward rise of the abdomen. Hence it is definite that every rise in the abdomen as a result of the contraction of these two pairs of levators must be preceded by the maximum forward movement of the abdomen. Both Duncan and Snodgrass have so far failed to clarify this point.

Depressors of the abdomen (Fig. 131, No. 157).

There is a pair of the depressor muscles each arising from the under surface of the corresponding meta-furcal arm ventral to the thoracic depressor of the hind trochanter and other
muscles arising therefrom. The two tendons converge from either side of the meta-endosternum to end on the raised central part of the anterior margin of the 1st abdominal sternum (the true 2nd abdominal sternum). The contraction of the two depressors of the abdomen pulls the sternum ventro-anteriorly with the result that the 1st abdominal tergum is pulled in a postero-ventral direction and the articular knobs of the propodeal notch get arrested in the anterior loocks of the median ridge of the petiole. This postero-ventral pull on the abdominal tergum is followed by the downwards bend of the abdomen as a whole. Both Duncan and Harison while describing the meta-furcal depressors of the abdomen (III. 52) and the musculus propodei retructor medius inter-ternalis post abdominis respectively have not gone in sufficient details as described above in case of Stenobracon deceae.

Meta-endosternal torsion muscle of the abdomen (Fig.130.No.158a, 158b).

These are two such muscles. Each of them consists of two distinct bundles one arising from the corresponding side of the vertical longitudinal ridge (Fig.130.No.158a) while the other from the under surface of the meta-furcal arm (Fig.130. No.158b). Their fibres converge to form a tendon, which ends on the lato-rano-torial tip of the 1st abdominal sternum. Both these muscles are ventral to all the other muscles originating from the meta-endosternum. The sternal torsion muscles of the abdomen (III. 1.53) and the lateral muscles of the petiole (119) as described by Duncan and Snedgrass respectively are comparable with the above mentioned meta-endosternal torsion muscles of the abdomen.
Propodeal torsion muscles of the abdomen (Figs. 106, 133, 134, and 135, No. 169).

These are a pair of propodeal torsion muscles of the abdomen. Each of them arises partly from the upper internal ridge of the corresponding lateral margin of the propodeum and partly from the prephragma dorsal to the 1st levator of the abdomen. These muscles end by their short tendons on the corresponding antero-lateral tips of the tergum of the petiolar.

The endosternal and the propodeal torsion muscles are together responsible for the side way movements of the abdomen.
The abdomen of Stego bracon deeseae is elongated and obtusely pointed at both the ends. It is broadest in the middle and is considerably compressed dorso-ventrally with almost flattened sterna and slightly arched terga. In the fully fed condition the abdomen becomes rounded with both the ends tapering, due to the extension of the pleural membrane.

The abdomen consists of nine complete segments in case of male and seven in female inclusive of the propodeum in both the cases. The posterior part of the third tergum is completely fused with the fourth tergum thereby forming a dorsal carapace (Figs. 118 & 138A). Such fusion does not occur in the corresponding sterna.

In male the dorsal wall of the abdomen excluding propodeum and also regarding carapace as two plates is composed of eight large plates (terga) of varying sizes with variable density of sclerotisation. The ventral wall, on the other hand in this sex consists of equal number i.e. eight, of feebly chitinised plates (sterna) of varying size (Figs. 124A, 123AB&xi). As regards dorsum of the female it consists of seven terga (second to eighth both inclusive) leaving aside ninth tergum which is modified into quadrate plates. The ventral wall in female possesses six sterna ranging from second to seventh both included (Figs. 125 & 126AB). The sterna and terga on either side are connected by a continuous lateral membrane called "Pleural conjunctiva" (Figs. 142, 143, 144, 146, 147 & 148, p.1). Besides, in segments 3 to 7, every tergum on its either side is fused with a narrow almost rectangular,
and feebly sclerotized plate. This plate is equal in length with the tergum bearing it and hangs from it's lateral margin over the pleural conjunctiva. The present writer regards it as the only true non-membranous part of pleural region whose major portion has become membranous. It has shifted towards the tergum to fuse with it; and may be called "Pleural plate"(Figs. 117,118, 119,120,147, & 148.pl). The presence of the pleural sclerite only in that region of the abdomen where crop is located lends the present writer to think that they share the strain brought on the pleural conjunctiva due to maximum expansion of the crop when the insect is full-fed and thereby protect them from being damaged. Duncan seems to be definite about the absence of such pleural sclerites in the abdominal segments of the wasp.

The dorsal and ventral walls of the abdomen should be divided into three main regions on the basis of structural modifications. These region are (i) Pre-genital,(ii) Genital, and (iii) Post-genital. The segments comprising the pregenital region are from 2 to 7 (both inclusive). Those of genital are eighth and ninth. The post genital region consists of the tenth segment which has not been described above.

**Pregenital terga of male.-**

The length of the 2nd tergum is almost twice of its width and it's anterior region is narrower as compared with the posterior region (Figs. 117, & 138A). This tergum is divided into a small anterior and a long posterior plate demarcated by a transverse antecostal suture (Fig.117.aes) which internally forms a distinct antecostal ridge (Figs.133,134,135,136, & 138.Ac). The anterior plate is the acetotergites which forms the dorso-
lateral part of the small pedicle (Figs. 117, 132, 133, 134, 135, 136, & 139A, atg). The aerotergal region has been shown as a separate part of the tergum by Duncan but he did not mention it as aerotergite. The remaining posterior region is divided into two lateral and one central parts by two oblique sutures which unite to form an inverted "V" shaped suture (Fig. 117, ce). Each oblique suture is stretched from the centre of the antecostal suture to the corresponding posterior lateral angle of the tergum. Internally the "V" shaped suture is represented by a similar broad ridge (Figs. 132, 133, 134, & 139A, Ros). The two lateral parts and a single triangular central one thus set off become the two latero-tergal lobes (Figs. 117, 133, 134, 135, 136, 139A, & 142, 1lg) and the scutum respectively (Figs. 117, 132, 133, 135, 139A, IIIdset). Each latero-tergal contains a crescent shaped spiracle (Figs. 117, 133, 139A, & 142, apr) near the middle of its lateral margin (Figs. 117, 133, 134, 135, 139A, & 142, IIIsetmar). The latero-tergal and scutal regions may together be compared with the entire posterior region of wasp as shown by Duncan who has failed to find the presence of the natural demarcation. The posterior margin (Figs. 117, IIIPostmar) has a marginal ridge which abuts against the anterior margin of the succeeding tergum. Besides it has a notch (Fig. 117, IIIPostmar) at its centre to allow the central convexity in the anterior margin of the succeeding tergum i.e. third tergum's aerotergite to fit in it (Fig. 139A, atg).

The fifth tergum sets off a narrow aerotergite from its anterior region (Figs. 119, 139, 144, & 148, VPostmar) by the appearance of a distinct antecostal suture (Figs. 119, 139, 143, & 144, atg). This suture has a well-developed but incomplete internal ridge...
119.

(Figs. 119, 139, 143, & 144, Aa). Posterior to it there is a pair of loop-like sutures. Each loop starting from the centre of the antecostal suture, runs in a ventro-lateral direction. After traversing a little distance, it, then, turns up wards and passes below the spiracle of its side to end with the anterior part of the corresponding lateral margin. These sutures internally form two incomplete ridges extending from the corresponding spiracles to the middle of the antecostal ridge (Figs. 119, 139, 142, 143, & 144, Bc). The presence of those sutures cuts off a pair of lateral lobes below the aerotergite which contains the spiracles and may be called as "Laterotergites" (Figs. 119, 139, 142, 143, & 144, itg). Slightly above the posterior margin of the tergum (Figs. 119, 139, 144, 147, & 148, TPostmar) is a broad transverse groove which internally possesses a broad ridge whose function the present writer has failed to find out (Figs. 119, d, 142, TPostmar). Duncan has an wasp shown no line of partition behind the pre-costal which probably corresponds to the aerotergite of Steno-Bracon deesse. At each end a triangular tergal apodeme is borne by the anterior margin (Figs. 119, 139, 143, 144, a). It is laterally bordered by antero-mental extension of the lateral margin (Figs. 119, LeaB) and internally with a small off shoot of the anterior margin (Fig. 119, b). The aerotergal region lies under the posterior margin of the tergum anterior to it with a folded intertergal membrane (Figs. 139 & 143, Tma). The third tergum is similar to the fifth one except for minor differences mentioned below. Firstly, it lacks tergal apodemes simply because its entire anterior margin is opposed to the posterior margin of the 2nd tergum instead of being inflexed below the latter. Secondly, the
entire anterior margin, leaving its small central portion, develops a marginal inflection which is so broad that it over-runs the whole length of the acrotergite and fuses with the antecostal ridge (Figs. 118, 138, & 142. III Dactmar). This condition disables both the acrotergite and the antecostal ridge to retain their separate identity. The small central part of the margin instead of developing inflection bends upwards in the form of a small arc thereby allowing the acrotergal region below it to maintain its identity (Figs. 112, & 138. stg). Thirdly, the spiracles (Figs. 112, 138A, & 142. Spg) are located in the scutum (Figs. 112, 138A, & 142. III Post) due to a change in the course of the loop-like sutures which instead of passing below now passes nasally to the spiracles (Figs. 112, & 138. Ros).

The fourth tergum, as described already, is fused by its acrotergal region with the posterior part of the third tergum with the result that acrotergite, anterior marginal inflection, antecostal suture and tergal apodemes are untraceable (Figs. 112, 138A, & 142. f). In other respects the fourth tergum resembles the fifth one.

The sixth tergum resembles the fifth one in all respects (Figs. 130, 139, 143, 144, 147, & 148) and the seventh tergum differs from the latter in several ways. Firstly its anterior margin (Figs. 121, & 140. VII Dactmar) is longer than the posterior one (Figs. 121, 140, & 144. VII Postmar) with the result that from here backwards the abdomen becomes gradually narrower. Secondly, it has lost the posterior transverse groove. Thirdly, almost whole of the posterior half is shaded dark brown (Figs. 121. ba). Finally it is comparatively thin and less sclerotised. Its anterior half
is considerably placed in the lap of the 6th tergum (Figs. 140, and 144) and the intertergal membranes at its ends are comparatively longer. It may be noted for the convenience of systematical the that by counting true second abdominal tergum as first abdominal (in this ease propodeum is excluded from being taken as first abdominal tergum); and by regarding the dorsal carapace as one single tergum the true seventh tergum becomes the fifteenth tergum.

The eighth tergum is markedly smaller and feebly sclerotised than any of the anteriorly placed terga (Figs. 122, 140, & 144, VIII T). It is deeply arched with its posterior margin (Figs. 122, & 140. VIII T Postmar) reduced to half of the length of the anterior one. The latter (anterior margin) (Figs. 122, 140, & 144. VIII Antmar) is concave in the middle with tergal epodemes at its ends (Figs. 122, 140, & 144.a). A major portion of the tergum is placed within the seventh tergum (Fig. 140, VIII T). Unlike a typical tergum it is not demarcated into different regions. Further more, greater part its middle region is shaded brown (Fig. 122, bs).

Genital tergum:

The dorsal wall of the genital segment i.e. 9th segment is represented by its tergum which is similar to the eighth one. It is the smallest tergum with small epodemes (Figs. 122, 140, & 146.a). It is narrower in the middle as compared to the lobular lateral portions due to markedly concave nature of both the anterior (Figs. 122, 140, & 146, IX Antmar) and posterior margins (Figs. 122, 140, & 145, IX Postmar). It is almost completely inflexed below the eighth tergum (Figs. 122, 140). The intertergal membranes at its anterior end is highly developed. This unusual increase in
the length of the intertergular membrane coupled with the increasing infolding of the seventh, eighth and ninth terga helps the male to extend the abdomen particularly at the time of copulation when it is bent downwards to make the male genitalia enter into the vestibulum of the mating partner.

**Post genital segment**

There is only one post genital segment which may, in other words, be called the tenth segment. The tenth segment in the case of male is dorsally represented by a narrow transverse membrane (Figs. 145, 146.M, XT) bearing a pair of processes or pygostyle on the lateral side close to the ninth tergum (Figs. 122, 145, & 146.Pgs). It then bends to form the dorsal (upper) wall of the anal vestibule. This wall of the vestibule is comparatively thick and may be called "Supranal plate" (Figs. 145, & 146, spinpl).

The ventral (lower) wall of the anal vestibule in its (outer) region fuses with the upper margin of the obliquely placed semi-sclerotized oboe-shaped tenth sternum (Figs. 143, & 146. MXst). In this region the tenth sternum bears a pair of perfectly sclerosed oval plate; beset with bristles (Figs. 145, & 146.B, 6); while its lower margin is fused with the basal ring. These two sclerosed lobes may be regarded as "Sub-anal plates" (Figs. 145, & 146, spinpl). The invaginated anal vestibule at its: narrow anterior (inner) end receives the rectal opening in the form of a transverse slit; while its: broad posterior (outer) opening is the true anus (Fig. 145, An).

The postgenital segment in the case of female is represented by a conical protuberance which consists of the larval tenth segment (Figs. 147, & 148, Ptegr). Its: dorsal plate is laterally in conti-
mmation with the posterior ends of corresponding quadrate plates; while anteriorly it is merged with dorsal sclerotic bridge of the latter (Figs. 147, A 148, Bpl). Posteriorly it receives the dorsal membranous wall of the anal vestibule concealed beneath it. The ventral part of the protgiger (tenth sternum) is a weakly scleritized plate placed in communication with the posterior end of the membranous central part of the ninth sternum (Figs. 147, A 148, Bpl). The posterior margin of the tenth sternum gives rise to a membrane which runs in an antero-dorsal direction to form the ventral wall of the anal vestibule. A pair of small processes beset with hairs is present in the lateral membranes of the tenth segment very close to the tergum and may be called "Socii" (Figs. 167, Soc). Snedgrass in bracaeid (morphology of the insect abdomen part II, 1933) has shown similar dorsal and ventral plates of the protgiger but has not regarded them as the tergum and sternum of the 10th segment.

Prenatal terga of the female:

The prenatal terga in female are similar to those of male. Each tergum of the former is however comparatively longer as compared to that of the latter. The intertergal and pleural membranes in the case of female are broader than those of the male.

The seventh tergum of female is free from subdivisions. Its central region is narrower while, laterally, lobular condition, almost like that of the eighth tergum of female, is present. Besides it, no part of the seventh tergum in female is shaded brown (Figs. 123, 141, 143, 147, A 148, VII T).

The eighth tergum or the first genital tergum of female is
Abdominal sterna of male:

The abdominal sterna of male should be described separately on the basis of their structure and shape. These are second sternum; third sternum; and a typical sternum. The latter includes sterna four to nine.

Typical sternum:

A typical sternum is a four sided semi-sclerotised structure with rounded ends. It is broader than long with more extensive anterior margin (Figs. 134A, 123Antmar IV to IXst; Figs. 144Antmar V to IXst; Figs. 146A & 153Antmar IXst) than the posterior one (Figs. 124A, 123Postmar IV to IXst; Figs. 145, 146B & 153Postmar IXst). An oblique, narrow and well sclerotised plate is found in each half of the sternum. Each sclerotised plate starting from the corresponding antero-lateral angle runs in a postero-mental direction to end well above the posterior margin (Figs. 124A, 123,opl IV to IXst; Fig. 144,opl IV to IXst; Fig. 146B,opl IXst). In between the two sclerotised plates is the large semi sclerose-
tised part of the sternum (Figs. 124A-123.NIV to IXst; Fig. 146. NIV to IX st; Fig. 146B.NIXst).

The fifth sternum is the biggest sternum; while the poste-
rior ones become smaller and smaller in succession. This condi-
tion coupled with the gradual increase in postero-mesal slanting
nature of the corresponding lateral margins helps the targa to
a great extent in giving a tapering shape to the abdomen.

The oblique sclerotised plates of sterna converge greater
and greater towards each other. This condition becomes maximum in
the 9th sternum in which the plates meet by their posterior ends
to form a semi circular sclerotised area (Figs. 124-123B,144, &
146B.oup IXst). Anterior to it is the semi sclerotised part of
the sternum (Figs. 124A,123B,144, & 146B.N IXst). The fourth
sternum is least inflected at its anterior margin into the post-
erior margin of the preceding one (third sternum); while others
are comparatively more deeply inflected in the adjacent anterior
sterna. This ultimately causes gradual increase in the interst-
ternal membranes, which are responsible to a certain extent for
prolongation in abdominal length.

The third sternum is similar to the second sternum in shape;
and almost twice the second sternum in size. The intersternal
membrane between it and the latter is least developed. Its
posterior region is broader than the anterior due to divergence
in the antero-posterior course of the lateral margins (Figs. 126
125,126A, 126A, & 142. III stlar) as opposed to mesally slanting
nature of the typical sternum. The oblique sclerotic plates as
suggested in latter case are present extending upto the middle
of the anterior half (Figs. 124A, 125,126A,126A, & 142.epl IIIst)
with a semi sclerotised part in between them (Figs. 124, 125, 126A, 128A, & 142. MIIIst).

The second sternum consists of an anterior and a posterior regions. The anterior region is a well-sclerotised four sided structure with its posterior margin becoming "V" shaped instead of being straight; and occupies about two third of the whole length. The present writer regards it to have been formed by the fusion of sclerotised plates found in other sterna to serve as venter of the pedisal (Figs. 124, 125, 126A, 128A, 130, 131, & 142. stPd). The venter of the pedisal has developed a small apodeme at each of its four angles in order to provide insertion to various muscles. The dorsal surfaces of the two antero-lateral apodemes abut against the ventral surface of the corresponding similar apodemes of the second tergum (Figs. 124, 125, 126A, 128A, 130, 131, & 142. ALAppd); while the two posterolateral apodemes are free (Figs. 124, 125, 126A, 128A, 130, 131, & 142. FLAppd).

The posterior one-third of the second sternum is semi-sclerotised having inter-sternal membraneous connection, with the third sternum. A similar intersternal membrane connects the second sternum with the propodeal sternum. Though the posterior margin of the 2nd sternum internally receives the intersternal membrane it is externally extended over the anterior region of the third sternum in the form of a free bi-lobed flap (Figs. 134B, II stL). This flap has no definite muscle hence the present writer is at a loss to find out its function.

**Sterna of female**

The second, third and fourth sterna of the female are similar to the corresponding sterna of the male with the only
127.

difference that they are greater in size than those of the latter (Figs. 125, 126, & 142). The fifth and sixth sterna are quite similar to those of the male with the following certain minor modifications. Firstly each has markedly concave anterior margin (Figs. 125, 126, 127, 129, 142, 143, & 143. Antmar V&Vist) deeply inflamed below the posterior margin of the preceding sternum; while the posterior margin is convex (Figs. 125, 126, 127, 129, 142, & 143. Antmar V&Vist). Secondly the sclerotised plates occupying more than half of the lateral region are not simple narrow plates as in the case of male, (Figs. 125, 126, 127, 129, 142, & 143. eplV&Vist). Thirdly, each anterior apodeme is prolonged backward over the sclerotised plate of its side (Figs. 125, 126, 127, 129, 142, & 143. AlApV&Vist) in the form of a narrow oblique internal ridge which serves for muscle attachments (Figs. 125, 126, 127, 129, 142, & 143. IR V&Vist). Lastly inter-sternal membranes are broad (Figs. 127A & 129.Ism). It may be noted here that all these characters are comparatively more developed in the sixth sternum.

The seventh sternum (Figs. 145, 147, 148. VIIst) is longest with broad anterior and pointed posterior regions. The posterior margin is obliterated and its place is taken up by the union of the Convergent lateral margins (Figs. 125, 126, 127, 129, 143, 146A, & 167. VIIst Imar). The anterior margin is highly concave and rests slightly posterior to the same margin of the preceding sternum (Figs. 125, 126, 127, 129, & 143. Antmar VIIst) with the result that intersternal membrane becomes well developed (Figs. 127B & 129.Ism). The sclerotised plates (Figs. 125, 126, 127, 129, 143, & 167. VIIist) by meeting with their mesal margins and
get it restricted as a small part just below the anterior margin. Further more the anterior apodemes (Figs. 125, 126A, 127B, 129, 143, 146A, 147, A1ApVIIt) are well developed with their internal and ridges covering about two-third of the whole length of sternum (Figs. 125, 126B, 127B, 129, 143, 147, A1VIIt).

This sternum functions as the subgenital plate and from the margin of its posterior half a long membranous sheath is given out. This membrane, running ventral to the genitalia in antero-dorsal direction, and spreading over the inner face of its sternum, ends on the dorsal margin of the eighth sternum. A space (passage) is enclosed ventro-laterally by this membrane and dorso-laterally by the ventral wall of the genitalia (mid membranous part of ninth sternum) and is called the vestibulum(Figs. 147, A148, VIt).

The eighth sternum consists of the first pair of valvifers called/(triangular plates) in Hymenoptera, and a small oval plate (Fig. 144A, VItstop). The triangular plates will be discussed later on.

The small oval plate (eighth sternum) is fused with the swollen anterior face of the two basal branches of the first pair of valvulae as if it works as a seat of origin for them (Fig. 164A, BrIV). Its ventral margin (Fig. 164A, vm) forms the dorsal wall of the aperture which is ventro-laterally bounded by the two convergent rami of the first pair of valvulae fused with their corresponding basal branches (Fig. 164A, PrIV). This aperture is the true genepore (Fig. 164A, Gpr). It leads to the vagina which opens in the vestibulum.
Abdominal musculature

The musculature of the abdomen consists of intertergal, intersternal, tergesternal, and spiracular muscles and the muscles constituting the two diaphragms. The intertergals and intersternals follow a common plan of arrangements based on functional coordination existing between terga and sterna. The muscles of the diaphragms have been dealt with in connection with the circulatory system.

On functional grounds the intertergal and intersternal muscles may be regarded as Contractors and Extensors. If the abdominal musculature is observed in an antero-posterior direction it would reveal that almost all contractor muscles in their size, thickness and strength are inversely proportional to the intensity of segmental overlapping; while those of extensors are directly proportionate to it. This condition is comparatively more marked in female than in male and is perhaps due to the high degree of abdominal extensibility present in the former.

Inter-tergal musculature

The intertergal muscles for all terga excepting the third of both the sexes and ninth in female only, are identical in every respect. The fourth tergum, due to the formation of carapace is not supplied with the intertergal muscles while those for the second tergum has already been described in connection with the propodusum.

Dermal internal median muscles (Figs. 139, 140 & 141, No.112).

There are two such muscles. Each originates from the mesal part of the antecostal ridge of a tergum in the region of the laterotergite of its side. The fibres running in a mesoposterior
direction converge to end in the centre of the anterior margin of the immediately lying posterior tergum. Snodgrass appears to be uncertain about its origin from the antecostal ridge. Furthermore, he has shown its insertion on the antecostal ridge. In the eighth tergum of male this muscle starts from its anterior margin instead of starting from the antecostal ridge which is absent.

**Dorsal internal lateral muscles** (Figs. 139, 140, & 141, No. 113).

These muscles are two in number. Each dorsal internal lateral muscle arises from the antecostal ridge lateral to the corresponding dorsal internal median and is also comparatively shorter than it. In some cases it originates from the latero-tergite but close to the antecostal ridge. Running in a postero-lateral direction it gets inserted with its convergent fibres on the corresponding lateral margin of the acrotergite of the adjacent posterior tergum. In the eighth tergum of male it originates from the anterior margin mesal to the anterior apodeme due to the absence of the acrotergal region.

**Dorsal external lateral muscles** (Figs. 139, 140, & 141, No. 114).

There is a pair of dorsal external lateral muscles. Each starts from the posterior margin of the tergum near its postero-lateral angle. It's fibres running in an antero-ventral direction and dorsal to the intertergal membrane and independently on the free margin of the corresponding anterior apodeme of the succeeding tergum. On the bases of its position and function it can rightly be called "Reverse intertergal muscle".

The musculature for the third tergum is very simple due to its close proximity with the second tergum. Besides, unlike other terga it is incapable of entering into and receding from
the posterior region of the preceding tergum (second tergum). The only movement it can perform is the vertical movement which is subsequently followed by the whole of abdomen. As the third tergum is at a lower level than the posterior region of the second tergum hence the former abuts against the latter along an obtuse angle. In order to make the third tergum, and thereby the whole abdomen to fall in straight line with the second tergum a pair of strong muscles is lying in the scutum of the second tergum.

The raising of the abdomen is antagonistic to the function of the reverse intertergal muscles; hence it would be correct to regard this pair of muscles as "Dorsal internal median muscles" (Fig.136, No.115a,115b).

Each dorsal internal median muscle originates as two broad muscle bundles from the inner face of the corresponding arm of the inverted "V" shaped internal ridge present in the second tergum. The fibres of this muscle running in a postero-ventral direction form a broad membranous apodeme which ends on the anterior margin of the central uncovered acrotergal region of the third tergum. The apodeme insertions of the muscles; their postero-ventrally directed course and the higher level of the region of the second tergum whence these muscles originate have led the present writer to regard them as muscles acting on the third tergum.

**Intersternal musculature**

The intersternal musculature in female is well-developed as compared to that of the male. The following account is based on the observations made in both the sexes. A typical plan of musculature is prevalent from the fourth to seventh sterna in
female. Excepting ventral internal median muscle the remaining muscles are wanting in male.

**Ventral internal median muscles** (Figs. 126, & 128, No. 116).

There are two ventral internal median muscles. Each amongst them originates from the outer face of the posterior half of the apodemal ridge and after traversing the sternum along a postero-mesal direction is inserted on the mesal face of the corresponding apodemal ridge of the following sternum. The ventral internal median of the fifth sternum originates from the anterior half of the sclerotised plate of fourth sternum due to the absence of an apodemal ridge there. In all the sterna of male where apodemal ridges are wanting it originates from the anterior region of the sclerotised plate of one sternum and ends on the corresponding sclerotised plate of the one immediate behind it (Fig. 128, No. 116).

**Ventral internal lateral muscles** (Fig. 126, No. 117).

This pair of muscles is supplied only to fifth, sixth and seventh sterna of female. The remaining sterna in this sex and all the sterna of male do not possess it. Each muscle originates from the middle of the sclerotised plate of its side in between the internal targe-sternal and the ventral internal median muscles. It takes up postero-lateral course inorder to end on the lateral surface of the corresponding anterior apodeme of the following sternum.
Lateral ventral external muscles (Figs. 126A, 127, & 129, No.118).

This pair of muscles has been shown as "Reverse muscles" by Snodgrass in honey-bee. Duncan labelled it as "Intersternal extensor", but has not regarded it as a definite reverse muscle, in wasp. The present writer considers it to be an oblique muscle for the fifth sternum and a definite reverse muscle both for the sixth and seventh sternums. As an oblique muscle it originates from the posterior most part of the sclerotised plate of fourth sternum pressed below the fibres of the ventral internal median muscle. Running in a postero-lateral direction it ends on the mesal face of the corresponding anterior apodeme of fifth sternum.

On shifting from "oblique" to "Reverse" condition a change in its course takes place. For example as a reverse muscle of the sixth sternum its fibres start from the posterior margin of the fifth sternum and after traversing in an antero-dorsal direction, ventral to the intersternal membrane, end on the mesal surface of the corresponding anterior apodeme of the sixth sternum.

The fourth sternum both in the male and female (Figs. 126A & 128A, No.116) contains only the ventral internal median pair of muscles. In its origin and insertion it follows the pattern of the same muscle of any of the following sterna of the male.

The third sternum in both sex is supplied with two distinct pairs of muscles. One of them is smaller and median while the other is longer and lateral. Each smaller muscle originates from the median apodermal part of the posterior margin of the second sternal plate. Running in postero-lateral direction it ends on the posterior half of the corresponding scleretic plate of the third sternum. This pair of muscles on the basis of its origin,
insertion, and also of its function may be called "Ventral internal median muscles" (Figs. 126A & 126A, No.119). Duncan has not shown it, while Snodgrass in honey bee differs from the present writer in describing its origin and insertion. This difference the present writer attributes to structural differences present in the sterna of honey-bee and those of Steno-heracleon deceae.

Each of the second pair of muscles (Figs. 126A & 126A, No.120) starts from the corresponding postero-lateral apodeme of the second sternal plate. It runs postero-medially towards the ends on the corresponding soleretised plate slightly lateral to the insertion of the ventral internal median muscle of its side. The origin and insertion of the this pair of muscles in comparison to those of the ventral internal median muscles lead the present writer to regard them as "Ventral internal lateral muscles". Duncan is silent on this point also; while Snodgrass describes it only in the male of the honey-bee.

These ventral internal muscles serve as contractors of the third sternum. Their combined action pulls this sternum up to fall in line with the second sternal plate. A simultaneous action by the contractor muscles of all the sterna consequently brings reduction in the length of the ventral surface of the abdomen as a whole.

A pair of extensor muscles has been described both by Duncan and Snodgrass in the wasp and honey bee respectively. The present writer did not find it. The absence of extensors in this sternum and in all other sterna of the male appears to be possible on the ground that in this insect the intersternal membranes
are least developed. This shows that the extension of the third sternum in both sexes and of the whole ventral surface of the abdomen in male is brought about by the tergo-sternal extensor muscles described in connection with lateral muscles.

**Lateral muscles**

It may be noted, at the very outset, that due to lack of marked overlapping of the terga and the sterna in Steno bracon dezaee, unlike wasps and honey-bee, the number of the lateral muscles, and their course considerably differ from what has been described by Duncan and Snodgrass in the wasp and honey-bee respectively. Besides, the second, eighth and ninth segments the remaining lot consists of two muscles on either side which on functional ground may be called "Extensor and contractor muscles".

**Tergo-sternal extensor muscles** (Figs. 142, 143, 144, No. 121).

Each of the tergo-sternal extensor muscles originates as a thin bundle from the lateral margin of the tergum slightly anterior to the spiracular region. It runs in a ventro-anterior direction across the lateral region obliquely and ends on the anterior tip of the corresponding sclerotised plate of the same sternum. This type of origin and insertion is found from third to seventh segments of the male and in the third and fourth segments of the female. In the fifth, sixth, and seventh segments of the latter (Fig. 143, No. 121), its point of origin gradually shifts to the posterior half of the tergal margin upto the seventh segment where it starts close to the posterior end of the lateral margin. As these sterna have developed anterior apodemes hence the insertion of this muscle shifts to them from the anterior tip of the sclerotised plates. These changes
increase the length of this muscle and moreover make it a more effective extensor. The second, eighth, and ninth segments do not possess it. Snodgrass had described it as "reverse muscle" because it has to discharge the function of extension as well as of dilation of the abdomen. But in Stecop bracon deeseae its function is primarily the extension of the abdomen. It is just possible a little bit of dilatory function is also done; but in that case it would be regarded as an accessory function of this muscle.

**Tergo-sternal contractor muscles** (Figs. 142, 143, 144, 146B, No. 122).

The tergo-sternal contractor muscle originates from the lateral area of a tergum slightly below the spiracle. Its fibres running in a postero-ventral direction end on the corresponding sclerotised plate of the same sternum lateral to the origin of the ventral internal lateral muscles. In the third segment (Fig. 142) the insertion shifts to the lateral margin; while in the second segment it is on the postero-lateral apodeme (Fig. 142). It may be noted that the insertion gradually shifts from anterior to the posterior part of the sclerotised plate in fourth to the eighth segments; while in the ninth segment (Fig. 146B, No. 122) the origin shifts close to the anterior margin of the 9th tergum mesal to its anterior apodeme. This shows how effective the contractor muscle gradually becomes. Besides, in all segments where both these lateral muscles are present, the tergo-sternal contractor crosses the tergo-sternal extensor at the latter's point of origin, excepting the third segment in which no such crossing is present.
Abductors of the subgenital plate (Figs. 129, 146A, No. 123).

These muscles are intersegmental and are present only in female. Each of them originates from the antero-lateral area of the eighth tergum mesal to the anterior apodeme of its side. After running along an antero-ventral direction it ends on the inner face of the corresponding anterior apodeme of the seventh sternum. The present writer thinks that the contraction of this pair of muscles pulls the sternal apodemes in a dorso-posterior direction with the result that the posterior part of the seventh sternum bends downwards. Consequently the vestibulum is exposed for copulation. Snedgrass's muscle (194) described in honey-bee is just the reverse in origin and insertion hence it cannot be compared with the abductor of the subgenital plate.

Abductors of the supraneal plate (Fig. 146B, No. 124).

Each abductor muscle of the supra anal plate arises from the ninth tergum's anterior apodeme; and after running in postero-mesal direction ends on the corresponding supra anal plate. The present writer thinks that the contraction of this pair of muscles pulls the supra anal plate in antero-dorsal direction thereby opening the anal vestibule in order to eject the faecal matter. This muscle should not be confused with muscle (202) of honey-bee for the simple reason that the latter is inserted on the ventral wall of the prostiger which can be compared with the semi-sclerotised tenth sternum of Steno-brason deessae if the prostiger is regarded as the tenth segment in honey-bee.
Female genitalia (Figs. 147, 148).

The female genitalia of Steno-bracoon deescas is boat-shaped with a membranous bottom and well sclerotised walls. It is placed in the posterior region of the abdomen guarded ventrally by the subgenital plate (Figs. 147, 148, VIIst) and dorsally laterally by the seventh and eighth terga (Figs. 147, 148, 166, & 167, VII-VIII). Structurally the genitalia consists of (i) a pair of quadrate plates (Figs. 147, 148, 160, 161, 166, & 167, Qd) (ii) a pair of oblong plates (Figs. 159A, 160, 161, 162, 163, 165, & 166, Ob), (iii) a pair of triangular plate (Figs. 149, 160, 164, 165, & 166, Tri), (iv) the bulb with (Figs. 159A, 160, 164, & 166, blb) fused second pair of valvulae (Figs. 148, 159A, 160, 164, stl), (v) a pair of first valvulae (Figs. 148, 159A, 160, 164, Lor) and (vi) a pair of third valvulae (Figs. 148, 159A, 160, 161, 162, 163, 165, 166, & 167, shem 3v2).

Quadrate plates (Figs. 147, 148, 160, 161, 166, & 167, Qd).

The quadrate plates according to Zander (as quoted by Ilms 1938) are part of the ninth sternum; while Snodgrass regards them as highly expanded lateral parts of the ninth tergum placed horizontal to the body-axis and connected with one another in the posterior region by a narrow dorsal sclerotised bridge (Figs. 147, 148, 159A, 160, 161, 162, & 166, Qdb). Snodgrass in Atanyscolus rugosiventris (Braconid) has failed to show this bridge. The dorsal margin of the quadrate plate (Figs. 147, 148, 159A, 160, 161, 162, & 166, Qdm) is broadest in the proximal region and narrowest in distal one, while its anterior (Figs. 147, 148, 160, 161, 162, & 166, Qdm) and ventral margins (Figs. 147, 148, 159A, 160, 161, 162, & 166, Qdv) are thin throughout. A semi-circular suture-like
impression starting from the antero-dorsal angle and after running throughout the whole length of the quadrate plate ends near the dorsal selenotised bridge (Figs. 159A,161, & 166.qd1). This demarcates the quadrate plates into an upper broader (Figs. 159A, & 161.Uqd) and a lower narrower semi-circular area (Figs. 159A, & 161.Lad). The proximal tip of the dorsal margin has a developed concavity (Figs. 159A,161,162, & 166.qdson) which provides articulation for the dorsal articular knob of the corresponding first valvifer (Figs. 159A, & 164ACC, & 166.Darth). The ventro-anterior margin has membranous connection with the semi-circular impression present on the outer face of the corresponding second valvifer.

Oblong plates (Figs. 159A,160,161,162,163,165, & 166.ob).

The oblong plates are regarded as second valvifers. Each of them is a long narrow horizontal plate. Its (Figs. 159A,160,161,162,163,165, & 166.obpl) proximal region is expanded with the anterior margin directed postero-dorsal (Figs. 159A,160,161,162,163,165, & 166.obsm) while the long distal part remains as a narrow plate. The proximal lobe is the only uncovered part of the 2nd valvifer; otherwise it is entirely covered by the corresponding quadrate plate. The thin dorsal margin (Figs. 159A,160,161,162,163,165, & 166.obdm) abruptly turns upwards in the proximal region to form an acute dorso-anterior angle by meeting with the dorsal tip of the anterior margin. A sub-marginal internal ridge very close and parallel to the entire dorsal margin gives origin to various muscles of the genitalia (Figs. 159A,160,161,162,163, & 165.obsmR). This ridge has not been described by Snedgrass in Atenyculus rugosiventris. The dorsal margin before bending
upwards develops a small emargination (Figs. 159A, 162, 163, & 165, obv) with the result that in this region the sub-marginal ridge is exposed to serve as an articular surface for the postero-ventral articular knob of the first valvifer (Figs. 159, 164A & C, 165 & 166, Fréthk). The ventral margin of the proximal lobe is bent upwards to make sufficient space for the bulb in between the two second valvifers. Besides, this bend provides an abutting area for the corresponding lateral process of the bulb.

Leaving aside proximal lobes the two valvifers are ventrally connected by a membrane which develops a longitudinal fold (Figs 165, Vmsh). This fold has dorso-laterally ensheathed the proximal part of the stylet. This fold probably resembles the "membranous lobe" described by Ints in hymenoptera (Ints, 1939, Fig. 633, 82&msh). He does not further throw any light on its connection or fusion with either quadrate plates or with the oblong plates. On the other hand the present writer has found it so perfectly fused with the ventral margins of the oblong plates that he is convinced to regard the membranous fold and the oblong plates as part of the same whole. Further more in StenOcean bracon descans the quadrate plates have no connections with the membranous fold hence the present writer does not think it sound to regard quadrate plates as parts of the ninth sternum as suggested by Ints which runs thus..."The quadrate plates represent part of the ninth sternum, the median portion of the latter region being probably seen in membranous lobe (83) which overlies the bulb of the sting." A semi-circular impression (Figs. 159A, 160, 161, 163, & 165, obi), like that of the quadrate plate, divides the second valvifer into an upper (Figs. 159A, 160, 161, 163, & 165, obi) and a lower semi-circu-
lar areas (Figs. 159A, 160, 161, 163, & 165, L6b).

The two long ventrally concave second valvulae are fused along their entire dorsal margins to form a common structure called "Stylet" (Hems has named it stylet sheath, 1938) which develops a longitudinal groove, facing ventrally, due to subsequent fusion of the concavities of the valvulae (Figs. 143, 159A, 160, 164A, 8t1). The posterior end of the stylet is considerably tapering and directed ventrally; while its anterior end expands to form the bulb (Figs. 159A, 160, 164A, bllb). The bulb has a pair of lateral blunt processes (Figs. 143, 159A, 160, 164A, bllbLp). Besides, its anterior margin in between the two lateral processes projects out in the form of a mid conical process with its tip bent downwards (Figs. 143, 159A, & 160, bllbLp).

On either side of the mid conical process and guarded by the respective lateral process is a space through which the rami of the valvulae descend into the bulb. The rami of each second valvula originates from the whole anterior margin of the proximal lobe of the respective second valvula (Fig. 159A, rglv1). On leaving the region of origin in a postero-ventral direction it passes through the space mentioned above inorder to fuse with the inner surface of the respective lateral process. From the distal extremity of each oblong plate or 2nd valvifer, a long, slender 3rd valvula (Figs. 160, 161, 165, 166, 3v1) is developed. It has a longitudinal concave groove facing downwards. Besides it is highly annular and externally covered with hairs. The mesal margins of the 3rd valvulae appose each other throughout and their two grooves united form a space in which the sting is enveloped.

The triangular plates are regarded as first valvifers. Each is located in front of the anterior margin of the quadrate plate and is posterior and parallel to the proximal lobe of the oblong plate or second valvifer. Its anterior margin covers externally the dorsally bent part of the dorsal margin of the second valvifer. The dorsal angle (upper tip) of the first valvifer is placed at the highest level among all the parts of the genitalia (Figs. 159, 160, 164A, & 166, Triut). This unusually high level of the upper tip enables the rami of the first valvulae to have a perfect hold on the back of the corresponding second valvulae. Drees, 1938, has used the terms stylets and dincets for the first valvulae while Snodgrass, 1942, has called them lances. The present writer has picked the term lances which is common to both for his paper. The posterior margin i.e. the region bearing articular knobs is the smallest (Figs. 159A, 164A, Tripm) and develops a thick marginal internal ridge which is the seat of insertion of the "inter valvifer muscle" (Figs. 159B, 163, 164C, 165, & 166, Trims).

The rami of each of the first valvulae is proximal the most part of the latter originating from the upper tip of the corresponding first valvifer (Figs. 148, 159, 160, 164A&C, & 166, xivl) On leaving the point of origin it runs in an antero-ventral direction up to the rami of the corresponding second valvula. Thence the rami of the first valvula overlaps the rami of the second valvula.

The inner margin of the rami of each first valvula fuses with the lateral margin of its basal branch, coming from the
oval plate of the eighth sternum (Figs. 159A, 164ABC, BrIV1) to form the first valvula. Besides, the basal branches and the oval plate are connected with the rami by a membrane with the result that all are bound to work in coordination. The two long first valvulae enter the groove of the stylet and meet along their entire inner margins to form a longitudinal groove facing upwards. Thus the two grooves of the two first valvulae unite to form the egg-passage. The distal end of the first valvula is tapering, and is bent downwards, and is provided with five big and several small teeth along its ventral face (Fig. 164B, Ivl1).

In Atanopius rupesiventricus, Snodgrass does not show that he calls "Basal branches of the first valvulae" in Megarhyssa atrata (Ichneumonidae). In the latter he regards them as mere branches of the first valvulae with no functional importance. The present writer, as already described, regards them as definite structures guarding the true gonopore in unison with the oval plate of the eighth sternum.

Musculature of the genitalia:

When the sting is not in use it forms a straight line with the abdomen. The proximal part of the shaft is concealed within the longitudinal groove of the dorsal wall of vestibulum; while its long distal part is unsheathed by the third pair of valvulae i.e. sheath of the ovipositor. When the sting goes into action it involves three simultaneous important movements well coordinated with one another. At first there is a ventro-posterior swing of the proximal part of basal mechanism of genitalia until it becomes vertical, with its anterior tip directed downward, instead of being horizontal to the body axis. Next, there is a ventro-
anterior swing of the shaft (1st and 2nd pairs of valvulae combined) which becomes perpendicular to the body axis. This downward swing enables the shaft to come out of the sheath. The latter forms a posteriorly directed loop in between the shaft and the distal end of the basal mechanism of genitalia with its distal tip resting on the posterior (dorsal in the resting condition) surface of the stylist. As the distal tip of the sheath is capable of gliding over the stylist hence increase and decrease in the loop are inversely proportionate to the lowering and raising of the shaft at the time of parasitisation. Third type of movement is the alternate back and forth movement of the lancets on the stylist. Each of the three types of movements has a separate set of muscles which are dealt with individually below.

The two abductor muscles of the subgenital plate on contraction pull the anterior apodemes of this plate in a dorso-posterior direction with the result that the hind end of the 7th sternum of the abdomen assumes a ventro-anterior course. This change in the position of the distal portion pulls the oval part of the eighth sternum downwards which in its turn transmits the pull to the 1st pair of valvulae through membranous connection. These valvulae pull the anterior part of the basal structures of the genitalia through their respective valvifers and thus a partial deviation from horizontal to vertical position of the genitalia is brought about. The simultaneous contraction of the reverse muscles of abdomen particularly those of the sternae helps extend the subgenital plate to/still downward. This indirectly increases the ventro-posterior deviation of the genitalia till the latter acquires a perfect vertical position.
Snodgrass holds contractor muscles of the abdomen responsible for the downward swing of the genitalia. This means that at the time of swing the sub-genital plate will be pulled anteriorly instead of extending in a posterior direction with the result that genitalia will never attain a perfect vertical position. Besides, the contraction of the abdomen will to a certain extent adversely affect the pull of the abductor muscles of the subgenital plate.

First Protractor muscles of the lomata (Figs. 162, 163, & 166, No. 125)

The protractor muscle is the largest muscle of the genitalia consisting of two distinct bundles which may on the basis of their origin be called "Upper" and "Lower" bundles of the protractor. The upper protractor originates by encircling from both sides the posterior half of the thick dorsal margin of quadrate plate. Its fibres run convergently towards the anterior lobe of the corresponding second valvifer to and independently on the submarginal ridge close to the dorsal angle (Figs. 162, 163, & 166, No. 128a). The lower protractor originates on the outer face of the posterior half of the upper semi-circular area of the quadrate plate. Its fibres travelling in an antero-dorsal direction, cross mesally the corresponding inter-tergal muscles, stretching between the quadrate plate and the eighth tergum, and end on the outer face of the anterior lobe corresponding to the insertion of the upper bundle (Figs. 162, & 163, No. 128b). The first protractor muscle resembles much No. 128, of Snodgrass in honey-bee.

Though Snodgrass is not clear as far the insertions of the upper and lower bundles are concerned, even then the present
writer agrees with him to regard them anatomically as two muscles performing one and the same function.

These bundles on contraction pull the posterior half of the quadrate plate in antero-dorsal direction which in its turn pushes forward the corresponding first valvifer. But a forward movement of the first valvifer is impossible due to its articulation with the second valvifer, hence the former with this point of articulation as its pivot moves in a ventro-posterior direction. This partial rotation ultimately protrudes the corresponding lamina.

Second Protractor muscles of the lamina(Fig.161, No.126).

The second protractor muscles start from almost the whole outer face of second valvifers leaving aside the anterior lobe. Their fibres take up a latero-ventral direction and end independently on the inner face of the anterior half of the corresponding quadrate plate. This muscle on contraction pulls the latter upwards and the corresponding lamina is protruded out in the manner described in the case of first protractor muscle of the lamina.

It is obvious that each of the two muscles has a definite zone of influence on the quadrate plate. But they cannot mar the efficiency of each other due to the presence of coordination in their common work. On the other hand they enhance it much more than what is exhibited in honey-bee where the second protractor is absent.

First Retractor muscles of the lamina(Figs.161,4162, No.127).

The first retractor muscle originates from posterior half of the dorsal margin of the second valvifer. Its fibres running
in an antero-dorsal direction and below the dorsal thick margin of the quadrate plate close to its antero-dorsal angle. This muscle on contraction pulls the anterior half of the quadrate plate in a ventro-posterior direction which in its turn drags the first valvifer downward. As the latter articulates with the second valvifer hence instead of being dragged along with the quadrate plate, makes a partial rotation in ventral direction over this point of articulation as its pivot. This rotation ultimately moves the dorsal (upper) tip of the first valvifer in a posterior direction with the result that the corresponding lancet is retracted within the abdomen. This muscle may resemble "No. 199" of Snodgrass described in honey-bee.

**Second retractor muscles of the lancets (Figs. 162, 163, No. 123).**

The second retractor muscle begins from the outer face of the posterior region of second valvifer close to the formation of the third valvula. Its fibres running obliquely in dorsal direction and independently on the inner face of the posterior region of the corresponding quadrate plate beyond the semi-circular impression.

The primary function of the second retractor muscle is to pull down the posterior half of the quadrate plate which is beyond the field of influence of the first retractor muscle. In other words if the posterior half is left unaffected when the first retractor muscle is in action it will, to a certain extent, diminish the intensity of action of this muscle. Hence the simultaneous contraction of the first and second retractor muscles compels the posterior half of the quadrate plate to move in accordance with the movement of its anterior half with the
result that the first retractor muscle is given full scope to work unhindered and with perfection. It may be noted here that the second retractor muscle while lowering the quadrate plate pulls the latter in a ventro-posterior direction as well. This pull retracts the corresponding valvula as exactly in the manner described in the case of the first retractor muscle. Hence it would not be unwise to regard it also as a retractor muscle of the first valvula. This muscle has not been shown by Snodgrass in honey-bee.

**Depressor muscles of the stylet** (Figs. 160,p & 162,No.129).

There is a pair of depressor muscles, each originating from the inner face of the posterior half of the corresponding second valvifer in between its submarginal ridge and the ventral margin. Their fibres running in an anterior direction cross over the corresponding blunt lateral process of the bulb inorder to converge on a small apodeme (Figs. 162,q & 160,q). Both of these apodemes have a common membranous connection with the ventrally directed tip of the central process of the bulb. These apodemes have not been described by Snodgrass in *Atanerolus repensventris*. The present writer thinks that it gives perfection and efficiency to the depressor muscles.

The depressor muscles by their contraction pull the bulb in dorso-posterior direction which move over two points of contact with the 2nd valvifer with the result that the stylet moves in ventro-anterior direction and assumes a vertical position with the body axis. Sometimes it so happens that the stylet still moves further and forms an acute angle with the body axis. This pair of muscles is similar to muscle No.197 of Snodgrass described in honey-bee.
Leverator muscles of the styllet (Figs. 160, 162, & 166, No. 130).

There are two leverator muscles of the styllet, each originating from the inner face close to the upper tip of the corresponding anterior lobe of the second valvifer. Its fibres running in ventro-dorsal direction converge to form a distinct tendon which is inserted on the dorsal tip of the corresponding blunt lateral process of the bulb. The contraction of these muscles compels the styllet to move in a postero-dorsal direction and thenceby to recede from the vertical to its natural position inside the sheath. Hence the leverator muscles are antagonistic to the depressor muscles and act only when the act of oviposition has finished. It resembles muscle No. 196 of honey-bee described by Snodgrass.

Secondary retractor muscles of the lancet (Figs. 141, 164, & 166, No. 131).

Each first valvifer is provided with a pair of long thin secondary retractor muscles of the lancet. One of them originates from the middle of the lateral margin of eighth tergum (Figs. 141, & 164C, No. 131a) and running in antero-dorsal direction crossed the quadrate plate obliquely in order to end on the corresponding first valvifer slightly dorsal to its dorsal articulation. It may be called the "external retractor muscle". The second "Interim retractor muscle" starts from the lateral area of the eighth tergum in between the spiracle and the anterior apodeme (Figs. 141, & 164C, No. 131b). It follows the course of the external muscle and acquire a common insertion with it on the first valvifer.

The external muscle is similar to No. 192 of honey-bee described by Snodgrass and to the tergo-sternal extensor of bee.
described by Norison. The internal one is definitely a different muscle on the basis of origin. But having common course of action, function and point of insertion with the external muscle it can rightly be claimed as a bundle of the latter rather than an independent muscle. The present writer regards this muscle as different form of the tergo-ternal muscle of the eighth segment. As regards function, its contraction, of course not independently but in conjunction with other retractors of the lancet, definitely pulls the first valvifer down wards, and thereby retracts the lancet.

**Levator muscles of the preotiger (Figs. 141 & 166, No. 132).**

There is a pair of long levator muscles. Each of them starting from the proximal region of eighth tergum mesal to its anterior apodeme converges to end on the dorsal sclerotised bridge of the ninth tergum. As the preotiger is anteriorly merged into the bridge and laterally into the posterior area of the quadrates plates, therefore, any pull on the bridge will act on the preotiger and consequently on the quadrates plates.

The levator muscles on contraction pull the distal part of the basal mechanism of genitalia in a dorso-anterior direction through the preotiger. In other words its proximal region is moved downwards. As the levator muscles work in conjunction and simultaneously with the abductor muscles of the subgenital plate hence they become indispensable partners of the latter in putting the genitalia in a vertical position. Secondly these muscles by undergoing slow relaxation control the genitalia which after parasitisation assumes its normal (horizontal) position.

It may be similar to the muscle No. 193, of honey-bee described by Snodgrass.
Intertergal muscles between the quadrate plates and the eighth tergum (Fig. 141, No. 133).

There are two such muscles. Each of them originates from the eighth tergum lateral to the origin of the corresponding levator of prostiger. Its fibres running in ventral direction and by spreading externally on the middle of the semi-circular impression of the corresponding quadrate plate. The present writer has failed to find out its exact function. It is just possible that by the contraction of this muscle the eighth tergum retains its normal position with the genitalia when the latter is moving from horizontal to vertical position. It may be compared with muscle "No. 157" of the honey-bee described by Snodgrass.

Inter-valvifer muscles (Figs. 164, & 165, No. 134).

There is a pair of inter-valvifer muscles. These have a common broad base in the proximal region of the membranous longitudinal fold which conceals a part of the styllet. Their fibres run in outward direction on both sides to end on the posterior margin of the corresponding first valvifers. The present writer has failed to find out its real function. Nevertheless he presumes that on the contraction of these muscles the first valvifers are pulled inwards. These in their turn compel their valvulae to come closer and closer with the result that the gonopore which is guarded by the latter is closed. Thus by shutting the vestibulum from the vagina the eggs are compelled to pass into the egg-passage of the genitalia.

Dilator muscles of the common oviduct (Figs. 129, & 167, No. 135).

There are two dilators of the common oviduct. Each arises
from mesal face of the anterior apodeme of the seventh sternum. It runs in a dorso-mesal direction to end on the corresponding side of the common evednt. Some of its fibres spread on the ventro-lateral area of anterior part of the vagina as well. These muscles on contraction probably dilate the common evednt to provide a clear passage for the descending eggs at the time of oviposition. This pair of muscles has not been described by Snodgrass in honey-bee.

**Dilator muscles of the vagina** (Figs. 141, & 167, No. 136).

There is a pair of vaginal dilator muscles, each starts as a thin but compact bundle from the anterior margin of the eighth tergum slightly mesal to the corresponding apodeme. After traversing in an antero-mesal direction its fibres spread over the corresponding half of the dorsal wall of vagina. These muscles may be compared with the closely running muscle Heg's "193" and "194" of honey-bee described by Snodgrass. On contraction naturally these dilators expand the vagina. The present writer is of opinion that these muscles and the dilators of the common evednt perform similar function and dilate the evednt and the vagina as much as possible so that a broad passage may be provided for the descending eggs.

**Male genitalia**

The male genitalia of Steno-bracoae deese is strongly sclerotised with its proximal half concealed by the ninth sternum (Fig. 183, Xet); while the distal half is exposed. The posterior margin of the ninth sternum and the lesser or inner margin of the tenth sternum have membranous connections with the ventral and dorsal surfaces of the genitalia respectively. These
concurrent membrae are broad enough to cope with the extension of the genitalia. The following structure unitedly constitute the male genitalia.

(a) **Basal rings** (Figs. 149, 150, 153, 154, 155, 156, & 157.BR).

The basal ring is a completely sclerotised ring. It is broadest in the middle of its ventral half; and, later on, gets narrowed gradually until it reaches the dorsal half where the two ends of the structure appose to give it the shape of a ring. The inequality in the two regions has made the ventral half to come within the eighth sternum; while the dorsal half remaining in the ninth segment. In other words the dorsal half of the ring is posterodorsal in position (Figs. 149, 150, 153, 154, 155, 156, & 157.BRFs) compared to the ventral half (Figs. 149, 150, 153, 154, 155, 156, & 157.BRFv, BRAv) with the result that the fenestra of the basal ring, which brings the body cavity in communication with the phallic cavity, is facing doro-anteriorly (Figs. 149, 150, 153, 154, 155, & 156.BRFv). The anterior margin of the basal ring (Figs. 149, 150, 153, 154, 155, 156, & 157.BRAv) in its ventral half is comparatively more sclerotised and thick with a small, median process called "Genocondyle" (Figs. 149, 150, 153, 154, 155, 156, & 157.ge); while its whole posterior margin (Figs. 149, 151, 153, 154, 155, 156, & 157.BRFv) encircles from outside the basal part of the two parameral plates (Figs. 149, 154, 155, & 156.BRlp & VRlp). This condition makes the parameral plates lie within the basal ring having their basal rims in membraneous communication with its posterior margin (Figs. 149, 150, 154, 155, 156, & 157.Conj).
(b) Parameral plates (Figs. 149, 150, 151, 152, 153, & 157). There is a pair of parameral plates having their apical parts modified as parameres (Figs. 149, 150, 151, 152, 153, & 157). The parameral plates in conjunction with the parameres from the lateral boundary of the genitalia. Each parameral plate is laterally curved. It is broad in the proximal region and has an incomplete circular basal rim (Figs. 149, 154, 155, & 156. Drp1p and VDr1p) with the incomplete portion placed mesally. The dorsal tip (Figs. 149, 154, 155, & 156. Drp1p) of each basal rim (Figs. 149, 154, 155, & 156. Drp1p) is produced anteriorly to fuse with the same of the other. Thus a "V" shaped structure is formed which is similar to the "Sclerotised bridge" (Figs. 149, 154, 155, & 156. Drp1b) of certain hymenoptera (Vide Snodgrass 1941 p. 18.). This account given by Snodgrass does not seem to be his own because no where else in this paper has he described the sclerotised bridge as a connecting link between the two parameral plates.

The thin doro-mesal margins of the parameral plates start from the sclerotised bridge along parallel lines, and later on, diverge away and fuse with the corresponding parameres (Figs. 149, 154, 155, & 156. Drp1m). In this way a big space is created in between the diverging margins which is occupied by the median plate of the ascagus (Figs. 149, & 155. BplAd).

The ventral end (Figs. 149, 150, 151, 152, 153, & 157. VDr1p) of each basal rim (Figs. 149, 150, 151, 152, 153, & 157. VDr1p) slightly turns upwards to meet the corresponding end of the other side. From the point of union of these ends there starts the thick ventro-mesal margin of each parameral plate. The two such margins take up a divergent course and end ultimately with the correspon-
The parameres, borne distally on the parameral plates, are small finger-like structures with their walls continuous with the walls of the corresponding parameral plates (Figs. 149, 150, 154, 155, 156, & 157, Par). There is no suture between the parameres and the parameral plates. Proximally their lumina communicate with that of the parameral plates. The whole ventral surface is sparsely spinose.

(c) Volsellae (Figs. 150, & 156, Vol).

There is a pair of volsellae which are ventro-median in position. They lie horizontally between the ventro-mesal margins of the parameral plates (Figs. 150, & 156, 1pVmm). Each volsella has a more-or-less, rectangular plate called "Basi-volsella" (Figs. 150, & 156, Bv) and a pair of unequal distal lobes, viz. digitus and suspens (Figs. 150, 156, & 156, Dig and Gus). The proximal half of the outer (lateral) margin of the basivolsella runs very close to the corresponding part of the ventro-mesal margin of the parameral plate of its side; while its distal half is far off due to the divergence in the course of the latter as described above (Figs. 150, & 156, Lmbv). The space thus formed is traversed by a membrane which connects the margins mentioned above.

The outer basal angle i.e. antero-lateral of basivolsella is produced like a conical process, called "basal apodeme of volsella" inside the parameral plate (Figs. 150, & 156, Apv). The mesal margins of the two basivolsellae run parallel to one another (Figs. 150, & 156, Mmbv) and enclose in between them the proximal half of the median ventral septum of the aedeagus (Fig. 150, AedS).
The basivolsella is divided into a narrow lateral (Figs. 150,Lbv) and a broad mesal parts (Fig. 150,Nbv) due to the appearance of internal longitudinal ridge (Fig. 156,rv) running almost parallel to the lateral margin (Figs. 150,& 156,Lmbv). Proximally the ridge starts from the basal apodeme and distally it curves inwards to fuse with the mesal half of the distal margin (Figs. 150, & 156,dmbv). Externally it is represented by a longitudinal groove (Fig. 150,grv).

The outer angle at the distal end of the lateral plate is protruded out bluntly to form the small immovable cuspis (Figs. 150,& 156,Cus). The digitus on the other hand appears to be a free and separate structure (Figs. 150,156,& 158,dig). It is, more-or-less like a mandible in shape having its basal curve margin (Fig. 150,156,& 158,digm) connected by a membrane with the entire distal margin of the volsella (Fig. 150,Conjdig). The distal part of the digitus with its mesal and lateral margins (Figs. 150,156,& 158,dig Mm and dig Im) corresponding to the incisor surface of the mandible is bent outwards with three conical projections coming out from it (Figs. 150,& 158,digPrej).

Aedeagus (Figs. 142,150,151,152,153, & 157,Aed).

The aedeagus is the true intromittent part of genitalia as it contains the terminus of the ejaculatory duct. It has acquired mid-dorsal position among the components of the genitalia guarded laterally by parameral plates (Figs. 149,155,& 157,lp) and ventrally by the volsellae (Fig. 150,Vol). Its entire body is slightly convexed dorsally having a broad base and blunt narrow distal apex (Figs. 149,151A,152, & 155,Aeddt).

The aedeagus consists of an entire dorsal wall (Figs. 149,
157.
151A, 152, 153, 156, 157, Aedw) fused laterally with its ventral wall (Figs. 151, & 157, Aedw) which is split up into two equal sized lateral halves by a mid-longitudinal slit (Figs. 151B, & 157, AedL). The broad base of the dorsal wall is continued proximally (anterior) to form the median plate which is shaped as an equi-lateral triangle (Figs. 149, 151A, & 155, DplAed). The vertex (i.e. anterior angle of the median plate rests slightly posterior to the sclerotic bridge; while each of its sides lies close to the medio-dorsal margin of the corresponding parameral plate, having membranous connection with it.

The two mesal margins of the lateral halves of the ventral wall bend abruptly downwards inorder to form two vertical septa. These septa are broad and apposed to each other along three-fourth of their length proximally (Fig. 152, Aeds). Their remaining one-fourth distal parts are held apart and enclose a narrow space in between them which may be termed as "Phallosome" (Figs. 150, 151B, & 157, Patr). As the phallosome is located below the apex of the aedeagus hence it can be regarded sub-apical in position. It may be noted that the presence of vertical septa is a novel feature of Steno-bracoon deeseae; as neither Snodgrass (1943) in the honey-bee and other hymenoptera nor Dumean in wasp; nor James in Harmolita graminicola (chalcid) has described them. The latero-proximal angle of each half of the ventral wall is produced below the aedagal apodeme in the form of a process called "Ergot" (Figs. 149, 151, 152, 155, 157, & 159, a).

Latero-dorsally the aedeagus contains a pair of well-developed elongated sclerites called "Penissvalves" (Figs. 149, 151, 152, 155, 157, & 158, pv). Each penis-valve running close to the corresponding
lateral wall converges into the apex where it ends very close to the tip of the corresponding penis-valve. Proximally the penis valves are prolonged in a divergent manner in the form of a pair of rods called "Aedeagal apodemes" (Figs. 149, 151, 153, 155, 157, A 158, apv). The aedeagal apodemes, along their way, pass through the basal rims of the parameral plates of their sides and enter the basal ring where they lie close to its corresponding lateral walls. The penis valves and the aedeagal apodemes are respectively comparable with the aedeagus ribs (P.R) and aedeagus arms (P.A) of Harnolita graminicola described by James.

Maturaiure of the male genitalia:

Due to unavoidable cause the writer could not get the opportunity of going through the work of Boulange (1924). The writer had however the advantage of acquiring the latest work of Snodgrass on the male genitalia of hymenoptera (1941), which has proved invaluable in the present studies and have made up every disadvantage.

There are two groups of muscles to control the function of the genitalia. First group includes those muscles which move the genitalia as a whole and have no control over the movement of its individual parts. As these muscles have their origins outside the genitalia hence they may be termed as "Extrinsic" muscles. The second group contains muscles responsible for the independent movement of the individual parts of the genitalia. These muscles are confined within the genitalia in respect of their origin as well as insertion.

Extrinsic muscles of genitalia:

This group consists of two protractor and one retractor muscles of genitalia.
Outer protractors of genitalia (Fig. 163, No. 127).

There is a pair of outer protractor muscles. These originate from the ninth sternum close to the middle of its lateral walls and converge in antero-mesal direction to end on the corresponding sides of the gonocondyle of the basal ring. The protractors are thin muscles and on contraction pull the basal ring backward which subsequently pushes the genitalia out of the abdomen. A more or less similar muscle has been labelled as "G" by Peak (1937) in Megaphysa humator.

Inner protractors of genitalia (Fig. 163, No. 128).

There are two inner protractor muscles of genitalia arising from the postero-lateral areas of the ninth sternum. These converge in antero-mesal direction to end in the ventral face of the gonocondyle. These are named as "Inner" protractors because of being mesal to the "Outer" protractors in origin, insertion, and course of action.

Retractors of the genitalia (Fig. 163, No. 129).

The two retractor muscles of the genitalia arise from the antero-lateral angles of the ninth sternum. These run in dorso-posterior direction to end on the corresponding ventro-lateral walls of the basal ring. On contraction the retractors pull the basal ring towards the body i.e., in anterior direction which in its turn retracts the genitalia into the abdomen from its protracted position.

Snodgrass says "Boulange (1924) has shown that there are generally present three pairs of these muscles, two of which insert on the gonocondyle, and one on the ventro-lateral margins of the basal ring". Neither this quotation nor Snodgrass's own
description throws any light on the functional importance of these muscles which has been numbered by him as "1,2, and 3 in fig. 6" of his paper (1941).

Musculature of the paramera:

Each paramera being in continuation with its parameral plate is controlled by four unpaired muscles. Three of them are adductor muscles while fourth is an abductor muscle.

First adductor of paramera (Fig. 154, No.140).

The first adductor muscle arises from the anterior margin of the ventral half of the basal ring away from the gonoscodyle. Running in meso-dorsal direction it ends on the mesal tip of the ventral basal rim of the parameral plate. It has been shown as "K" and by Peck who has not described its function.

Second adductor of paramera (Fig. 154, No.141).

It also originates from the anterior margin of the ventral half of the basal ring slightly posterior to the first adductor muscle. The former adductor on running parallel to the latter ends slightly lateral to it on the ventral basal rim of the parameral plate.

Third adductor of paramera (Fig. 154, No.142).

The third adductor muscle starts from the middle of the anterior margin of ventral half of the basal ring and ends on the mesal tip of the dorsal basal rim of the parameral plate. It runs in a postero-dorsal direction and crosses all the parameral muscles dorsally. It may be considered as "G" of M.Ismator described by Peck who is silent on assigning function to this muscle.
Abductor of the parameral (Fig. 184, No. 143).

The abductor muscle originates from the anterior margin of the ventral half of the basal ring close to the ganocondyle. On its way, to end on the lateral part of the basal rim of the parameral plate, it passes below the regions of origin of all the three adductor muscles.

The adductor muscles on contraction pull the upper (dorsal) and lower (ventral) mesal parts of the basal rim in antero-lateral direction. This change in the level of the parameral plates acts on the parameres through dorso-mesal and ventro-mesal margins of the former; and consequently the latter (parameres) moves towards the acetabagus. Such a move if executed by the two parameres simultaneously brings a marked reduction in the width of the distal region of genitalia which is essential at the time of copulation. The abductor muscles of the two parameres, being antagonistic to the adductors, on contraction pull the lateral part of the basal rims of the parameral plates back to their original level from their posteriorly deviated position. This antero-mesally directed pull is transmitted to the parameres, through the lateral walls of the parameral plates, which, consequently, return to their normal position and thereby enable the distal region of the genitalia to regain its width.

Snodgrass (1941) has reported four pairs of intrinsic muscles as "No. 4, 5, 6, and 7; fig. 6A"; which had been described by Boulanje, to be of general occurrence in the hymenoptera. He has also, like Peck, not mentioned their function.
Musculature of the volcellae

Some of the volcellar muscles are responsible to move the volcella as a whole; while others control the movements of the digitus only. Each volcella is supplied with five unpaired muscles which are described below.

Protractor of the Volcellae (Figs. 150 & 156 No. 144).

The protractor muscle originates from the ventral wall of the paramere to end, by a definite tendon, on the basal apodeme of the volcella. It runs in antero-mesal direction and on its way receives few muscle fibres from the distal region of the parameral plate. On contraction the protractor muscle draws the volcella in a posterior direction; which ultimately pushes the digitus muscle to lie ahead of the distal apex of the ascengae. It resembles "O" of tenthardiidae described by Pack.

First Flexor of the Digitus (Figs. 156 & 158 No. 145).

The first flexor muscle originates from the whole lateral plate and the internal longitudinal ridge of the volcella. Its fibres pass over the suspis to form a small membranous tendon which gets inserted in the outer, i.e. lateral, basal angle of the digitus. On contraction the first flexor muscle pulls the lateral basal angle of the digitus in antero-mesal direction with the result that the distal part of the digitus projects out laterally. So far the origin is concerned the first flexor muscle may be compared with the "Intrinsic muscle of volcella" labelled as No. 21 by Snodgrass (1941) who has shown it to end either on the suspis or in between the suspis and the digitus. The function allotted to it by Snodgrass does contain the probability of flexing the digitus laterally. Therefore, the present writer is of
opinion that it would be wrong to regard these two muscles as
different from one another simple because of a difference in
their points of insertion.

Second flexor of the digitus (Figs. 156 & 158. No. 146).

The second flexor muscle originates from the nasal part of
the dorsal rim of the parameral plate. Its fibres running in a
posterior direction, lateral to the saccagial apodeme and dorsal
to the first flexor muscle of its side, converge in order to form
a small membranous tendon which ends at the lateral basal angle
of the digitus slightly outer to the first flexor. Functionally
it may be regarded as a sister muscle of the first flexor of the
digitus. Snodgrass does not mention any muscle comparable with
the second flexor. It means, therefore, that Boulange, has also
failed to describe it. It should not be confused with muscle"F"
of Peck shown in Megarhysa. Hence the present writer considers
himself justified in regarding the second flexor muscle as an
undescribed muscle of the male genitalia of hymenoptera.

First extensor of the digitus (Figs. 156 & 158. No. 147).

The first extensor muscle of the digitus arises from the
inner plate of the volsella. Running in posterior direction its
fibres converge to form a small membranous tendon which ends in
the meso-basal angle of the digitus. On contraction the first
extensor pulls the nasal basal part of the digitus towards the
volsella which makes its laterobasal part to move away; and
ultimately the digitus gets straightened. This muscle corresponds
to the "Volsellar extensor of the digitus" described by Snodgrass
(1941).
Second Extensor of the Digitus (Fig. 155. No. 148).

The fibres of the second extensor muscle arise from the anterior half of the aedegal apodeme wrapping it from all sides. The fibres, running dorsally to the 1st extensor muscle and in ventro-posterior direction converge to form a membranous tendon which gets inserted in the meso-basal angle of the digitus slightly mesal to the 1st extensor. The direction of the course of this muscle suggests that on contraction the digitus is not only straightened. Its meso-basal part is pulled over the distal margin of the volsella with the result that a partial rotatory movement is also performed by the digitus. This muscle may be compared with muscle "N" of Peck shown in Chalastogaster.

Musculature of the aedegus:

There are six pairs of muscles to control the movements of the aedegus. These arise from different parts of the genitalia as shown below. Snodgrass has reproduced Boulange's account of the aedegal muscles; but he has not named them on the basis of their functions. The present writer has made an attempt to find out the function of these six pairs of muscles with a view to provide a ground for future hymenopterists to explore thoroughly their functional importance.

First Protractor of Aedegus (Fig. 155. No. 149).

The first protractor muscles are the stoutest muscles amongst all the muscles of the genitalia. These arise from the meso-basal area of the dorsal walls of parameral plates. Running in ventro-lateral direction their fibres converge inorder to end on the lateral or outer free ends of the corresponding aedegal apodemes backward with the result that the body of the aedegus
apodemes. On contraction the first protractors pull the aedeagal
apodemes backward with the result that the body of the aedeagus
comes to lie ahead of all the other components of the genitalia.
It is more-or-less similar to muscle "H" of Peck in Megarhyssa.
A muscle with this course cannot be attributed with the function
of simply raising the aedeagus as suggested by Peck.

Second Protractors of Aedeagus (Figs. 155, No. 150).

The second protractor muscles of the aedeagus derive their
origin from the meso-basal part of the ventral walls of the
parameral plates. After traversing in antero-lateral direction
their fibres converge inorder to end on mesoventral face of the
tips or free end of the corresponding aedeagal apodemes. The
second protractors help the first protractors of the aedeagus in
protruding the distal part of the aedeagus ahead of the remaining
parts of the genitalia. As these muscles originate from two
levels which are opposed to each other hence the aedeagus is not
influenced by any of them to change its level while it is being
protruded out.

First retractors of aedeagus (Fig. 157, No. 151).

The first retractor muscles of the aedeagus start from the
meso basal part of the ventral walls of the parameral plates
posterior to the origin of the corresponding second protractor
muscles of the aedeagus. The fibres of each first retractor
converge in a posterior direction to end on the ergot of its
side. These muscles on contraction bring the aedeagus from
extended position back to its natural position. It is similar to
muscle "No. 9" of Snodgrass (1941) and to "No. F", described in N.
Limator by Peck, in function.
Second Retractor of the Aedeagus (Fig. 157, No. 152).

These muscles originate from the ventral walls of the parameral plates slightly medial to the corresponding first retractor muscles of the aedeagus. The second retractors running on a posteriorly directed course and in between the first retractors of the aedeagus, and on the anterior i.e. proximal margins of the corresponding halves of the aedeagal ventral wall. This pair of muscles helps the first retractor muscles of the aedeagus.

Adductors of the aedeagal apodemes (Fig. 151A, No. 153).

The adductor muscles of the aedeagal apodemes arise from the proximal part of the sides of the aedeagal median plate. These, running in antero-lateral direction, are inserted on the meso-dorsal face of the corresponding aedeagal apodemes. The adductor muscles on contraction bend the aedeagal apodemes towards one another thereby reducing the distance between them. This reduction in the inter-apodeme space enables the apodemes to pass freely through the basal rims of the parameral plates.

Abductors of the aedeagal apodemes (Figs. 157, No. 154).

The abductor muscles of the aedeagal apodemes start from the ventral wall of the parameral plates lateral to the corresponding first retractors of the aedeagus. Each abductor of the aedeagal apodeme, running in meso-posterior direction, passes over the region of insertion of the first retractor of its side obliquely and ends on the corresponding aedeagal apodeme close to the argot. On contraction these muscles pull the aedeagal apodemes away from each other in order to counteract the effect of the abductors of the aedeagal apodemes. Besides, the secondary function of the abductor muscles may be to help the retractor muscles of
the aedeagus. Thus the aedeagal apodemae are restored back to their normal position, a condition in which these cannot pass through the basal rim of the parameral plates.

**Nutting of the male genitalia:**

The male brings the distal part of his abdomen, with its end turned in anterior direction, below that of the female. When the copulatory organ is about to enter the vestibulum it's extrinsic protractor muscles of the basal ring become active with the result that it is produced out to its entire capacity. This, simultaneously, is followed by contraction in the adductor muscles of the parameres which makes the distal region of the genitalia most tapering. Probably at this stage the genitalia traverse the vestibulum unhindered to reach at the female gonopore.

Now the adductor muscles of the parameres relax, and its abductor muscles undergo contraction. This brings an end to the unusual tapering condition of the distal portion of the genitalia and the parameres clasp the vestibular membrane.

Meanwhile the protractors of the volsellae and the extensors of the two digitus become active with the result that the two digitus, with their free distal ends straightened, enter into the gonopore. Immediately after their entry the flexors of the digitus become active. These, being supported by the relaxation in the extensors of the digitus, bend the incisor surface of the digitus which arrest by their conical projections the 2 rami of the first pair of valvulae.

When the male parasite has attained full hold on its partner, the protractors of the aedeagus and the adductors of the aedeagal apodemae undergo simultaneous contraction. This contraction pushes
the aedeagus ahead of the remaining parts of the genitalia with
the result that its distal apex with the phallosome enters
into the gonopore.

At the end of copulation the withdrawal of the male genita-
ilai is affected in the following manner.

First of all the retractors of the aedeagus become active
and withdraw the aedeagus with the help of relaxation shown by
the protractors of the aedeagus. This is followed by relaxation
in the flexors of the digitus and contraction in its extensors
with the result that the digitus lose their grip; and the
volsellae are taken out due to relaxation in the protractors of
the volsellae. Now the abductors of the parameres and the retrac-
tors of the basal ring undergo simultaneous contraction and are
assisted by relaxation in the abductors of the parameres and the
protractors of the basal ring to withdraw the genitalia back to
its normal position. Lastly the abductors of the aedeagal
apodemes which were so far unusually extended under the pressure
of the adductors of the aedeagal apodemes contract back to their
normal form; and consequently the normal condition is restored
to the aedeagal apodemes.
Cephalic stomodeum and its musculatures:

The part of the foregut lying within the head capsule is appropriately called "cephalic stomodeum" by Duncan. This part of the stomodeum can easily be split up into two well-defined regions on the basis of their position, structure and function. These are: (i) Pharynx and, (ii) Preoral vestibulum.

Pharynx:

The foregut anterior to foramen magnum is the "Pharynx" which rises upwards and passes below the brain up to the bases of the antennae. This part of the stomodeum may be called "Posterior pharynx", which is almost equal to the esophagus in diameter (Figs. 27, 29, 30, & 31.PPhy). Onward from below the bases of the antennae the stomodeum curves down running almost parallel to the dorsal wall of the head capsule, up to the middle of the labium and may be called "Anterior pharynx" (Figs. 27, & 28. APhy). It is therefore evident that the stomodeum in the head region has acquired the shape of a more or less imbedded "V".

The "anterior pharynx" is broader than the "posterior pharynx", and is provided with a pair of lateral pouches at its posterior end called the "Pharyngeal diverticula" (Figs. 29, 30, & 31.PPhDi). The dorsal and ventral walls of each diverticulum is membranous while its lateral wall is distinctly sclerotised.

The dorsal (upper) wall of the anterior pharynx is throughout membranous in order to respond in accordance with the contraction and relaxation of the various muscles inserted upon it. Thus an increase in the volume of the anterior pharynx is mainly due to the membranous nature of the latter. Anteriorly
the dorsal wall is fused with the posterior end of ventral wall of the epipharynx (Figs. 27 & 28, MPhy).

The ventral wall of the anterior pharynx is a sclerotized plate throughout with the exception of its anterior and posterior ends where it is membranous in nature. This large sclerotized region may be called, "Pharyngeal plate" comparable with the small "oral plate" of honey-bee described by Snodgrass (Figs. 27, 30, & 31, Phyl). The lateral margins of the pharyngeal plate extend posteriorly into a pair of small processes called "posterior pharyngeal arms" which are fused with the corresponding lateral walls of the pharyngeal diverticula (Figs. 30 & 31, PhPa). A pair of similar processes is borne in the anterior region as well by the pharyngeal plate. These run over the anterior membranous part of the ventral wall to a little distance and are called "Anterior pharyngeal arms" (Figs. 30 & 31, PhAa). The pharyngeal plate and its four arms hold together the whole of the ventral wall of the anterior pharynx in its position. This arrangement gives support to the pull of the muscles on the dorsal wall (upper) to bring maximum increase in the volume (space) of the entire anterior pharynx.

Pre-oral food channel:

The anterior membranous part of the ventral wall is fused with the posterior margin of the roof of the hypopharynx. This fusion ends in a continuous membranous sheet called floor of the preoral food channel extending from the anterior pharyngeal arms upto the base of the lingua (Figs. 27, 30, & 31, WC). The floor is dorsally roofed over by the ventral wall of the epipharynx and the space thus enclosed between them, with mandibles on the
corresponding sides, is called the "Pre-oral feed channel" (Fig. 27.FC). The convergent course of the roof and the floor, in ventro-posterior and dorso-posterior directions respectively, to meet the corresponding walls of the anterior pharynx, reduces the space of the channel. The reduction ultimately leaves the channel in its posterior most region in the form of a transverse slit. This slit is the "true mouth" which establishes communication between the pharynx and the pre-oral feed channel (Fig. 27.Nth).

Musculature of the Pharynx:

Clypeal dilators of the anterior pharynx (Figs. 27, & 28, No. 30).

It is a pair of short stout muscles originating from the clypeus. These end on the dorsal surface of the anterior pharynx. They are without any tendon and face each other lying in front of the frontal ganglion. This pair of muscles may correspond to one of the 5 pairs (26-30) in honey-bee described by Snodgrass and also to "d l b c" of wasp described by Duncan.

First frontal dilators of the anterior pharynx (Figs. 27, 428, No. 31).

These are two in number, originating from the frons behind the episternal suture. Their insertions on the anterior pharynx are exactly as mentioned in the case of the clypeal dilators but on either side of the recurrent nerve. It may resemble "First dorsal dilators of pharynx" in Gryllus described by Walker.

Second frontal dilators of the anterior pharynx (Figs. 27, 428, No. 32).

There are two such muscles originating from the middle region of the frons. These are similar to the first frontal dilators in all respects with insertions placed behind the latter. These two pairs of the frontal dilators have not been mentioned both by Duncan and Snodgrass in wasp and honey-bee
respectively. It may be compared with the "Second dorsal dilators of the pharynx" in Gryllus described by Walker.

**Third frontal dilators of the anterior pharynx (Figs. 37, 42b, No. 33)**

This pair of muscles originates from the upper half (proximal half) of the frons. Their bases of origin unlike the other frontal dilators of the anterior pharynx are in line one after the other. Similarly they are inserted in line on the dorsal wall of the anterior pharynx close to the diverticula. This pair resembles very much "No. 34" of honey-bee described by Snedgrass. Duncan has again mentioned no similar muscles in the wasp.

**Tentorial dilators of the pharyngeal diverticula (Figs. 27, 32, & 31, No. 34)**

There are two tentorial dilator muscles. Each of the two originates from the anterior end of the anterior tentorial arm of its side. After running in a meso-posterior direction it ends on the lateral chitinized wall of the pharyngeal diverticulum of its side. A similar pair of muscles "Lateral pharyngeal muscles" has been described by Duncan in wasp; but his account of their insertions makes them secondary dilators of the diverticulum.

The present writer thinks that a revision of Duncan's work may show these muscles with their points of insertion of the diverticula to act as principle dilators of the diverticula.

**Frontal dilators of the pharyngeal diverticula (Figs. 27, 39, 431.)**

There are two such muscles originating from the frons between the two antennal sockets. Each running in a meso-anterior direction ends on the chitinized wall of the corresponding pharyngeal diverticulum posterior to the insertion of the tentorial dilator. The frontal dilators of the anterior pharynx of the wasp described by Duncan may be similar to this pair of
muscles provided they are inserted on the diverticula. Here again the present writer suggests Duncan to revise and find out the true points of insertion of these muscles which should belong to the diverticula rather than to the anterior pharynx.

**First Ventral dilators of the anterior pharynx (Fig. 31, No. 36).**

It is a pair of muscles arising laterally from the tentorial bridge. These running parallel to one another in an antero-dorsal direction end on the posterior arms of the pharyngeal plate of their sides.

**Second ventral dilator of the anterior pharynx (Fig. 31, No. 37).**

It is an unpaired muscle originating from the dorsal tip of the tentorial bridge in the form of a slender tendon. The fibres running parallel and in between the 1st ventral dilators end on the ventral surface of the anterior pharynx close to the pharyngeal diverticula.

**Occipital dilators of the posterior pharynx (Fig. 37, No. 38).**

This is a pair of small muscles originating from the occipital region. Each is inserted on the posterior pharynx slightly anterior to the occipital ganglion.

**Frontal dilators of the posterior pharynx (Figs. 37, 229, No. 39).**

There are two such muscles arising from the proximal half of the frons behind the 3rd frontal dilators of the anterior pharynx. They are inserted on the dorsal wall of the posterior pharynx close to the diverticula. These muscles are similar to the 3rd frontal dilators of the anterior pharynx in all respects.

**Note of Dissection.**

Steno-bracon deceae subsists on liquid food. The process of the intake of the food is totally dependent upon the dilator muscles of the pharynx.
As this insect reaches the food the dilator muscles of the pre-oral food channel and the levator muscles of the labrum contract to open the channel. It is immediately followed by the contraction of all the dilator muscles of the anterior pharynx assisted by the contraction in the dilator muscles of the pharyngeal diverticula. The pharyngeal plate being kept in its position the contraction in these muscles brings enormous increase in the space of the anterior pharynx. This condition turns the latter into a suction pump which gets filled with the upward flow of the food. Now a wave of relaxation in these muscles, starting from the levators of the labrum and ending with the unpaired second ventral dilator of anterior pharynx, is set up. Consequently an antero-posterior contraction of the anterior pharynx comes into play to push the food up. This condition is synchronized with contraction in the frontal dilators of the posterior pharynx which expands the posterior pharynx and the food is poured into it. Hence the food flows down into the esophagus due to the contraction of the occipital dilators of the posterior pharynx which makes a broad passage for its flow. In order to check back-word flow of the food a relaxation in the frontal dilators of the posterior pharynx follows the contraction of its occipital dilators. This, besides reducing the anterior passage, exerts a downward directed pressure as well in order to push the food into the esophagus. A repetition of this process many times renders the insect in a position to quench the hunger to its entire satisfaction.
Oesophagus (Fig. 109.0c)

The cephalic portion of the digestive system has been described above. It is followed by the oesophagus which is a straight narrow tube of uniform cross-section extending from the foreman magnum to the anterior region of the true 2nd abdominal segment (Fig. 169. cc). On its way to the abdomen it passes through the prothoracic and pterothoracic neural foramina and the posterior notch of the mesosternum.

The oesophageal epithelium (Fig. 170A.Epth) being thrown into folds forms villi hanging into the lumen (Fig. 170A.EpthF). It consists of closely lying cubical cells which have small but distinct nuclei. The nuclei contain few chromatin granules and have no definite plan of arrangement i.e. some are in the centre others in the top while still others in the base of the cells (Fig. 170A. En). The cytoplasmic part of the cells is also not free from granulation (Fig. 170A.eM). The cell walls and the basement membrane (Fig.170A.BM), though present, are inconspicuous.

Internally the epithelium is covered over by a distinct chitinous "Intima" which separates it from the lumen (Fig.170A. In). Both circular and longitudinal muscle layers are present (Fig. 170A.CLs & LMs). The former is stouter and placed external to the latter.

The villi get larger and larger in size as they proceed from anterior to the posterior regions of oesophagus. This causes gradual reduction in the lumen which is the least wide in the part of oesophagus which joins the crop. Besides, villi of
the oesophagus near its junction with the crop meet by their free tips in the cavity of the crop with the result that the oesophageal lumen is partly blocked from being in direct continuation with the crop. This condition certainly does not allow any return flow of food material into the oesophagus from the crop where it is stored up for a longer period. On the other hand being non-muscular in nature, it cannot stop food entering the crop under the pressure of the oesophageal circular muscles and few pharyngeal muscles.

Crop (Fig. 169, 171. Cr).

The crop is the highly dilated sacklike part of the digestive tract lying from 2nd to the 6th abdominal segments (Fig. 169.Cr). When empty it collapses to a small pouch with wrinkles over it. These wrinkles have no bearing whatsoever on the internal epithelial foldings.

Histologically the crop falls in line with the oesophagus, of course with few differences. Firstly the intima is broader (Fig. 170A.In). Secondly there are indefinite epithelial folds of smaller size with nuclei considerably bigger (Fig. 170B.Na). Lastly the basement membrane is slightly conspicuous (Fig. 170B BN).

In a fully distended crop the epithelium (Fig. 170B.Ep.th) becomes almost uniform with intima-like a layer over it.

Preventriculus (Fig.169.Pvent).

The preventriculus is the last part of the stomodæum and has the form of a small tube connecting crop with the midgut (Fig. 169.Pvent). It's anterior end is invaginated in the lumen of the crop and has developed three medially directed conical
lips at its apex which combinely control the communication of proventricular lumen with that of the crop (Figs. 171, 172B, pvent1). The posterior part of the proventriculus hangs as a narrow tube into the lumen of the ventriculus and may be considered as "stomodaeal valve"; while its middle free region is the true proventriculus (Fig. 173. Sv1v).

The lumen of the highly muscular proventriculus is narrowed in antero-posterior direction (Fig. 172B, 173.Lum). There are three well-developed longitudinal internal ridges starting from the bases of the corresponding conical lips and ending in the region of the formation of stomodaeal valve.

Each ridge is internally covered over by a thick chitinous plate (Figs. 172A, 173.Inpl). Each plate anteriorly extends on the under surface (ventral) of the corresponding lip which is beset with long hairs directed backwards (Figs. 171, 172B, h). In the lower part of the mid-proventriculus it is thrown into several mesally directed small folds; (Fig. 173. Inf) while in the oesophageal valve it is reduced to a thin intima (Fig. 172B, In).

Next to each plate runs the epithelium of rectangular cells similar to crop's epithelium (Figs. 172, 173.PEpth) which joins it on the lips. According to Beal, 1927 in the anterior part of the proventriculus in adult Pityogena (Coleoptera) the epithelial layer is represented by few epithelial cells or sometimes they are wanting. Such a state of things is wanting in Stenobracon deeseae. In the oesophageal valve (Fig. 173. Sv1v) the epithelium (Fig. 173.PEpth) is comparatively more distinct; and is outwardly covered over by the extension of the first epithe-
lial fold of the ventriculus (Fig. 173. VIIth). It may be noted that Avati (1939) in thrips has regarded the outer cellular covering of the oesophageal valve as mere extension of the crop's epithelium which in Stenobrason does definitely does not go beyond the formation of internal epithelium of the oesophageal valve.

After the epithelium comes a stout layer of longitudinal muscles (Figs. 172, 173. SLm1). It extends from the outer surface of the lips to the lower part of mid-proventriculus. Next to it and occupying almost the same regions is a strong circular muscle layer (Figs. 172, 173. SCM1). These two muscles having no counterparts in the other regions of the digestive tract may be called "Special muscles". The usual stomodal circular muscle layer is absent; while the stomodal longitudinal muscle passes as outermost layer over the whole length of the proventriculus leaving its parts placed in the crops and the oesophageal valve (Figs. 172, 173. Lm1).

Function of the proventriculus-

When the crop is full the special longitudinal muscles contract to open the gate of the proventriculus by raising the lips (Fig. 171. Premtg). This raised condition of the lips brings hairs present on their under surface in direct contact with the food. Snodgrass is mistaken in holding circular muscles responsible for raising the lips, and longitudinal ones for closing them for the simple reason that any downward pull on the outer region of the base of a lip will undoubtedly move its free tip upwards. The function of the hairs at the anterior end of the proventriculus is a subject of controversy. Snodgrass in
honey-bee regards them to serve as pollen grain Catches which subsequently transfer the pollen grain to the ventriculus. It appears to the writer that the fluid part of the food obtained by Steno-brason deceae is separated from the particles which are later on transferred to the lumen of the proventriculus by the contraction and relaxation of the longitudinal muscles of the lips.

On entering proventricular lumen the food particles are subject to contraction of the special circular muscles in an antero-posterior direction. This action, besides, helping food to descend, enables the three broad plates of the three ridges to crush the coarser part of the food. By now the food is made to reach the lower part of the mid-proventriculus where the plates are thrown into numerous folds. This region probably carries on filtering as well as partial crushing of the food particles which, later on, under the pressure of the special circular muscles are forced through the oesophageal valve into the ventriculus. Snodgrass in honey-bee and Green in wasp do not deal with this aspect of proventriculus. James in Harnolita graminicola has described proventriculus simply as a pump with a possibility to work as a strainer.

This elaborate structure of the proventriculus including the lips and the stomodaeal valve leaves no room to support the view that ventriculus exercises regurgitation.

Ventriculus (Fig. 169, Vent).

The ventriculus is a creamy coloured cylindrical tube of uniform cross-section stretched from the 6th to the 8th segment.
Externally it is wrinkled by numerous transverse constrictions which have no bearing on the internal epithelial folds.

The ventriculus is externally covered over by a longitudinal muscle layer which is in continuation with the longitudinal muscle of the crop over the proventriculus (Figs. 174, 175.ILa1). Next to it comes the circular muscle layer which is comparatively broad and strong (Figs. 174, 175.CMa1).

The epithelium (Figs. 173, 174, 175.VEpth) is thrown into numerous longitudinal folds or villi. The finely granulated epithelial cells are tall and columnar in shape resting on a distinct basement membrane (Figs. 173, 174 175.BM). The nuclei of the epithelial cells are big oval shaped bodies arranged in line in the basal halves of the cells; and contain a large number of chromatin granules in each (Figs. 173, 174, 175.Ba).

The internal wall of the cell is conspicuously broad and highly sensitive to stains (Figs. 173, 174, 175.1). It can be compared to (c.fig.69B) of Snodgrass in honey-bee. This wall of the cell had been regarded as striated by Green in wasp who did not show any other layer or border internal to it. The present writer finds a fine broad continuous membrane lining the lumen along the internal walls of the cells. It has fine striations perpendicular to the cells (Figs. 173, 174.3). A similar layer has been described as "galatimus layer" by Snodgrass (d.fig.69B) in honey bee who considered striations as elongate vacuoles. Hertig regards striations as fine hairs.
Peritrophic membranes

The internal striated band (Figs. 173, 175, 5) laden with digestive enzymes (Fig. 174B, g) falls down into the lumen. It envelopes the food contents and becomes transformed under certain chemical actions into a thin conspicuous sheet called "Peritrophic membranes" (Fig. 175, Pwb). So far as it remains attached to the cells it is thick and opaque and gives little indication of its peculiarities viz. chitinous texture, uniform and smooth surface, brilliance and transparency.

Cells of the first epithelial folds at the base of the stomodaeal valve, beyond any doubt, are most active in the formation of the peritrophic membrane. But it would be incorrect to regard them in absolute charge of this function as suggested by Swingle 1927 in humble-bee (Bombus). (Vide Wigglesworth's paper "The formation of peritrophic membrane in insects with special reference to the larva of mosquitoes, Q.J.M.S. 1920"). The peritrophic membrane rolling down from the first fold of the mid-gut is never found to shelter the whole length of the epithelium. It is always joined and supplemented by several pieces of such membranes secreted by the epithelial cells throughout the whole length of the ventriculus. In other words it may be suggested that the cells near the oesophageal valve have got upper hand in the formation of the peritrophic membrane while the remaining cells contribute normally to it.

Reparative cells (Figs. 174, 175, rg).

The epithelial regeneration in the ventriculus is most conspicuous. It is performed by multinucleated cytoplasmic masses scattered under no definite plan at the bases of the
tall columnar cells. These are called "Nidi" or regenerative cells (Figs. 174, 175, rg). It is wrong to suppose that irregularity in the distribution of nidi is so great that sometimes these lie contiguous to one another as shown by Pradhan in Enallagma indica. Variations in shape and size of nidi are very common. Some are saucer-shaped while others dome-like.

Each nodus is separated from the circular muscle by a definite membranous wall of its own. Internally the nodal wall is merged into the portion of basement membrane which supports the columnar cells immediately internal to it. The finely granulated cytoplasmic content of the nodus is too little in quantity as compared to its nucleated mass. The number of nuclei in the latter varies from 2 to 5 in number. Green had shown nidi as mono-nucleated and almost similar to the columnar cells. Besides, the nidi are arranged in groups of 2 to 3 and lie adjacent to the columnar cells. The present writer finds his observations amazingly differing from Green's account. On being thoroughly satisfied with his own observations the present writer is of opinion that Green has failed to find the true regenerative cells and has mistakenly taken up ordinary columnar cells for them. Both Snodgrass in honey bee and James in Harmolita graminicolor are silent on this point.

Meias of secretion in ventriculus:—

The contents of the epithelial cells enter the lumen in the following ways:—

1. Discharge of free non-nucleated globules: The epithelial cells become markedly elongate and their nuclei follow the
same course. At the narrow pointed tips bulgings appear with cellular contents within them (probably digestive enzymes). These swellings are constricted off as circular non-nucleated globules; and their places are taken up by similar other swellings. This process is repeated for several times with the result that a large number of globules are accumulated in the striated layer which ultimately falls into the lumen under heavy pressure of accumulation (Fig. 1743.g). This is the true mesocrine mode of secretion.

2. Holocrine mode of secretion: It takes place in two ways:

(i) Squashing out of epithelial cells: This process does not require elongation of the cells. The broad inner margin of the cells behind the striated layer suddenly bursts and the contents including nuclei slowly stream out into the lumen along with the striated layer. The regenerative cells develop new epithelial cells, to replace the exhausted ones. This method has been given no mention by Snodgrass in honey-bee.

(ii) Delamination of portions of epithelium: (Fig. 1744).

It has been observed that occasionally epithelial cells in small batches along with the corresponding portions of the basement membrane fall down into the lumen. These sloughed off epithelial portions never take along with them the nidi (Fig. 1744.rg) which remain unaffected in their places and, later on, regenerate new columnar cells which take up the position of the delaminated epithelial regions.

At the junction of midgut with the hindgut the epithelial folds of the former project into the lumen of the latter. In
other views the epithelium of the midgut gets telescoped into the lumen of the small intestine as a short tube to function as an entrance for the latter and may be regarded as "pyloric valve". The upper (inner) face of the pyloric valve consists of midgut's epithelial cells while the lower (outer) face is made up of hindgut epithelium. Hence it may be noted that both midgut and the proctodaeum equally share the formation of the pyloric valve. No muscular specialities are developed external to the pyloric valve. Sandfors, Green and James said had given no histological account of it. Pradhan regarded midgut epithelium totally responsible for its formation. He further said that the nature of epithelium near the base of the valve before falling in continuation with the intestinal epithelium had acquired a few characteristic features of the latter. This shows that even he doubted the purity of the valve which according to him should be meet with midgut epithelial cells.

Small intestine-

The intestine (Fig. 169.Int) as a narrow uniform tube with about three convolutions. It is smaller as well as narrower than the midgut and has developed longitudinal folds of varying depth; Histologically it can be split up into (i) anterior and (ii) posterior halves.

The anterior half just behind the pyloric valve receives the malpighian tubules (Fig. 169.Mal). The epithelial cells (Fig. 176A.Epith) are cubical with a small nucleus embedded in the proximal half of each. The nucleus (Fig. 176A.Nu) as compared to the cytoplasm has inconspicuous granulations. In the distal
region of each cell a small vacuole is invariably present (Fig. 176A.v). Cellular demarcations are faint, and a distinct basement membrane is present (Fig. 176A.BM). Internally the epithelium is covered over by a thin intima (Fig. 176A.In). As the folds (Fig. 176A.Ep.th) are smaller hence the lumen is spacious (Fig. 176A.Lum). The two muscular layers i.e. circular (Fig. 176A.CMol) and longitudinal are present (Fig. 176A.LMol) one after the other outside the epithelial layer. The circular layer is internal to the longitudinal one. Besides it is unusually stout.

In the posterior half the intima is broader. The villi are long and deep with the result that the lumen is markedly reduced. The epithelial cells are smaller in size. Besides, the longitudinal muscles are weaker.

The presence of vacuoles and the non-glandular nature of the epithelium lead the writer to regard the small intestine as partially absorptive. James had attributed secretory function to the small intestine but his account is not sufficient to regard intestinal epithelium of secretory nature. Snodgrass Green and Pradhan do not make any mention on this point.

Rectum (Fig. 169.Rect).

The rectum is an elongated sack with a considerable power of extension in its walls. Its anterior three-fourth region is expanded and receives the small intestine. Posteriorly it tappers out into a narrow tube to open into the anal vestibulum.

Externally the rectum possesses weak longitudinal muscle layer (Fig. 177.LMol) which is internally followed by a strong
layer of circular fibres (Fig. 177, CML1). Next to the circular muscles comes the epithelium (Fig. 177, EptH1) which is thrown into innumerable small folds in between the rectal pads (Fig. 177, EptH1). It consists of thinly granulated cytoplasm (Fig. 177, ga) with no trace of cell walls. The nuclei are scattered in the cytoplasm (Fig. 177, NuH1). These are circular with few chromatin granules in each. Internally the epithelium is covered over by a thin intima (Fig. 177, In). In the rectal pad region (Fig. 169, NestPd) the syncytial epithelium (Fig. 177, EptH1) becomes a little concave facing towards the rectal lumen with a distinct basement membrane (Fig. 177, BM1) inner to the circular muscle layer (Fig. 177, CML1). At intervals the appearance of tracheal branches separate the basement membrane from the muscle layer (Fig. 177, Fra).

There are four oval shaped rectal pads arranged longitudinally at almost equidistance in the anterior half of the rectum. Each pad consists of a layer of columnar cells resting on the concave face of the syncytial epithelium (Fig. 177, EptH1). The oval shaped nuclei with distinct chromatinic granules have no common plan of distribution in the cells (Fig. 177, NuP).

Smudgrass in honey bee found two definite layers of small distinct cells instead of concave epithelial extension in the pad region as shown by the present writer whose view are supported by Green in Vespa Vulgaris with the only difference that the extension there is in the form of a raised surface. The scattered nature of the nuclei in syncytial epithelium, "prima facie"; makes one to consider the presence of definite cells. But on closer observations it would be revealed that the cell:
walls are definitely lacking; and the nuclei are not arranged in a manner which is consistent with the presence of two or more layers of cells.

The lateral columnar cells of a pad stretch out in the form of a thin cytoplasmic membrane with indistinct nuclei (Fig 177.CeP). This cytoplasmic extension arches over the same pad and ends on its other end. Thus a big longitudinal space "Lumen of the pad" is arrested in between the sheet and the columnar cells (Fig. 177.Lm). The extension of the rectal intima in the pad region runs over and in close association with the cytoplasmic sheet instead of being placed in touch and immediately internal to the columnar cells (Fig. 177.In).

The present writer regards rectal pads as absorptive regions of rectum. These pads absorb watery contents from faecal matters; and diffuse them into their lumina. From the lumen of the pad water reaches the columnar cells which pass it onwards.

**Salivary glands**: (Figs. 178,179).

There is a pair of small bunch like cream coloured salivary glands situated in the ventro-lateral regions of the mesopharyngeal anterior half. Each gland consists of four glandular tubes (Fig. 179.Salt) which bear innumerable ampulla-like stumpy glandular bodies (Fig. 179.Amp). The lumina of the ampullae (Fig. 179.LmnAmp) have independent and direct communication with the lumen of the tube which bears them (Fig. 179.LmnSalt). The four tubes of each gland unite by their anterior uncovered parts to form a broad and long tube called "Salivary duct" (Fig. 179.SalD).
The two salivary ducts traversed the prothorax. They maintain their separate identity and enter into the foregut as two convergent tubes. Afterwards, just while passing below the posterior tentorial bridge, they unite to form the common salivary duct (Figs. 23, 179, SalEx). The common salivary duct runs above the whole length of the fused medial part of the posterior tentorial arms till the articulatory region of the cardines is reached. Here it descends along and in between the cardines; and later on, crosses the labium in a postero-anterior direction in order to enter into the hypopharynx (Fig. 179,Ephy). On reaching the hypopharynx it expands to form the salivary pump (Fig. 23, SalPum) which opens in between the two anterior lingual plates (Figs. 23, 179, or).

The epithelium of the salivary gland consists of big flat cubical cells which are rich in granulation (Fig. 178A&B,ga). The nuclei are big and circular with several granules in each (Fig. 178A&B,nu). Externally the epithelium is guarded by a non-nucleated, thin, cytoplasmic layer (Fig. 178A&B,0) while internally it is separated from the narrow circular lumen (Fig. 178A&B,Lum) by a thin chitinous intima (Fig. 178A&B,In).

The epithelium of the salivary duct is composed of small cubical cells with poor granulation in the cytoplasm (Fig. 178C,ga). The nuclei (Fig. 178C,nu) are likewise smaller with indistinct granulation. The internal intima (Fig. 178C,In) and the outer covering (Fig. 178C,0) are mere extensions of the corresponding similar layers present in the gland region. There is no trace of muscles either on the gland region or on the duct.
The malpighian tubules are the chief excretory organs. These are numerous thread like convoluted tubes coiled around one another and about the internal viscera found in the posterior half of the body cavity. These are almost of uniform cross section with their free ends closed. Each of them becomes comparatively narrower towards its proximal end and opens separately into the small intestine very near the pyloric valve.

The epithelium of the malpighian tubule is composed of columnar cells (Fig. 1763.Epth) containing thinly granulated cytoplasm (Fig. 1763.Eu). The nuclei are big with few distinct granules in each (Fig. 1763.Eu); and are arranged centrally in the cells. Externally the epithelial cells rest on a distinct basement membrane (Fig. 1763.BM). Internally each cell has a clear conical striated border (Fig. 1763.3) consisting of rod like convergent structures with the vertex directed into the lumen (Fig. 1763.Lum). The striated borders of all the cells are in continuation with one another at their bases; while their pointed spicules are free. This peculiar type of striaion has reduced the lumen markedly. Marshall in his paper "The malpighian tubules of the larva of Heptagenia interpunctata, say" has not shown the presence of striated layer. Further more he has tried to strengthen his observation of quoting Bannough and Holmgren who have also failed to show striated layer in adult chrysops and Apian respectively. The present writer has not found, so far, any internal cuticular intima as suggested by Snodgrass.

There is no distinct muscular layer; but the basement membrane appears to be followed externally by few scattered
weak muscle fibres those lying immediately next to the basement membrane appear to be circular (Fig. 176B. GM1); while others are longitudinal muscle fibres (Fig. 176B. LM1). The neck of each malpighian tubule receives extension like the longitudinal muscle layer of the small intestine.

THE VASCULAR SYSTEM.

The heart is a long tube stretched from the anterior region of the 6th abdominal tergum up to the brain. The main part of the heart lies mid-dorsally along the alimentary canal in the abdominal region. From the abdomen onwards it forms a narrow tube "aorta" which runs up to the brain (Fig. 180A. Ao).

The main part of the heart from the 3rd to the 7th terga contains four pairs of ostia situated dorso-laterally equidistant from one another (Fig. 180. OSt). The heart is thus divided into five chambers (Fig. 180. 1-5). Each chamber is a cylindrical tube with the anterior region tapering out like a jet of a glass-funnel (Fig. 180B. ASt). The posterior end undergoes expansion to acquire the shape of the funnel's head (Fig. 180B. PSt). This end receives the anterior end of the preceding chamber and a pair of oblique narrow spaces thus left between them forms the ostia of that region. The second, third and fourth chambers are typical and of equal size. The first chamber neither possesses ostia nor is it equal in size to the rest. Besides, it is posterior end tappers out into a blind duct instead of being an open expanded end. The fifth chamber is
considerably longer than all and does not possess the anterior jet like terminus, but opens in the aorta which is swollen at its base (Fig. 130A, E80).

The aorta (Fig. 130A, Ae) starts from the anterior region of the 2nd tergum. On reaching the posterior part of propodeum dorsal to the oesophagus it enters the region of the posterior notch of the post phragma. Before emerging out of the post phragma the ventral wall of aorta develops a small diverticulum probably pulsatile organ which supplies to the dorsal longitudinal muscles of the fore-wings (Fig. 130A, AeB1). On leaving the post-phragmal region through its anterior notch the aorta runs in antero-dorsal direction until it crosses the middle region of the mesotergum. Here it dives down deep almost at right angle to its own longitudinal axis. This dorso-ventrally directed portion of the aorta on reaching the vicinity of the oesophagus suddenly turns forwards. This anteriorly directed portion enters the prethoracic region through the neural foramen of the proependosternum. There it runs longitudinally above the oesophagus until it reaches the ventral surface of the brain where it ends in two short capillaries.

The abdominal cavity is longitudinally divided up into 3 distinct chambers due to the presence of both dorsal and ventral diaphragms. These dorsal, ventral and visceral sinuses fail to maintain their separate identities in the head and the thorax, due to the absence of diaphragms in these regions. The presence of dorsal diaphragm, besides, demarcating visceral sinus from the dorsal or pericardial one, does not allow the heart to ex
in contact with the alimentary canal, as it apparently seems to be.

The dorsal diaphragm is stretched from the posterior region of the 2nd tergum up to the anterior part of the 9th tergum (Fig. 180B. DDph). In each segment excepting 2nd and 9th it is represented on either side of the heart by a triangle. There are six pairs of such triangles in all. The apex of each triangle is fixed on the corresponding side of the tergum near its anterolateral angle; while its base unites ventral to the heart with the base of the corresponding triangle. The anterior side running antero-nasally meets the postero-mesally running posterior side of the triangle placed below the next anterior tergum.

This condition makes the dorsal diaphragm a continuous structure over which the heart actually runs. Apart from it, this incomplete lateral union of the two adjoining triangles leaves a gap in between them. Such six pairs of gaps are present in the whole abdominal region which render dorsal sinus accessible to the blood coming from the visceral sinus.

Dorsally each triangle is traversed by muscle fibres originating from the apex and ending on the corresponding side of the heart. Thus there are six pairs of such muscles which may be regarded as alary muscles (Fig. 180B. DDph M2).

The ventral diaphragm (Fig. 181. VDph) in the male is a continuous sheet of membrane stretched from 2nd to 8th sternae; while in the female it does not go beyond the seventh. In each segment the ventral diaphragm has a pair of lateral attachments on each of the lateral sclerotised sternal plates. Such attachments keep the diaphragm stretched over the sternal area (Fig. 181.3 - d'Anta & Posta).
Dorsally the ventral diaphragm is traversed over by transverse muscle fibres (Fig. 181, VDph,Mc) which have their tips fixed on the sternal plates at the points of attachment of the diaphragm. In each segment some of the muscle fibres originating from the anterior part of a sternal plate curve upwards to end on the posterior part of adjoining plate of the anteriorly placed sternum (Fig. 181, ISMc,Mc). Such intersternal connections open six pairs of curved passages in the male and five pairs in the female which put the ventral sinus in communication with the visceral sinus (Fig. 181, ISp). 

THE RESPIRATORY SYSTEM.

The respiratory system does not fall in a line with that of the honey-bee where, as shown by Snodgrass, the entire body is dominantly supplied with air sacs. Nor it can be regarded as a typical case in which the main role is taken up by definite and perfect tracheae assisted, of course, here and there with few air sacs. Here as a matter of fact both the abdominal and head regions are covered over by tracheae only and no trace of air sacs of any dimension whatsoever, can be found. Contrary to it, the air sacs are the chief figures in the thoracic region supported off and on, with small tracheae. The structural similarity in the thoracic and abdominal respiratory systems is the presence of a pair of common lateral trunks (Figs. 185, 186, 187, S185, L186). Each extends laterodorsally as a continuous tube from first to the last spiracles of the body. Besides, each spiracle, irrespective of the region it is borne in, opens into
a short spiracular tube which ends on the dorso-lateral surface of the respective lateral trunk.

Tracheation of the thorax:

The two main lateral trunks (Figs. 135 & 133, Ltrs) cross the pedicle running parallel and on either side of the digestive tract. These on entering the propodeum receive the propodeal spiracular tubes (Fig. 185.a) on their dorso-lateral surface and expand into two oval shaped air sacs occupying dorso-lateral area up to the posterior half of the mesothorax. This pair may be called "Thoracic dorso-lateral air sacs" (Figs. 135 & 133.j). The dorso lateral air sacs give out 2 pairs of tracheae from their dorsal surface in the propodeal region slightly anterior to the propodeal spiracular tubes which spread over the whole dorsal region of this segment, and may be called "Propodeal dorsal tracheae" (Fig. 135.d). Usually the two air sacs in their posterior region are connected by a transverse loop called "propodeal loop" (Fig. 135.e). Just anterior to the loop there comes out a pair of tracheae "Propodeal ventral tracheae" (Fig. 135.b), from the ventral surface of the air sacs in the propodeum and spreads over the ventral region of the metapleura. The ventro-lateral surfaces of the air sacs give out a pair of "Propodeal ventro-lateral tracheae" (Fig. 135.c). Each propodeal ventrolateral tracheae divides into 3 branches - the anterior (Fig. 135.p) and posterior (Fig. 135.r) branches to the respective metapleuron; and the middle one to the respective hind leg and may be called "Meta coxal tracheae" (Fig. 135.q).

The air sacs receive a pair of spiracular tubes from the 2nd thoracic spiracles (Fig. 135.e); but do not give out any
prominent trachea in the meta thoracic segment. In the posterior region of the mesothorax a pair of Tracheae "Posterior mesothoracic tracheae" (Figs. 125 & 126.g) comes out from the latero-dorsal surfaces of the air sacs and spreads over the mesothoracial muscles. Immediately anterior to the posterior mesothoracic tracheae the two air sacs are interconnected on their mesal surfaces by a transverse trachea called "Mesothoracic posterior loop" (Figs. 125 & 126.f). This loop gives out dorsally a pair of tracheae which gets lost in the mesothoracic muscles (Figs. 125, & 126.f1).

The two air sacs after the formation of mesothoracic posterior loop taper out anteriorly into a pair of distinct and complete tracheae which on the basis of its course i.e. dorso-lateral can rightly be called "Thoracic lateral trunks" (Figs. 125 & 126.f2). Each thoracic lateral trunk gives out a pair of tracheae "Mesothoracic tracheae" (Figs. 126.b), from its dorsal surface for the mesothoracic muscles. Slightly anterior to it is the insertion of the 1st spiracular tube (Figs. 126.a & 126.i). The region of the trunk in between the 1st spiracular tube and the mesothoracic tracheae gives out a branch from each of its ventro-mesal and ventro-lateral surfaces. The mesal one "1st posterior pleurothoracic tracheae" (Fig. 125.a1) dives down to spread over the posterior part of the pleureleum and the pro-endosternum. The ventro-lateral (Figs. 125.a1 & 126.m) divides into an outer and an inner branches. The outer branch expands into an air sac called "Mesopleural antero-lateral air sac" (Figs. 125, and 126.t1). Thus there are two such air sacs in the anterior region of the mesopleureon. The posterior surface of each air sac gives out five branches. These later on, expand out into
five distinctly separate oval air sacs lying antero-posteriorly in the latero-ventral part of the mesopleuron and supply minute branches to both the meso and meta pleural regions. These sacs which are naturally ten in all may be called "Mesopleural latero-ventral air sacs" (Fig. 195,F1-10). The ventral surface of each mesopleural antero-lateral air sac develops these branches the anterior of the three "Prop踱cal trachea" goes to the foreleg (Fig. 199,w); while the remaining two "2nd and 3rd posterior prop踱cal tracheae" get lost into the propleuron (Fig.199,E).

The two inner tracheae (Figs. 195&196,t) of the two ventrolateral tracheae of mesopleuron fuse to form a big air sac "Mesopleural ventral air sac" (Figs. 195&196,u) running ventral but parallel to the oesophagus upto the mesofurcal bridge. Two pairs of small air sacs come out from the posterior region of this unpaired air sac. The inner pair "mesoceleal air sacs" (Fig.199,y) goes to the middle legs; while the outer branches off over the metapleural region (Fig. 199,n). Besides, the mesopleural ventral air sac gives out five pairs of lateral branches which form a net work of tracheae over the mesopleural area (Fig.199,w,t). The lateral trunks before getting out of the mesothorax are interconnected mesally by a "Mesothoracic anterior loop" (Figs. 195&196,n) which develops a branch "Anterior prop踱cal trachea" from its mid-ventral surface for the anterior region of propleuron (Figs. 195,t & 196,n).

- Treatment of the head -

The two lateral trunks run, instead of being separate, attached to one another mesally, over the digestive tract in the anterior region of the prothorax. Each before stepping into the
The foramen magnum divides longitudinally into a dorsal and a ventral
and a ventral tracheae. These branches enter the head capsule
as a single bundle of four tracheae. Inside the head separation in
the dorsal and ventral pairs occurs; and all of them divide to
form eight tracheae to spread by their sub-branches in the head
region (Fig. 185.LtraB).

Tracheation of the abdomen:

Here a typical tracheal system devoid of air sacs is
present. It is similar in all the 1st seven spiracle-bearing
segments (true 2nd to 8th segments of both sex); but the last
segment (true 8th) exhibit certain modifications which will be
dealt with later on.

The tracheal system consists of a pair of lateral trunks.
Each trunk (Figs. 185,186,187.Ltra) runs as a sub-marginal
longitudinal tube parallel to the respective lateral margin of
the dorsal wall of abdomen from 2nd to 8th segments. The lateral
trunk receives a short spiracular tube in the anterior half of
each spiracle bearing segment(Figs. 185,186,187.S). This part
of the trunk gets swelled to give out two distinct tracheae. One
of them "Tergo-visceral trachea"(Figs. 185,186,187.N) originates
from its dorsal surface and immediately divides into an upper
"Dorsal tracheae"(Figs. 185,186,187.B) and a lower "Dorsal
visceral tracheae"(Figs. 185,186,187.C). The dorsal tracheae
spreads over the dorsal diaphragm, vascular system and the
tergal muscles; while the "dorsal visceral tracheae supplies
branches to the vascular, digestive and reproductive systems if
the latter is there.

The second branch of the lateral trunk "sterno-visceral"
(Figs. 185, 186, 187, j) in each segment is given off from its ventro-mesal surface. This bifurcates into (i) ventral (Figs. 185, 186, 187, U) and (ii) visceral trachea (Figs. 185, 186, 187, V). The former redivides into a "sternal trachea" (Figs. 185, 186, 187, K) supplying branches to the ventral diaphragm, nerve cord and sternal muscles; and a "ventral commissural trachea" forming a definite ventral tracheal commissure by meeting the same of the corresponding side (Figs. 185, 186, 187, g). The visceral tracheae is meant only for internal organs viz. digestive, reproductive, and excretory systems which are covered over by its minute branches.

The tracheation in the true 8th segment of male, in broad principles is exactly on the line adopted by the rest. In other words it also possesses spiracular tube, tergo-visceral tracheae, sterno-visceral tracheae and their branchings in the usual manner (Figs. 185, 186, 188, 424, A). The difference lies in extra branching of visceral tracheae to meet the requirements of both 8th and 9th segments.

Each visceral tracheae (Figs. 185, 186, V) immediately on appearance from sterno-visceral tracheae gives out a pair of branches from its dorsal surface to supply branches to the dorso-lateral region of the digestive system, excretory system, reproductive system and partly to the dorsal diaphragm. It may be noted that these two pairs of branches have actually taken up the whole burden of the visceral pair of other segments; hence these may be called "Principal visceral tracheae" (Fig. 186, 422a). Each usual visceral tracheae (Figs. 185, 186, V) after the origin of principal visceral tracheae bifurcates into an
anterior (Fig. 186,W) and a posterior branchless (Fig. 186,X). The anterior branch meets the same of the corresponding side to form a transverse loop in between the digestive system (rectum) and the ventral diaphragm. While the latter bends down to enter the genitalia and may be called "Tracheae for genitalia". The transverse loop gives out two pairs of tracheae one from it; dorso-anterior and the other from dorso posterior surfaces. The dorso-anteriorly originating tracheae spread over the ventral surface of rectum and may be called "Ventral rectal tracheae" (Fig. 186,E). The dorso-posteriorly originating tracheae (ninth tergum's tracheae) goes to the IX tergal muscles etc.,(Fig. 186,F).

In the 8th segment of female the lateral trunk gives out three independent tracheae from its ventro-mesal surface, in an antero-posterior order, instead of single sterno-visceral. The anterior of the order spreads over the dorso-lateral surface of rectum and the sting glands and may be called "special visceral tracheae"(Fig.187,A). The central one resembles the sternal tracheae of the other segments in all respects except that it directly originates from the trunk instead of becoming a branch (Fig. 187,B). It dorsally gives out a branch which enters the genitalia and may be called first tracheae of genitalia"(Fig. 187,E). The posterior most tracheae is the visceral tracheae with the only difference that here it independently originates instead of being a branch of the sterno-visceral (Fig. 187,F). It gives out two principal visceral X tracheae (Fig. 187,Ht7) and ultimately itself enters into the genitalia (Fig. 187,X). At the base the visceral tracheae gives out a branch "2nd tracheae of genitalia"which also goes to the genitalia.(Fig.187,H).
The tergo-visceral trachea (Fig. 197.B) and its branchings (Fig. 197.B&C) are as usual. The female has six ventral tracheal commissures instead of seven found in the male for the simple reason that the former has only seven functional sterns.

THE SPYRACLES.

There are ten pairs of spiracles. The first pair is located in the intersegmental membrane between the pronotum and the mesepisternum. The second pair is found in the intersegmental membrane between the mesepisternum and the metepisternal. The remaining seven pairs are borne by the first seven abdominal terga including that of the propodeum.

First pair of spiracles:

Each dorsal angle of the pronotum expands out, instead of being an acute angle and is called spiracular lobe (Fig. 35, 3L). This spiracular lobe covers the corresponding portion of the mesepisternum which has undergone a depression. The marginal inflection along the postero-ventral margin of the side lobe faints out on reaching the dorsal angle (Fig. 35, Lvpv1). The marginal inflection of the posterior margin of the central bridge of pronotum (Fig. 35, Bpl) becomes sub-marginal (Fig. 35 Ldsml) along the entire length of the dorsal margin (Fig. 35, Ldm) of the side lobe. These two inflections are connected by a cross ridge across the base of spiracular lobe (Fig. 35, Py). A similar connecting ridge has been described by Duncan, in Wasp, in the form of an arc. According to Duncan the spiracle appears to have
been enclosed in between the arc and the tergal angle itself.
The present writer does not find the ridge arising over the
spiracle. On the other hand, the ridge becomes the base on which
the spiracular trachea (Fig. 35.e) rests to open by its
spiracle into the intersegmental membrane found in the corres-
ponding depression of the mesonectus. Externally the spiracular
lobe at its margin is covered over by a dense growth of hairs
which according to Snodgrass, in honey-bee, appear to guard the
entrance of the mesonectal depression.

The first spiracle has a more-or-less circular sclerotised.
The ventral portion of the rim (Fig. 189.vrs) develops a small
semicircular lower (ventral) lip (Fig. 189.v) which is slightly
inclined towards the lumen of the spiracle (Fig. 189.o). The
dorsal (upper) lip of the spiracle (Fig. 189.d) is also semi-
circular but is comparatively bigger than the ventral lip.
Besides, it rests attached to the dorsal rim of the spiracle
(Fig. 189.drs) by its inner surface instead of being developed
as a part of the rim as happens in the case of the lower lip.
This shows that the dorsal lip is the main mobile part of the
spiracle.

Dorsal muscle of the spiracle (Fig. 189.No.160).

It is a small muscle with its fibres originating from the
mobile apodeme developed from the postero-ventral margin of the
side lobe. The fibres converge to end by a tendon on the outer
surface of the lower lip. The inner surfaces of both lips facing
each other are connected by a transverse thin elastic connection
running along the lateral portion of the spiracular rim (Fig. 189.
e).
It appears that, ordinarily, the spiracle remains open. The contraction of the esculator muscle tells upon the less mobile ventral lip. The ventral lip slightly bends out and, meanwhile, transmits the force of the muscle to the upper lip through the elastic connection with the result that the upper lip covers the spiracle and thereby disconnects the spiracular tracheae from the outside world. On relaxation of the esculator muscle the lower lip goes back to its place, the elastic connection regains its original place and size, and the upper lip returns to its normal position.

Second pair of spiracles:

Each second thoracic spiracle is located in the intersegmental membrane in between the upper part of the dorsal margin of mesoseptus and the upper part of the anterior margin of the corresponding metapleuron. The spiracle is oval shaped, with a chitinous rim all round it. The anterior half of the rim (Fig. 190.a) possesses a big chitinous plate which is fixed on the upper (dorsal) face of the outward expansion of the descending dorsal margin of the mesoseptus. This plate may be regarded as immovable anterior lip (Fig. 190.a) of the spiracle which keeps the spiracle and its trachea in position. The posterior half of the spiracle’s wall is differentiated into three parts (i) a semichitinous plate immediately after the posterior wall of the tracheae (Fig. 190.q), (ii) A thin membranous strip next to the first (Fig. 190.m), (iii) a small chitinous plate which includes the posterior half of the spiracle’s rim and may be called posterior lip of the spiracle (Fig. 190.p). The posterior lip
at the lower (ventral) end in conjunction with the ventral part of the spiracle's rim forms a blind diverticulum (bulging). From this bulging (Fig. 190.d.) an oblique elastic connection (Fig. 190.e) originates which ends on the inner face of the anterior lip.

Dilator muscle of the spiracle (Fig. 190.No.161).

The dilator muscle of the spiracle is a small muscle originating from the outer face of the mesopleural ridge of its side. Its fibres converge to end on the outer surface of the posterior lip.

It appears that ordinarily the second thoracic spiracles, unlike first thoracic spiracles, remain closed. The contraction of the dilator muscle pulls the posterior lip back-wards which bends down away from the spiracle keeping the membranous strip of the spiracle's walls as its hinge-line. As the anterior lip is immovable hence the oblique elastic connection (Fig. 190.e) extends and the spiracle gets opened. The relaxation in the dilator muscle allows the posterior lip to return to its original place; which is also pulled back due to the elastic nature of the oblique connection.

Snodgrass in honey bee has not dealt with the mechanism of the second thoracic spiracles in detail. Duncan in wasp has taken the muscle to be an occlusor muscle. This means that he regards the spiracles always open. This is a view quite contradictory to the observations of the present writer.
THE NERVOUS SYSTEM.

The central nervous system consists of a brain (Fig. 182, & 184, Br) and nine ganglionic masses connected with one another by small paired inter-ganglionic connectives. The brain lies above the junction of the anterior and posterior pharynx. Just below the posterior pharynx is the suboesophageal ganglion (Fig. 183, Se seeing). The rest of this system is the ventral nerve cord (Fig. 182. VNve) containing all the remaining ganglionic masses situated in the body region.

Brain-

The brain exhibits its triple division in form and structure for there are usually to be distinguished three more-or-less distinct parts, viz. protocerebrum, deutocerebrum and tritocerebrum. Each of these parts is composed of two lobes which are fused into one.

The protocerebrum occupies the most anterior and dorsal part of the brain contributing, approximately, to one half of its whole mass (Fig. 183, Br). The two lobes of the protocerebrum fuse by their mesal surfaces along an antero-posterior line and shape the brain dorsally into an oval structure. The line of fusion of these lobes is externally marked by a faint furrow. The mid-dorsal region of the protocerebrum undergoes a marked depression from which the three ocular nerves originate (Figs. 182, d133,0Wv).

Laterally each protocerebral lobe is produced into a ganglionic mass called "optic lobe" or optic ganglion (Figs. 182, d133,0PL). Each optic lobe is more-or-less semicircular
and almost equal to whole mass of the brain. The outer surface of this lobe is broadest. The meso-dorsal part is constricted and is merged into the protocerebral lobe along a conspicuous external circular furrow which serves as a line of demarcation between the two. The meso-ventral region of the optic lobe is distinctly free having no union with any part of the brain.

The deutocerebrum occupies the middle region of the brain (Fig. 183, D2r). Its external demarcation from the remaining two parts is inconspicuous. Anteriorly a pair of lobe is developed from it called "Antennal lobes" (Figs. 182, A122, AntL). The ventral and dorsal surfaces of these lobes can only be regarded as demarcating lines for deutocerebrum from the corresponding parts of the tritocerebrum and protocerebrum. Each oval antennal lobe tappers out anteriorly into a distinct nerve which enters unpaired into the antenna of its side (Figs. 182, AntNv).

The tritocerebrum is the ventral and hind most part of the brain and hangs from it in the form of a pair of small lobes (Fig. 183, D3r). Each lobe from it's anterior surface gives out a group of 3 nerves. One of these nerves bifurcates to spread over the anterior pharynx and may be called "Pharyngeal nerve" (Fig. 183, PhyNv), and may constitute the 2nd commissure. The second nerve becomes labral nerve as it goes to the labrum (Fig. 183, LmNv); while the last one ends on the corresponding side of the frontal ganglion (Figs. 183, A1244, Fron.).

The posterior part of each tritocerebral lobe passes down along the corresponding side of the pharynx to form the suboesophagial ganglion (Fig. 183, SescGng). The present writer regards this region of the tritocerebrum as a structure formed by the
shortening of the corresponding circum-oesophageal connectives. This view is based on the union of a part of tritocerebral lobes with the suboesophageal ganglion.

**Sub-oesophageal ganglion**

The suboesophageal ganglion is an unpaired gangliionic mass placed below the pharynx (Fig. 183. Solecng). It is broader in the upper and narrower in the lower regions. Three pairs of nerves originate from its anterior surface. The middle pair goes to the labium and may be called labial nerves (Fig. 183. LbNV); the other two lying on the sides of the labial nerves become the maxillary nerves (Fig. 183.MxNV) while the remaining two (outer most nerves) innervate the two mandibles and are called "mandibular nerves" (Fig. 183.MdNV). The lower end of the suboesophageal gives out a pair of parallel and distinctly separated intergangliionic connectives which after passing through the lumen of the mesenterial bridge and the foramen magnum ends on the anterior tip of the 1st thoracic ganglion.

**Ventral nerve cord** (Fig. 182.VNv).

The ventral nerve cord of the body region consists of eight gangliionic masses of varying size. These are named after the regions they are located in. Each pair of gangliionic mass is composed of two ganglia fused along their mesal surface.

The prothoracic ganglion of the larval stage retains its identity as an oval gangliionic mass situated on the basisternum (Fig. 182.Inv). It is connected anteriorly with the suboesophageal ganglion by a pair of small intergangliionic connectives. Laterally it gives out four pairs of distinct transverse nerves to innervate this whole segment. The lowest pair becomes
"Proximal pair of nerves" (Fig. 152, l.) The posterior pair of interganglionic nerves after passing through the neural foramen of prothoracic endoskeleton ends on the meso-thoracic ganglion.

The mesothoracic ganglion is a composite one consisting of the two thoracic and 1st abdominal ganglia of the larva. It is placed on the longitudinal ventral ridge beneath the neural bridge of the pterothoracic endoskeleton (Fig. 152, 2ThGng). About eight or more pairs of prominent nerves come out from the ganglion. The meso-thoracic legs get a pair of nerves from the middle of the ganglion (Fig. 152, 1g) while the meta-thoracic legs are supplied from its posterior half (Fig. 152, 2g). Besides the posterior half also innervates the metathoracic and propodeal regions. Nerves originating from the anterior half of the ganglion invariably spread into the mesothoracic segment.

Smog grass in honey-bee includes the 2nd abdominal ganglion as well in the formation of the mesothoracic ganglion. According to him the 2nd abdominal segment has no independent ganglion and is consequently innervated by the mesothoracic ganglion. The present writer gets a definite ganglion in the posterior half of the 2nd abdominal sternum. This ganglion supplies nerves to both the 2nd and 3rd abdominal segments for which reason it may be considered as a composite 1st abdominal ganglion (Fig. 152, 1AbdGng) formed by the union of the two ganglia of these segments i.e. larval 2nd and 3rd abdominal ganglia. The 2nd abdominal ganglion (Larval 4th) is placed on the anterior border of the 4th sternum and gives out nerves to the 4th segment (Fig. 152, 2 AbdGng). In the case of female it is clearly
located in the 4th segment. The 3rd, 4th and 5th ganglia are formed in the corresponding anterior halves of the 5th, 6th and 7th segments. Each of these ganglia innervates the segment it is placed in (Fig. 182. 3, 4, 5 AbdGng).

The sixth ganglion, which is larval 8th, lies slightly posterior to the 5th one in the 7th segment and the interganglionic pair of connectives in between these is markedly reduced (Fig. 182. 6 AbdGng). It is biggest in all the abdominal ganglia. Three prominent nerves come out from it. Two of them being lateral are the transverse nerves for the 3rd segment while the posterior unpaired one spreads in the 9th segment by means of small branches.

In the case of female the 4th ganglion (larval sixth) is smallest and has been located on the anterior tip of the genitalia instead of sixth sternum. It gives out a pair of nerves to the 6th segment. The interganglionic connectives between fourth and fifth ganglia are markedly reduced and the two consequently come to lie very close to each other.

The 5th ganglion is the biggest in the list. It is placed on the common oviduct and gives out a pair of nerves from its anterior half to the 7th segment. The posterior half innervates the whole region of the abdomen posterior to this segment. As this ganglion combines the work of both 5th and 6th ganglia of male; hence it should be regarded as a composite form of these two.

**Stomodaeal nervous system:**

The stomodaeal nervous system is located on the dorsal
surface of the stomodaeum partly in front and partly behind the brain (Fig. 184A.Br). That portion found in front of the brain is a single small ganglionic mass called "Frontal ganglion" with its nerves (Figs. 27,184A.FrGng). While the rest consists of (i) An occipital ganglion (Fig.184.oGng),(ii) a pair of oesophageal ganglia (Fig. 184.oeGng), (iii) a pair of corpora allata (Fig. 134.CA), (iv) a pair of stomachic ganglia (Fig. 184B.3Gng).

The frontal ganglion (Figs. 27, & 184A.FrGng) is situated on the dorsal surface of the anterior pharynx (Figs. 27,184A. Aphy) in between the insertions of its clypeal and 1st frontal dilator muscles. Laterally it gives out a pair of nerves called "Frontal ganglion connectives"(Fig. 184A.Frcon). Each connective forms a loop on the side of the pharynx and posteriorly ends on the anterior surface of the respective tritocerebrum (Fig.183. Frcon). The posterior region of the ganglion gives origin to an unpaired recurrent nerve. This nerve running dorso-longitudinally over the posterior pharynx ends on the anterior tip of the occipital ganglion (Figs. 27,184.RNv).

The occipital ganglion (Fig. 184.0Gng) is oval shaped and placed over the dorsal surface of posterior pharynx(Fig.184 PPhy)slightly posterior to the insertions of its two occipital dilator muscles. Lateroventrally it is joined by a pair of oesophageal ganglia. Each oesophageal ganglion is a swelling with its base merged into the occipital ganglion (Fig.184. oeGng). Hence there is no distinct nerve connections to connect the occipital with the oesophageal ganglia. From the lower part of each oesophageal ganglion there hangs a small corpora allatu-
The posterior tip of the occipital ganglion gives out a pair of oesophageal nerves (Fig. 194B.30Nv). These run parallel to each other and dorso-lateral to the whole length of the oesophagus. On reaching the anterior most part of the crop each oesophageal nerve ends by a swelling called "Stomachic ganglion" (Fig. 194B.30ng).

**REPRODUCTIVE SYSTEM OF THE ADULT.**

**The male reproductive system:**

The male reproductive system is composed of a pair of testes, a pair of lateral ducts (vasa deferentia) which distally swells up to form a pair of seminal vesicles, a common small ductus ejaculatorius and a pair of accessory glands.

**The Testes** (Fig. 169, d151.Tes).

The testes are globular structures placed in the seventh segment dorsal to the ventriculus. These are yellow in colour and attached with one another by their mesal surface.

Each testis is externally enclosed in a peritoneal sheath (Fig. 192A.Psh). Internal to the peritoneal sheath are two distinct cytoplasmic layers which on the basis of their situation may be called (i) Inner and, (ii) outer epithelial layers. The outer layer (Fig. 192A.0Epth) being placed immediately next to the external covering cannot be differentiated from it easily. Besides, it is a thin nonnucleated layer, and may be compared with the outer tunica of diptera.
The inner epithelial layer (Fig. 192A. Epth) encircles the big lumen of the testis (Fig. 192A. Lum). It is a broad distinct cytoplasmic layer with prominent nuclei scattered all over (Fig. 192A. Nu). The cell walls are almost indistinct. This layer has a clear basement membrane (Fig. 192A. BM) which serves as a line of demarcation from the outer epithelial layer.

The lumen of the testis is filled with numerous spermato-
epithelium cysts (Fig. 192A. cst). These do not arrange themselves in a manner necessary to confirm the presence of spermatubules i.e. never enclosed in various oblique or longitudinal envelopes as suggested by James in Harmolita and by Snodgrass in honeybees. Each spermatoocyte in the upper region of the testis contains some circular specks of cytoplasm with a nucleus in each (Fig. 192A. Nu). These may be called spermatogonia (Fig. 192A. spg). The present writer has not discovered the apical cell.

By the time the spermatoocytes have reached the middle region of the testis the spermatogonia divide into a large number of pyramidal or circular bodies. These, later on, pass through various stages of spermatogenesis to develop innumerable thread-like bodies called "Spermatogca", which are shed into the lumen of the lower region of the testis by the rupture of the spermatoocytes.

The vas deferens and seminal vesicles:

There is a pair of yellow coloured tubes. These running in a ventro-posterior direction go round the corresponding sides of the midgut till they lie completely ventral to it. Thence they run in a convergent manner to end into the corresponding accessory glands.
That part of the tube starting from the testis and going round the midgut is of narrow uniform calibre and may be called "Vas deferens" (Figs. 169, &191, VDef). The remaining part of the tube is the seminal vesicle which is comparatively broader with a wider lumen (Fig. 191, Vsm).

Both the vas deferens and the seminal vesicles have a continuation of the "Peritoneal sheath" (Fig. 192B&C, Psh) of the testis as their outer most covering. Besides, their internal epithelium (Fig. 192B&C, Epth) is simply an extension of the "Inner epithelial layer" of the testis. In between these two layers comes a layer of circular muscle fibres (Fig. 192B&C, CMcl) which becomes broadest in the region of the seminal vesicles.

The ejaculatory ducts (Fig. 191, EjD).

The ejaculatory duct is an unpaired tube receiving the ducts of the accessory glands in its proximal (anterior) region. It runs medially in between the dorsal and ventral surfaces of the aedeagus (Fig. 191, Aed) exactly over the mesal longitudinal ridge of the ventral surface to open in the phallothrom (Fig. 191, Phtr).

The epithelium of the ejaculatory duct (Fig. 192D, Epth) consists of columnar cells with oval shaped nuclei arranged in no definite plan. In otherwards these may be found in any part of the cells. These cells are borne on a basement membrane (Fig. 192D, Bm) which demarcates them from a definite outer circular muscle layer (Fig. 192D, CMcl). Next to the epithelium is a thin internal intima which encircles the lumen (Fig. 192D, In).
The accessory glands: (Figs. 169, 191, AcG1).

There is a pair of elongated creamy coloured accessory glands of almost uniform thickness. These are enclosed in a greyish peritoneal envelope (Figs. 191A193, Phh). This envelope is partitioned into two lateral chambers due to the presence of a longitudinal septum (Fig. 193,e) in it. Each of these chambers possesses the corresponding accessory gland. This bi-chambered envelope with accessory glands is placed in the ventral sinus just below the ventral diaphragm. None has so far, described a distinct bi-chambered envelope embedded with accessory glands and located in the ventral sinus.

The posterior part of the envelope is not concealed by the ventral diaphragm as the latter does not extend over it. Each chamber of the envelope in its posterior region is dorsally pierced by the corresponding seminal vesicle which, later on, opens into the accessory gland of that particular chamber. The accessory glands ultimately taper out into two small ducts (Fig. 191, AcG1d) which end in the anterior part of the ejaculatory duct.

The accessory gland has a narrow syncytial epithelium (Fig. 193, Epth) with nuclei (Fig. 193, Nu) scattered in its cytoplasm. External to the epithelial cells is a well-developed circular muscle layer (Fig. 193, Cncl). The present writer has not come across any layer of longitudinal muscle fibres either internal or external to the circular muscle layer as suggested by Bishop. (This view of Bishop is quoted by Snodgrass in his book "Anatomy and Physiology of the honey-bee"). The lumen (Fig. 193, Lum) of the gland is of almost uniform cross-section, and is filled with the secretion of the gland (Fig. 193,e).
The Female organs.

The female reproductive system consists of a pair of ovaries, each with an oviduct which unite to form a short common oviduct, and a spacious vagina.

The ovaries (Fig. 194,ovr).

The two ovaries occupying the main bulk of the abdomen from true 2nd to the 6th abdominal segments and are placed dorso-lateral to the digestive tract. Each ovary consists of seven egg tubes (ovarioles) which closely adhere together. Each ovariole is of varying diameter being narrowest in its free anterior part and broadest in the posterior region. The former part of the ovariole is termed as "Terminal filament" (Fig. 194, TF). It is followed by a small zone of germarium (Fig. 194,drm) which communicates with the last and longest zone of the ovariole called "Vitellarium" (Fig. 194,Vtl). All the terminal filaments of an ovary unite to form a single terminal thread which, later on, unites with its fellow of the second ovary. The median filament so formed gets lost in the fat-bodies below the dorsal diaphragm in the 2nd abdominal tergum.

The ovarioles.

The whole length of an ovariole is externally covered over by a non-nucleated thin peritoneal layer (Fig. 194,psh). The terminal filament and the germarium have a smooth outer surface. The anterior region of the vitellarium has acquired a beaded condition due to a continuous series of swellings which gradually increase in size from before backward. The posterior part of the vitellarium which puts the ovariole in communication with the corresponding oviduct, is broadest with a smooth outer surface.
The terminal filament (Fig. 194, TF) is devoid of lumen and works as a suspensorium for the ovary. The germarium possesses a mass of undifferentiated germ cells (Fig. 194, Gc1) which in due course of time develop into oocytes (Fig. 194, Oe1), follicular epithelium, and the nurse cells (Fig. 194, Nrc1). The groups of nurse cells i.e. nutritive chambers (Fig. 194, Nrc) and the oocytes chambers (Figs. 194, & 196, Ec) alternate with one another in the vitellarial region and hence may be held responsible for the beaded nature of the ovary. This type of arrangement renders every oocyte to develop at the expense of the contents of the nutritive chamber placed just anterior to it.

In the vitellarium the peritoneal layer (Figs. 195&196, Psh) is followed by a distinct syncytial epithelium (Figs. 195 & 196, Epsth) of fine, granulated cytoplasm (Figs. 195A&196, gn) with small nuclei scattered in it (Figs. 195A196, Nu). This layer is the true epithelium of the ovariole and can be compared with the inner tunica propria of Nemesia viridula described by Malouf1. Next to it comes the follicular epithelium (Figs. 195 &196, Fel) enclosing the lumen. It consists of distinct columnar cells with big, granulated nuclei (Figs. 195 &196, FelNu) and markedly granulated cytoplasm (Figs. 195A&196, Fclgn). The columnar cells are borne on a distinct basement membrane which demarcates them from the syncytial epithelium of the ovariole (Figs. 195A, &196, BM).

The peritonium (Fig. 196, Psh) and the syncytial epithelium (Fig. 196, Epth) are continuous throughout the whole length of vitellarium. At intervals they simultaneously bend inward and
outward to give a beaded form to the vitellarium (Fig. 194, 196,b). As the bends are incomplete hence successive beads are never cut off from each other (Fig. 196,p).

The follicular layer unlike peritoeenium is discontinuous. It is broken up into several envelopes. Each envelope contains a developing oocyte (Figs. 194,195,&196,00c) and a nutritive chamber (Figs. 194,&196,Nrc). The chamber of oocyte (Figs.194, &196,Be) is always posteriorly placed to the nutritive chamber. The passage or communication between these two regions is reduced to a small opening (Fig. 196,p) due to inward bend (Figs. 194,&196,b) of the walls of the envelope. The oocyte and its nutritive chamber are cut off from the lower (posterior) and upper (anterior) parts of the ovariole respectively due to the fusion of the walls of the envelope to form a transverse septum in each region (Fig. 196,s). Each nutritive chamber (Figs. 194,&196,Nrc) contains a large number of nurse-cells of varying size (Figs. 194,&196,Nrc1). The follicular epithelium in this region consists of small cubical cells instead of columnar cells as found all round the oocyte.

In the posterior region of the vitellarium both the follicular layer (Fig. 195B,Fc1) and the epithelium of the ovariole (Fig. 195B,Epth) are drawn out independently into two sheets of highly attenuated cells. Not only this but they are at the verge of disintegration. Besides, the oocyte (Fig.195B,00c) is ensheathed by a distinct chorion (Fig. 195B,c) which is probably a secretion of the columnar layer.

The oviducts-

The ovarioles of each ovary some where in the 6th segment
leave their original position and run convergently in a postero-ventral direction until they reach exactly below the digestive tract. There they open independently into a small broad oviduct. The two oviducts (Fig. 194.ovid1) of the two sides rise upwards in a convergent manner. On reaching above the anterior tip of the genitalia they fuse to form a short common oviduct (Fig. 194.ode) which is overlapped by the last abdominal ganglion. It later on opens into the spacious vagina (Fig. 194.vag).

Externally the oviduct is covered over by a non-nucleated layer (Fig. 97A,Phl). It may be regarded as an extension of the ovariole's peritoneum. It is followed by a layer of circular muscles (Fig. 197A,Cmusl) which is not described by Snodgrass in honey-bee. The longitudinal muscle layer as shown by Malouf in Nesara viridula is not found in this insect. Next to the circular muscle layer comes the epithelium of elongated cells (Fig. 197A,Epcth) with big muscles (Fig. 197,Ne). The epithelial cells are borne on a definite basement membrane which demarcates them from the muscle layer (Fig. 197A,BM). The wall is thrown into three internal longitudinal folds which render oviduct capable of distending its lumen to a very great extent (Fig. 197A,f).

The Vagina:- (Fig. 194.vag).

The vagina is the most spacious part in the whole of female reproductive system.

The dorsal (upper) wall of the vagina on receiving the spermatheca (Fig. 194.spt) in its proximal region extends posteriorly to a considerable length. It forms a posteriorly
directed blind diverticulum by suddenly bending down and then turning to move towards the bulb where it ends over the 1st pair of valvulae. The lubricant gland opens into the dorsal wall just near its terminus. The short ventral (lower) wall darts down to fuse with the ventral margin of the 8th abdominal sternum which is a small oval plate fused with the anterior surface of the two rami of the 1st valvulae. The rise in the dorsal wall and the fall in the ventral wall reduces the vagina to a narrow tubular structure to communicate with the vestibulum through the gonopore which is guarded ventro-laterally by the proximal convergent parts of the 1st pair of valvulae and dorsally by the 8th abdominal sternum.

The vagina is externally covered over by a non-nucleated (Fig. 197B, Psh) peritoneum which is internally followed by a circular muscle layer (Fig. 197B, CMcl). This muscle layer is not described by Malzouf in Nezara. Next to the muscles comes the epithelium of columnar cells (Fig. 197B, Epth) with basally placed small nuclei (Fig. 197B, Nu). Internal to the epithelium is a layer of thin chitinous intima surrounding the spacious lumen (Fig. 197B, In).

**The spermatheca** (Fig. 194, Spt).

The spermatheca is a short tube swollen at its free end and lies pressed below the last abdominal nerve ganglion. It consists of two distinct regions called (i) spermathecal gland and, (ii) True spermatheca or sperm-reservoir.

The spermathecal gland occupies the free distal half of the spermatheca. It consists of two oval lumina (Fig. 193A, Lum1&2) which taper out individually into a short gland duct.
These ducts converge and fuse to form the common gland duct which opens into the spermathecal duct (Fig. 193B, spGld). The two lumina and the ducts are surrounded by finely granulated cytoplasmic matrix (Fig. 193m) which is irregularly embedded with a large number of granulated big nuclei (Fig. 193Nu).

**The sperm reservoir:**

The sperm reservoir is a big space located in the spermatheca at a lower level with the gland lumina. It is surrounded by an epithelial layer (Fig. 193B, Epth) of short cubical cells with small nuclei. The lower part of the reservoir tappers out into spermathecal duct which enters the vagina dorsally in its proximal region (Fig. 193B, sptd).

The spermatheca is externally covered over by a non-nucleated coat which seems to be a prolongation of the vaginal peritoneum (Fig. 193, Psh). Internally placed to the peritoneum and surrounding the whole internal structure of spermatheca and its duct is a layer of circular muscle fibres (Fig. 193, CMcl).

Sendar, in Habrobracon has not described any muscular layer.

**The poison apparatus:**

The well developed poison apparatus consists of poison glands, reservoir, poison duct, and the lubricant gland. All these structures excepting the lubricant gland are located in the distal half of the visceral sinus and coiled round the malphighian tubules.

**The poison glands** (Fig. 194, AG1).

The poison glands are cream coloured blind tubular structure of almost uniform cross-section. These glands are individually much longer than the reservoir and open by a small narrow duct independently into its bulb (Fig. 194, blb).
The circular lumen (Fig. 193A, Lum) of the gland is surrounded by a regular layer of epithelium (Fig. 193A, Epith). The epithelial cells are columnar containing more than one nucleus in each. The biggest nucleus (Fig. 193A, Nu) of the cell is oval and always placed on the periphery, while the other small ones are scattered in its remaining part (Fig. 193A, n). The cytoplasm is finely granulated (Fig. 193A, gn). The distal region of the cell contains a clear vacuole close to the lumen (Fig. 193A, v). Bender suggests a multivacuolated condition of the cells if vacuoles are at all to be found in them. The walls of the glands are not provided with muscles.

The Reservoir (Fig. 194, A01R).

The reservoir is an oval shaped body with strong musculature. It's lumen is closed at the top (Figs. 199D, 200B, Lum); and is in communication with the poison duct below. The lumen is enclosed in a coat of laminated chitin of inconsistent chitinization (Figs. 199D, & 200B, In). The chitinous coat due to inconsistency appears to be composed of two types of rings— one of higher chitinization (Fig. 200A, Inh) and the other of feeble one, (Fig. 200A, Inl) arranged one after the other. The highly chitinized rings are comparatively broader and are the real seat for the attachment of short longitudinal muscles (Fig. 200, LMc1s).

Immediately outside the chitinous coat is a narrow layer of syncytial epithelium (Figs. 199D, & 200B, Epith) with small nuclei scattered in it (Fig. 200B, Nu). Bender does not describe any epithelial layer in Hyperacon. The epithelium is externally covered by a heavy coat of longitudinal muscles (Fig. 199D, LMc1), consisting of (i) Complete muscles (Fig. 200, LMc1c) and (ii)
short muscles (Fig. 200, LMoIs). The short muscles connect only the highly chitinous rings with one another, while the complete muscles run from top to the bottom of the reservoir and are placed externally to the short muscles. This elaborate arrangement of muscles shows that contraction in the complete longitudinal muscles is sufficient for a normal course of stinging. But if the parasite requires greater quantity of stinging than the short longitudinal muscles are brought into action with the result, that lumen of the reservoir is highly reduced and almost the whole of its content is ejected out. The subsequent relaxation in muscles allows the reservoir to suck fresh quantity of the venom from the bulb (Figs. 194, d 200B, b1b).

The poison duct is (Fig. 194, pd).

The poison duct starts from the bulb of the reservoir and after making several convolutions ends in between the 1st pair of valvulae (Fig. 194, lv1) slightly posterior to the vaginal opening. The epithelial cells of the duct are glandular in nature (Fig. 199B.Epth). These are almost conical in shape. Each has its granulated cytoplasm (Fig. 199B, gm) confined to its periphery in the form of a curved band with a big granulated nucleus there-in (Fig. 199B, Nu). The remaining part being totally free from cell contents is transformed into a big vacuole (Fig. 199B, v).

As the secretion of the poison gland is generally regarded as acidic; hence any secretion from the poison duct cells may be considered alkaline. This presumption will enable 3tence-brason deesae to stand on equally footing with other hymenoptera so far the completeness and efficiency of the stinging apparatus are concerned.
The lubricant gland—(Fig. 194, Lumb).

There is an unpaired tubular lubricant gland of uniform cross-section lying amidst the female genitalia. Its tapers out into a short duct to open externally into the vagina. The gland is covered on its outer surface by a non-nucleated peritoneum (Fig. 193c. Psh) which may be considered to be an extension of the vaginal peritoneum. It is followed by the syncytial epithelium (Fig. 193c. Epth) of finely granulated cytoplasm (Fig. 193c. gn) with nuclei (Fig. 193c. Nu) scattered. Besides the above a distinct basement membrane is present to demarcate it from the peritoneum (Fig. 193c. BM). Internal to the epithelium is a thin wavy chitinous intima (Fig. 193c. In) which surrounds the lumen (Fig. 193c. Lum).

The present writer does not find vacuoles in the epithelium. Though Bender reports their occurrence but he himself has not found them in all the cells. As regards intima Bender has failed to find out its presence in his insects. The present writer upholds the following view of Bender as regards the function of this gland which is given below "Due to the position of the mouth of the gland on the vagina near the base of the ovipositor the secretion of the gland probably aids in the passage of the eggs down through the poison canal of the valvulae". A more-or-less similar unpaired gland has been described as "Alkaline gland" by Genieys (1925) in Habrobracon brevicornis. Grandi also reports the presence of similar gland in Blas-tophasysenes. He also regards it as alkaline gland and not lubricant gland.
THE BIOLOGY.

Introduction-
Steno-bracon ceesae is an ectoparasite of the larvae of all the three types of sugar-cane borers; namely root, stem and top-shoot borers. It attacks the larvae of the Juar borers as well. The borers which are generally made victim of it are those of (1) Scirpophaga nivella; (2) Scirpophaga monostigma; (3) Argyria sticticrassis; (4) Eumalocera depressella; (5) Sesamia uniformis; (6) Dumna; (7) Diatrea auricilia; (8) and chilosimplex.

Steno-bracon ceesae is found in abundance in all the three sugar-cane regions of the United Provinces viz., Eastern, Central and Western regions. The districts of the U.P. visited by the present writer in connection with the collection of this parasite are Gorakhpur, Mirzapur, Ghazipur, Basti, Bada Banki, Moradabad, Meerut, Musaffarnagar, Bulandshahr and Aligarh. In all these places it was found along with its allied species Steno-bracon nicevillei.

The parasite belongs to the sub-family Braconinae, and was formerly named as "Glyptomorpha ceesae". It was first introduced to the entomologists by Cameron in 1902. Since then, it had been reported to occur in Punjab by M.Afzal Hussain (1923); and in Southern India by T.V. Ramakrishna Ayyar (1923) and M.C. Cherian (1932). It was only in 1938 that E.S. Narayana published a brief account on the life-history of this parasite. It can be inferred therefore, that Steno-bracon ceesae is widely prevalent in almost the whole of India.

The present writer has already published a note on some of the important features of its life history and now intends
to give a more extensive account of his observations made in the laboratory on approximately seasonal field temperatures. He has deliberately avoided to go in detail about the effect of ecological factors on the biology of this parasite as it was outside the scope of the problem assigned to him for research.

Habits of the adult-

The parasite is abundantly found in the sugar-cane and Juar fields from May to November in the Aligarh district. During winter days (ranging from December to March) the population of the parasite gradually dwindles away. This condition is slightly improved in March and April probably on account of the occurrence of "Delayed emergence" in this parasite after its winter-sleep.

In bright sunny days it flies at a moderate speed invariably visiting the upper half of the cane stems. Its visit to the lower portion of the stem is comparatively low probably due to less intensity of light in that region. In cloudy weather and in electric lamp light its activities are reduced as compared to a sunny day.

The bright yellow colour of the body and dark wings make the parasite a prominent object in the fields. The female can easily be differentiated from the male due to her long ovipositor. It flies more swiftly and has longer body.

During summer the parasite is easily available in the fields in the early hours of the morning after sun-rise. In rainy season it comes out late during the morning; while in winter days its appearance takes place very late in the forenoon.

The green wild grasses and (Sarkanda)Saccharumsp, near the sugar-cane fields, provide best abode for rest and pairing. It
is perhaps from copulation point of view that the males are abundantly found in this locality, while females visit it casually.

Method of Rearing:

It was not the writer's object to develop to any degree a technique best suited for breeding the parasite on a large scale. His aim was to get a regular supply of the parasites which could provide material for his studies of its biology and morphology.

The parasites, upon emergence or after being collected from the fields, were released in glass-troughs measuring 4\(\frac{1}{2}\)" x 4\(\frac{1}{2}\)" x 4\(\frac{1}{2}\)". Each rearing-trough was covered over by a piece of fine muslin cloth stretched across a square wooden frame about 4" thick. One or two small and thin pieces of Juar stem were kept within them resting obliquely by their walls. These served as suitable places for rest and mating. One or two pieces of sterilised white cotton imperfectly soaked in sugar and water solution were placed in the bottom of the feeding trough at considerable distances. Besides sugar, honey-water squash were also tried as food for the parasite. It was observed that "Kishmish" whether in squash or in pieces wet with water, was liked best by them.

Copulation:

When a female comes within the sight of a male; the latter chases her and over comes her very soon. He mounts upon the female and licks her vertex and thorax as preliminary manoeuvre to actual mating. The female struggles to come out of males grip by fluttering her wings, and moving her legs and abdomen.
Such unwillingness on the part of female reduces the chances of fertilization. If the female is willing she keeps still and allows the mating partner to copulate. The copulation is carried out within a few seconds. It may be noted that bright sunlight or electric light, high temperature and high relative humidity excite sexual impulse both in the male and female.

Oviposition tubes-

The present writer has used glass tubes 4½" long and 1¾" wide for egg-laying. Each tube was filled to its one-quarter depth with sand which was soaked with water to its maximum capacity. A three inches long piece of fresh juar stem was hollowed in the middle into a deep rectangular space which is long and wide enough to allow the borer to move in freely. The borer was confined in this chamber and a thin piece of juar rind was wrapped over the chamber as its lid by means of a piece of thread, leaving behind a narrow longitudinal slit to keep the chamber in communication with the outside world. This piece of juar with a borer in it was fixed in the oviposition-tube and a female parasite was released on it. The tube was then covered by a piece of muslin cloth held by means of a circular elastic.

Oviposition-

No case of immediate oviposition, after emergence could be recorded. The female is found to wait up to a length of about eleven days after emergence without laying eggs in search of an active host during winter season. The present writer thinks that in pre-winter days there is a reduction in the duration of the preoviposition period.
When a female is released on a host she makes a reconnaissance of the Juvar piece by tapping it with her antennae. On discovering the locality of the host she raises her abdomen and brings the tip of the ovipositor to rest on the surface. The antennae are stretched forward and the wings are raised upward. When the exact place of the host is detected the sheath of the ovipositor lays the sting bare by making a postero-dorsally directed loop. The sheath covers the sting at its tip and there by helps this organ not to deviate from its course. If the host is very deep the sheath releases the sting and straightens itself backward with the result that the entire sting enters into the Juvar piece through the longitudinal slit.

The female goes on introducing and withdrawing her sting until its tip touches the host. It is then immediately thrust into the host's body where few drop-lets of colourless fluid is injected. The sting is withdrawn completely for about a little while probably in order to keep it away from the bite of the ferociously agitated host. If the larval slips away beyond the reach of the sting the parasite will remain in oviposition pose for several hours and will leave the spot only after egg-laying or under some external influence.

**Effect of stinging on the host:**

At the end of this pause she again introduces the sting to find out if the host is perfectly paralized. In case it is not so the host is stung again. Generally stinging once or twice is sufficient to paralize the host within a minute or so. It has been observed that a stung host passes out a drop of brown colour liquid through its mouth. Within few minutes its locomo
emotion practically ceases; and other activities including those of feeding, ecdysis etc. are stopped for ever. The host after being stung may live for several days but it can never recover; and ultimately ceases to live.

**Number of eggs per host:**

When the host is completely paralysed the female breaks the pause and re-introduces the sting and deposits only one egg on the host's body. The egg is generally found embedded by its pedicle into the integument of the host. If the ecological factors are favourable and fresh supply of hosts is stopped then a female is found to lay up to nine eggs in a day on one and the same host. These eggs are deposited on or nearabout the host under no definite plan.

**Host selection:**

The female always prefers an active host for oviposition. It refuses to oviposit on dead or exposed hosts. Nor does it lays eggs on the hosts already paralysed by other insects. It may be noted that rise in temp, light, humidity and vigorous activities of the host are directly proportionate to the increase in the egg-laying activities of the parasite.

**Pre-imaginal stages:**

The parasitised hosts were put in rectangular glass-trough (10"x4"x2") whose three-fourth depth is filled with sand. The sand was kept wet with water to its maximum capacity so that the juar twigs did not dry up. The trough was placed in a cage of wooden frame with wire guaze walls. In order to provide field temperature the cage was heated with electric bulb.

The parasite under goes the usual four pre-imaginal stages
viz egg-stage, larval stage, prepupal stage and pupal stage. A detailed account of the salient features of these stages is given below.

**Egg Stage**

Maximum number of eggs laid by a female in its life time is thirty-two; but as a general rule it does not lay more than twenty two eggs. During long period generation (winter season) the number of eggs is still reduced.

The egg (Fig. 201A) is creamy white in colour. It is 2.65mm long including the highly drawn out narrow pedicel of 1.44mm. long. The body of the egg has a uniform cross-section with its free end bluntly tappering and can be distinguished from the pedicel on the basis of its cross-section. The egg is a curved whole.

**Hatching**

If the egg is examined a little before hatching it will be found to contain a distinct larva with head, invariably facing towards the blunt-end. At the time of hatching the larva pushes itself through a small anterior lid and wriggles out of the egg with its head emerging first.

The hatching period ranges between twenty-three to twenty six hours during pre-winter days when short period generation is passed (Table.1). The maximum percentage of successful hatching is about 70%. During long period generation the hatching period varies from forty-five to forty-eight hours; and the percentage of success is hatching is markedly reduced.

If a female is forced to lay more than one egg on one and the same host; and the eggs are later on, distributed on separate
hosts then about 50 per cent of the total eggs hatch out. In case these eggs are left on the same host never more than two eggs undergo hatching. Besides, cases of hatching have been recorded even after the expiry of the normal incubation period when eggs with their corresponding hosts have been transferred from dry Java twigs to fresh and wet ones; provided these eggs are not dried up.

**Larval Stage**

The larva undergoes four moultts before spinning a cocoon for itself. Each stadium is of twenty-four hours duration in short period generation; while during long period generation it is almost doubled (Table 1).

The newly hatched larva (Fig. 201B) is creamy white in colour, having transparent integument. Its transparency gradually fades away as the larva develops into a mature one. The average length of the newly hatched larva is 1.75 mm (Table 4). It has a triangular shaped brown head with mouth parts situated on its ventral end (Fig. 201B, h). The head is followed by thirteen segmented cylindrical trunk region which has tapering posterior end. It is further divisible into three segmented thorax and ten segmented abdomen. The average maximum temperature and average minimum temperature during the larval period both in short/ and long period generations at a constant relative humidity of 65 to 75% is given in table No. 1.

Immediately on hatching the larva punctures the host's integument and starts feeding on its blood. It does not necessarily feeds on one spot; and thus has been observed shifting from one region of the host to the other.
The larva refuses to feed on unparalysed hosts. Besides it willingly feeds during all its stages before the fourth moulting has taken place on other paralysed borer if supplied to it in place of its original host. It refuses to feed on a second paralysed borer after the fourth ecdysis.

Description of a typical larva-

A typical larva possesses in addition to head, thirteen complete segments (3 thoracic and ten abdominal). The presence of head makes the anterior end of the larva bluntly rounded as compared to its posterior end which is tapering and pointed. The head is markedly small in proportion to other body segments and is partly sunk in the first thoracic segment. The ventral surface of the head carries mouth parts while its facial wall possesses a pair of unsegmented conical shaped antennae, each surrounded by a concentrically ringed base. There are no ocelli in the larva.

The length of the larval body including head and the length of the head of the larva vary in each stadium as shown in table No.4. The larva is curved longitudinally with its head and last segment directed downwards; while its ventral surface is almost straight. A dorsal hump (Figs. 20B,C,D,202,A203,Dh) is present in each segment but is especially prominent from the 2nd abdominal to the 7th abdominal segments.

The width of the segments increases in a gradual manner from first thoracic to fifth abdominal segments, the latter having the widest. From the fifth abdominal segment back-ward a gradual decrease in the width takes place until the 10th abdominal segment which is smallest and pointed.
Excluding the cranium each segment is beset with numerous small setae. Some of them are markedly longer and scattered here and there under no definite plan. The longer setae are comparatively more numerous in the ultimate and penultimate abdominal segments.

The intersegmental grooves are well-marked and there is no trace of any setae on them (Figs. 201, 202, &203). The intersegmental groove between pro and meso thoracic segments in its dorso-lateral region possesses the first pair of thoracic spiracles. The second pair of the thoracic spiracles is not apparent during larval period; while in pupal stage its presence can easily be detected. The remaining eight pairs of spiracles of the imago are developed on the targa of the first eight abdominal segments.

The head Capsula (Figs. 201, 202, &203, 213, 215, &216). The head is circular and light brown in colour. Posteriorly a small circular ribbon like post occiput (Figs. 206, 207, &211, Poe) is marked off from the head due to the presence of the post-occipital suture (Figs. 206, 207, &211, Poe). The latter bears the two posterior tentorial pits in its ends (Figs. 206, &207). The post-occipital region along its entire posterior margin is fused with the entire anterior margin of the prothorax with the result that the foramen magnum is as wide as the post occipital region.

The epicranial suture (Fig. 206) longitudinally down the dorsal surface of the head. On reaching in between the two antennae (Fig. 206) it bifurcates into two faint frontal sutures (Fig. 206, fso) which disappear before reaching the epistomal suture.
There is a pair of yellowish broad hypostomal scleromes, each extending from the posterior tentorial pit of its side to the mouth in an antero-mesal direction (Figs. 206, & 210, hy). The hypostomal scleromes separate the maxillae from the dorsal surface of the head. The yellowish pleurostomal sclerome (Figs. 206, 209, & 210, pl) is like an arc with its two extremities projecting towards the mouth called superior and inferior pleurostomal rami (Fig. 206, splr & 1plr). The lower part of each pleurostomal sclerome receives the hypostomal sclerome of its side while its upper part is brought in communication with the corresponding region of the other side by a semi-circular yellowish plate called "Epistomal sclerome" (Figs. 206, ep). The area enclosed below the epistomal sclerome is the "Labrum" (Figs. 207, & 208, Lm); while that above it and guarded laterally by the reduced frontal sutures may easily be regarded as the "Frons" (Fig. 206, Fr). The absence of subgenal areas in Polistes gallicus described by Parker has made it difficult to differentiate maxillae and labrum from the dorsal areas of the head.

Both the eyes are absent. Close to the origin of the frontal suture in each half of the cranium is a circular colourless depression called "Antennal foramen" (Fig. 206, antf). The conical unsegmented antennae are borne by them (Fig. 206, ant). In the posterior region of the head a transverse sclerotised bar joins the two posterior tentorial pits and may be regarded as "Transverse tentorial bar" (Fig. 207, t Tb).

The mouth is guarded dorsally by the labrum, ventrally by labium and laterally by the maxillae and mandibles. The labrum (Fig. 206 & 208, Lm) is a semicircular feebly sclerotised plate.
over-hanging the mouth from the epistomal sclerome (Figs. 206, 209, ep). It possesses three pairs of sensory spines (Fig. 208, s) along its margin and five pairs at the base. Any separate identity of the elypeal region is doubtful.

There is a pair of strongly sclerotized mandibles guarding the mouth cavity on the sides (Figs. 206, 209, Md). Each mandible develops a condyle (Figs. 206, & 209, Mdc) at its lower (outer) angle which fits into the pleurostomal sclerome (Figs. 206, & 209, pl) very close to the inferior pleurostomal ramus (Figs. 206 & 209, plr). The upper basal angle of the mandible simply rests on the inner face of the superior pleurostomal ramus (Figs. 206, 209, plr). The whole basal margin in (Fig. 209, Mdbm) between the two angles suspends by a membrane (Fig. 209, conj) from the pleurostomal sclerome. Parker has only mentioned the membranous suspension of the mandible and has not shown any definite articulation. The distal region of the mandible is octa-dentate. Out of these eight curved and pointed teeth (Fig. 209, t) the uppermost is the largest and broadest and may be called "Blade" (Fig. 209, Mdb). The two blades of the two mandibles lie like cross swords in front of the mouth (Fig. 206, Mdb).

Each maxilla as already described is demarcated from the upper half of the head capsule by the presence of the hypostoral sclerome (Figs. 206, & 210, hy). Ventrally it is bordered by an incomplete thick dark brown sclerotised band called "Maxillary sclerome" (Figs. 206, 207, 210, & 211, Mx). It is incomplete in the sense that it does not meet the hypostoral sclerome. The small distal region of the maxilla is marked off from its remaining part by a dark brown stipital sclerome (Figs. 206, 207, & 210, sts) joining the hypostoral sclerome with the corresponding
maxillary sclerome. This distal part is the stipes (Figs. 206, &210, st) and possesses a tiny distal lobe called "galea" (Figs. 206, &210, g) lying by the side of the labiostipital sclerome (Figs. 206, 207, 210, &211, lsts). Slightly proximal to the galea is the unsegmented maxillary palp (Figs. 206, &210, Wxplp) placed in a colourless circular depression (Fig. 210, Wxplp soc). Besides, there are three sensory spines present in the stipital region (Fig. 210, s). The cardo is stretched from near the posterior tentorial pit to the stipital sclerome. It can easily be differentiated into a small sclerotised yellow proximal part (Figs. 206, 207, 210, &211, Pcd) and a membranous distal part (Fig. 206, 207, 210, dcd). The former extends from near the posterior tentorial pit to the terminus of the maxillary sclerome. This division of cardo is not described by Parker in Polistes gallicus and by Glover in Bracon tachardiae.

The ventral wall of the head capsule in its antero-medial region develops a thick brownish curved sclerotised structure called labio-stipital sclerome (Figs. 206, 207, &211, lsts). Each end of this sclerome fuses with the distal part of the corresponding maxillary sclerome. The semi-circular area thus enclosed in between the mouth and the labiostipital sclerome is the "Prementum" (Figs. 206, 207, &211, pm). The remaining membranous area of the ventral wall may be regarded as "Post mentum" (Figs. 206, 207, &211, postm). It is evident that the whole ventral wall becomes "Labium" or the lower lip (Fig. 206, Lb). The proximal and distal parts of the lower lip have been termed as "sub-mentum and labium respectively by Parker in Polistes Gallicus instead of &211 post mentum and prementum as suggested by the present
Besides, Parker has not shown any line of demarcation between the two parts of the lower lip. There are four sensory spines (Fig. 211, a), originating from prementum slightly posterior to the palpi (Figs. 206, 211, LbPlp).

The hypopharynx (Fig. 207, Hphy) is an elongated structure consisting of two lateral walls (Fig. 207, Hwiphy) which are joined with one another in the proximal region by a small transverse wall (Fig. 207, Twiphy). It roofs the free distal margin of the prementum and forms a cavity opening by a slit like aperture above the prementum close to the middle of its free distal margin. There is no spinneret.

Cocoon formation:

The larva spins a cocoon for itself after the fourth ecdysis if the latter synchronizes with the exhaustion of the host. It is incorrect to say that feeding is totally stopped after the fourth moult. The larva has invariably been found busy in finishing up its food which is generally consumed within few hours of the ecdysis. Sometimes, though very seldom, it has been found busy in eating up the food for another twenty-four hours after ecdysis. Such cases are very rare. Generally within a period of twenty-four hours after the fourth moult a cocoon is spun by the larva. In the beginning the cocoon is a delicate silky texture which later on becomes a thick, but translucent, complete parchment like covering all round the larva. Internally the cocoon is perfectly smooth while externally it is rather rough. It is slightly longer than the size of the larva; but has no shape of its own which is totally dependent upon the tunnel of the host.
PRERNUAL STAGES (Fig. 204).

During short period generation the larva though inside the cocoon is still active and retains all the salient features of a typical larva described above till the end of the sixth day after fourth moult. This period of six days may be regarded as duration of 5th larval stage. By the expiry of the sixth day the larva becomes inactive, passes out faecal matter of brownish colour enveloped probably within its peritrophic membrane (dejecta) and acquires the shape of a prepupa, though it is still inside the last i.e. fifth larval moult. At the termination of the seventh day the fifth larval skin is cast off; and the prepupa has transformed itself into a colourless pupa. This shows that the whole length of the seventh day (about twenty-four hours) is the prepupal period (Table. No.3). In certain cases prepupal duration has been found to end slightly earlier to the expiry of the seventh day. Such cases are rare. It may be noted that the length of period ranging between the fourth and the fifth moultings is almost doubled during long-period generation.

The prepupal body loses its dorsal curvature, and all the three regions of the body fall almost in a straight line (Figs. 204A,B, n, Th, Abd). Two marked constrictions appear, one in between the head and the thorax regions and the other in between the first and the second abdominal segments (Fig. 204A,B, aAb). The thoracic region is markedly swollen (Fig. 204A,B, Th). The eye spots become faintly visible (Fig. 204A,B, E). Antennal buds are everted out as a pair of stumpy unsegmented structures (Fig. 204A, Ant). Labial bud protrudes out as a small trough with
undivided labial palpi hanging from its distal portion (Fig. 204B, Lb). The maxillary buds bulge out on either side of the labium with undivided maxillary palpi at their distal halves (Fig. 204B, Mx).

The thorax of the prepupa exhibits evagination of two pairs of wing-buds in its second and third segments (Fig. 204A, v1a2). These wing-buds are just like small paddles resting on the sides. Each of the three thoracic segments in the posterior half of its venter contains a pair of retort-shaped eversed out leg-buds (Fig. 204B.1, 2a33).

In the case of female the abdomen at its distal end exhibits evagination of valvular buds in the form of five short flappy processes. Two of them are dorsal and may be regarded as third pair of valvulæ in miniature (Fig. 204C, 3v1); one of them is centrally placed and may be taken as "Fused second pair of valvulæ" or "Stylet" (Fig. 204C, 2v1). The remaining two are ventral most which will eventually develop into first pair of valvulæ or "Lanceta" (Fig. 204C, 1v1).

Morris in the case of "Prepupal stages in Ichneumonidae" has split up prepupal stage in two distinct stages viz; eonymphal and pronymphal stages of prepupa. The eonymphal of ichneumonids, more or less, is similar to the fifth larval stage of Steno-bracoidea sec. From Morris's own account it is evident that the eonymphal stage retains comparatively more characteristic features of a full-grown larva than those of a prepupa. Hence there seems to be no reason in hammering out a new stage which has no morphological support to demarcate it from the last larval stage. This objection of the present writer is driven
further deep if one goes through the description of the prepupal stage given by Morris, which is exactly similar to the pupal stage of Steno-bracon deceae.

Pupal stage—(Fig. 205)

The prepupa transforms into a colourless pupa of "Exarate type" at the expiry of the seventh day after fourth moult. The pupa is a typical hymenopterous type. After few days pigmentation of the body starts from the head region. The ovipositor (Fig. 205.c) which retains the fifth larval moult in its distal region (Fig. 205.d), is last to get pigmented. The fifth larval cast-skin or exuvia retained at the tip of the ovipositor is shed either in toto or in fragments at the time of emergence, there is as a matter of fact no pupal moult. It may be noted that maximum proportion of successful emergence is above 90%.

The period between the fourth moult and the emergence is of seventeen to twenty-one days duration. This is the period in which the parasite remains within a cocoon. The actual pupal duration is ten to fourteen days. These periods become almost double during long period generation (Table No. 1). The total number of days required from the time of egg-laying up to emergence varies from twenty-two to twenty-six days in short period generation; while during long period generation it becomes forty-six to fifty-eight days (Table No. 1).

Delayed Emergence—

The present writer has not overlooked the fact that Juar crop in general, and sugar-cane rarely, are stocked in stores and godowns where the range of temperature is below that of the field temperature during winter season. In order to see wh
of the two types of generations is followed by the parasite's larva a number of experiments were made. The observations revealed that larvae in stored-stems take longer time to emerge than those in fields. Such cases have been labelled by the present writer as "Delayed emergence" cases. Each at an average takes about one-hundred-and-four day (Table. No.2).

The occurrence of delayed emergence cases has convinced the present writer that there is no possibility of total disappearance of parasites. Nor there can be any break in its life-cycle in any part of the year.

**Parthenogenesis:**

The phenomenon of parthenogenesis is very common during winter and less common in the remaining part of the year. The imagines emerged out parthenogenetically were invariably males.

**Longevity:**

The maximum longevity of a parasite both male and female after emergence is fifty-one days. The average longevity of male is thirty-seven days. These age limits fall down during pre-winter days. The females invariably die soon after they have finished egg-laying.

**Directions for rearing:**

In laboratory, generally, the parasites neither exhibit so much vigour as is normally witnessed in them in the fields nor they attain maximum longevity. Besides females appear never to lay maximum number of eggs in captivity. All these drawbacks are caused by the parasites being highly sensitive to unhygienic environments. In order to overcome the drawbacks it would be advisable to take the following precautionary measures
at the time of breeding Stano-bracocon disease.

(a) The sand of the oviposition-tubes and breeding troughs should be changed weekly.

(b) Fresh and healthy stem-pieces should be used for borers above.

(c) Stem-pieces should not be allowed to dry up and shrink. In such a condition heat tells upon the parasite larva which turns yellow and ultimately dies.

(d) That part of the stem-piece which is inside the sand should not contain the parasite larva with its host; as there is every possibility of the stem being attacked by a white fungus which takes no time in destroying the larva.

(e) A borer larva developing innumerable black spots on its integument should not be used for further feeding. It is some fungal disease which ultimately destroys the parasite larva as well.

(f) The feeding trough should be washed daily in running water, and later on, dried, if possible in sun strongly light. Secondly cotton pieces soaked in food solution should be changed twice a day. These will not allow the stink caused by decomposition of food on being mixed with fecal matter, to accumulate in the feeding trough and perhaps to act upon the parasite as fumigant.

(g) Cotton pieces should be imperfectly soaked in food solution so that there can be no smearing at the bottom with the solution. If the solution gets spread it will make the whole bottom slippery. Secondly at maximum temperature the bottom becomes sticky with which legs and wings of the parasites get stuck and ultimately break.
In this connection it may also be mentioned that ants are the most ferocious enemies of the parasite. They make a mass attack on adult parasites, cut them into pieces, and drag them away to their nests. They can reach the cage through electric connection, even if the cage is kept on a table with pods filled with water below its legs. Hence in order to avoid their approach the plug point should be smeared with captcha. As the latter is non-volatile, therefore, it would not be necessary to smear the plug point frequently.

Importance of the parasite in the control of borers-

The parasite invariably attacks all the three types of borers of sugar-cane and Juar crops, and is therefore useful in the control of all of them. It's life-cycle is comparatively shorter than that of the host with the result that there is every possibility of its attaining greater number of generations in a year than the host.

The presence of a long ovipositor helps the parasite to attain greater percentage of success in parasitizing the host.

The habit of laying one egg per host coupled with the instinct of attacking healthy and active hosts tends to enhance the percentage of success in the control of borers.

The practice of delayed emergence saves the parasite from being confronted with the problem of tiding over the off-season. Over and above it, the habit of utilizing Saccharum sp. by borers as their alternate hosts enables the parasite to breed upon them in areas where Saccharum sp. are growing till the sugar-cane or Juar crop has developed infestation of the borers.
This shows that there is no possibility of any break in the life-cycle of the parasite in any part of the year. Lastly it may be noted that so far no hyper-parasite of this parasite has been reported.

From the fore-going account it is obvious that *Steno-bracaon deesa* is of potential importance as a parasite for the control of borers provided its release in fields at a large scale is well-timed and well calculated.

THE INTERNAL ANATOMY.

The Digestive System

The alimentary canal consists of three main parts namely (i) fore-gut, (ii) mid-gut and, (iii) hind-gut. These regions can be seen from outside without dissecting the larva while it is feeding and has not undergone the 2nd ecdysis.

The fore-gut is a short tube extending from mouth to the posterior region of the prothorax. Its anterior part in front of the brain is called "Anterior pharynx" which is dorso-ventrally compressed (Fig. 212A, Aphy). The membranous dorsal wall of the anterior pharynx is fused with the free lower margin of the labrum while the ventral wall is considerably sclerotized in its middle. This sclerotized plate may be termed as "Pharyngeal plate" which anteriorly ends with the posterior margin of the hypopharyngeal roof.

The remaining part of the fore-gut from anterior pharynx to the foramen magnum is narrower as compared to the anterior pharynx and may be called "Posterior pharynx" (Fig. 212A, Pphy). The walls of the posterior pharynx are totally membranous. It
passes below the brain and in between the circumoesophageal commissures to meet the oesophagus at the junction of the head with the thorax.

Parker’s "epipharyngeal pump" in Macrocanthus gifuensis or Mazaffar’s "pharynx" in Rhogas testaceus represents the combined anterior and posterior pharynx of the present writer. They have failed to split up the pharynx into its two distinct parts. The present writer considers the anterior pharynx mainly responsible for sucking purposes; while the posterior pharynx besides helping the anterior pharynx in sucking, serves like a passage for food to descend into the oesophagus. The oesophagus is the last part of the fore-gut lying in the prothorax. It is a short tube of uniform thickness and connects the posterior pharynx with the mid-gut (Fig. 212AOcc).

The mid-gut is the longest part of the alimentary canal occupying the whole length of the body except one anterior and two posterior segments. It is oval shaped with tapering ends and broad mid region. Anteriorly it receives the oesophagus and posteriorly ends into the hind-gut (Fig. 212A.mg).

The hind-gut (Fig. 212A.hg) is a short tube running in the 12th and 13th segments of the body or the 9th and 10th abdominal segments. The anterior part of the hind-gut joins the mid-gut (Fig. 212B.mg) and receives the two malpighian tubules in its proximal region (Fig. 212AA.mt). It may be called "Ileo-colon" (Fig. 212B.Ileo1) which distally ends with the posterior part of the hind-gut namely "Rectum" (Fig. 212A&B.Rect). The dorsal wall of the rectum at its union with the ileo-colon swells out in the form of a blind pouch called "Rectal diverticulum" (Fig.
245.

The rectum ends by a transverse slit called "Anus" at the junction of the tergum and sternum of the last body segment (Fig. 212A&B,An). From diverticulum to the anus it becomes gradually tapering and dorso-ventrally compressed.

**Principal Silk Gland:**

There is a pair of silk glands. Each gland (Fig. 212A,Rs1kg1) bifurcates into two convoluted tubes in the anterior region of the abdomen. The lower branch (Fig. 212A,lbs1kg1) spreads over the latero-ventral surface while the upper (Fig. 212A,ubs1kg1) over the latero-dorsal surface of mid-gut upto the latter's junction with the hind-gut. Each silk gland from the point of bifurcation upto the anterior region of the prothorax runs laterally along the digestive tract almost like a straight tube free from convolutions. Later on it enters the head region passing ventral to the transverse tentorial bar and tappers down into a narrow ducts running on the sides of the respective circumoesophageal connective (Fig. 212A&C,LS1kg1d,RS1kg1d). On entering the hypopharynx it fuses with its sister duct of the other side to form a common duct. This common duct (Fig. 212A, slkg1cd) of the silk glands ends with a slit like aperture in the distal region of prementum below the mouth.

**Accessory Silk Gland:** (Fig. 212A&C,Asg1).

It is a convoluted glandular tube lying below the 1st thoracic ganglion. Its small duct (Fig. 212C,Asg1d) passing below the suboesophageal ganglion enters the hypopharynx (Fig. 212C,Hphy) guarded on either side by two ducts of principal silk glands. The common duct of the principal silk glands receives that of the accessory silk gland. The present writer
considers this gland as an accessory to the principal silk glands. This unpaired gland has not so far been described by Parker, Vance and others. In order to ascertain if the present writer made numerous dissections and in all cases the gland was found present.

There is a pair of long equisized cylindrical malpighian tubules originating from the ventral wall of ileo-colon. These run free from convolutions attached to the ventral wall of the mid-gut and end in the prothorax as narrow blind tubes.

**Respiratory system:**

The respiratory system consists of two lateral trunks of cross uniform section extending parallel to each other but on either sides of the body from prothorax to the 8th abdominal segment (Fig. 213, LTr). Each lateral trunk receives nine small tracheal tubes on its dorsal surface (Fig. 213, d). The anterior most of these nine leads to the 1st spiracle of its side located in the postero-lateral region of the protergum and may be called "First spiracular tube". The remaining eight spiracles of one side are situated in the antero-lateral regions of the 1st eight abdominal terga. The short spiracular tube of each abdominal spiracle ends on the dorsal surface of the lateral trunk of its side when the latter is about to enter into the segment immediately anterior to it. The penultimate and the last segments both of thorax and abdomen do not possess spiracles with the result that the total number of spiracles amounts to nine pairs.

Slightly anterior to the junction of the spiracular tubes in each of the spiracle bearing segment with the lateral trunk the latter gives out a trachea from its mesal surface, called
"Dorsal tracheae" (Fig. 213, b). This gives off two branches; one posterior which spreads over the dorsal region of the same segment (Fig. 213, c) and the other anterior which supplies to the segment placed anterior to it (Fig. 213, a). The lateral trunk from its ventral surface and slightly posterior to the spiracular tube gives out a branch called "Ventral tracheae" which branches into two (Fig. 213, e). The posterior one of the two branches meets its sister branch of the other side of the same segment to form a loop called "Ventral loop" (Fig. 213, g); while the anterior one spreads over the ventral region of the same segment and the segment anterior to it (Fig. 213, f). In the posterior region of the mesothorax each lateral trunk gives out a dorsal and a ventral tracheæ (Fig. 213, b, e) which are exactly similar in all respects to their sister branches in the spiracle-bearing segments.

Each lateral trunk enters the head capsule as a single narrow tube which later on divides into minute branches (Fig. 213, k, l). Posteriorly it is extended into the 10th abdominal segment where it ends by two branches (Fig. 213, m, n). On its way and before leaving the 9th abdominal segment it gives off a dorsal and a ventral branches which spread over the corresponding regions of the 9th segment (Fig. 213, b, e).

**Circulatory System**

The heart is a long unconvoluted tube. It is stretched from the anterior region of the 10th abdominal segment to the brain running mid-dorsally over the whole length of the alimentary canal. It is not allowed to rest on the digestive tract, as it superficially appears due to the presence of membranous dorsal
diaphragm running ventrally to its whole length (Fig. 214, DDph). The dorsal diaphragm consists of twelve pairs of membranous triangles arranged on either side of the heart from mesothorax to the 9th abdominal segment in equal number i.e. twelve triangles on each side. The apex of each triangle is fixed in the inter-tergal groove; while its base fuses with the base of the corresponding triangle beneath the heart. Besides each triangle meets near the base by its anterior side with the posterior side of the triangle placed anterior to it. This condition makes the dorsal diaphragm a continuous structure over which the heart actually runs. No trace of this diaphragm is found in the 1st and last body segments and also in the head region.

The dorsal surface of each triangle is traversed by few muscle fibres originating from its apex and ending on the corresponding lateral part of the heart. These twelve pairs of allary muscles are prominent in the abdominal region and keep the heart stretched in position (Fig. 214, DDphMel). The presence of dorsal diaphragm sets off the "Dorsal sinus" from the "visceral sinus" both being in communication through the inter-triangular spaces on either side of the heart.

The ventral diaphragm is a continuous oval shaped membranous sheet stretched from mesothorax to the 9th abdominal venter (Fig. 215, VDph). Excepting the two lateral margins which are fixed on the respective sides of the venter the remaining whole of the ventral diaphragm is free (Fig. 215, Lmar).

Dorsally the diaphragm is covered over by transverse more or less parallel muscle fibres which constitute the "Ventral
transverse muscles" of the abdominal musculature (Fig. 215.vDph-Mel). The presence of the ventral diaphragm sets off "Ventral sinus" from the "Visceral sinus". The ventral sinus contains the ventral nervous system; while the visceral sinus encloses principal internal organs. Unlike dorsal sinus the ventral sinus is in communication with the visceral sinus only in the 1st and the last body segments which lack extension of the ventral diaphragm in them. Besides, there is no trace of ventral diaphragm in the head region.

The heart contains four pairs of ostia (Fig. 214.ost) situated dorso-laterally at equidistance in the abdominal region. These divide the heart into five distinct chambers.

**Typical chamber**

A typical chamber is a cylindrical tube with anterior region (Fig. 214.3ante) tapering out like jet of a glass-funnel; while the posterior end (Fig. 214.4poste) expands and takes up the shape of the funnel's head. The posterior end of a chamber receives the anterior end of the preceding chamber; and a pair of oblique narrow space thus left between them becomes the pair of ostia in that region (Fig. 214.ost). All typical chamber, besides, these characteristics are equal in size as well. Such chambers are the 2nd, 3rd, and 4th chambers. The 1st chamber i.e. posterior most, has no funnel-like head nor there is any ostium possessed by it. The size of this chamber is comparatively smaller. The 5th chamber is longest in all and its anterior jet-like terminus is not visible on account of being merged into the aorta. The short narrow aorta occupies the thoracic region and ends over the posterior pharynx below the brain.
The whole nervous system can be divided into two parts according to its disposition (1) Cephalic part, (II) Body region. The cephalic part consists of a bilobed brain placed in the dorsal region of the head slightly posterior to the antennal sockets (Fig. 216, Br). The three typical parts of the brain cannot be differentiated. The ventral side of the brain gives out a pair of small and thick nerves called "Circumpharyngeal" connectives (Fig. 216, Cirphycod), which meet with the dorso-anterior surface of the suboesophageal ganglion (Fig. 216, SubOng). The latter gives out two nerves from its posterior region to join with the 1st thoracic ganglion (Fig. 216, ThOng).

In the body region there are eleven ganglia connected with one another by a pair of small separate and parallel interganglionic connectives (Fig. 216, IntOngcon). Each ganglion appears to be composed of two oval mass fused by their mesal surfaces. The three thoracic ganglia (Fig. 216; 1, 2, 3, ThOng) are bigger as compared to the eight abdominal ganglia and are placed in the posterior half of the respective venter. Each thoracic ganglion gives out two pairs of transverse nerves (Fig. 216, Tranv). The eight abdominal ganglia (Fig. 216, 1-8, AbdOng), are placed in the posterior halves of the 1st eight abdominal venters; and a pair of transverse nerves come out from each. The eighth ganglion is biggest in all and sends out four pairs of nerves.

The Reproductive System-

The reproductive system are present in rudimentary form and have yet to develop its various components. These parts probably crop up somewhere after the larval period has ended.
Male Reproductive System—(Fig. 217A.)

The male reproductive system consists of a pair of oval testes (Fig. 217A.Tes.) placed latero-ventrally to the digestive tract in the eighth abdominal segment. Each testis from its posterior end develops a thin tube called Vas deferens (Fig. 217A.Vd) which, running in mesoventral direction, ends slightly anterior to the developing genitalia. Each vas deferens swells out at its terminal end which definitely does not enter of fuse with the genitalia (Fig. 217A.Vds). This system appears as early as the larva after first ecdysis.

Female Reproductive System—

In the seventh segment the two ovaries are situated on either side of the digestive tract. Their terminal filaments twist round each other dorsally across the gut. The two short oviducts running ventro-mesally end at six bay into a pair of ampullae.

Male Genitalia—(Fig. 217B).

The male genitalia makes its first appearance in the larva after first moult as a pair of oval ectodermal thickenings (Fig. 217B.db) on the posterior half of the ninth abdominal sternum (Fig. 217B.Xst). These are placed so close to one another that it becomes rather difficult to regard them as two thickenings and not one. In the subsequent larval stages these become distinctly separate from one another and get lodged in a genital chamber (Fig. 217B.gc) which is externally covered over by the body cuticle. In the last larval stage each thickening is partly split up into two by an incomplete oblique split (Fig. 217B.s) starting from its anterior margin (Fig. 217B.Antmardb).
and ending before reaching the opposite margin (Fig. 217B. Post mardb).

Regarin in Pteromalus (braconid) describes the first appearance of the genitalia when the larva is about 2 mm long. Had he given the particular larval stage in which the genitalia makes its first appearance instead of size of the larva his account would have been of greater value to the entomologists for making a comparative study on the development of male genitalia in insects.

**Female genitalia**-(Fig. 217C).

There are two pairs of buds. The anterior pair (Fig. 217C.db) is placed within the genital chamber (Fig. 217C.go) concealed beneath the cuticle in the middle of the eighth abdominal sternum (Fig. 217C.VIIIst). The genital chamber is on its way to divide into two lateral halves, each with a bud in it, due to anteriorly directed bend (Fig. 217C.b) in the middle of its posterior margin (Fig. 217C.Postmargc). The buds remain oval shaped and do not undergo any modifications during larval period.

The posterior pair of buds (Fig. 217C.db) is located in the posterior half of the ninth sternum (Fig. 217C.IXst) exactly in the manner described for the anterior pair. Here the genital chamber (Fig. 217C.go) is perfectly split up into two lateral halves with a bud in each. Each bud hanging from the anterior margin (Fig. 217C.Antmargc) of the respective half of the genital chamber, is partly divided into an outer and an inner halves due to the appearance of anteriorly directed invagination on its posterior surface (Fig. 217C.Inv).
### Table No. 1.

**Seasonal variations in life history-durations**

from July to February with over 200 cases from different females under experiment.

<table>
<thead>
<tr>
<th>Various Stages of the Life History</th>
<th>Duration during winter pre-period</th>
<th>Duration during winter pre-period</th>
<th>Range of Temp.</th>
<th>Range of Temp.</th>
<th>Humidity</th>
<th>Range of F</th>
<th>Range of F</th>
<th>Max.</th>
<th>Min.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Stadium of larva.</td>
<td>44-50 hrs.</td>
<td>24 hrs.</td>
<td>Do.</td>
<td>Do.</td>
<td>65°</td>
<td>70°</td>
<td>75%</td>
<td>65%</td>
<td>75%</td>
</tr>
<tr>
<td>2nd stadium of larva.</td>
<td>Do.</td>
<td>Do.</td>
<td>Do.</td>
<td>Do.</td>
<td>65°</td>
<td>70°</td>
<td>75%</td>
<td>65%</td>
<td>75%</td>
</tr>
<tr>
<td>3rd &quot; &quot;</td>
<td>Do.</td>
<td>Do.</td>
<td>Do.</td>
<td>Do.</td>
<td>65°</td>
<td>70°</td>
<td>75%</td>
<td>65%</td>
<td>75%</td>
</tr>
<tr>
<td>4th &quot; &quot;</td>
<td>Do.</td>
<td>Do.</td>
<td>Do.</td>
<td>Do.</td>
<td>65°</td>
<td>70°</td>
<td>75%</td>
<td>65%</td>
<td>75%</td>
</tr>
<tr>
<td>5th &quot; &quot;</td>
<td>11-13 days, 5-6 days.</td>
<td>Do.</td>
<td>Do.</td>
<td>Do.</td>
<td>65°</td>
<td>70°</td>
<td>75%</td>
<td>65%</td>
<td>75%</td>
</tr>
<tr>
<td>Prepupal Stage.</td>
<td>44-50 hours.</td>
<td>24 hrs.</td>
<td>Do.</td>
<td>Do.</td>
<td>65°</td>
<td>70°</td>
<td>75%</td>
<td>65%</td>
<td>75%</td>
</tr>
<tr>
<td>Pupal stage i.e. period after 5th moult till emergence</td>
<td>20-30 days, 10-14 days.</td>
<td>Do.</td>
<td>Do.</td>
<td>Do.</td>
<td>65°</td>
<td>70°</td>
<td>75%</td>
<td>65%</td>
<td>75%</td>
</tr>
<tr>
<td>Total duration from egg-laying till emergence</td>
<td>46-53days, 22-26days.</td>
<td>Do.</td>
<td>Do.</td>
<td>Do.</td>
<td>65°</td>
<td>70°</td>
<td>75%</td>
<td>65%</td>
<td>75%</td>
</tr>
</tbody>
</table>
### Table No. 2.

**Cases of Delayed Emergence.**

<table>
<thead>
<tr>
<th>Eggs laid on.</th>
<th>Emergence on.</th>
<th>Total No. of Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>11th Nov. 1944.</td>
<td>13th February 1945.</td>
<td>93 days.</td>
</tr>
<tr>
<td>14th October 1944.</td>
<td>5th February 1945.</td>
<td>113 Days.</td>
</tr>
<tr>
<td>5th November 1944.</td>
<td>13th February 1945.</td>
<td>104 Days.</td>
</tr>
<tr>
<td>13th November 1944.</td>
<td>1st March 1945.</td>
<td>118 Days.</td>
</tr>
<tr>
<td>30th December 1944.</td>
<td>1st April 1945.</td>
<td>92 Days.</td>
</tr>
</tbody>
</table>

**Average 104 Days.**

### Table No. 3.

**Chart of Preupal Stages.**

<table>
<thead>
<tr>
<th>4th Ecdysis on.</th>
<th>7th day begins on.</th>
<th>Prepupa starts on.</th>
<th>Prepupa ends on.</th>
<th>Duration of prepupal stage.</th>
</tr>
</thead>
<tbody>
<tr>
<td>23rd. &quot;</td>
<td>&quot;</td>
<td>29th &quot;</td>
<td>&quot;</td>
<td>29th &quot;</td>
</tr>
</tbody>
</table>
Table. No. 4.

Record of variations in the length of the larval body including head and in the length of the head only in various stadia.

<table>
<thead>
<tr>
<th>Parts of the larva</th>
<th>Newly hatched</th>
<th>Larva after 1st moult.</th>
<th>Larva after 2nd moult.</th>
<th>Larva after 3rd moult.</th>
<th>Larva after 4th moult.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Newly hatched</td>
<td>after 1st moult.</td>
<td>after 2nd moult.</td>
<td>after 3rd moult.</td>
<td>after 4th moult.</td>
</tr>
<tr>
<td></td>
<td>larva.</td>
<td>first moult.</td>
<td>2nd moult.</td>
<td>3rd moult.</td>
<td>4th moult.</td>
</tr>
<tr>
<td>Length of larva</td>
<td>1.75 mm.</td>
<td>3.2 m.m.</td>
<td>5.6 m.m.</td>
<td>8.6-9.5 m.m.</td>
<td>13-16 m.m.</td>
</tr>
<tr>
<td>Length of larval</td>
<td>0.38 m.m.</td>
<td>0.44 m.m.</td>
<td>0.52 m.m.</td>
<td>0.86 m.m.</td>
<td>0.94 m.m.</td>
</tr>
<tr>
<td>head.</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Table. No. 5.

<table>
<thead>
<tr>
<th>Instars</th>
<th>Calculated width of the head of larva.</th>
<th>Observed width of the head of larva.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newly hatched</td>
<td></td>
<td>0.42 m.m.</td>
</tr>
<tr>
<td>Larva after 1st</td>
<td>0.42 x 1.3 = 0.546 m.m.</td>
<td>0.58 m.m.</td>
</tr>
<tr>
<td>moult.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Larva after 2nd</td>
<td>0.546 x 1.3 = 0.7 m.m.</td>
<td>0.8 m.m.</td>
</tr>
<tr>
<td>moult.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Larva after 3rd</td>
<td>0.7 x 1.3 = 0.91 m.m.</td>
<td>1.08 m.m.</td>
</tr>
<tr>
<td>moult.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Larva after 4th</td>
<td>0.91 x 1.3 = 1.183 m.m.</td>
<td>1.42 m.m.</td>
</tr>
<tr>
<td>moult.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Application of Dyar's Law to Stenobracon deccas's larvae:

The table No. 5. deals with the observed and calculated head-width of the larva in its five instars. It indicates that the increase in the width of the head of Stenobracon deccas
follows a regular geometrical progression in successive instars as envisaged under Dyar's Law. The ratio of increase in the width of each instar is 1.3 which can be had by dividing each observed number in the series by the one which precedes it. The approximation of the observed to the calculated measurements is so close that there is no probability of an ecdysis being overlooked. It can now be said that Dyar's Law is applicable on Steno-brason deesae as well.
<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>8.</td>
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<td>... 1940. Investigations on Spatius ericola (Nixon), an important braconid parasite of the cotton stem weevil (Pempheres affinis Fast) of South Ind. - Ind. Journ. Agric. Soc. Vol. X, part VI.</td>
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<tr>
<th>No.</th>
<th>Author</th>
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<tr>
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<td>&quot; &quot;</td>
<td>1920</td>
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<td>&quot; &quot;</td>
<td>1941</td>
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<thead>
<tr>
<th>No.</th>
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<tr>
<td>77</td>
<td>Henson, H.</td>
<td>1929</td>
<td>On the development of the mid-gut in the larval stages of Vanessa urticae (Lepidoptera) - Q. J. M. 3, Vol. 73, pp. 103.</td>
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<td>&quot;</td>
<td>1931</td>
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<td>Bruces, C.T.</td>
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<td>Metcalfe, M.E.</td>
<td>1932</td>
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<td>&quot;</td>
<td>1932</td>
<td>Note on structure and development of the reproductive system in Philaenus spumarius—Q.J.M.S. Vol. 75, No. 299.</td>
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<td>Cameron, E.</td>
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<td>Morris, K.R.S.</td>
<td>1937</td>
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<td>Parker, D.L.</td>
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<td>Tiegé, O.W.</td>
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<td>Wigglesworth, V.B.</td>
<td>1929</td>
<td>Digestion in the Tsetse fly - a study of structure and function - Parasitology. Vol. XXI.</td>
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<td></td>
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</table>
ABBREVIATIONS USED ON THE FIGURES OF THE HEAD REGION.

Aeon, antennal concavity.
ALIP, anterior lingual plate.
AmarO, anterior margin of outer region.
APhy, anterior pharynx.
Artcém, articular concavity of margin of foramen magnum.
AShe, antennal socket.
AZ, anterior tentorial arm.
BSPgl, basal sclerite of paraglossa.
C1p, clypeus.
ChSt, central region.
CrSt, ridge of the stipes.
DId, dorsal part of scapes.
distal rim.
E, eye.
EA, epipharyngeal bar.
es, epistomal suture.
FRGng, frontal ganglion.
Gc, galea.
HB, hypostomal bridge.
hs, hypostomal suture.
ImerC, innermargin of C. region.
Lb, labium.
Lm, labrum.
Li, ligula.
Lum, lumen.
Mes, mesal cardo.
Mth, mouth.
Oc, ocellus.
Ocd, outer cardo.
Ofr, oral fossae.
orifice of salivarium.
Osc, ocular sclerite.
OR, outer region.
Pgl, paraglossa.
PPmt, proximal part of prementum.
PhDi, pharyngeal diverticulum.
Pgl, post genal lobe.
Poc, post occipital sclerite.
PR, pleurostomal ridge.
Psl, pleurostomal suture.
Phyp, pharyngeal plate.
PhPa, posterior arm of pharyngeal plate.
pF, pin.
S, scape.
St, stipes.
af, antennesae.
Amar I, anterior margin of inner region.
Amar, anterior margin of facial wall, and internal apodeme of pedicel.
ARKSc, articular knob of the scapes.
ARKPe, articular knob of the pedicel.
at, anterior tentorial pit.
BPGl, body of paraglossa.
BSLe, basal sclerite of lacinia.
Cd, cardo.
conj, conjunctiva.
CS, epicranial suture.
DAphy, dorsal wall of anterior pharynx.
Damr, foramen magnum's dorsal margin.
DRPe, dorsal part of proximal rim of pedicel.
ER, epistomal ridge.
FR, foramen magnum.
FC, preoral food channel.
FR, frons.
Ge, genna.
Hphy, hypopharynx.
Hst, hypostomal sclerite.
IReg, inner region.
LC, lacinia.
LbPip, labial palp.
Lin, lingua.
M, mandibular articulation.
M, mandible.
MxFip, maxillary palp.
OC, occiput.
OC, ocular pharynx.
Ocs, occipital suture.
Oso, occular suture.
OmarC, outer margin of central region.
P, pedicel.
PLIP, posterior lingual plate.
PPhy, posterior pharynx.
Pge, post genna.
PIs, pleurostoma.
pos, post occipital suture.
PSTe, pivotal sclerite of lacinia.
PT, posterior tentorial arm.
PHea, anterior arm of pharyngeal plate.
PhDi, pharyngeal diverticulum.
Pram, prementum.
RNV, recurrent nerve.
SPmt, spatulate process of prementum.
tb, tentorial transverse bar.
VdrSe, ventral part of distal rim of scape.
Vmar, foramen magnum's ventral margin.
V Fe, ventral wall of pre-oral food channel.

VprPdt, ventral part of proximal rim of pedicel.
Vr, vertex.
WhpHy, wall of hypopharynx.

ABBREVIATIONS USED ON THE FIGURES OF THE PROTHORACIC REGION.

a, submarginal ridge of the mesal long. margin of the ventral plate of propleuron.
Antr, anterior transverse ridge of prothoracic endosternum.
b2, posterior divergent arm of mesal long. margin of ventral plate of propleuron.
Bpm, prenotal posterior margin's bridge.
Bam, median bridge's anterior marginal inflection.
BSlm, basisternal lateral margin.
Cz1, procoxa.
Cz2, procoxal articular process.
d2, lateral process of basisternum.
Dpl, dorsal plate of propleuron.
Dplp, depressor's apodemal plate.
Endstcn, endosternal concavity for articulation.
Fp, posterior triangular plate of furcasternum.
j, outer margin of dorsal plate.
Lavm, prenotal lobe's antero-ventral margin.
Ldsm1, prenotal lobe's dorsal submarginal inflection.
Lpvm, prenotal lobe's postero-ventral margin.
MB, central bridge of premestum.
mg, median groove of prothoracic endosternum.
mars2, mesal marginal inflection of supra neural bridge.
OP, occipital process of propleuron.
Pl1, propleuron.

Antg, prothoracic endosternum's anterior transverse groove.
ar, submarginal ridge of the mesal margin of ventral plate.
b, mesal long. margin of the ventral plate of propleuron.
b1, anterior divergent arm of the mesal long. margin of ventral plate of propleuron.
bs, basisternal suture.
Bam, prenotal anterior margin's bridge.
Bpm, median bridge's posterior marginal inflection.
Box, basicoxite.
BS, basisternum of prothorax.
conj, conjunctiva.
CerAp, servical apodeme of occipital process.
Cz2, procoxal rim.
d1, anterior process of basisternum.
Dmar1, dorsal marginal inflection of supra neural bridge.
Dap, depressor's apodeme.
DFor, dorsal rim of foramen magnum.
Endstarn, endosternal articular knob.
For, foramen magnum.
Fsp, furcasternal pit.
hoAp, horizontal apodeme of propleuron.
L, prenotal lobe.
Ldm, prenotal lobe's dorsal margin.
Lavm, prenotal lobe's antero-ventral marginal inflection.
Lpvm1, prenotal lobe's postero-ventral marginal inflection.
Lmar1, lateral marginal inflection of supra neural bridge.
mmr, median ridge of prothoracic endosternum.
N1, pronotum.
NP, neural's foramen.
Occen, occipital concavity for articulation of occipital process.
OspP, attachment peg for occlusor muscle of 1st thoracic spiracle.
**ABBREVIATIONS USED ON THE FIGURES OF THE MESOTRTHORACIC REGION.**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accon</td>
<td>Articular concavity of mesocoxal rim.</td>
</tr>
<tr>
<td>Ak3x</td>
<td>Mesocoxal articular knob.</td>
</tr>
<tr>
<td>Al</td>
<td>Anterior lamella of meso-post phragma.</td>
</tr>
<tr>
<td>Ar72</td>
<td>Anterior spine of mesofurcal bridge.</td>
</tr>
<tr>
<td>B2x</td>
<td>Second axillary selerite of fore-wings.</td>
</tr>
<tr>
<td>Bo</td>
<td>Basicostal suture.</td>
</tr>
<tr>
<td>BoD</td>
<td>Basalare dorsal knob.</td>
</tr>
<tr>
<td>C3</td>
<td>Long carina of postero-lateral lobe of scutum.</td>
</tr>
<tr>
<td>Cx2</td>
<td>Mesocoxa.</td>
</tr>
<tr>
<td>Cx2pr</td>
<td>Mesocoxal sockets posterior rim.</td>
</tr>
<tr>
<td>Cx2RI</td>
<td>Mesocoxal rist internal inflection.</td>
</tr>
<tr>
<td>F3s</td>
<td>Trochantin of 3rd axillary.</td>
</tr>
<tr>
<td>Fpp</td>
<td>Furcal pit.</td>
</tr>
<tr>
<td>Hf2</td>
<td>Horizontal plate of meso-endosternum.</td>
</tr>
<tr>
<td>Hf2s</td>
<td>Stalk of the horizontal plate of the meso-endosternum.</td>
</tr>
<tr>
<td>Lamsr2</td>
<td>Laminae of median sternal ridge.</td>
</tr>
<tr>
<td>Mns</td>
<td>Median suture of scutum.</td>
</tr>
<tr>
<td>M2s</td>
<td>Mesonotal margin.</td>
</tr>
<tr>
<td>M2sm</td>
<td>Mesonotal margin's off shoot.</td>
</tr>
<tr>
<td>Nd2d</td>
<td>Dorsal neural foramen of mesoendosternum.</td>
</tr>
<tr>
<td>Nop</td>
<td>Parapsidal suture.</td>
</tr>
<tr>
<td>Ot2a</td>
<td>Outer triangle.</td>
</tr>
<tr>
<td>Pl2an</td>
<td>Mesopleural anterior margin.</td>
</tr>
<tr>
<td>Pl2at</td>
<td>Mesopleural posterior margin.</td>
</tr>
<tr>
<td>Pl2i</td>
<td>Mesopleural oblique ridge.</td>
</tr>
<tr>
<td>Pl2m</td>
<td>Mesopleural dorsal margin's inflection.</td>
</tr>
</tbody>
</table>

**PostJ** | Posterior transverse groove of prothoracic endosternum.|
**Pla** | Pleural apophysis. |
**Snb** | Supra neural bridge. |
**Supb** | Supporting base of furcasternum. |
**Vpl** | Ventral plate of pleuroton. |
**Vrl** | Ventral rim of foramen magnus. |
**Wpl** | Wing plate of endosternum. |
**Wpostmar** | Posterior margin of wingplate. |
Pl₂, mesopleural triangular area.
Pl₂dm, mesopleural dorsal margin.
 póT, mesoprepsectus.
1Ph₃, mesoprephragma.
2Ph₃, mesopostphragma.
2Ph₄, anterior notch of mesopostphragma.
2Ph₅, longitudinal impression of mesopostphragma.
Prec, precoxal area.
p, muscle bearing process of mesopostphragma.
Pl₃R, mesopleural ridge.
Prec, precoxal postero-lateral expansion.
Set₁, scutum.
Set₁, postero-lateral lobe of scutum.
Sel₂, submarginal inflection of the posterior margin of scutellum.
SUR₁, subalar mesopleural ridge.
Tg, tegula.

Pf₄, flange.
Pl₂, mesopleuron.
Pl₂P₂, mesopleural pit.
Pl₂S₂, mesopleural suture.
Pl₁S₃, mesopleural oblique suture.
1P₁, mesoprephragmatic notch.
2Ph₃, anterior margin of mesopostphragma.
2Ph₄, posterior notch of mesopostphragma.
P₁N₂, posterior notal process of mesonotal.
Pl₄, posterior lamella of mesopostphragma.
Prec, prescutum.
Fl₁, 2nd ridge of triangular plate.
3e, semicircular bend of the descending dorsal margin of mesopleuron.
Scl₂, scutellum.
Sclpe₃, posterior margin of scutellum.
sf, mesonotal fissure.
Sph₂, spiracular lobe of the 2nd thoracic spiracle.
t₁, precoxal suture.
t₁₁, transsternal suture.
W₁, true scuto scutellar suture.

ABBREVIATIONS USED ON THE FIGURES OF THE META-THORACIC REGION.

AF₃, metafurcal arm.
Am₃, anterior half of median sternal ridge.
1Ax, first axillary sclerite of hind wings.
3Ax, 3rd axillary sclerite of hind wings.
bc₃, basicostral suture.
Bcz, basicoxite.
conj, conjunctiva.
ex₃, metacoxite.
ex₃ar, anterior rim of meta thoracic coxal socket.
ex₃pr, posterior rim of meta thoracic coxal socket.
ex₃pr₁, posterior rim of meta thoracic coxal socket.
Eps₃, metaepimeron.
Fs₃, metaepisternal furca-sternum.
hstm, humeral sclerite's mesal end.
hstps, humeral sclerite's posterior margin.
msg₃, median sternal groove of meta thorax.

Akm₃, metacoxal articular knob.
Ark₃, articular knob for the pedicle.
ANF₃, anterior notal process of meta-notum.
2Ax, 2nd axillary sclerite of hind wings.
Axx, axillary cord.
Ba₃, basalar.
Bs₃, basisternum of meta thorax.
CT₃, oblique carina of metanotum.
ex₃, metacoxal socket.
ex₃lr, lateral rim of meta coxal socket.
ex₃r, meta coxal rim.
E₃, metaepisternum.
fp₃, meta sternal pit.
hst₃, humeral sclerite.
hstan₃, humeral sclerite's anterior margin.
hstp₃, humeral sclerite's posterior process.
HF₃, horizontal plate of meta-endosternum.
Must₃, subalar muscle's tendon.
Ng₃, metanotum.
N\textsubscript{3am}, meta anterior margin.
N\textsubscript{3pm}, meta notum posterior margin.
N\textsubscript{3}, meta notal ramus.
N\textsubscript{sR}, leaver of metanotal ramus.
Pl\textsubscript{3am}, metapleural anterior margin.
Pl\textsubscript{3dm}, metapleural dorsal margin.
Pm\textsubscript{3r}, posterior half of median sternal ridge.
Pl\textsubscript{3}, metapleuropropodial suture.
Pn\textsubscript{3}, metanotal posterior notal process.
S\textsubscript{3}AR, metasternal anterior submarginal ridge.
Sa, subalarare selerite of meta thorax.

N\textsubscript{3amI}, meta notal anterior marginal inflection.
N\textsubscript{3pmI}, meta notal posterior marginal inflection.
N\textsubscript{sR}, metanotal submarginal ridge.
Pl\textsubscript{3}, metapleuron.
Pl\textsubscript{3amI}, metapleural anterior marginal ridge.
Pl\textsubscript{p}, metapleural pit.
Pl\textsubscript{3s}, metapleural suture.
Pl\textsubscript{A}, metapleural apophysis.
Pl\textsubscript{3Prpl}, metapleuropropodial terminal plate.
Pl\textsubscript{Wp}, metapleural wing process.
S\textsubscript{3}Ag, metasternal anterior submarginal groove.
S\textsubscript{3}PR, metasternal-pleural ridge.
S\textsubscript{3Pr}, metasternopleural suture.
St, subalarare selerite’s tendon.
TD\textsubscript{p}, thoracic depressor’s em apodeme.

ABBREVIATIONS USED ON THE FIGURES OF THE PROPODIAL REGION.

Lim\textsubscript{Pr}, lower half of the lateral margin of propodeum.
Pr\textsubscript{m}, propodeal notch.
Sp\textsubscript{p}, propodeal spiracle.
Ulim\textsubscript{Pr}, upper half of the lateral margin of ridge of propodeum.
3P\textsubscript{p}, prephragma of propodeum.
Pr\textsubscript{p}, propodeum.
Pr\textsubscript{am}, propodeal anterior margin.
Pr\textsubscript{t}, propodeal tooth.
Ulim\textsubscript{Pr}, upper half of the lateral margin of propodeum.

ABBREVIATIONS USED ON THE FIGURES OF THE THORACIC LEGS.

A, con, articular concavity for coxal process.
Ap, apodeme.
be, basicostal suture.
Box, basiconite.
Tar, proximal ventral or dorsal rim of basitar-
TarFV, sus.
con, conjunctiva.
con\textsubscript{1}, fore-coma.
con\textsubscript{2}, mesocoma.
con\textsubscript{3}, forecoxal rim.
con\textsubscript{3}, mesocoal rim.
con\textsubscript{4}, metacoal rim.
con\textsubscript{5}, distal rim.
con\textsubscript{1}, distal ventral rim of forecoxm.
Ap, apodeme of tibial depressor muscles.
Artk\textsubscript{a}, trochanteral articular knob.
arc, arcus.
Be\textsubscript{3}, basicosta.
Btar, basitarse.
con, constriction.
con\textsubscript{1}, articular concavity of claw.
con\textsubscript{1}, concavity in internal ridge of dorsal wall of tibia.
con\textsubscript{2}, metacoa.
con\textsubscript{3}, forecoxal rim’s inflection.
con\textsubscript{3}, mesocoal rim’s inflection.
con\textsubscript{4}, metacoal rim’s inflection.
con\textsubscript{1}, articular knob of forecoxal distal rim.
con\textsubscript{1}, distal rim.
con\textsubscript{1}, distal dorsal rim of forecoxm.
ex, Artk, articular knob of
distal rim of
gnathocephalic corn.

DFm, distal femur.

DRr, central ridge of trocha-
antal proximal dorsal
rim.

DMus, tendon of the thorae-
elis depressor of

Appli, tibial extensor's
apodermal plate.

Pncouj, concavity in ventral
of femur for trocha-
antal articulation.

h, dorsal articulation of
trochanter with femur.

mm, manubrium.

PDFm, proximal distal rim
of femur.

FVRFm, proximal ventral rim
of femur.

SClpl, selerite of the claw's
flexor muscle.

ThrR, tarsal central ridge.

ThrLr, tarsal lateral ridge.

ThrDVR, pretarsal distal
ventral rim.

ThPVFR, proximal ventral rim
of tibia.

ThDVR, tibial distal ventral
rim.

ThRi, inflection of tibial
proximal rim.

TDVR, distal dorsal rim of
trochanter.

TVw, trochanter's ventral wall.

TPDm, proximal dorsal rim of
trochanter.

Tr, trochanter.

Urh, unguiather.

Utrg, unguitractral groove.

UtrR, unguitractral ridge.

dorsal
ex. DRm, distal rim of mesothorax.

ex. DWR, distal ventral rim of mesothorax.

DFm, apodeme of coxal depressor of
trochanter.

Appli, apodermal plate of depressor of
trochanter.

Dm, manubrium distal end.

DRIr, internal ridge in dorsal wall of
tibia near its distal rim.

Eap, tibial extensor's apodeme.

Fm, femur.

FDW, femur's dorsal wall.

FmLr, femur's internal apodeme.

FVw, femur's ventral wall.

gf, geminiflexor plate.

Inv, invagination of the arolium.

Lum, lumen.

mb, base of manubrium.

FFm, proximal femur.

PPRm, proximal rim of femur.

q, chordotonal organ.

s, spur.

Tar, tarsus.

Tark, tarsal central knob.

TarLr, tarsal lateral knob.

TarDVR, pretarsal distal dorsal rim.

Tb, tibia.

TPDEr, proximal dorsal rim of tibia.

ThRi, tibial articular knob.

ThDVR, tibial distal dorsal rim.

The, emargination in the ventral wall
of tibia at its distal end.

TDArtG, trochanter's distal ventral
articulations with femur.

TDm, distal rim of trochanter.

TDwr, distal ventral rim of trochanter.

TDw, tarsal dorsal wall.

TPVR, proximal ventral rim of trochanter.

TPVRi, inflection of proximal rim of
trochanter.

Urh, knob of the unguiather.

Utr, unguitractor.

ABBREVIATIONS USED ON THE FIGURES OF THE ANTERNA CLEANER.

b, bristles.

B, bimar, lateral margin of brush.

conj, conjunctiva.

S seoc, spur's concavity.

smar, spur's lateral margin.

Tri, tibial notch.

B, brush.

hm, median part of the brush.

s, spur.

sk, spur's knob.

smr, spur's median ridge.

Tmnr, margin of tibial notch.
ABBREVIATIONS USED ON THE FIGURES OF THE FORE-WINGS.

C, fused costa sub-costa
  radius and media.
M3, media three.
M2+3, fused media three and four.
A, anal.
R-M, radio-medial cross vein.
R3, radius three.
R3, radius sector.
St, stigma.
F, frenulum.
A, median cell.
D, anal cell.
F, 2nd discoidal cell.
H, first cubital cell.
I, second cubital cell.
K, radial cell.
Cu, cubitus.
Cu1, cubitus one.
M1&2, fused media one & two.
M4, media four.
M1, media one.
m-cu, medio-cubitus cross vein.
R1, radius one.
R4, radius four.
M, medius.
r, radial cross vein.
x, frenulum fold.
b, sub-marginal cell.
e, first discoidal cell.
g, confluent 3rd discoidal & 2nd apical cell.
j, third cubital cell.

ABBREVIATIONS USED ON THE FIGURES OF THE HIND-WINGS.

C, fused costa sub-costa
  and radius.
Cu, cubitus.
I, costellum cell.
R, radial cell.
Q, submedial cell.
R, radius.
M, media.
A, anal.
N, medial cell.
P, cubital cell.
T, anal cell.
ABBREVIATIONS USED ON THE FIGURES OF THE ABDOMINAL REGION.

- a, tergal apodeme.
- A, anterior disc formation.
- AlAp III-XII, antero-lateral apodeme of sternum.
- AT, acrotergite.
- b, offshoot of the anterior margin of terga.
- c, line of fusion of third and fourth terga.
- Icm, intersternal membrane.
- ltc, lateral-tergal lobe.
- nXst, membranous part of tenth sternum.
- n XI-XII, membranous part of sternum.
- pl, pleural plate.
- Pim, pleural conjunctiva.
- Pgs, pygostyle.
- Pte, proctiger.
- Postmar II-Xst, posterior margin of sternum.
- VIII, stop, oval plate of seventh sternum.
- Sp, sp., Ist to eighth spiracles.
- Sod, socii.
- std, ventral of pedicel.
- IIXst, bilobed flap of 2nd sternum.
- II-IXIst mar, lateral margin of terga.
- II-IXIst set, scutum of terga.
- Vpl, membranous central part of ninth sternum.
- acs, anticostral suture.
- ALApPd, antero-lateral apodeme of pedicel.
- An, amia.
- Antmar II-Xst, anterior margin of sternum.
- At, acrotergite.
- Dpi, dorsal sclerotic bridge.
- IIm, intersternal membrane.
- LV-VII, internal ridge of sternum.
- L, lobes of female's eighth tergum.
- LmarE, anteromesal extension of lateral margin of terga.
- M, membranous part of tenth tergum.
- M XI-XII, membranous part of tenth sternum.
- os, oblique suture.
- Opi, III-XII, oblong plate of ninth sternum.
- IV-VI, Postmark, ridge near posterior margin in fourth to sixth terga.
- PIApPd, posterolateral apodeme of pedicel.
- Ras, ridge of oblique suture.
- 3bAnpl, subanal plate.
- SpAnpl, supra anal plate.
- IIXst, 2nd to 9th sternum.
- II-IXIst mar, lateral margin of sternum.
- II-IXIst, 2nd to 9th terga.
- II-IXIst mar, anterior margin of terga.
- II-IXIst postmar, posterior margin of terga.
- IIIPostn, notch in posterior margin of second tergum.
- b', bristle.

ABBREVIATIONS USED ON THE FIGURES OF THE FEMALE GENITALIA.

- blb, bulb.
- blbNp, median process of the bulb.
- DArkt, dorsal articular knob of the triangular plate.
- Lct, lancet.
- Lq4, lower part of quadrate plate.
- Ob, oblong plate.
- Obdm, dorsal margin of oblong plate.
- Obi, semicircular impression of the oblong plate.
- PVArkt, posterior articular knob of triangular plate.
- blbLp, lateral process of the bulb.
- Br1, basal branch of lst pair of valvulae.
- rvl, ramus of lst pair of valvulae.
- Gp, gonopore.
- Lb, lower part of oblong plate.
- Ob, oblong plate.
- Obam, anterior margin of oblong plate.
- Obae, emargination in the dorsal margin of the oblong plate.
- Obpl, proximal lobe of the oblong plate.
- Obm, submarginal ridge of oblong plate.
- q, apodeme near the bulb.
Qd, quadrate plate.
Qd, dorsal sclerotic bridge of quadrate plate.
Qd, articular concavity of quadrate plate.
PVL, ramus of 2nd pair of valvulae.
Stl, stylet.
Tri, triangular plate.
Tri, posterior margin of triangular plate.
UOb, upper part of oblong plate.
SVL, second pair of valvulae.
Vmp, ventral margin of oval plate.
Qd, anterior margin of quadrate plate.
Qd, dorsal margin of quadrate plate.
Qd, semi-circular impression of quadrate plate.
Qd, ventral margin of quadrate plate.
reVl, ramus of 2nd pair of valvulae.
Sh, sheath of ovipositor.
VII, stop, oval plate of 7th sternum.
TriR, marginal internal ridge of posterior margin of triangular plate.
TriL, upper tip of triangular plate.
UQd, upper part of quadrate plate.
VII, teeth of 1st pair of valvulae.
SVL, 3rd pair of valvulae.
Vmp, ventral margin of oblong plate.
Vst, vestibulum.

ABBREVIATIONS USED ON THE FIGURES OF THE MALE GENITALIA.

Aed, aedeagus.
Aedlw, dorsal wall of aedeagus.
Aedvw, ventral wall of aedeagus.
bv, basi volsella.
BRAVm, anterior margin of basal ring.
BRPVm, posterior margin of basal ring in its ventral half.
conj, membranous connection (Conjunctiva).
dmvh, dorsal margin of basi volsella.
digBm, basal margin of the digitus.
egr, endot.
gv, longitudinal groove of basi volsella.
lPm, dorso-mesal margin of parameral plate.
Lbv, lateral part of basi volsella.
MBVm, mesal margin of basi volsella.
Phtr, phalotremes.
tWBrlp, tip of the ventral half of basal rim of parameral plate.
Voll, volsella.
Aedd, distal apex of aedeagus.
AedS, ventral septum of aedeagus.
AedSd, mid longitudinal slit of aedeagus.
apa, aedeagal apodeme.
apv, basal apodeme of volsella.
BR, basal ring.
BFp, foramen of basal ring.
BFRm, posterior margin of basal ring in its dorsal half.
cus, cuspis.
conjdig, conjunctiva connecting digitus with basi volsella.
DBrlp, dorsal half of basal rim of parameral plate.
DpIAed, median plate of aedeagus.
DpIAed, median plate of aedeagus.
dig, digitus.
g, gomphodyle.
lp, parameral plate.
lpdp, sclerotised bridge.
lpVm, ventro mesal margin of parameral plate.
Lnbv, lateral margin of basi volsella.
MBv, mesal part of basi volsella.
Par, paramere.
pv, penis valve.
tBrlp, tip of dorsal half of basal rim of parameral plate.
VBRl, ventral half of basal rim of parameral plate.
vr, internal longitudinal ridge of basi volsella.
ABBREVIATIONS USED ON THE FIGURES OF THE
DIGESTIVE SYSTEM OF THE ADULT.

ar, orifice of the salivary pump.
BM, basement membrane.
Cr, crop.
APh, dorsal wall of anterior pharynx.
EphP, rectal pad's epithelium.
g, digestive enzyme.
gn, granulation incytoplasm.
h, hairs.
Inf, folds of the intima.
Int, intestine.
Lum, lumen of salivary gland tube.
LMBl, longitudinal muscle layer.
Nu, nucleus.
NuP, rectal nucleus.
ce, ceosophagus.
Pepth, proventriculus epithelium.
Pab, peritrophic membrane.
Phyl, pharyngeal plate.
Provent, proventriculus.
Provent1, proventriculus lip.
RectPd, rectal pad.
Salod, salivary gland's common duct.
Salpum, salivary pump.
SMal, special circular muscle layer.
Sylv, stomodeal valve.
v, vacuoles.
Vepth, ventriculus epithelium.

Amp, ampulla of the salivary gland.
APh, anterior pharynx.
CMal, circular muscle layer.
CyP, cytoplasmic extension over thepad.
Eph, epithelium.
Ephf, epithelial folds.
EphR, rectal epithelium.
Fca, preoral food channel.
Hph, hypopharynx.
Gn, granulation in pad's epithelium.
In, intima.
InfP, intimal plate.
Inl, internal wall of epithelial cells.
LumAmp, lumen of the ampulla.
Lum, lumen.
Mal, malpighian tubules.
Mth, true mouth.
NuP, nucleus of pad's epithelium.
N, non-nucleated external layer of the salivary gland.
PhA, anterior pharyngeal arm.
PhD1, pharyngeal diverticula.
PhP, posterior pharyngeal arm.
PhPh, posterior pharynx.
Provent2, gate of the proventriculus.
Rect, rectum.
rg, regenerative cells.
s, striated band.
Sal, salivary gland duct.
Slt, salivary gland's tube.
SMal, special longitudinal muscle layer.
Trach, tracheae.
Vent, ventriculus.
Wfc, floor of the preoral chamber.

ABBREVIATIONS USED ON THE FIGURES OF THE RESPIRATORY SYSTEM OF THE ADULT.

(THORAX):-
a, propodeal spiracular tube.
c, propodeal loop.
2nd thoracic spiracular tube.
g, posterior mesotergal tracheae.
1st thoracic spiracular tube.

b, propodeal ventral tracheae.
d, propodeal dorsal tracheae.
f, mesothoracic posterior loop.
f1, tracheae of mesothoracic posterior loop to mesotergal muscles.
h, mesotergal tracheae.
j, thoracic dorso lateral air sacs.
1, lst posterior propleural tracheae.
2, ventro-lateral tracheae.
3, anterior propleural tracheae.
4, meta coxal tracheae.
5, posterior branch of propodeal ventrolateral tracheae.
6, mesopleural ventral air sacs.
7, 10, mesopleural latero-ventral air sacs.
8, 2nd & 3rd posterior propleural tracheae.
9, lateral trunk.
10, branches in the head region.
11, mesothoracic anterior loop.
12, propodeal ventro-lateral tracheae.
13, anterior branch of propodeal ventro-lateral tracheae.
14, inner tracheae of ventrolateral tracheae.
15, mesopleural anterolateral air sacs.
16, lateral branches from mesopleural ventral air sac.
17, procoxal tracheae.
18, mesocostral air sacs.
19, outer pair of air sacs from mesopleural ventral air sac.

(ABDOMEN):-

A, special visceral tracheae (anterior branch from the lateral trunk).
B, dorsal tracheae.
C, dorsal visceral tracheae.
D, central branch from the lateral trunk.
E, list tracheae of the genitalia.
F, posterior branch from the lateral trunk.
G, ventral tracheal commissure.
H, 2nd tracheae of the genitalia.
I, sternocostal tracheae.
J, tergo visceral tracheae.
K, sternal tracheae.
L, ninth tergum's tracheae.
M, ventral tracheae.
N, anterior branch of visceral tracheae.
O, principal visceral tracheae.
P, posterior branch of visceral tracheae.
Q, ventral rectal tracheae.
R, metathoracic gills.
S, spiracular tube.
T, visceral tracheae.
U, spiracular tracheae.
V, spiracular lobe.
W, ventral half of the rim of spiracular tracheae.
X, ventral half of the rim of spiracular lobe.

(THORACIC SPIRACLES):-

a, anterior half of the spiracular rim.
B, marginal inflection of the posterior margin of central bridge of the prometum.
C, transverse elastic connection.
D, dorsal lip.
E, dorsal rim of the spiracle.
F, posterior lip of the spiracle.
G, semi chitinous plate.
H, submarginal inflection of the postero-ventral margin of the lobe.
I, membranous strip.
J, lumen of the spiracle.
K, submarginal inflection of the dorsal margin of the lobe.
L, cross ridge across the base of the spiracular lobe.
M, anterior margin of the lobe.
N, lateral branches from mesothoracic ventral air sac.
O, spiracular flaps.
P, ventral lip.
ABBREVIATIONS USED ON THE FIGURES OF THE VASCULAR SYSTEM OF THE ADULT.

- Sante, jet at the anterior end of the 2nd chamber.
- DDph, dorsal diaphragm.
- Ism, passage in between visceral sinus & the ventral sinus.
- Sae, swollen base of the aorta.
- 3-4stAnta, anterior attachment of the ventral diaphragm on 3rd & 4th sterna.
- 1-5, chambers of the heart.
- Ass, aorta.
- Ao, aorta.
- AoDi, diverticulum of the aorta.
- DDpmel, allary muscle of the dorsal diafrgm.
- ost, ostium.
- SPosta, funnel-like posterior end of the 3rd chamber.
- VDph, ventral diaphragm.
- VDpmel, transverse muscle fibres of the ventral diaphragm.

ABBREVIATIONS USED ON THE FIGURES OF THE NERVOUS SYSTEM OF THE ADULT.

- 1-6AbdGng, abdominal ganglia.
- AntEn, antennal nerve.
- Br, brain.
- ZEr, deutocebrum.
- CA, corpora allatuum.
- FrGng, frontal ganglion.
- 1, 2, procoxal pair of nerves.
- 3, mesocoxxal pair of nerves.
- 4, metacoxal pair of nerves.
- LaNv, labral nerve.
- MaxNv, maxillary nerve.
- OesGng, oesophageal ganglion.
- ONv, ocellar nerve.
- PPhy, posterior pharynx.
- Mv, recurrent nerve.
- SeneGng, suboesophageal ganglion.
- AntL, antennal lobe.
- APhy, anterior pharynx.
- 1Br, protocerebrum.
- 3Br, tritocerebrum.
- FrCon, frontal connectives.
- 1, nerve connection between corpora allatuum and the corresponding oesophageal ganglion.
- LbNv, labial nerve.
- MfNv, mandibular nerve.
- OesGng, occipital ganglion.
- OesNv, oesophageal nerve.
- oPL, optic ganglion.
- PhyNv, pharyngeal nerve.
- SOnGng, stomacic ganglion.
- LA2mGng, thoracic ganglia.
- VnV, ventral nerve cord.

ABBREVIATIONS USED ON THE FIGURES OF THE MALE REPRODUCTIVE SYSTEM OF THE ADULT.

- AcGl, accessory gland.
- AcD, accessory gland duct.
- e, content of the accessory gland.
- ER, ejaculatory duct.
- ExPhth, inner epithelial layer.
- LnX, lumen.
- OEPth, outer epithelial layer.
- BN, basement membrane.
- CMel, circular muscle layer.
- ost, spermatosyst.
- ExPhth, internal epithelium.
- In, intima.
- Nu, nucleus.
- Phtr, phallicremes.
Psh, peritoneal sheath. 
Spg, spermatogonia. 
VDer, vas deferens. 

**ABBREVIATIONS USED ON THE FIGURES OF THE FEMALE**

**REPRODUCTIVE SYSTEM OF THE ADULT.**

AGL, acid gland.  
AGLR, acid gland reservoir.  
b, band.  
hb, bulb of the reservoir.  
Bm, basement membrane.  
C, chorion.  
CM1, circular muscle layer.  
E, chamber of the oocyte.  
Ept, epithelium.  
f, internal folds.  
Fellg, granulation in the cytoplasm of follicular cells.  
Fellgn, nucleus of the follicular layer.  
Gcn, germ cell.  
Gn, granulation in cytoplasm.  
Gxr, germarium.  
In, intima.  
Inl, lower chitinization of intima.  
L, lumen.  
LHoe, complete longitudinal muscles.  
LubGl, lubricant gland.  
LMel, short longitudinal muscles.  
Ln, lumen.  
M1, smaller muscles of acid gland.  
Mnr, nutritive chamber.  
Muc, nucleus.  
Od1, left oviduct.  
Odr, right oviduct.  
Ooo, oocyte.  
P, passage in between two successive beads.  
Pd, poison duct.  
Psh, peritoneum.  
Pt, terminal filament.  
Spt, spermatheca.  
SptGl, spermathecal gland duct.  
Spttd, spermathecal duct.  
V, vacuole.  
Vag, vagina.  
Vtl, first pair of valvulae.  
Vsm, seminal vesicle.
ABBREVIATIONS USED ON THE FIGURES OF THE BIOLOGY SECTION.

(EXTERNAL MORPHOLOGY OF THE PRE-IMAGINAL STAGES):

a, constriction between head and thorax.
Ab, abdomen.
conj, conjunctiva.
es, epiphalan suture.
dcd, distal part of cardo.
E, eye spots.
Fr, frons.
g, galea.
HpHy, hypopharynx.
Iplr, inferior pleurostomal rami.
Lb, labium.
Lm, labrum.
lupHy, lateral wall of hypopharynx.
Mdc, condyles of mandibles.
MxPlp, maxillary palp.
Mxs, maxillary scleromés.
OV, ovipositor.
pl, pleurostomal scleromés.
Pos, post occiput.
Postm, postmentum.
s, sensory spines.
St, stipes.
t, teeth of the mandibles.
tib, transverse tentorial bar.
TVl, 1st pair of valvulae.
2Vl, 2nd pair of valvulae.
w, 2, two pairs of the thoracic wing buds.
ant, antennae.
antf, antenial foramen.
b, constriction between 1st & 2nd abdominal segments.
d, fifth larval moult.
Dh, dorsal hump.
Ep, epistomal sclerome.
fs, frontal sutures.
h, head.
hy, hypostomal scleromés.
Isg, intersegmental groove.
1, 2, 3, three pair of leg buds.
LbPlp, labial palp.
LstPlp, labialstipital sclerome.
Mdb, blades of the mandibles.
Mdbm, basalmargin of the mandibles.
Md, mandibles.
MlPls, depression of the maxillary palp.
pcd, proximal part of the cardo.
pn, prementum.
Pos, post occipital suture.
pt, posterior tentorial pits.
Spl, superior pleurostomal rami.
Sts, stipital scleromés.
Th, thorax.
3Vl, 3rd. pair of valvulae.
ABBREVIATIONS USED ON THE FIGURES OF THE DIGESTIVE SYSTEM

OF THE LARVA.

Aegl, accessory gland. Aegl, duct of the accessory gland.
An, anus. APhy, anterior pharynx.
hg, hind-gut. Iloc, ileo-colon.
LSpikgl, lower branch of LSikgl, duct of the left silk gland.
the silk gland. mg, mid-gut.
Mt, malpighian tubules. cc, esophagus.
PPhy, posterior pharynx. Rect, rectum.
RectD1, rectal diverticulum. RSikgl, right silk gland.
Slglod, common duct of RSikgl, duct of the right silk gland.
the silk glands. ubSlgl, upper branch of the silk gland.

ABBREVIATIONS USED ON THE FIGURES OF THE RESPIRATORY SYSTEM OF THE LARVA.

a, anterior branch of b, dorsal tracheae.
the dorsal tracheae. c, posterior branch of the dorsal tracheae.
d, spiracular tubes. e, ventral tracheae.
f, anterior branch of g, ventral loop.
the ventral tracheae. k, tracheae in the head region.
l, tracheae in the head 
region. Litra, lateral trunks.
m, tracheae in the tenth abdominal segment.

ABBREVIATIONS USED ON THE FIGURES OF THE CIRCULATORY SYSTEM

OF THE LARVA.

3Ante, anterior end of DDPH, dorsal diaphragm.
3rd, chamber. DDPHMc1, afferent muscles of the dorsal Diaphragm.
est, estia. VDPH, ventral diaphragm.
4Poste, posterior end VDPHMc1, muscles of the ventral diaphragm.
of the 4th chamber.

ABBREVIATIONS USED ON THE FIGURES OF THE NERVOUS SYSTEM

OF THE LARVA.

AbdGng, abdominal ganglia. CirPhycon, circum-pharyngeal connectives.
IntGng, interganglionic connectives. SeeGng, sub-oesophageal ganglion.
Tranv, transverse nerves.
ThGng, thoracic ganglia.
ABBREVIATIONS USED ON THE FIGURES OF THE REPRODUCTIVE SYSTEM
OF THE LARVA.

Antmargn, anterior margin of the genital chamber.
Antmargb, anterior margin of the genital buds.
b, bend in the genital buds.
bd, genital buds.
gd, genital chamber.
Inv, invagination in the genital buds.
Postmargb, posterior margin of the genital buds.
Postmargc, posterior margin of the genital chamber.
s, oblique split.
VIIIst, eighth abdominal sternum.
IXst, ninth abdominal sternum.
Tea, testis.
Vds, swelling of the vas deferens.
Vd, vas deferens.
EXPLANATION OF THE FIGURES OF THE "HEAD" REGION.

Fig. 1. Anterior view of the head capsule.

2. Posterior view of the head capsule.

3. Lateral view of the head capsule.

4. Mouth parts.

5.a. Dorsal view of the tentorium.

5.b. Tentorial bridge with muscles.

6. Outer view of the hypostomal sclerite with mouth parts removed. ... (Diagramatic).

7. Inner view of clypeo laberal region. (Diagramatic).

8. Antennal socket viewed from outside. (Diagramatic).

9. Proximal rim of scape. ... (Diagramatic).

10. Proximal rim of the right scape with lumen facing sky. ...

11. Ventral view of distal part of scape at its junction with the pedicel. ... (Diagramatic).

12. Dorsal view of the distal part of scape at its junction with the pedicel with their dorsal walls removed. ... (Diagramatic).

13. Dorsal view of the proximal part of pedicel (Diagramatic).


15. Inner view of ventral wall of scape. (Diagramatic).

16. Outer surface of the inner region of right maxilla facing sky. ... (Diagramatic).

17. Outer surface of the outer region of right maxilla facing sky. ... (Diagramatic).

18. Dorsal view of the labial connection with the right maxillary stipes in dorso-ventral compressed condition. ... (Diagramatic).

19. Dorsal view of the stipes in dorso-ventral compressed condition. ... (Diagramatic).

20. Dorsal view of the central region of the left stipes. ... (Diagramatic).
Fig. 21. Inner view of left half of prementum without labial palpus. ... (Diagramatic).

" 22. Inner view of left half of prementum with labial palpus. ... (Diagramatic).

" 23. Dorsal view of the ligula with the walls of hypopharynx flattened. ... (Diagramatic).

" 24. Proximal margin of prementum cut in its middle and flattened so as to provide inner view of the labium. ... (Diagramatic).

" 25. Lateral (outer) view of the left maxilla in its natural condition. ... (Diagramatic).

" 26. Dorsal view of lingua. ... (Diagramatic).

" 27. Lateral view of pharyngeal muscles in relation to cranium. ... (Diagramatic).

" 28. Outer view of the dorsal wall of anterior pharynx with muscles. ... (Diagramatic).

" 29. Ventral view of anterior pharynx in relation to the corresponding parts of the facial wall of cranium. ... (Diagramatic).

" 30. Outer view of the ventral wall of anterior pharynx. ... (Diagramatic).

" 31. Outer view of the ventral wall of anterior pharynx with muscles... (Diagramatic).

EXPLANATION OF THE FIGURES OF THE "THORACIC" REGION.

Fig. 32. Dorsal view of the thorax.

" 33. Ventral view of the thorax.

" 34. Lateral view of the thorax.

" 35. Inner view of promotal lobe and the dorso-anterior region of the corresponding mesopleuron.

" 36. Ventral view of propleural region with the coxae... (Diagramatic).

" 37. Ventral view of propleural region without coxae. (Diagramatic).

" 38. Inner surface of propleuron facing sky. (Diagramatic).

" 39. Dorsal view of proendosternum... (Diagramatic).
Fig. 40. Inner surface of propleuron with muscles facing sky. ... (Diagramatic).

41. Inner surface of propleuron with muscles facing sky. ... (Diagramatic).

42. Back of the procoxal rim facing sky... (Diagramatic).

43. Outer view of the procoxal rim after longitudinal incision up to its articular concavity... (Diagramatic).

44. Inner surface of propleuron with coxal muscles facing sky. ... (Diagramatic).

45. Inner surface of propleuron with trochantal muscle facing sky. ... (Diagramatic).

46. Procoxa with muscles... (Diagramatic).

47. Lumen of procoxal rim with muscles facing sky. (Diagramatic).

48. Dorsal view of propleuron and proendocesternum showing muscles with dorsal plates pressed on respective sides. ... (Diagramatic).

49. Dorsal view of propleuron and proendocesternum with dorsal plates pressed on respective sides and inner view of one half of pronotum, showing muscles (Diagramatic).

50. Dorsal view of propleuron and proendocesternum with dorsal plate pressed on respective sides showing muscles. ... (Diagramatic).

51. Dorsal view of posterior half of proendocesternum showing muscles. ... (Diagramatic).

52. Foremost magnum with muscles of one side facing sky. ... (Diagramatic).

53. Inner view of proximal portion of mesonotum and posterior margin of pronotum with muscle (Diagramatic).

54 a. Prothoracic leg.
   b. Mesothoracic leg.
   c. Metathoracic leg.

55. Coxo-trochantal articulation... (Diagramatic).

56. Proximal region of trochanter with ventral wall removed showing muscles.... (Diagramatic).

57. Outer view of trochanters femoral joint... (Diagramatic).
Fig. 58. Inner view of distal portion of tibial dorsal wall. (Diagramatic).

59. Inner view of tibio-tarsal joint... (Diagramatic).

60. Ventral view of pretarsus. (Diagramatic).

61. Dorsal view of pretarsus. (Diagramatic).

62. Inner view of ventral wall of trochanter and a portion of femur with muscles. (Diagramatic).

63. Depressor muscles of trochanter with apodemal plate. (Diagramatic).

64. Tibio-tarsal joint with muscles. (Diagramatic).

65. Inner view of tibial and tarsal ventral walls with muscles. (Diagramatic).

66. Inner view of distal portion of tibial ventral wall. (Diagramatic).

67. Lateral view of antenna-cleaner... (Diagramatic). Lateral

68. /Antenna view of spur articulation.

69. Inner view of mesnotum. (Diagramatic).

70. Inner view of one side of mesnotum.. (Diagramatic).

71. Outer view of posterior half of mesnotum and dorsal region of mesopleuron. (Diagramatic).

72. Inner view of mesopleuron. (Diagramatic).

73. Posterior region of mesopleuron with coxal articulation. (Diagramatic).

74. Lateral view of meso endosternum.

75. Lateral view of meso endosternum.

76. Lateral view of one half of pterothoracic.

77.A. One half of mesocoxxal rim with it's inner surface facing sky. (Diagramatic).

77.B. Lumen of mesocoxxal rim facing sky. (Diagramatic).

78. A. Lateral view of trochantero femoral joint. (Diagramatic.)

B. Lumen of proximal rim of femur facing sky. (Diagramatic)

79. A. Lumen of mesocoxxal distal rim facing sky. (Diagramatic)

B. Coxo-trochantal joint of mesothorax. (Diagramatic).
Fig. 90. Axillary sclerites of fore-wings.

91. Inner view of basal region of fore-wings with axillary sclerites.

92. Inner view of mesonotum with muscles. (Diagramatic).

93. Inner view of mesonotum with muscles. (Diagramatic).

94. Inner view of mesonotum with muscles. (Diagramatic).

95. Inner view of mesopleuron with muscles. (Diagramatic).

96. Inner view of mesopleuron with muscles. (Diagramatic).

97. Inner view of mesopleuron with muscles. (Diagramatic).

98. Mesocoelm with muscles. ... (Diagramatic).

99. Mesocoelm with muscles. ... (Diagramatic).

100. A part of the mesocoxal wall removed to show the origin of trochantal muscles. (Diagramatic).

101. Dorsal view of a part of pterothoracic endosternum. (Diagramatic).

102. Proximal rim of trochanter of mesothorax. (Diagramatic).

103. Inner view of posterior half of mesonotum and metanotum with muscles. ... (Diagramatic).

104. Inner view of metanotum. ... (Diagramatic).

105. Outer view of metasternum.

106. Inner view of one half of propodeo-meta thoracic region.

107. Outer view of articular region of the hind-wing, corresponding metanotal portion and corresponding metapleural portion and the axillary sclerites.

108. Outer view of basal region of hind-wing and corresponding portion of meta notum with axillary sclerites.

109. Outer view of basal region of hind-wing and the corresponding portion of meta pleuron with axillary sclerites.

110. Axillary sclerites of the hind-wings.

111. Inner view of propodeo meta pleural region with muscles.
Fig. 102. Inner view of one half of propodeo-metapleural region with muscles.

103. Inner view of one half of propodeo-metapleural region with muscles.  

104. Inner view of the pressed one half of propodeo-metapleural region with muscles.  

105. Inner view of the pressed one half of propodeo-metapleural region with muscles.  

106. Inner view of the pressed one half of propodeo-metapleural region with muscles.

107A. Outer view of trochantero femoral joint.

B. Lateral view of proximal portion of femur.

C. Ventral view of femoro-tibial joint.

D. Ventral view of distal rim of femur.

108A. Outer view of proximal portion of trochanter with muscles.

B. Outer view of proximal portion of trochanter with muscles.


110. Outer view of proximal portion of trochanter with muscles.

111. Proximal part of the dorsal wall of trochanter with muscles.

112. Outer view of proximal portion of meta-coxa with thoracic depressor muscle of trochanter.

113. Lumen of meta coxal proximal rim facing sky with muscles,  

114. Lumen of meta coxal proximal rim facing sky with muscles.  

115. Outer view of proximal portion of tibia with muscles.

116. Outer view of proximal portion of tibia with muscles.

168B. Fore-wing.

168C. Hind-wing.

A. Inner view of the longitudinal half of the thorax.
EXPLANATION OF THE FIGURES OF THE "ABDOMINAL" REGION.

Fig. 117. Outer view of 2nd abdominal tergum.

* 118. Inner view of 3rd & 4th abdominal terga.
* 119. Inner view of 5th abdominal tergum.
* 120. Inner view of 6th abdominal tergum.
* 121. Inner view of 7th abdominal tergum.
* 122. Inner view of 8th & 9th abdominal terga.
* 123. Inner view of 7th & 8th abdominal terga of female only.
* 124. Inner view of 2-9 sterna of male.
  B. Inner view of 2/3 3rd sterna of male.
* 125. Inner view of 2nd to 7th sterna of female.
* 126. Inner view of 2nd to 5th sterna of female with intersternal muscles.
  B. Inner view of 5th to 7th sterna of female with intersternal muscles.
* 127. Inner view of 5th & 6th sterna of female with intersternal muscles.
  B. Inner view of 6th & 7th sterna of female with intersternal muscles.
* 128. A. Inner view of 2nd to 5th sterna of male with intersternal muscles.
  B. Inner view of 5th to 9th sterna of male with intersternal muscles.
* 129. Inner view of 5th to 7th sterna of male with intersternal muscles.
* 130. Inner view of 2nd sternum with muscles of the pedicel.
* 131. Inner view of 2nd/3rd with muscles of the pedicel.
* 132. Inner view of 2nd tergum with muscles of the pedicel.
* 133. Inner view of 2nd tergum with muscles of the pedicel.
* 134. Inner view of 2nd tergum with muscles of the pedicel.
* 135. Inner view of 2nd tergum with muscles of the pedicel.
* 136. Inner view of 2nd tergum with propodeal hemiserraulus notch in position.
Fig. 137. Outer view of propodeal notch showing its movement on the vertical plate of the pedicel.

138A. Inner view of 2nd and 3rd terga with muscles.
B. Inner view of 2nd tergum with muscles.

139. Inner view of 4th to 6th terga with inter-tergal muscles.

140. Inner view of 6th to 9th terga with intertergal muscles.

141. Inner view of 7th & 8th terga of female only, with intertergal muscles.

142. Inner view of 2nd to 5th segments with tergo sternal muscles.

143. Inner view of 5th to 7th segments of female only with tergo-tergal muscles.

144. Inner view of 5th to 9th segments with tergo-tergal muscles.

145. Anal region of male facing sky. (Diagramatic).

146A. Inner view of half 8th tergum and half sub-genital plate of female with muscle.

B. Inner view of 9th segment with muscles.

147. Lateral view of 5th to 8th segments of female only.

148. Lateral view of 4th to 8th segments of female only.

149. **Explanation of the figures of the "Male genitalia"**

Fig. 149. Dorsal view of the male genitalia.

150. Ventral view of the male genitalia with muscles.

151A. Dorsal view of aedeagus with muscles.

B. Ventral view of aedeagus.

152. Lateral view of aedeagus.

153. Dorsal view of basal w ring with muscles.

154. Dorsal view of basal ring and parameral plate with muscles.
Fig. 155. Dorsal view of male genitalia with muscles.

156. Dorsal view of male genitalia with muscles.

157. Dorsal view of male genitalia with muscles.

158. Digitus with muscles. ... (Diagramatic).

EXPLANATION OF THE FIGURES OF THE "FEMALE GENITALIA".

Fig. 159A. Inner view of one half of female genitalia.

B. Inner view of triangular plate.

160. Inner view of female genitalia with muscles (Diagramatic).

161. Outer view of one half of female genitalia with muscles (Diagramatic).

162. Outer view of one half of female genitalia with muscles. ... (Diagramatic).

163. Inner view of oblong plate with muscles (Diagramatic).

164A. Ventral (outer) view of bulbus. (Diagramatic).

B. Lateral view of a portion of distal part of lancet.

C. Inner view of triangular plate with muscles.

165. Inner view of oblong plate & triangular plate with muscles.

166. Outer view of one half of female genitalia with muscles. (Diagramatic).

167. Dorsal view of female genitalia and vagina with muscles. ... (Diagramatic).
Fig. 169. Dorsal view of the alimentary canal.

170A. T.S. of oesophagus.
170B. T.S. of crop.
171. Anterior end of the proventriculus opening into the lumen of crop.
172A. T.S. of proventriculus in its middle region with chitinous plates distinct.
172B. L.S. of proventriculus through its anterior end.
173. L.S. passing through the junction of proventriculus with the ventriculus.
174A. L.S. of ventriculus showing epithelium's sloughing off.
174B. L.S. of ventriculus with non-nucleated globules coming out.
175. L.S. of ventriculus showing formation of peritrophic membrane.
176A. T.S. of intestine.
176B. T.S. of malpighian tubule.
177. T.S. of rectum.
178B. T.S. of salivary gland.
178C. T.S. of salivary gland duct.
179. Entire salivary gland.

Fig. 180A. Entire heart.
180B. A part of the dorsal diaphragm.
181. Dorsal view of the ventral diaphragm.
EXPLANATION OF THE FIGURES OF THE "NERVOUS SYSTEM" OF ADULT.

Fig. 189. Dorsal view of the nervous system. (Diagramatic).

" 183. Dorsal mf view of the brain. (Diagramatic).

" 189A. Dorsal view of anterior portion of the stomodaeal nervous system. (Diagramatic).

" B. Dorsal view of the posterior portion of the stomodaeal nervous system. (Diagramatic).

EXPLANATION OF THE FIGURES OF THE "RESPIRATORY SYSTEM" OF ADULT.

Fig. 185. Dorsal view of the respiratory system. (Diagramatic).

" 186. Dorsal view of the respiratory system of VII, VIII and IX segments of male. (Diagramatic).


" 188. Dorsal view of the respiratory system in the thoracic region only. (Diagramatic).

" 189A. Lateral view of the first thoracic spiracle.

" B. Lumen of the first thoracic spiracle facing sky.

" 190. Lateral view of the 2nd thoracic spiracle with its posterior wall facing sky.

EXPLANATION OF THE FIGURES OF THE "MALE REPRODUCTIVE SYSTEM" OF ADULT.

Fig. 191. Dorsal view of the male reproductive system.

" 192A. T.S. of testis.

" B. L.S. of vas deferens.

" C. T.S. of seminal vesicle.

" D. T.S. of ejaculatory duct.

" 193. T.S. of accessory glands.
EXPLANATION OF THE FIGURES OF THE "FEMALE REPRODUCTIVE SYSTEM" OF ADULT.

Fig. 194. Dorsal view of female reproductive system.

- 195A. T.I. of anterior part of the vitellarium.
- B. T.I. of posterior part of the vitellarium.
- 196. L.I. of the vitellarium passing through one oocyte chamber and one nurse-cell chamber.
- 197A. T.I. of oviduct.
- B. T.I. of vagina.
- B. L.I. of spermaticca.
- B. T.I. of poison gland duct.
- C. T.I. of lubricant gland.
- D. T.I. of reservoir.
- 200A. L.I. of reservoir before lumen is reached.
- B. L.I. of reservoir passing through lumen.

EXPLANATION OF THE FIGURES OF THE "BIOLOGY SECTION".

Fig. 201A. Egg of the parasite.

- B. Lateral view of newly hatched larva.
- C. Lateral view of larva after 1st moult.
- D. Lateral view of larva after 2nd moult.
- 203. Lateral view of larva after 4th moult.
- 204A. Dorsal view of prepupa.
- B. Ventral view of prepupa.
- C. Ventral view of posterior region of prepupa.
- 205. Lateral view of pupa.
Fig. 206. Dorsal view of head capsule.
207. Inner view of ventral wall of head.
208. Dorsal view of labrum.
209. Dorsal view of mandible.
210. Dorsal view of maxilla.
211. Outer view of ventral wall of head.
212A. Lateral view of alimentary canal after 3rd moult.
B. Ventral view of rectum after 3rd moult.
C. Accessory silk gland.
213. Respiratory system. ... (Diagramatic).
214. A portion of the heart.
215. Dorsal view of ventral diaphragm (Diagramatic).
216. Dorsal view of nervous system. ...(Diagramatic).
217A. Dorsal view of male reproductive system.
B. Ventral view of male genitalia.
C. Ventral view of female genitalia.

THE END.