MORPHOLOGY OF CHRYSOCHUS AURATUS FAB...

SLOAN JACOB WILSON

THE UNIVERSITY OF WICHITA

THE MORPHOLOGY OF CHRYSOCHUS AURATUS FAB. WITH AN EXTENDED DISCUSSION OF THE WING-VENATION

A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

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SLOAN JACOB WILSON

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CHAPTER 1

INTRODUCTION.

Chrysochus auratus was first described in 1775 by Fabricus. It is described in Coleoptera of Indiana, by Blatchley (1), as "oblong and convex. Green, brightly polished; elytra often with a coppery tinge; antennae, legs and under surface bluish black. Head and thorax with coarse, very sparse, deep punctures intermingled with minute ones. Elytra finely and irregularly punctate." Blatchley states further that the species is common throughout the state and is present from June 11 to August 10th, and occurs on dogbane or indian hemp (Apocynum) as well as milkweed (Asclepias).

The species was found in great numbers during July 1931 in this region, being so plentiful in one spot on the campus that it was possible to gather over two-hundred specimens in less than an hour.

The specimens obtained were preserved in a 10% solution of formalin. Due to the deep color of the insect it was necessary to bleach in 10% KOH in order to study the external anatomy. About four weeks, with an occasional changing of the liquid was necessary.

CHAPTER 11

EXTERNAL ANATOMY

Similar to all insects, Chrysochus auratus is divided into three large divisions; head, thorax and abdomen. The prothorax is free so that it appears to form all of the second or thoracic region of the body. The location of the hinder two pairs of legs shows which part belongs to the thorax. The body is very strongly chitinized.

Parts of the Head
(Plate 11)

Fixed parts of the head

The fixed parts of the head are fused and form a strong, firm box.

Epicranium.- The epicranium of all beetles is in reality a compound sclerite (4), being composed of the true epicranium and front. An epicranial suture is visible on the cephalic portion of the head. It is not a continuous line but is broken. Two lines run cephalad and meet the clypeal suture. A frontal ridge is evident below which the antenna arises just cephalad to the compound eye. Small pits are scattered over the epicranium.

Clypeus.- The clypeus is apparently fused to the front of the epicranium and is not distinguishable as a separate element.

Genae.- The genae are situated below the eyes and the antennae. The genae, with certain portions of the occiput form

the lateral portion of the ventral part of the head.

Occiput.- The occiput is fused to the epicranium. The postgenae and the occipital regions cannot be distinguished as separate elements but are fused to the epicranium.

Gula.- The gula is a broad sclerite on the ventral portion of the head and is bounded by the gular sutures. Among the coleoptera the gula is usually a well developed sclerite and plainly visible, Comstock (4).

Appendages of the head

Antennae.- The antennae are moderately long, filiform and twelve jointed. The second segment is longer than the basal segment. The antennae are inserted between the eyes and the frontal ridge, and are widely separated at the base.

Mouth parts.

Labrum.- The labrum covers the mandibles, in part. It is comparatively long and narrows at its distal end.

Mandibles.- The mandibles are of the blunt, herbivorous type. The left mandible is longer than the right which fits into a groove in the left mandible.

Maxillae.- The cardo is large and broad and is triangular in shape. The median portion of the maxilla is composed of stipes, palpifer and subgalea. The stipes and the galea are fused forming a large sclerite. The lacinia is short and blunt and bears hairs on its tip. The palpifer is a fairly large sclerite from which arises a four jointed palpus. The galea

is fairly large and tongue shaped.

Labium.- A straight transverse line divides the labium from the gula. The submentum is very narrow but wide. The submentum and the mentum are separated by a transverse suture. On either side of the mentum lie the palpigers from each of which arises a labial palpus which is three jointed. Projecting forward from the mentum is the ligula, which consists of a pair of movable flaps.

Hypopharynx.- On the inner surface of the labium lies a large hypopharynx which almost covers the labium. The large size is probably due to the adaptation of the insect to the food plant which is very juicy in nature and would have to be lapped to be eaten.

Parts of the Thorax
(Plate 1)

Prothorax

Dorsal aspect.- The pronotum is not divided into separate sclerites but is prominent and rounded. A lateral line is apparent and the lateral portion is called the prothoracic epipleura.

Ventral aspect.- The ventral portion is formed by the sternum and the pleural sclerites. The episternum is a small, almost triangular, sclerite and forms a portion of the body wall between the sternum and the epipleura. The epimeron is a sclerite enclosing the coxal cavity, caudad and laterad.

Mesothorax

The mesothorax is much reduced in size, its chief function being to support the elytra and to keep them together by means of the scutellum.

Dorsal aspect.- When the elytra are in position the only visible part of the mesothorax is the scutellum. After removing the elytra the scutum may be seen. The praescutum is represented by a narrow membranous strip. The postscutellum is a small curved bar which is seen laterad on each side of the caudal apex of the scutellum.

Ventral aspect.- The sternal and the pleural sclerites compose the ventral aspect. The mesosternum completely surrounds the coxal cavity and is plainly marked off by the sutures. The episternum is a small triangular sclerite and does not reach the coxal cavity. The epimeron is a larger sclerite than the episternum and does not reach the coxal cavity.

Metathorax

The metathorax is much larger than the mesothorax due to the attachment of the heavy muscles for flight.

Dorsal aspect.- The median portion has a large groove extending caudo-cephalad along the middle of the back with strongly chitinized margins projecting upward. In these the elytra rest. Due to the fusion it is difficult to discern the sclerites of the metathorax.

Ventral aspect.- The metasternum is the largest sclerite of the ventral aspect of the entire thorax. A round blunt tongue meets the caudal projection of the mesosternum. A distinct suture is present on the median line of the sclerite. A line or suture is apparent near the caudal margin of the metasternum. The portion of the metasternum caudad of the suture is the antecoxal piece. A long narrow sclerite lies laterad to the metasternum which narrows toward its caudal end. This is the episternum. The small sclerite caudad to the episternum is the epimeron.

Appendages of the Thorax

Wings

The mesanotum and metanotum each bear a pair of wings. The elytra are the wings of the mesanotum and are heavily chitinized to form the hard case of the beetle. The wings of the metanotum are membranous and used for flight. These will be discussed later.

Legs

The unusual part of the legs is the tarsi. The tarsi are dilated and pubescent underneath. The third joint is deeply bilobed. The fourth and fifth tarsal joints are joined firmly together, the fourth joint being very small, the tarsi therefore appearing but four jointed. The claws are without serrations.

Abdomen
(Plate 1)

The abdomen is composed of flattened segments. The dorsal surface is completely covered by the elytra. Six sterna are seen on the ventral side, the most anterior being the larger. The most posterior sternum is very small and rounded on the caudal margin. The external genitalia are not visible from the ventral aspect.

CHAPTER 111

WING-VENATION AND VARIATIONS

The comparative study of the wing veins of the various groups of insects, and that of their larva wing trachea, has shown the wing-venation to be based on a common plan, with modifications in the different orders. Venation of the coleoptera is unique and complicated resulting in many differences of opinion. The venation of Chrysochus auratus Fab. in this paper is based, principally, on the study of W. T. M. Forbes (5).

The Main Veins
(Plate 4)

Costa.- The costal vein lies along the costal border of the wing.

Subcosta.- The second vein is concave and lies at the foot of a trough in the surface of the wing. In the wings examined there is a short fusion of costa and subcosta. This is in the region of the humeral cross-vein.

Radius.- The third vein of the wing is strongly convex and forms the principal articulation with the thorax and arises from the anterior tracheal branch. Costa, subcosta and radius are very close together near the costal margin.

Media.- Media is the most unstable of all the veins in the various orders of insects. The main stem has dropped out leaving a short portion of M_{1+2} and M_{3+4} (or M_1 and M_4),

Forbes (5).

Cubitus.- Cubitus is a strong vein, the distal end fusing with M_4 which swings down and fuses with it.

First anal.- The base of 1st anal is lost and gives the vein the appearance of being a fusion of Cu and 1st anal for a portion of its length. This is due to the cu-a cross-vein which remains. 1st anal is branched.

Second, third and fourth anals.- The 2nd and 3rd anals are branched. The 4th anal is not branched.

Permanent cross-veins.- Certain cross-veins are so constant in the higher insects as to be considered a part of the hypothetical plan. The humeral is present as a short fusion of costa and subcosta. An arculus is also present.

Forking of the Veins
(Plate 4)

The distal portion of R and Sc are fused.

Radius. - According to Forbes (5) there is little reason to doubt that the anterior branch of the radial stem continues in the common cavity as R_1. The base of Rs is atrophied leaving the outer part as an apparent backward projecting spur-the radial recurrent (Rr). A short portion of Rs is present and a radial cross-vein exists between R_1 and Rs. A second radial cross-vein swings into this portion of Rs and is usually regarded as being a portion of radial recurrent.

Media.- The base of media has dropped out leaving in evidence M_{1+2} and M_{3+4} (or M_1 and M_4). M_4 swings down and fuses

with Cu toward the margin.

Cubitus.- Cubitus is not branched (if the first anal is not considered a branch as it is by some authorities) but exists as a heavy vein fusing with M_4 near the margin.

First anal.- The base of the 1st anal has dropped out and the cross-vein cu-a remains to connect it with the stem of cubitus. It is entirely possible, however, that the 1st anal is fused with the stem of cubitus but the evidence seems to be to the contrary as will be noted in the discussion of the variations. 1st anal is branched, the first branch extending to the margin and the second branch is fused with the first branch of the 2nd anal.

Second anal.- The 2nd anal is branched. The first branch is fused with the second branch of the 1st anal and extends nearly to the margin. The second branch fuses with the first branch of the 3rd anal. On the basal side of the cell thus formed exists an oblique vein running from the stem of the 2nd anal to the upper branch of the 3rd anal. As stated by Forbes (5) it is not clear whether this is a branch of the 2nd anal which has joined the first branch of the 3rd anal or a cross-vein.

Third anal.- The 3rd anal forks once. The upper branch is connected to the 2nd anal by two transverse veins enclosing a cell between them.

Fourth anal.- The 4th anal is a heavy vein and stiffens the alula. It is not forked. Forbes (5) states that the 4th anal of coleoptera is comparable to the jugal brace of the lepidoptera.

Cross-veins
(Plate 4)

The order Coleoptera is considered by Forbes (5) to have decended from a form or forms with a considerable number of cross-veins. The humeral has already been discussed as a short fusion of costa and subcosta.

Two radial cross-veins are present.

A cross-vein exists between Rs and M_{1+2} but is very faintly outlined.

A cross-vein exists between M_{1+2} and M_{3+4} but is very faintly outlined.

The cross-veins in the anal region have been discussed.

An arculus is distinctly present.

Variation of Wing-venation
(Plate 5)

The anal region of wing-venation may vary as seen in Plate 5. Two groups are shown, one showing the right wing of various specimens and the other showing the variations in the right and left wings of the same specimen.

The wing-venation, especially in the anal region, is difficult to determine unless more than one specimen is examined. It was found that if a number of wings were examined, the

variations in forking and the fusion of the anal branches were a great aid in determining the venation as a whole in the anal region.

Variations in Different Specimens

Fig. 1.- 1st A and 2nd A_1 seem to be fused for a short distance. They then fork into 1st A_1 and 1st A_2 + 2nd A_1. 1st A_2 + 2nd A_1 fork at the distal end and exist as separate vein. 2nd A_2 and 3rd A_1 fuse and fork as separate veins at the distal end.

Fig. 2.- 1st A_2 exists as a cross-vein meeting and fusing with 2nd A_1 where they again branch as separate veins at the distal end. 2nd A_2 and 3rd A_1 fuse and do not fork.

Fig. 3.- 2nd A_1 fuses for a short distance with 1st A_2. They then fork into 1st A_1 and 1st A_2 + 2nd A_1. 1st A_2+2nd A_1 doesnot fork at the distal end.

Fig. 4.- 1st A_2 exists and crosses over to fuse with 2nd A_1 and fork as separate veins near the distal end. 2nd A_2 and 3rd A_1 fuse and do not fork.

Fig. 5.- A cross-vein exists between 1st A and 2nd A_1 which seems to be comparable to the cross-vein between the base of 2nd A and 3rd A_1. 1st A and 2nd A_1 fuse for a short distance and branch into 1st A_1 and 1st A_2 + 2nd A_1. An entirely new cell is formed due to the presence of this cross-vein.

Fig. 6.- The cross-vein exists between 1st A and 2nd A_1 as before. 1st A and 2nd A_1 do not fuse however. 1st A_2 crosses

over and fuses with 2nd A_1.

Variations of Right and Left Wings of the Same Specimen

Fig. 1.- In the left wing 1st A_2 and 2nd A_1 fuse and do not fork at the distal end. In the right wing 1st A_2 and 2nd A_1 fuse and fork at the distal end.

Fig. 2.- In the left wing 1st A_2 crosses over and fuses with 2nd A_1. In the right wing the same occurs and a cross-vein also exists between 1st A and 2nd A_1 forming another cell.

Fig. 3.- In the left wing 1st A and 2nd A_1 fuse for a short distance and forks into 1st A_1 and 1st A_2+ 2nd A_1. A cross-vein also exists between 1st A and 2nd A_1. In the right wing 1st A and 2nd A_1 fuse and then fork into 1st A_1 and 1st A_2+ 2nd A_1. The cross-vein is not present.

Forbes (5) states that in species where the base of 1st A has dropped out and the cu-1st a cross-vein exists it is difficult to tell whether 1st A has fused with Cu or whether a cross vein exists. However, if the specimen is examined under a microscope a bump exists where the base of 1st A would exist. It would seem that the base of 1st A has dropped out leaving the cu-1st a cross-vein.

After examining many specimens, the conclusion was reached that there are many variations in the anal region and no one specimen may be taken as a constant, even though there is a similarity in them. There were no variations noticed in the other regions of the wings.

Wing Folding Pattern

In Plate 4 the dark portions are the areas of the wing which are reversed in folding. The Axillary, Antemedian, Pivot, Principal and two areas in the apical portion of the wing are reversed in folding.

CHAPTER IV

GROSS INTERNAL ANATOMY

Only the digestive tract and the reproductive systems of the male and female will be discussed.

Alimentary Tract
(Plate III)

From the dorsal aspect the pharynx is not visible as the head is telescoped into the prothorax as far as the eyes.

Oesophagus.- From the dorsal aspect the oesophagus appears to come from the floor of the prothorax due to the position of the head. The oesophagus is short.

Proventriculus.- The beginning of the proventriculus is marked by a constriction which is the position of the oesophageal valve. The posterior end is marked by the position of the gastric caeca. The proventriculus is short and lies in the prothorax and the metathorax.

Ventriculus.- The ventriculus is enlarged and from the cephalic end project the gastric caeca, sixteen in number. The ventriculus narrows toward the posterior end of the body on the left side and coils twice before the attachment of the malpighian vessels, which marks the posterior end of the ventriculus. The malpighian vessels, over fifty in number, nearly fill the body cavity.

Intestine.- The small intestine is very short turning left and cephalad to meet the large intestine. The rectum is clearly

defined in this species.

Reproductive System

The reproductive systems of this species are unusual in many respects. The reproductive systems of both male and female are comparatively large in relation to the body cavity. (This is probably due to the fact that the specimens examined were taken during the mating season).

Male

The testes are bifurcated giving the appearance of four testes, two on each side of the body and located on the ventral portion of the abdominal cavity. A small duct leads from each lobe of the testes meeting the vasa efferentia. The vasa efferentia fuse into a common tubule and enter the caudal end of the seminal vesicle which lies dorsad to the ventriculus. From the cephalic end of the seminal vesicle extends the vas deferens. There is a single vas deferens present in this species and in the specimens examined was always on the left side of the body lying dorsad to the alimentary tract. After much coiling the vas deferens joins the ejaculatory duct. The penis is very heavily chitinized, surrounded by heavy muscles and lies ventrad to the rectum. In the specimens examined, the penis was always in a position having the hooked end toward the right.

Female

The ovaries lie laterad on each side of the ventriculus. They are supported by the ligaments of the viscera which are

plainly visible. The egg-tubes which make up the ovaries fill a large part of the body cavity. The egg tubes open posteriorly into the oviduct. The two oviducts unite near the caudal end of the body, ventrad to the rectum, and form the vagina. Emptying into the vagina on the dorsal side is a coiled tubule leading to the spermatheca, which is on the right side of the body. The spermatheca is very strongly chitinized and, more or less, pear shaped. A small white spermathecal gland is present and is attached to the large chitinized end of the spermatheca. Near the caudal end of the body are two colleterial glands which are rounded and flat and lie over a part of the ventriculus. A coiled tubule leads from each of the glands and joins the vagina near the body exit.

Although not a part of the internal anatomy the following observations may be given here. The females lay their eggs in what appear to be droppings and were thought to be such until no eggs appeared from about twenty-five mating pairs of beetles placed under a bell jar with their native food plant. The eggs are covered with a black dirt like substance. After hatching, the small larvae stay beneath the covering for a period of time.

BIBLIOGRAPHY

1. Blatchley, W. S. The Coleoptera or Beetles Known to Occur in Indiana. Nature Publishing Co.

2. Comstock, John Henry, The Wings of Insects. Ithaca, New York; The Comstock Publishing Co., 1918.

3. Comstock, John Henry, An Introduction to Entomology. Ithaca, New York; The Comstock Publishing Co., 1925.

4. Comstock and Kellogg, Elements of Insect Anatomy. Ithaca, New York; The Comstock Publishing Co., 1929.

5. Forbes, W. T. M. The Wing-venation of the Coleoptera. Annals of the Entomological Society of America, Vol. XV, No. 4, December, 1922.

6. Forbes, W. T. M. How a Beetle folds its Wings. Psyche, Vol. XXXI, No. 6, 1924.

7. Forbes, W. T. M. The Wing Folding Patterns of Coleoptera. Journal of the New York Entomological Society, Vol. XXXIV, June, 1926.

8. Henneguy, L. Felix, Les Insectes. Paris, 1904. Mason et Cie, Editeurs.

PLATE I

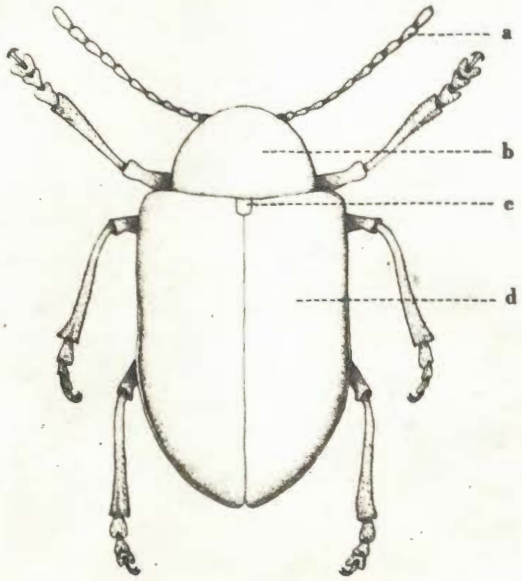
Fig. 1.- Dorsal aspect of Chrysochus auratus.

a.- antenna.
b.-pronotum.
c.- scutellum.
d.- elytra.

Fig.2- Ventral aspect of Chrysochus auratus.

a.- epipleura.
b.- episternum.
c.- epimeron
d.- sternum
e.- epimeron
f.- episternum
g.- sternum
h.- sternum
i.- episternum
j.- antecoxal piece

PLATE I



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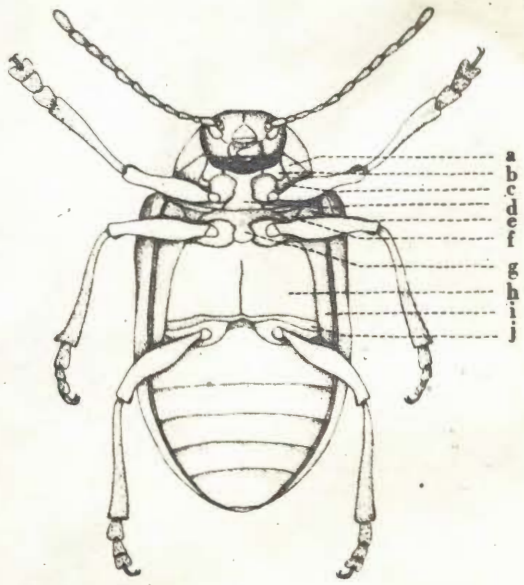

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PLATE II

Fig. 1.- Dorsal aspect of the head

a.- epicranial suture.
b.- compound eye.
c.- frontal ridge.
d.- labrum.
e.- mandible.
f.- labial palpus.
g.- maxillary palpus.
h.- antenna.

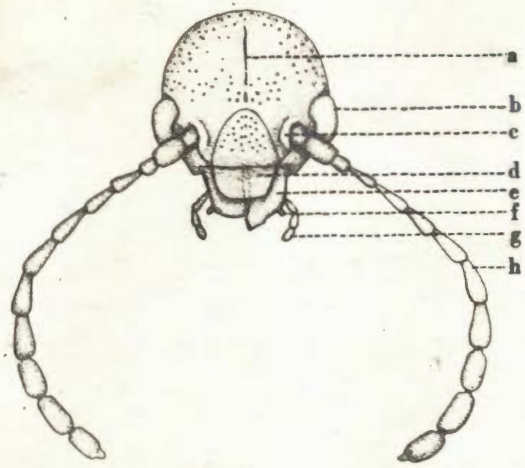
Fig. 2.- Ventral aspect of the head.

a.- compound eye.
b.- gula.
c.- labium.
d.- maxilla.
e.- mandible.
f.- labial palpus.
g.- maxillary palpus.
h.- antenna.

Fig. 3.- Mouth parts.

a.- labrum.
b.- right mandible.
c.- left mandible.
d.- right maxilla.
e.- left maxilla.
1.- lacinia.
2.- galea.
3.- palpifer.
4.- cardo.
f.- labium.
5.- labial palpus.
6.- ligula.
7.- palpiger.
8.- submentum.
9.- mentum.

PLATE II



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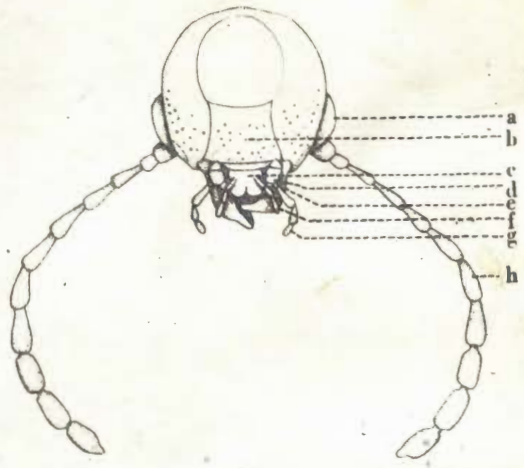

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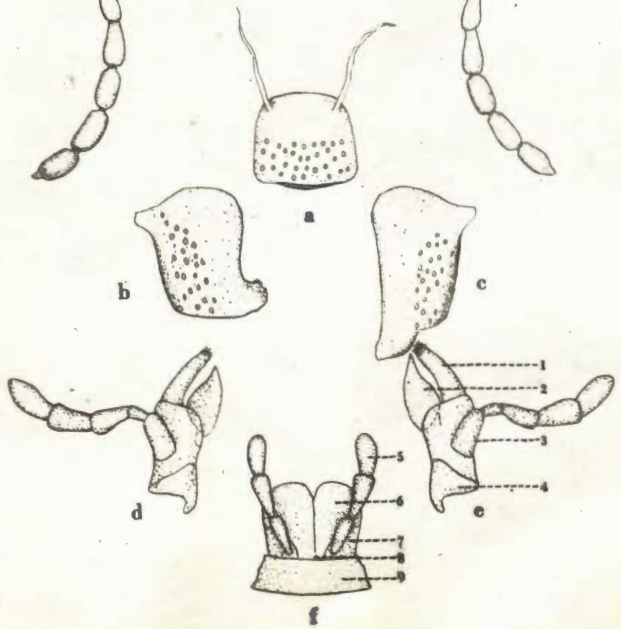

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PLATE III

INTERNAL ANATOMY.

Fig. 1.- Alimentary canal.

a.- oesophagus.
b.- proventriculus.
c.- gastric caeca.
d.- ventriculus.
e.- malpighian vessels.
f.- intestine.
g.- rectum.

Fig. 2.- Male reproductive system in relation to alimentary tract.

a.- seminal vesicle.
b.- testis.
c.- vasa efferens.
d.- vas deferens.
e.- eyaculatory duct.
f.- penis.

Fig. 3.- Female reproductive system in relation to the alimentary canal.

a.- ligament of the viscera.
b.- alimentary tract.
c.- ovary (made up of egg-tubes.)
d.- spermatheca.
e.- oviduct.
f.- colleterial gland.
g.- vagina.

PLATE III

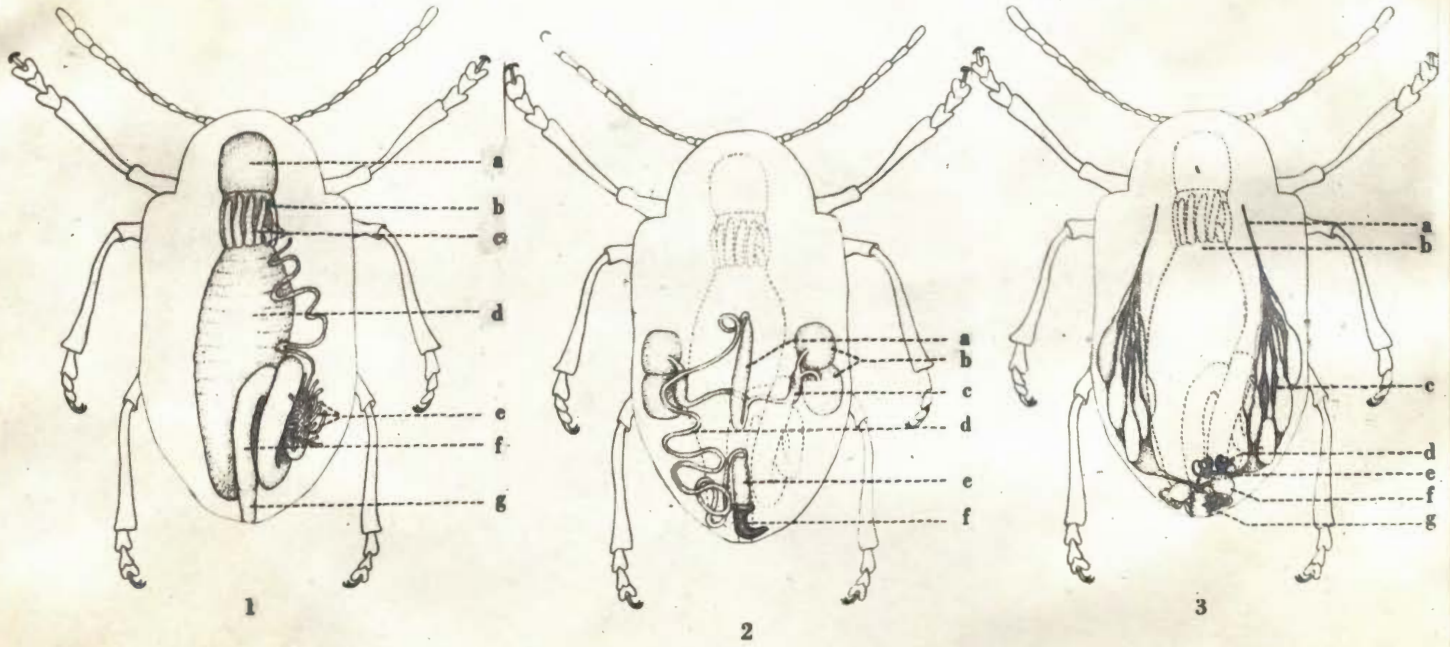


PLATE IV

WING-VENATION AND FOLDING PATTERN.

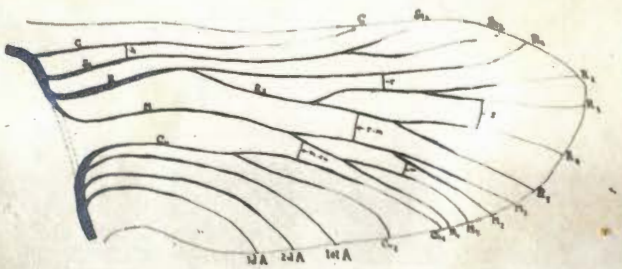
Hypothetical primitive type of wing-venation (after Comstock).

Wing-venation of Chrysochus auratus.

Folding pattern of Chrysochus auratus. Dark areas reversed in folding.

A.- antemedian.
C.- central
D.- pivot (distal pivot).
P.- principal.
J.- jugal or axillary.

PLATE IV



Hypothetical primitive type of wing-venation (after Comstock).

Wing-venation of Chrysochus auratus.

Folding pattern of Chrysochus auratus.

PLATE V

VARIATION OF WING-VENATION.

Variations of wing-venation of Chrysochus auratus(different specimens).

Fig. 1-6

Variations in right and left wings of same specimen (Chrysochus auratus).

Fig. 1-3.

PLATE V

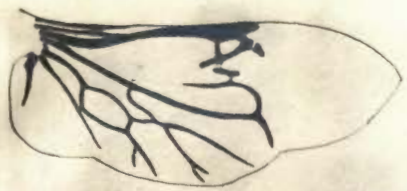


Fig. 1.

Fig. 4.

Fig. 2.

Fig. 5.

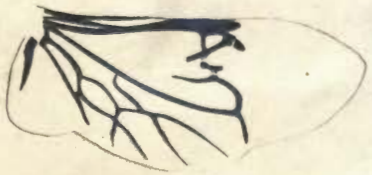


Fig. 3.

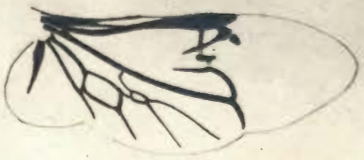


Fig. 6.

Variations of wing-venation of Chrysochus auratus.

Fig. 1.

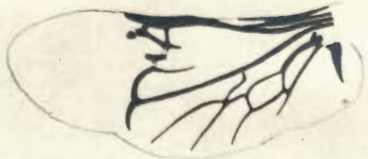


Fig. 2.

Fig. 3.

Variations in right and left wings of same specimen (Chrysochus auratus).