

THE HISTOLOGICAL STRUCTURE OF THE REPRODUCTIVE ORGANS
OF THE DRONE

by

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Summary

Inasmuch as the act of mating of the queen and drone take place in the air, and the drone is unknown, this makes it impossible to exert any influence upon the parents selection. Artificial insemination is the only means of assuring such a selection. Best results will be obtained with this method when artificial insemination will resemble closely the natural act of mating.

The queen returns from the mating flight with a part of genital organs of the drone. It is therefore essential to determine this fragment and its disposition accurately. For that purpose a detailed study of the reproductive organs structure, both the male and queen, seems indispensable.

In the work presented here the author describes chiefly the histological structure of genital organs of the male with partly everted endophallus (fig. 2). The results yielded are following:

1. The copulatory organ and ejaculatory duct of a sexually mature drone consists of an epithelium overlying the basement membrane, and of a layer of vitreous chitin. Inside the copulatory organ, overlying the chitin layer, is a layer of epicuticle which is wanting in the ejaculatory duct. Both the copulatory organ and the ejaculatory duct are destitute of muscles.

2. The outer surface of the partly everted copulatory organ and the posterior part of the non-everted neck are covered with irregular structures, or with hairs of varying structure.

3. There are two essential types of hairs: 1) chitin hairs invested only with a thin layer of a transparent epicuticle (Fig. 5 aa and ac), and 2) those covered with yet another layer of a thick yellow epicuticle. The latter ones can be still further subdivided.

4. The so called areas resemble in structure the remaining walls of the endophallus. These areas bear only the longest very densely distributed hairs of the endophallus.

5. The outer surface of the mid-lateral and ventral walls of the everted cornua is formed into irregular structures (Fig. 5 ad) or covered with hairs (Fig. 5 ac). The surface of the dorsal and outer lateral wall is smooth and covered with a yellow viscid layer. Owing to such a structure the viscid layer may slide over the chitin layer when the endophallus is being everted, which causes the cornua to bend.

6. The bulb of endophallus consists of a thick-walled part (Fig. 1 B₁ and 3 B₁) provided with chitin plates, and of a thin-walled part (Figs. 1 B₂ and 3 B₂). The chitin plates are covered from the outside with a columnar epithelium and a thick layer of vitreous chitin. Within the thick layer of transparent chitin (endocuticle) two separate strata may be distinguished. At the chitin plates starts a reinforcing layer (Fig. 9 Wz) which extends in a broad band round the interior of the thick-walled part. The plates, as well as the reinforcing layer, are joined by a connective substance (Fig. 9 Ł). In the thin-walled part of the bulb the epithelium is flat and the chitin layer very thin.

7. At the spot where the ejaculatory duct converges with the bulb of the endophallus, the chitin layer becomes the thicker while the epithelium becomes columnar.

8. Inside the bulb inserted into the everted vestibulum the semen is contained only in the posterior part and near the wall opposite to the plates. Towards the front, as well as laterally and anteriorly, it is shut up by mucus. The inside of the oral part of bulb and also the whole ejaculatory duct are filled up with the epithelium originating from the mucus glands.

9. After the bulb is filled, the mucus glands contain neither mucus nor epithelium. The epithelium has been torn off and thrust into the ejaculatory duct and bulb.

10. The seminal vesicles are after the ejaculation empty containing no more spermatozoa. Within the seminal vesicles there remains the epithelium which is, at this moment, in a condition of definite resorption.

11. The epithelium within the seminal vesicles is arranged in for closely disposed spirals. Both, in the first and second vesicles the spirals twist in the same way. Viewed from behind the spirals show a clockwise twist and are at the same time shifted posteriorly.

12. In the vasa deferentia the epithelium is likewise arranged in four spirals, their curves revolving similar to those found within the seminal vesicles.

13. The testes of the drone are by this time considerably reduced and totally degenerated.

14. Besides the changes occurring within the mucus glands and seminal vesicles, the factors determining the sexual maturity of the drone

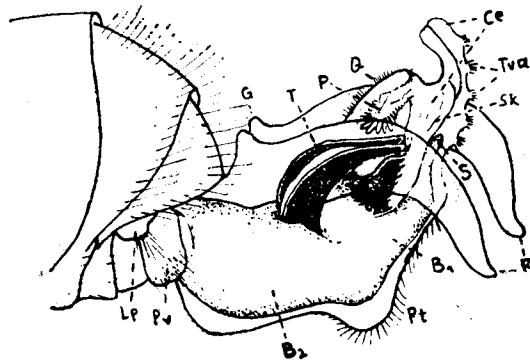
are also the changes which occur in the ejaculatory duct as well as in the endophallus.

15. The bulb of the endophallus fills up in the following way: first contract the muscles of the seminal vesicles pressing the spermatozoa into the ejaculatory duct, next muscles of the mucus glands contract thus squeezing out the mucus; finally the three inner bundles of the glands muscles, break the glandular epithelium, forcing it into the ejaculatory duct and into the anterior part of the endophallic bulb. The broken glandular epithelium urges on the mucus which, in turn, pushes forward the semen.

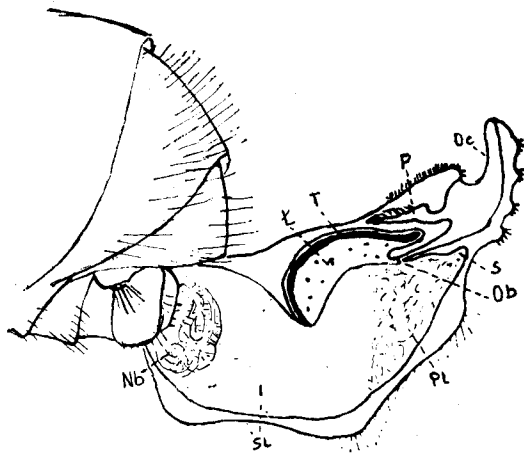
EXPLANATION OF ABBREVIATIONS

- aa — hairs on dorsal wall of the proximal end of vestibulum.
ab — irregularities on dorsal edges of the proximal end of vestibulum.
ac — hairs at the base of the hills of vestibulum and on ventral wall of the cornua.
ad — irregular structures on the mid-lateral wall of cornua.
ae — spicules on posterior area of ventral wall of vestibulum.
af — hairs on lateral wall of distal end of vestibulum.
ag — spicules on lateral wall of vestibulum and on ventral wall of distal part of neck.
ah — hairs on triangular area. The ventral area of vestibulum, and the areas on transverse corrugation of neck, are covered with similar hairs.
B — bulb of endophallus.
B₁ — thick-walled part of bulb.
B₂ — thin-walled part of bulb.
Ce — neck of endophallus.
Ch — chitin layer (endocuticle).
Ch₁ — zone of endocuticle proximate to the epithelium.
Ch₂ — zone of endocuticle further away from the epithelium.
Cz — ^{broad}inner plate of bulb.
d — ventral wall of neck between longitudinal folds.
De — ductus ejaculatorius.
Dp — proximal area of ventral wall of vestibulum.
G — hill of vestibulum.
Gm — mucus gland.
J — testis.
K — yellow viscous layer covering the cornua.
Lp — lamina parameralis.
L — connective substance.
M — muscles.
MJ — vestibulum of endophallus.
Mp — basement membrane.
N — vas deferens.
Nb — epithelium.
Ob — aperture from bulb into neck.
Oc — hind aperture of partly everted endophallus.
P — fimbriate lobe.
Pl — semen.
Pt — ventral area of vestibulum.

- Pv — penis valve.
Q — triangular area.
R — cornua.
S — sacculus.
Sk — longitudinal fold of neck.
Sl — mucus.
T — ^{long}dorsal plate of bulb.
Tch — tracheae.
Ti — connective tissue.
Tva — areas on transverse corrugations of the neck.
Vs — vesicula seminalis.
Wz — reinforcing layer.



Ryc. 3



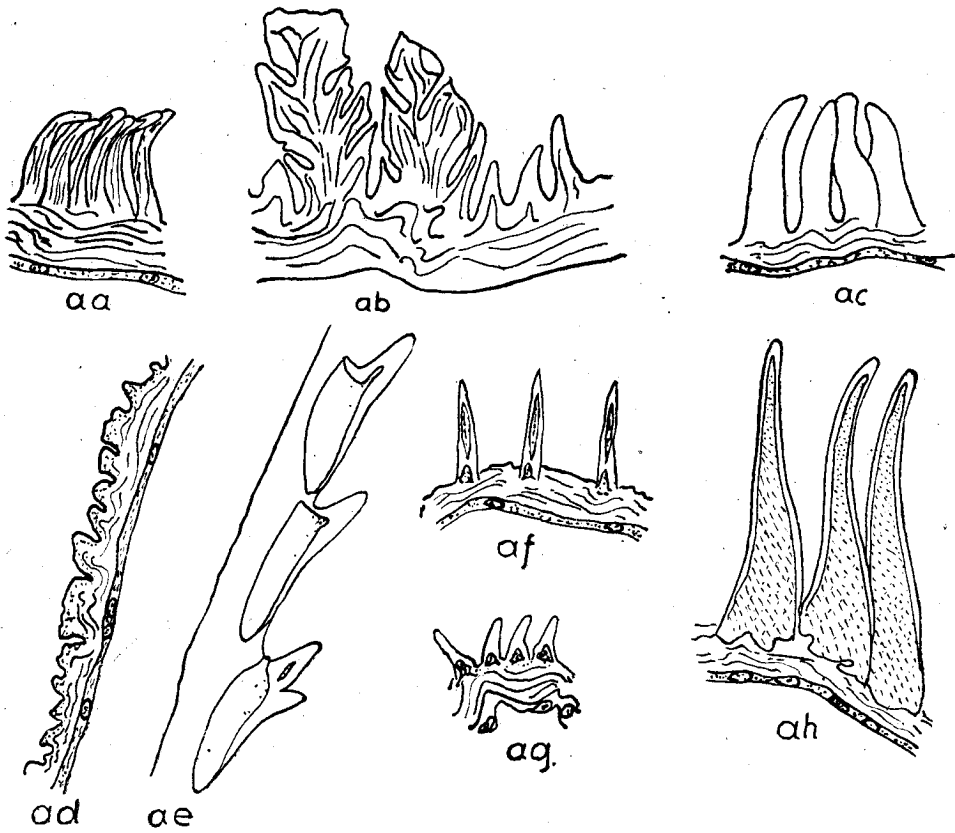
Ryc. 4

Ryc. 3. Częściowo wycięty aparat koplacyjny, w którym uwidoczniło się ułożenie części niewyciętych.

Fig. 3. Partly everted endophallus in which is made visible the position of non everted parts.

Ryc. 4. Częściowo wycięty aparat koplacyjny w przekroju podłużnym.

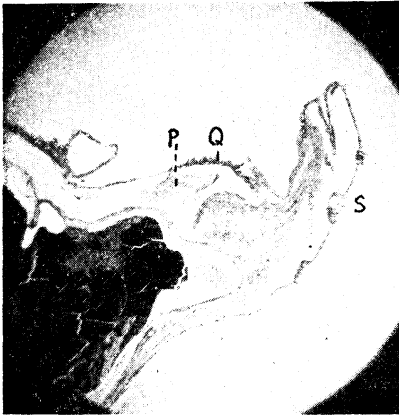
Fig. 4. Longitudinal section of partly everted endophallus.



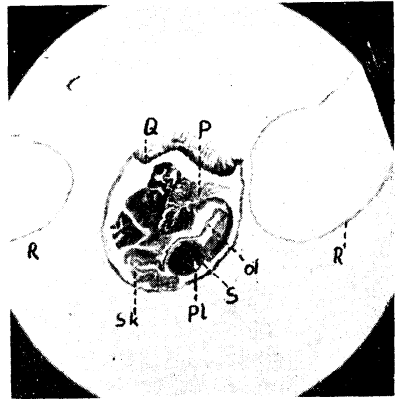
Ryc. 5

Ryc. 5. Włoski znajdujące się na aparacie kopulacyjnym. (Pow. 380 X).

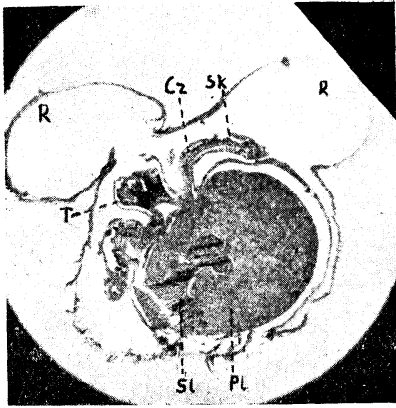
Fig. 5. Hairs, irregular structures and spicules beseting the endophallus X 380.



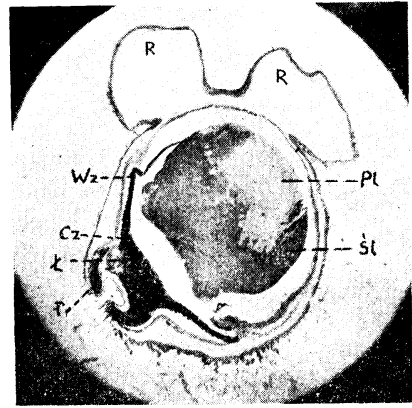
Ryc. 6



Ryc. 7



Ryc. 8



Ryc. 9

Ryc. 6. Przekroj podłużny przez tylny odcinek częściowo wynicowanego aparatu kopolacyjnego. (Pow. 22 X).

Fig. 6. Longitudinal section of the distal part of partly everted endophallus X 22.

Ryc. 7. Przekroj poprzeczny przez tylny odcinek częściowo wynicowanego aparatu kopolacyjnego. (Pow. 18 X).

Fig. 7. Cross-section of the distal part of partly everted endophallus X 18.

Ryc. 8. Przekrój poprzeczny przez tylny odcinek bulwy w częściowo wynicowanym aparacie kopolacyjnym. (Pow. 18 X).

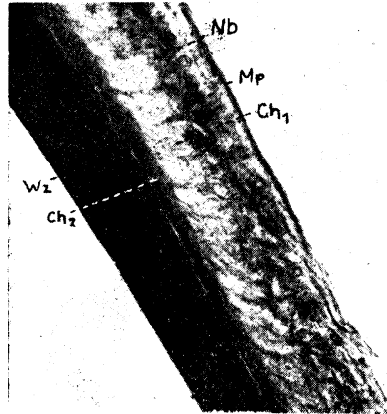
Fig. 8. Cross-section of the posterior part of the endophallic bulb in the partly everted endophallus, X 18.

Ryc. 9. Przekrój poprzeczny przez środkowy odcinek bulwy w częściowo wynicowanym aparacie kopolacyjnym. (Pow. 18 X).

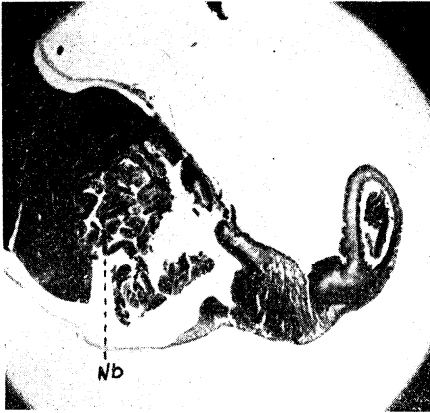
Fig. 9. Cross-section of the medial part of the endophallic bulb in the partly everted endophallus, X 18.



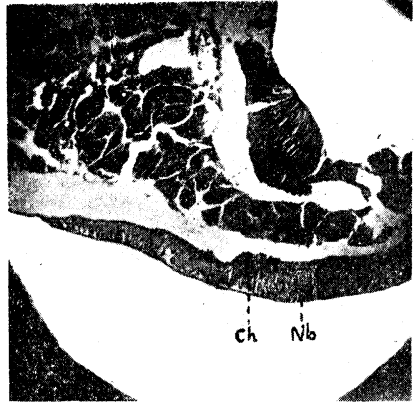
Ryc. 10



Ryc. 11



Ryc. 12



Ryc. 13

Ryc. 10. Przekrój poprzeczny przez bulwę jednodniowego trutnia. (Pow.16×).

Fig. 10. Cross-section of the endophallic bulb of one-day old drone, $\times 16$.

Ryc. 11. Przekrój poprzeczny przez boczną ściankę bulwy (w świetle spolaryzowanym). (Pow. 328 ×).

Fig. 11. Cross-section of lateral wall of the bulb. $\times 328$.

Ryc. 12. Przekrój podłużny przez przedni odcinek bulwy. (Pow. 22 ×).

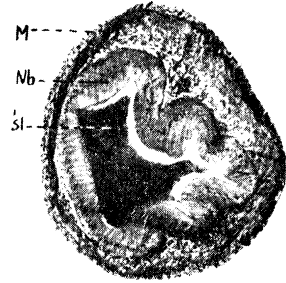
Fig. 12. Longitudinal section of the anterior part of the endophallic bulb, $\times 22$.

Ryc. 13. Przejście nabłonka płaskiego w nabłonek cylindryczny między bulwą a kanałem wytryskowym. (Pow. 37 X).

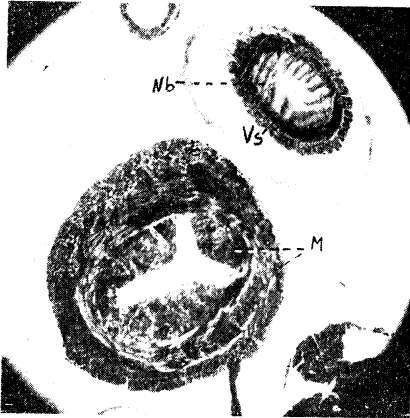
Fig. 13. Transition of the flat epithelium into the cylindrical epithelium between endophallic bulb and the ejaculatory duct $\times 37$.



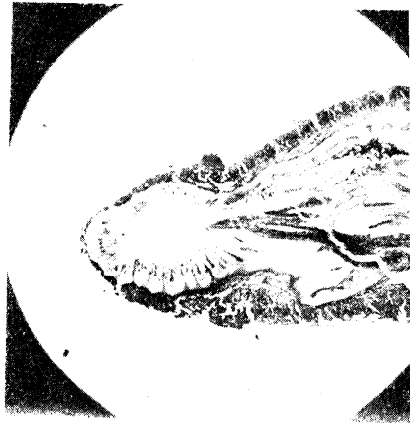
Ryc. 14



Ryc. 15



Ryc. 16



Ryc. 17

Ryc. 14 Odcinek przejściowy między nabłonkiem płaskim a nabłonkiem cylindrycznym. (Pow. 18 \times).

Fig. 14. Part transitory between the flat epithelium and the cylindrical epithelium. ($\times 18$).

Ryc. 15 Przekrój poprzeczny przez gruczoł śluzowy jednodniowego trutnia. (I 18 \times).

Fig. 15. Cross-section of the mucus gland of drone one-day old. ($\times 18$).

Ryc. 16 Przekrój poprzeczny przez gruczoł śluzowy i pęcherzyk nasienny płci dojrzałego trutnia po wyciowaniu aparatu kopulacyjnego. (Pow. 26 \times).

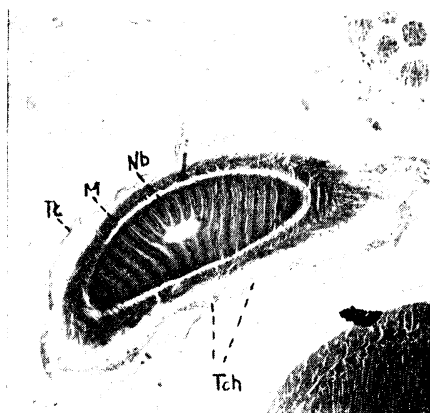
Fig. 16. Cross-section of mucus gland and seminal vesicle of a sexually mature drone after eversion of endophallus. ($\times 26$).

Ryc. 17 Przekrój styczny przez gruczoł śluzowy przed wyciowaniem aparatu kopulacyjnego. (Pow. 22 \times).

Fig. 17. Contiguous section of mucus gland before the eversion of endophallus. ($\times 22$).



Ryc. 18



Ryc. 19



Ryc. 20

Ryc. 18. Przekroj poprzeczny przez pecherzyk nasienny płciowo niedojrzałego trutnia. (Pow. 120 X).

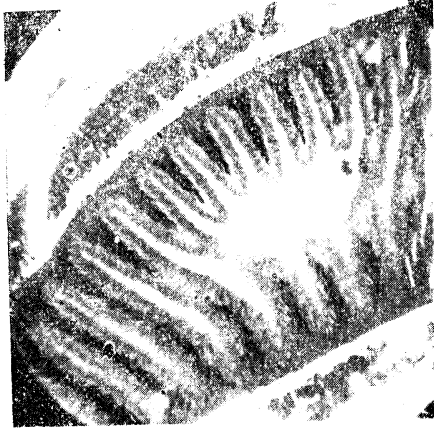
Fig. 18. Cross-section of seminal vesicle of drone sexually immature $\times 120$.

Ryc. 19. Przekroj skośny przez prawy pecherzyk nasienny. (Pow. 40 X).

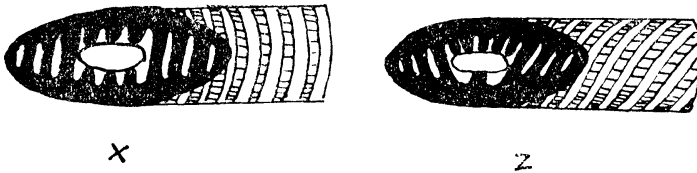
Fig. 19. Slant section of the right — side seminal vesicle, $\times 40$.

Ryc. 20. Przekroj skośny przez lewy pecherzyk nasienny. (Pow. 40 X).

Fig. 20. Slant section of the left — side seminal vesicle, $\times 40$.



Ryc. 21



Ryc. 22

Ryc. 21. Nabłonek w pęcherzyku nasiennym poczwarki. (Pow. 120 X).

Fig. 21. Epithelium of seminal vesicle in pupa, $\times 120$.

Ryc. 22. Przekrój skośny przez przewód.

x — gdy wewnętrzne fałdy tworzą obręczki.

z — gdy wewnętrzne fałdy tworzą spirale.

Fig. 22. Slant section of the duct: x — inner folds forming rings, z — inner folds forming spirals.