The Anatomy of the Female Reproductive System of *Microbracon gelechiae Ashmead*

Hymenoptera: Braconidae

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(With 14 figures)

Introduction

There are few contributions on the morphology of the reproductive organs of the parasitic Hymenoptera as most of them are small and sometimes microscopic. Besides, except in few cases, it is rather difficult to obtain them in large numbers for these studies. The morphology of *Habrobracon juglandis Ashm.* has been studied in detail by Genieys (1925) and Bender (1943). Fulton (1933) has described the mechanism of oviposition in the chalcid parasite *Habrocytus cerealellae Ashm.*

The important accessory organs in addition to the pair of ovaries are, the spermatheca, the spermathecal glands, the lubricating glands, and the poison glands. The organs are of the same type throughout the Hymenoptera but their structure and function differ to some extent in the subdivisions of the Order. It is hoped that these studies will help in understanding the more complicated mechanism of oviposition in certain groups of Hymenopterous parasites.

Material and Methods

The parasites used in these studies were imported from Canada in 1944, by the Indian Agricultural Research Institute, to combat, if possible, the potato tuber moth, *Gnorimoschema operculella Zell.* whose larva it parasitises. Since then the parasite has been bred in thousands in the Section of Insect Parasitology of the Entomological laboratory of the Indian Agricultural Research Institute.

Dissections of the females were made in Insect Ringer's solution under a binocular microscope. For section studies the insects were fixed in hot Kahle's fluid and Henning's fluid. Sections were cut at 8 to 12 microns and were stained with Delafields Haematoxylin and by the Feulgin methods.

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External Morphologsy

The abdomen of the female *Microbracon gelechiae* exhibits 8 tergites and 5 sternites (Fig. 1). The ovipositor extends from the end of the abdomen between the subgenital plate and the proctiger (Sg., ptg). The seventh sternite which is known as the subgenital plate projects out slightly beneath the ovipositor. The ovipositor is made up of 3 pairs of valvulae. The first pair are the lancets which are toothed at their distal end. The second pair of valvulae, which are fused, form the median dorsal sheath (Fig. 7, Vl_1, Vl_2). The third pair are the palpi. Under resting conditions the first and second pair of valvulae are ensheathed by the third pair of valvulae. The first pair of valvulae are grooved on their dorsal side and the median dorsal 2nd pair of valvulae rides on the groove. The first and second pair of valvulae can slide anteriorly and posteriorly by the help of rails. The rails and the grooves of the 1st and 2nd pair of valvulae form a dove-tail joint, which cannot be slipped or separated under any circumstances or pressure (Fig. 7, Dj). The distal end of the first and second pair of valvulae are not closely united. The first and second pair of valvulae are so joined and constructed as to delimit a narrow canal through which the poison as well as the eggs descend down. The other cavities seen in the cross section have no connection with the outside; they are the extension of the body cavity (Fig. 7, Bc).

The structure and the arrangement of the valvifers and their attachment to the muscles fully agree with the description given by Bender (1903) in the case of *Habrobracon juglandis*.

Anatomy

After the preoviposition period of 48 hours, the gravid female abdomen is mostly filled with the fully ripened eggs. The two ovaries, each consisting of a pair of ovarioles, occupy the lateral sides of the abdomen, covering the mid intestine on both of its sides. The ovarioles are of the Polytrophic type and various stages in development of the eggs are seen when they are stained with aceto-carmine. The fully developed eggs are found at the posterior ends of the ovarioles which are sack like. Ventral to the intestine the right and left oviducts continue posteriorly and unite under the large posterior abdominal ganglion. The common duct is continued as the vagina and the spermatheca is attached on the dorsal side of the vagina, between it and the posterior abdominal ganglion. The vagina ultimately opens into the bulb of the second valvulae and thus the eggs descending down the vagina enter the bulb of the ovipositor. At the inside of the neck of the second bend, which is also the last, is attached off the median unpaired lubricating gland. The latter is attached to the vagina by a short stout neck. A group of large poison glands is found in the posterior part of the abdomen, situated either to the left or to the

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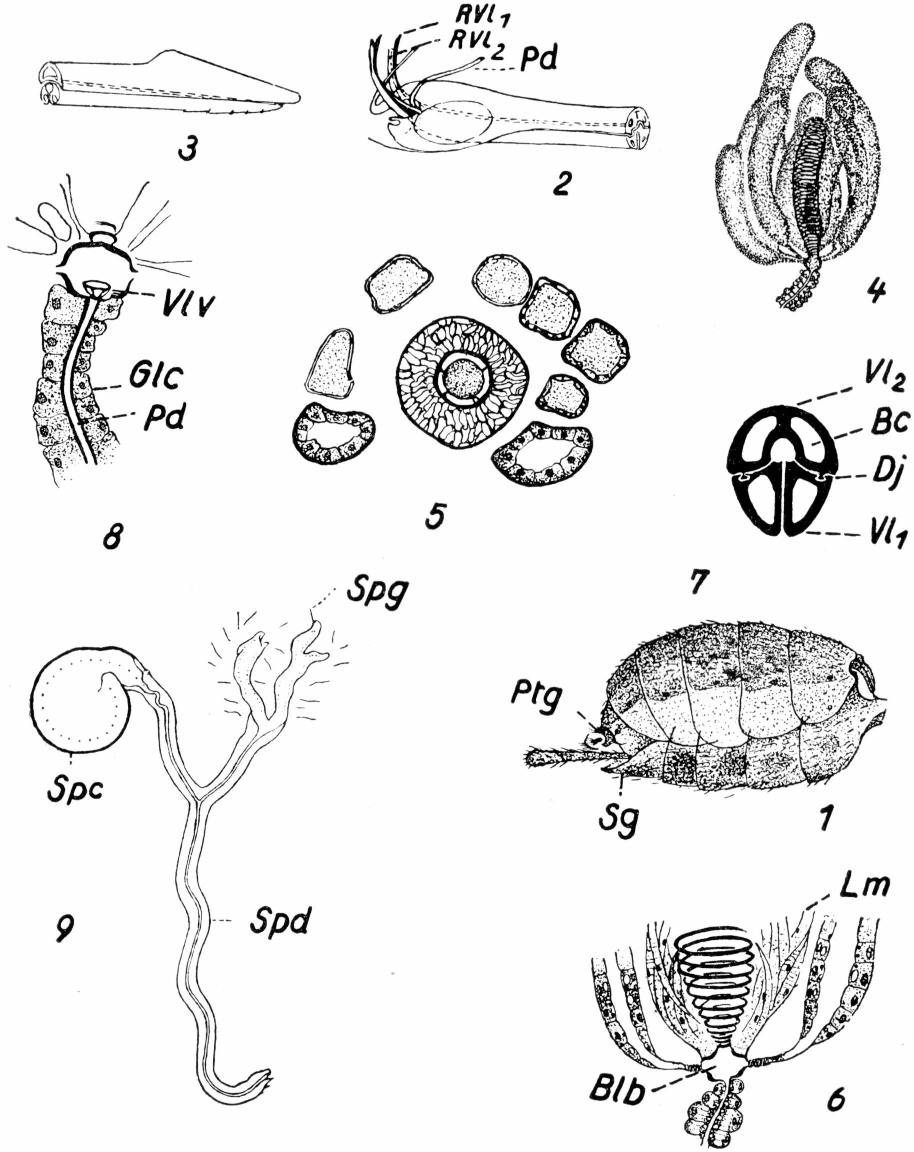

Fig. 1. Abdomen of *Microbracon gelechiae Ashm.*; female. — Fig. 2. The base of the ovipositor showing the bulb of the ovipositor and the rami. — Fig. 3. The distal end of the ovipositor showing the lancet. — Fig. 4. The poison glands. — Fig. 5. Transverse section of the poison glands and the reservoir. — Fig. 6. Longitudinal section of the poison glands. — Fig. 7. Transverse section of the ovipositor showing the arrangement of the 1st and the 2nd valvulae. — Fig. 8. Longitudinal section of the poison gland passing through the bulb region, showing the valve. — Fig. 9. Spermatheca (highly enlarged)

Bc: Body cavity; Blb: Bulb of the poison reservoir; Dj: Dove tail joint between the 1st and 2nd valvulae; Glc: Globular cells; Lm: Longitudinal muscles of the poison gland reservoir; Pd: Poison duct; Ptg: Proctiger; RVl_1: Ramus of first valvula; RVl_2: Ramus of second; Sg: Subgenital plate; Spc: Sperm capsule; Spd: Spermathecal gland; Vlv: Valve; Vl_1: first valvulae; Vl_2: Second valvulae

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right of the mid intestine (Fig. 4). In dissections, it is usually found on the left side. The poison glands which look like a bunch of cylinders, are 8 or 10 in number. These elongated glands surround a poison reservoir. Usually the length of these glands varies from $1^1/_2$ to 2 times the length of the reservoir. Two, however, are highly elongated (Fig. 4). From the base of the poison reservoir a long duct surrounded by large secretory cells descends to end in the bulb of the ovipositor.

Spermatheca

The spermatheca which is situated on the dorsal wall of the vagina, consists of three main parts, namely the sperm capsule, the associated sperm gland and the sperm duct which connects the sperm capsule and the vagina (Fig. 9, Spc, Spg, Sp). A number of minute canals of spermathecal glands open into a central reservoir, which is an enlargement of the gland canal. The reservoir is very small when compared to that of the sperm capsule. Though the sperm capsule is chitinous in nature, it is semitransparent. The lumen of the sperm duct between the sperm capsule and the gland canal is spirally convoluted corresponding in its structure to the undulations of active sperms. A careful study of the spermatheca further revealed that there was no visible structure, that might represent a valve similar to the one occurring in the chalcidoids or in the aculeates. The spermatheca and its ducts are covered by fat cells which are easily stained in Sudan III.

Lubricating glands

This gland bears a similarity to the lubricating gland described by PAMPEL (1913) in certain Ichneumonids. The wall of the gland is composed of a single layer of cells with nuclei of varying sizes and in various positions. As the gland is situated just near the bulb the function must be that of lubricating the valvulae and the ovipositor canal.

Poison glands

The venom with which the insect paralyses its host is secreted by both the large and small groups of glands already referred to. According to the description given by BENDER (1943) one set produce an alkaline, the other an acid secretion. The cross section of the poison glands show (Fig. 5) that the two large glands have heavy cuboidal cells with granular cytoplasm and large nuclei, whereas the smaller set have thin walled cells with small nuclei. It is evident that the fluid secreted in these differ from one another. The stalk of each gland possesses a delicate chitinous spiral wiring and leads into a cuticular bulb at the reservoir (Fig. 6). Apparently the secretion from the cells passes into the lumen down the stalk into the bulb and up into the reservoir.

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Reservoir

The reservoir which is also a pump appears to be almost a spindle shaped body pointed at either end and lined with a heavy cuticular spiral in its inner side. The cuticular lining is brown in colour and presents a striking appearance. This type of poison gland was described by Berlese (1909) and Bender (1943) in Braconids. The reservoir is surrounded by a heavy muscular coating made up of innumerable striated longitudinal muscle fibres which are attached at numerous points along the spiral lining (Fig. 6). It is evident from the arrangement that when the muscle fibres contract, the spiral line is compressed like a spring and the content of the reservoir is driven out with great force. When the coil assumes its normal position a vacuum is created in the reservoir and a fresh quantity of poison is sucked in.

The bulb of the poison reservoir

This is a small rounded chitinous structure in between the poison reservoir and the poison duct. It is completely devoid of any musculature. Small narrow tubes coming from the distal ends of the elongated poison glands connect the bulb and pour out the secretion of the glands into the bulb. There is a cup shaped cuticular structure at the bottom of the bulb just before the origin of the poison duct. This cup shaped structure has two cuticular plates which act as valves and can open only in one direction (Fig. 8, Vlv). The importance of this valve will be discussed later. Bender who made a thorough study of the reproductive organ of *Habrobracon* did not observe this structure.

Poison duct and cells

From the base of the bulb of the poison reservoir runs the poison duct with its numerous globular cells (Fig. 8, Glc.). In sections the wall of the duct appeares to be heavily sclerotised. The surrounding cells are heavilly vacuolated and possess large nuclei at the periphery. The cytoplasm is finely granular. The cells are connected to the poison duct by extremely fine necks. Through these openings the cells pour their secretion into the poison canal. These cells surround the poison duct beginning from the bulb to the end of the duct, where it enters the bulb of the ovipositor.

Discussion

The valve in the bulb of the poison reservoir has an important relation to the flow of the poison downward. When the longitudinal muscle fibres contact, the cuticular lining is pressed like a mattress spring and the poison is pumped out with great force. When the reservoir assumes its normal shape, it is assumed by Bender (1943) that a vacuum is created

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and a fresh quantity of poison is sucked into the reservoir. This assumption, unless there is a valve which opens in one direction only cannot hold good. Furthermore, the fluid entering the bulb would trickle down the the poison canal instead of going up if there was no valve.

Coming to the function of the globular cells found throughout the length of the poison duct, the assumption of Bender (1943) that the secretion of these cells adds to the ,,venom of the poison" is quite debatable. In discussing the nature of the secretion of these cells and their function, we have to understand the mode of oviposition in Braconids.

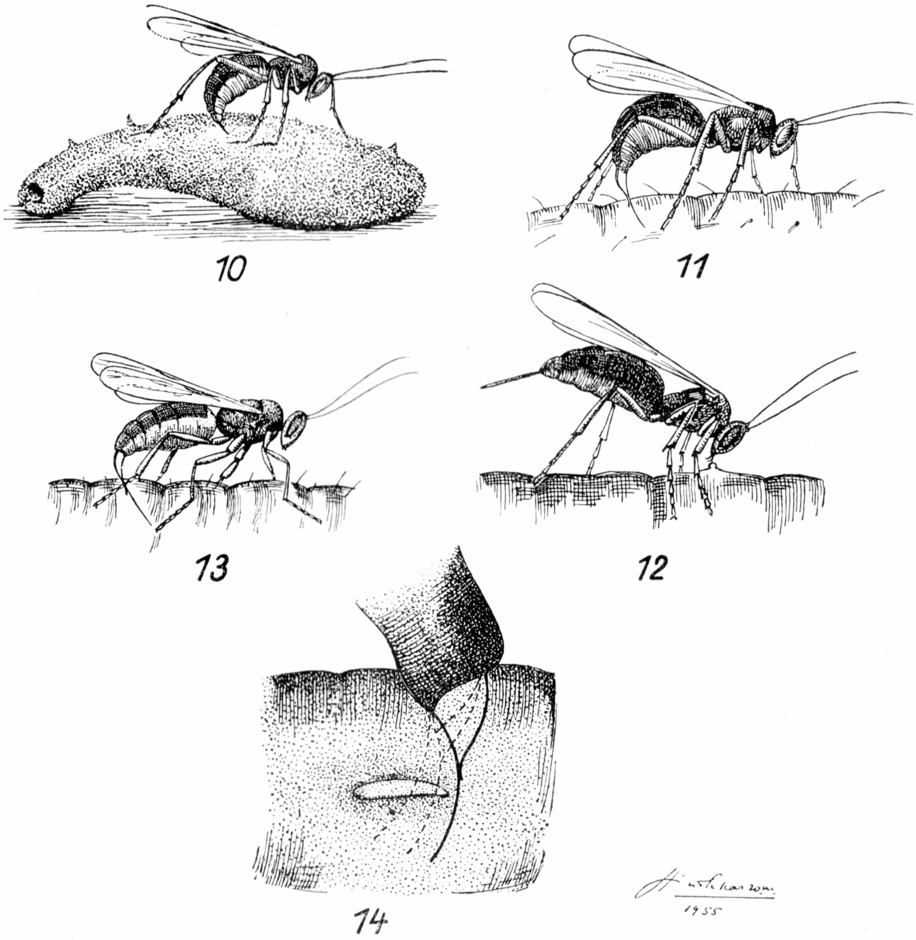

Fig. 10—14. Oviposition and feeding habits of *Microbracon gelechiae Ashm.*

Fig. 10. Female ovipositing through the cocoon of the host. — Fig. 11. Female stabbing a naked larva prior to oviposition. — Fig 12. Female feeding through the puncture of host larvae as a result of stabbing. — Fig. 13. Female in the act of oviposition on *Corcyra* larva. — Fig. 14. Close up of the ovipositing abdomen of the female

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The studies on the structure of the ovipositor have revealed that the 2 pairs of valvulae enclose a very narrow canal and the valvulae cannot be displaced by pressure as they are very well connected by dove-tailed joints. Then the question is how does the eggs pass through such a narrow canal? The idea that the eggs swell after they are deposited cannot hold good, because many careful dissections of the female abdomen show that the uterine eggs are of the same size as those deposited on the host Evidently the eggs must be forced through the narrow ovipositor canal a little at a time. Let us see the mode of oviposition in *Microbracon gelechiae*. On reaching the host through the muslin the ovipositor is quickly extended to make several thrusts into various parts of the host and then is almost withdrawn while the parasite rests for a time. The ovipositor is then extended as far as possible to reach the host caterpillar and utilised to explore the space near it. With the ovipositor in a vertical position the insect stands quietly for a time. Then the abdomen quivers slightly and an egg suddenly appears at the end of the ovipositor. The whole process of exploring, stabbing, paralysing and oviposition is completed in a few minutes. The eggs while passing through the ovipositor which did not show any appreciable enlargement were clearly seen under the binocular microscope. The greatest diameter of the egg is at least 22 times the diameter of the spacae available for its passage. Even allowing for a slight expansion of the ovipositor during oviposition the egg would have to be compressed to about 20 times to its greatest diameter. The only logical conclusion is that the egg has to go through the ovipositor like a thread. How can the chorion stand this terrific pressure? How is this accomplished? As we have already seen, there is a separate lubricating gland at the base of the uterus which helps in the lubrication of the two pairs of valvulae. The poison glands are there to secrete venom. Then it is those globular cells found around the poison duct, that secrete a fluid which will help in softening the chorion and it can be assumed that the thinly stretched egg assumes its normal shape and rigidity as soon as it comes into contact with the atmosphere. Perhaps the chorion does not harden until the egg is deposited.

Although the whole process seems utterly impossible and unbelievable, the fact remains that the egg actually goes through the ovipositor without causing any appreciable increase in the size of the organ. FULTON (1933) who had described the mode of oviposition in *Habrocytus cerealellae* has expressed the same opinion, but he says that the chorion of the egg is elastic and easily stretched. This cannot be accepted as we know, the chorion is quite rigid and breaks up into pieces at the slightest pressure. Hence the importance of such a secretion as secreted by the globular cells is stressed.

Why in nature the egg has to undergo such a treatment may easily be answered. *Microbracon gelechiae* is a prepupal parasite on *Gnorimo-*

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schema operculella, a serious pest on potato in storage. The potato in storage is usually infested by many predaceous mites which feed on eggs of the pests as well as its parasites. It is quite evident that if the hole made in the pupa by the parasite at the time of oviposition is small, the mite will be unable to enter and thereby the parasitic egg is safe from destruction. It is an adaptation hy the female parasite to safeguard its progeny and thereby perpetuate the race.

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Einige Bemerkungen über den Bau der Tarsen von *Gyropus* und *Gliricola*

(*Mallophaga*)

Von Stefan von Kéler

Zoologisches Museum der Humboldt-Universität, Berlin

(Mit 14 Textfiguren)

Die Beine von *Gliricola* und *Gyropus* stellen zwei völlig verschiedene Anpassungsformen dar, deren Bau lange verkannt war. Erst Ewing (1924) hat den Bau des *Gyropus*-Beines richtig dargestellt und gezeigt, daß das von älteren Autoren für die Kralle gehaltene, quer geriffelte Endglied der Mittel- und Hintertarsen keine Kralle, sondern das 2. Tarsenglied darstellt, an dessen Spitze die kleine, dreieckige, echte Kralle sitzt.

Den Tarsus von *Gliricola* hat Ewing (l. c.) zwar richtig abgebildet, aber falsch gedeutet. Der Verfasser (Kéler, 1943) hat dann den Tarsus von *Gliricola* an mehreren Arten untersucht und die Deutung Ewing's berichtigt.

Charlotte Mayer (1954) scheinen die beiden oben erwähnten Arbeiten entgangen zu sein. Die Folge davon ist, daß in ihrer Arbeit wieder die alten Irrtümer lebendig geworden sind. Da es sich sonst um eine groß angelegte und gründliche Arbeit aus der weltbekannten entomo-morphologischen Schule von Weber (Tübingen) handelt, liegt die Gefahr nahe, daß diese Irrtümer, falls sie nicht rechtzeitig berichtigt würden, Eingang in die Literatur finden könnten. Dieser Gefahr sollen die folgenden Zeilen vorbeugen.

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