KOREAN JOURNAL OF ZOOLOGY
Vol. 24, No. 2, 65-75 (1981)

Acrosome Morphogenesis in *Gerris paludum* (Heteroptera)

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소금쟁이의 尖體形成

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(Received February 28, 1981)

적 요

*Gerris paludum*의 精子形成동안의 尖體形成에 대한 연구를 요약하면 다음과 같다. 1. Golgi體는 精母細胞의 초기단계에서 細胞質에 산재되어 있다가 서로 융합하여 囊胚形을 하며 이들이 모여서 감수분열 전기에는 몇개의 큰 Golgi 體群을 형성하는데, 이들은 결국 精細胞에 균등히 분포된다. 2. 精子完成에서 acroblast는 처음에 하나의 큰 胞로 나타나다가, 그 내부에서 尖體顆粒이 分化된 후, acroblast는 顆粒에서 分離되어 결국 tail filament를 따라 사라진다. 3. 尖體는 mitochondrial derivatives의 반대편인 核 전면부로 이동한 후, two zones 즉 core와 sheath로 分化된다. 4. Basal bodies와 tip은 모두 sheath에서 由來한다. Basal bodies는 sheath의 基部에서 발생해서 尖體가 伸長되고 좁아짐에 따라 점차로 尖體의 基部를 싸기 시작하여 결국 완전히 둘러싸게 되며, 分化된 tip은 core의 前端部에 인접해서 나타나지만 sheath와 뚜렷이 연결되어 있다. 5. 分化된 tip은 basal bodies보다 앞서서 伸長한다. Basal bodies는 精細胞 후기에 하나의 顆粒으로 융합하지 않고 서로 연결된 twin-tubes로 나타나며, sperm bundle에서는 basal bodies group을 형성한다.

INTRODUCTION

There have been some studies on the spermatozoa of the hemipterans (Montgomery, 1911; Bowen, 1922; Barker and Riess, 1966; Payne, 1966; Tandler and Moriber, 1966; Pratt, 1968; Afzelius *et al.*, 1976; Lee and Lee, 1980b). It is known that their acrosomes are very large and highly structured. With the exception of the study by Pollister (1930)

This work was aided by a grant from The Korea Science and Engineering Foundation, for Graduate Student Scholarship, 1980.

and Tandler and Moriber (1966), there has been little work reported on the acrosome of the sperm of *Gerris*. According to Pollister (1930), the acrosome constituted a far greater proportion of the mature spermatozoon than is usually the case. A detailed study was done concerning the differentiation and ultrastructural organization of the acrosome in *Gerris*, but little attention has been given to the basal bodies of the *Gerris*.

Recently we reported some observations on spermatogenesis in this species involving unusual structural aspects (Lee and Lee, 1980a, 1980b).

Therefore, the formation of the acrosome is discussed in this paper. Particularly the basal bodies are dealt in developmental process associated with the acrosome during the spermiogenesis of the species.

MATERIALS AND METHODS

Adults of *Gerris paludum* were obtained from two ponds in the Kyungpook University and reared in the laboratory during the summer months. Testes were dissected out in a 0.8% physiological saline. Some samples were followed by Defano's method for Golgi apparatus (Lee, 1968), that is, they were fixed in cobalt nitrate solution for 2 to 4 hours, rinsed in distilled water, stained with silver nitrate solution in the dark for 24 hours and placed in Ramon Y Cajal's reducing solution for 8 hours. Other samples were placed for 4 days in fresh Regaurd's fixative each day, followed with 3% potassium dichromate for 8 days, the solution was changed every 2 days and washed for 24 hours. These samples were then embedded as usual, cut at 2 to 3 microns and stained by Cain's method (Lee, 1968). The sections were examined with a Nikon universal photomicroscope.

RESULTS

Golgi bodies are generally dispersed throughout the cytoplasm at the early stage of the spermatocyte. Gradually they fuse together to increase in size and are randomly scattered around the nucleus (Fig. 1). Meanwhile they are in shape double-walled sac, gastrular form by the invagination of one side (Fig. 2). The reduction of the number of Golgi bodies in a spermatocyte occurs before the beginning of each division.

During the prophase of the division they get together to form several large group of many bodies in the equatorial region of the cell (Fig. 3). At late anaphase of the division they appear as small uniform fragments, they then scatter through the cytoplasm at first stage of spermatid termed by Lee and Lee (1980b) (Fig. 4). A large transparent vacuole lies in the angle between the nucleus and the nebenkern, and above the nucleus (Fig. 5).

As the nebenkern is divided into two parts (Fig. 6) and at once begins to elongate to form the mitochondrial sheaths of the tail filament (Fig. 7), the proacrosome first appears in the form of crescents (Fig. 8), and later forms a single relatively large body (Fig. 9).

nucleus.

Pollister (1930) described that in later stages the only signs of differentiation are a single granule at the base of the acrosome and the differentiated tip. But during this stage of *G. paludum* two basal bodies become elongated and appear to be contiguous twin-tubes, not a single granule (Figures 19 and 20).

After forming the twin-tubes of basal bodies, we could not observe the following ultrastructural changes with the light microscope. It needs to reveal further clarification by electron microscopy. Tandler and Moriber (1966) reported that the basal bodies disappear in later stages of development. However, their descriptions are different from our results on the grounds that the basal bodies are apparently observed in the sperm bundles of Figure 21, the last stage of spermiogenesis termed by Lee (1980b). They also suggested that in *Gerris remigis* the core is rich in protein and contains little polysaccharide depending on the PAS-negative, and the sheath is intensely PAS-positive.

Therefore, the above observations on the morphogenesis of unusually large acrosome, may throw some light for the role of the acrosome in the fertilization process of *Gerris*.

SUMMARY

The formation of the acrosome during spermatogenesis in *Gerris paludum* was studied. The Golgi bodies are dispersed randomly in the cytoplasm at the early stage of the spermatocyte and get together to form several group of many bodies, and then they are equally divided into the spermatids by the meiotic divisions. The acroblast first appears in the form of a vesicle and soon an acrosomal granule is differentiated within it. The acroblast is separated from the acrosomal granule at the posterior of the nucleus and is finally sloughed off along the tail filament. The acrosome, after moving to the side of the nucleus opposite the mitochondrial derivatives, differentiates into two zones. The two basal bodies and the differentiated tip originate from the sheath. The basal bodies appear at the proximal part of the sheath simply in contact with the core on one side. During elongation and and narrowing of the acrosomes of the spermatids, they surround the one side at the base of the acrosome and finally all the other are immediately adjacent to the nucleus. The differentiated tip continues to the sheath at the anterior of the core and is elongated prior to the two basal bodies. They appear to be contiguous twin-tubes, not a single granule in the later stage of the spermatids, and a group of the basal bodies in the sperm bundle.

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EXPLANATION OF FIGURES

Fig. 1. The spermatocyte showing Golgi bodies (G) scattered around the nucleus (N) at the early stage of the spermatocyte. ×1,500.

Fig. 2. Golgi bodies (G) showing double-walled sac, gastrular form. ×1,500.

Fig. 3. Several large group (LG) of many Golgi bodies in the equatorial regions of the spermatocytes during prophase of the division. ×1,500.

Figs. 4 & 5. The transparent vacuoles (TV) are shown in the angle between the nucleus (N) and the nebenkern (Ne), and above the nucleus. Golgi fragments (GF) scattered through the cytoplasm. ×600, ×1,500.

Fig. 6. The divisions of the nebenkerns (Ne). ×1,500.

Fig. 7. The mitochondrial derivatives (MD) in tail filament in twisting beads. ×1,500.

Fig. 8. The crescents (Cr) shaped proacrosomes with two centrioles (Ce) opposite to the proacrosome. ×1,500.

Fig. 9. The acrosome (A) showing a single large body. ×1,500.

Figs. 10 & 12. The acroblasts (Ab) disappearing along the tail filament (TF). ×1,500.

Fig. 11. After forward movement of the acrosome, the acrosomes (A) are appeared at the anterior part of the nucleus (N). ×1,500.

Fig. 13. Light part, the sheath (S) and dark part, the core (C) of the acrosome in Defano's method. ×1,500.

Fig. 14. The acrosome showing two basal bodies (BB) at the proximal part of the sheath. They are stained like the sheath. ×1,500.

Fig. 15. L.S. through the acrosome showing the differentiated tip (T), the sheath (S) and the core (C). The tip continues to the sheath at the anterior of the acrosome. A basal body (BB) is within the sheath. ×1,500.

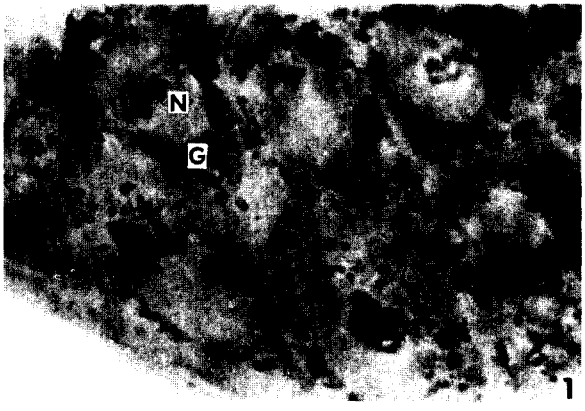
Fig. 16. L.S. through the acrosome stained with Cain's method. Light part, the core (C) and dark part, the sheath (S) are observed. ×1,500.

Fig. 17. The sheath (S) surrounding only one surface of the columnar core (C). ×1,500.

Fig. 18. The sheath surrounding most of the core. The basal bodies (BB) are located at one side of the acrosome. ×1,500.

Figs. 19 & 20. Basal bodies (BB) in the form of rods with contiguous twin-tubes. ×1,500.

Fig. 21. The basal bodies group (BBG) in a bundle (B). ×600.



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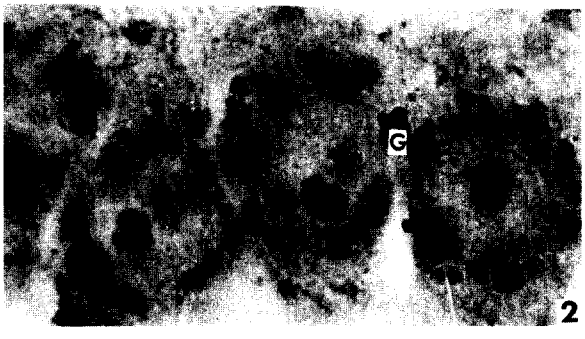

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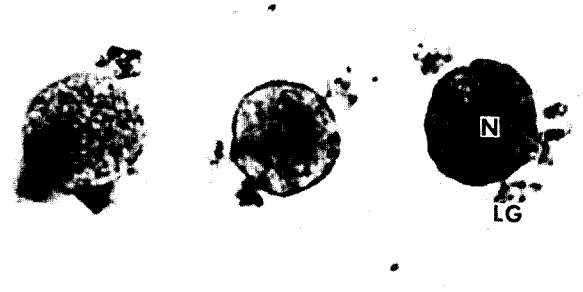

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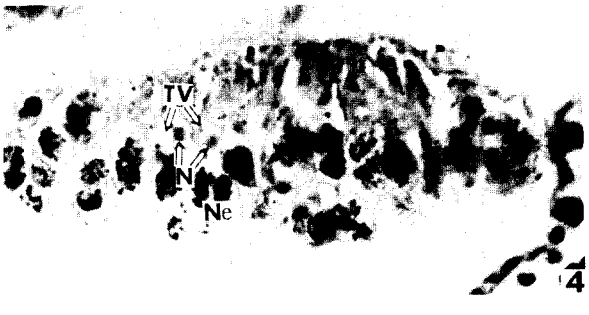

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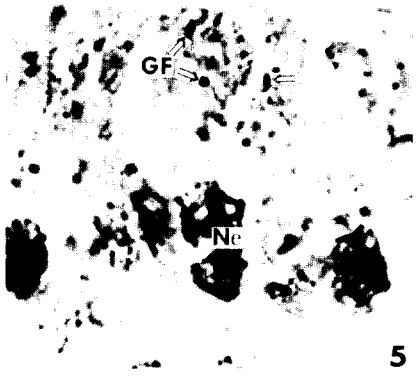

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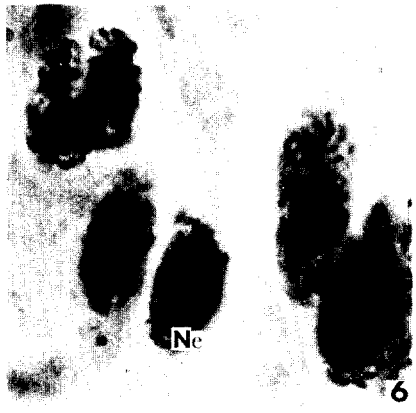

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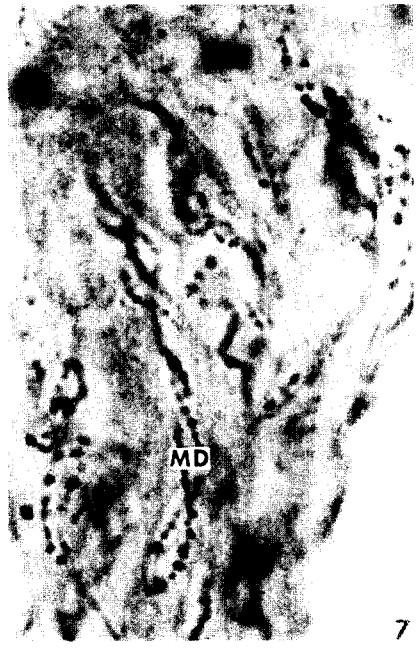

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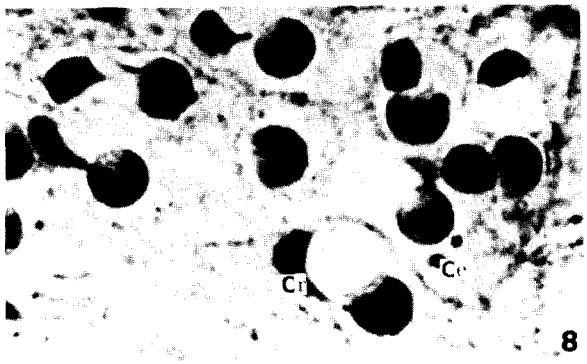

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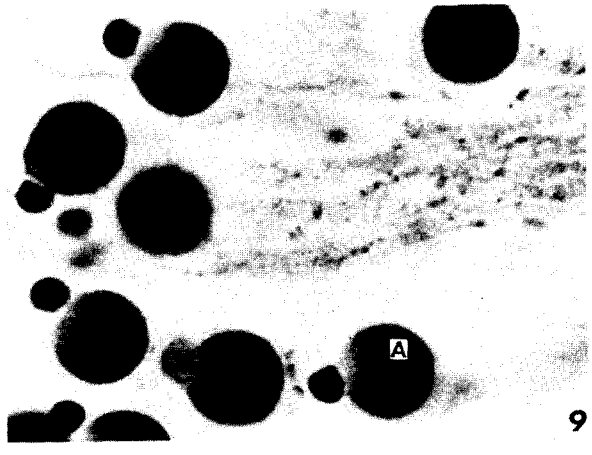

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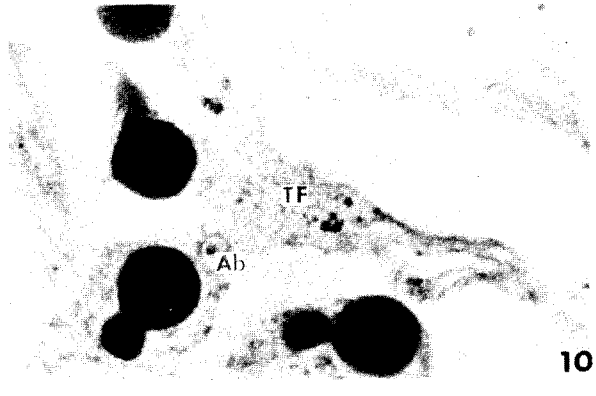

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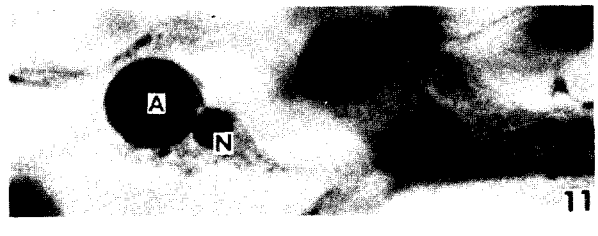

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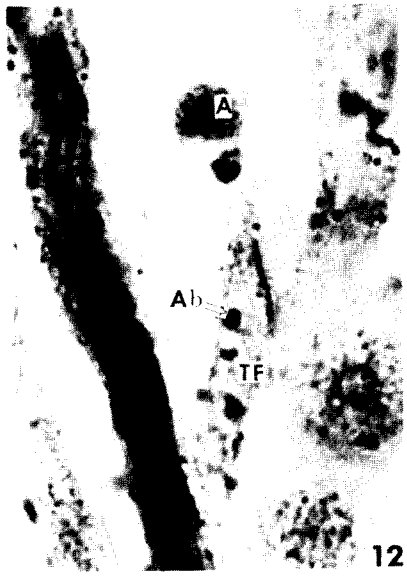

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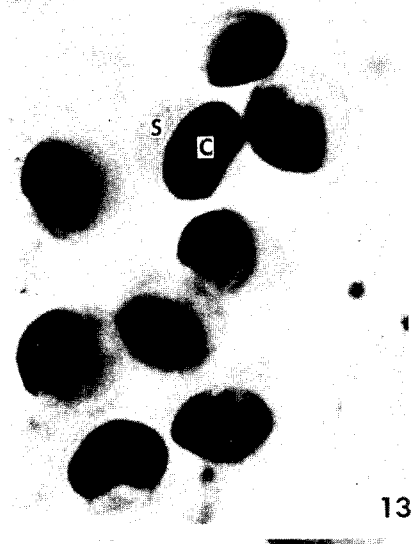

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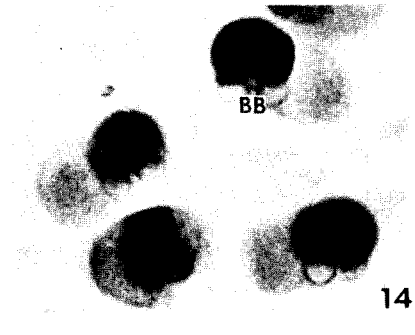

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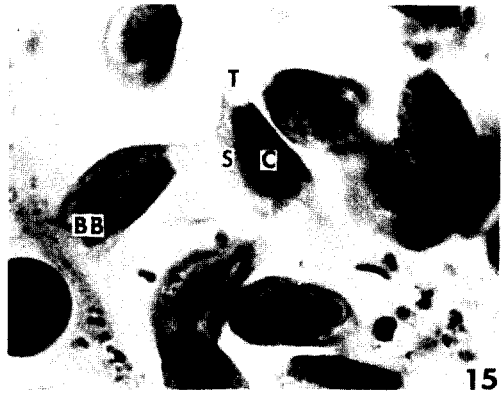

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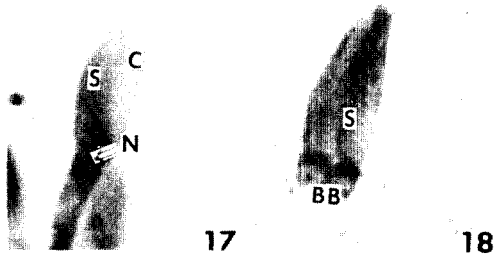

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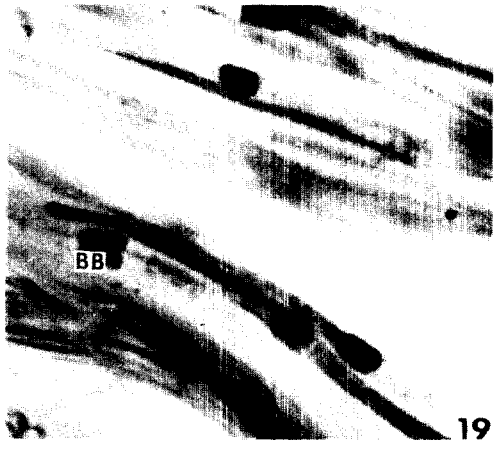

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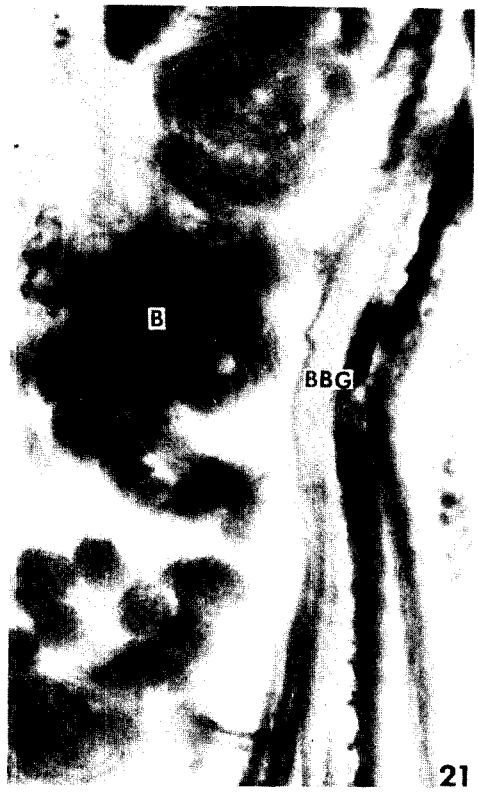

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