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Scanning Electron Microscopic Observations on the Surface Structures of the Tick, *Haemaphysalis longicornis* Neumann 1901

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走査電子顯微鏡 映像分析에 의한 *Haemaphysalis longicornis*의 表面 微細構造

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抄 錄: 家畜의 外部寄生虫 중에서 가장 被害가 크고 發生密度가 높은 진드기인 *Haemaphysalis longicornis*의 表面 微細構造를 觀察하기 위하여 走査電子顯微鏡(Model; SEM ISI-DS-130)을 使用하여 그 映像 및 寫眞分析을 實施하여 그 結果를 報告하는 바이다.

本 論文圖鑑에 收錄한 主要內容을 要約하면 다음과 같다.

1. 未吸血 암컷에 對한 正面所見 및 未吸血 수컷에 對한 正側面所見.
2. 암·수컷의 顎體部 背面所見 및 腹面所見.
3. 口下片 齒列과 冠狀 柱列의 所見.
4. 肢關節의 構造.
5. 背板, 轉節 및 腿節上의 剛毛 形態와 體表面 構造.
6. 觸肢上의 剛毛와 剛毛腭의 形態.

Introduction

The tick *Haemaphysalis longicornis* Neumann 1901, (Acarina: Ixodidae) incorrectly referced to as synonyms *H. bispinosa* or *H. neumanni* in some literature for many years[6,16,36], has now been recognized as the proven vector of the important animal diseases, such as Far-eastern type theileriosis caused by *Theileria sergenti*[28] and Japanese type babesiosis caused by Babesia ovata[27]. These protozoan diseases are regarded as the important vernacular diseases causing immense economic loss in livestock industry especially in the exotic cattle in the North-east Asian countries including Korea.

So many noticiable references on the classification and identification,[15] geographical distribution[4,15,33,42], epidemiological and epizootiological vector role[6,9,26~28,36], biological and genetical significance[8,24,30,31], population dynamics[20] ecological and physiological properties[4,21,38,41], laboratory colonization for mass production[20], hostparasite relationship with acquired immunity[22,23] and resistance[10,39] of *H. longicornis* are available.

Scanning electron microscopy characterized by its depth of focus and wide magnification range endows images of surface structures with the unaccustomed

three-dimensional presentation. Since the scanning electron microscope (SEM) had been introduced in the parasitological laboratories, it was used in the studies on the fine structures of some protozoan parasites[5,18,29,32,35,40,43] and in the presentation of some extraordinary pictures on some ectoparasites [1~3,37] and endoparasites[7,11~13,19,25]. In this pictorial monograph, the scanning electron microphotographs of the female and male specimens of *H. longicornis* are provided for the understanding of the surface fine structures and the comparison of the structures between the sexes.

Materials and Methods

Tick Specimens: The strains of *H. longicornis* used in these observations were the progeny of the laboratory colonized bisexual diploid types originally collected from cattle or pastures in Namwon-district, Cholla-Pukdo and Kangnung-district, Kangwon-Do in Korea. Numbers of the identified unfed ticks of *H. longicornis* were colonized under the controlled conditions using the rabbits and maintained at 25°C and 85% RH.

Preservation and Scanning Electron Microscopy: The specimens were preserved and fixed in 10% formal-saline or 70% ethyl alcohol containing 10% glycerine. Drying was performed in the air approximately 30°C and it was confirmed that air-drying was sufficient for the chitinous specimens especially for the unfed ones. The dried specimens were than fixed on the stubs by means of paste with special formulation for the scanning electron microscopes and finally subjected to evaporation with gold(Au) by means of an ion coater. The scanning electron microscope manufactured by the Korea I.S.I. Co. Ltd. (Model; SEM ISI-DS-130) was used for the observations and microphotography of the specimens. Microphotographs were made at 15 KV with the range of 20 X to 13,140 X on Kodak polaroid films. The magnification was determined automatically by the ratio of the screen surface to that of the scanned specimen.

Results

A total of 18 photographs was selected from the numerous SEM photographs of the female and male specimens of *H. longicornis* for the observations of the fine surface structure and the comparison between the female and male structures.

It was confirmed that the scanning electron microscopy was unique among microscopical observation techniques since it has some delicate physical characteristics analogous to conventional micro-or macroscopic observations. With the secondary emission SEM, the specimens are always seen in three dimensions.

Explanations on the findings of the tick specimens observed were referred to the 'Legends for Figures' below and the furthur detailed information and comparison should be referred to the descriptions of Hoogstraal *et al* (1968)[15], Roberts (1970)[33], Yamaguti *et al* (1971)[42] and Kang(1980)[20], although the descriptions are from conventional microscopy.

Discussion

The taxon of *H. longicornis* has long been incorrectly referred to as *H. bispinosa* or *H. neumanni* by many workers in some literature, however, as a matter of fact, *H. bispinosa* is a separate species which occurs in tropical South-east Asia and the taxon *H. neumanni* is a synonym of *H. longicornis*. Hoogstraal *et al* (1968)[15] have mentioned that the species *H. longicornis* distributed in Australia, New Zealand, Fiji, Japan, Korea, China and the USSR is one of the Subgenus *Kaiseriana* and one of *H.* (K.) *bispinosa* group of Asian haemaphysalids [14~17,34] and resurrected the taxon.

Stendel and Holm (1975)[37] have described that the specimens to be studied with the scanning electron microscope must be vacuum-resistant, able to withstand the electron bombardment and electrical conductive. However, these three requirements are not always satisfied in biological specimens as they contain a large proportion of water, consist of sensitive organic substances and are nonconductive. Therefore, the specimens to be used under the scanning electron microscope should be subjected to the preparation steps, such as, fixation, dehydration and evaporation. It was recognized that the tick specimens especially unfed ones were excellently

suited for the SEM photography since they have chitinous cuticle retainning its original shape and surface structure to a large extent even after death.

Summary

Scanning electron microscope (Model; SEM ISI-DS-130) was used to observe the fine surface structures of the predominant cattle tick *Haemaphysalis longicornis* Neumann 1901 (Acarina: Ixodidae) in Korea and some SEM microphotographs were presented in this pictorial monograph.

Brief descriptions of the main contents are consisted of followings;

1. Mean body size is 2.43mm in unfed males and 2.58mm in unfed females. the eyes are absent.
2. The scutums are inornated but there are some short-setae on the surface of the body.
3. The festoons on the dorso-marginal part of the body are present and segmented with 11 sectors.
4. The cornua is well-developed and the bypo stome dentition is usually 5/5 in both sexes but rarely 4/4 also seen.
5. There is no dorsal projection on the anterio-internal margin of the palpal article 2, however, there are well developed dorso-internal setae with setal fossa on it.
6. The joints of the legs (Coxatrochanter and trochanter coxa, etc) are well developed.

Legends for Figures

Haemaphysalis longicornis Neumann 1901

Scanning Electron Microscope (SEM ISI-DS-130) 15KV.

Fig. 1. Cranial view of an unfed female, showing the head part and some legs. (20×).

Fig. 2. Dorsolateral view of the unfed male, showing the head part, scutum with grooves and festoons and spiracular plate and legs on left side of the abdomen. (40×).

Fig. 3. Dorsal view of the female capitulum, showing the pedipalps with processes and setae, hypostome, corona and the left area porosa on the basis capitulum. (170×).

Fig. 4. Dorsal view of the male capitulum, showing the pedipalps with processes and setae, hypostome, corona and a part of the basis capitulum. (200×).

Fig. 5. Ventral view of the female capitulum, showing the hypostome, articles with ventrointernal setae, article processes, corona and files. Hypostome dentition 5/5. (200×).

Fig. 6. Ventral view of the male capitulum, showing the hypostome, articles with ventrointernal setae and processes, corona and files. (300×).

Fig. 7. Cranial aspect of the female hypostome with the highly magnified corona files. (5,000×).

Fig. 8. Cranial aspect of the male hypostome with the highly magnified corona files. (2,000×).

Fig. 9. The corona files with extremely high magnification in the female hypostome. (13,140×).

Fig. 10. Cranial aspect of the female hypostome, showing the corona files and the setae on the articles with high magnification. (9,800×).

Fig. 11. Dorsolateral view of the coxa-trochanter joint and the trochanter-femur joint of the right leg I with the setae in the female specimen. (175×).

Fig. 12. Dorsolateral view of the coxa-trochanter joint with setae of the right leg I in the male specimen. Parts of the article I, the basis capitulum and the punctated scutum. (150×).

Fig. 13. A seta on the scutum of the female specimen with high magnification. (2,000×).

Fig. 14. A seta on the scutum of the male specimen with high magnification. (1,000×).

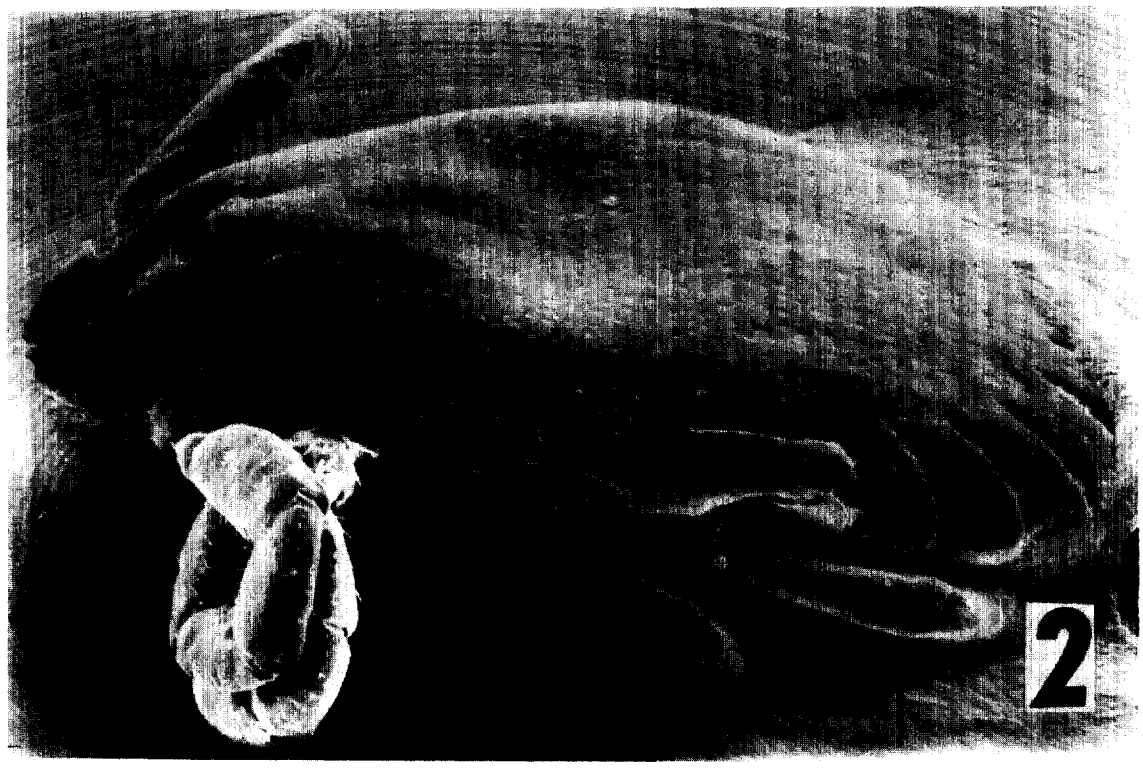
Fig. 15. Setae on the surface of the trochanter the female specimen with high magnification. (2,000×).

Fig. 16. Seta on the surface of the trochanter of the male specimen with high magnification. (3,000×).

Fig. 17. A seta on the surface of the femur of the female specimen with high magnification. (2,000×).

Fig. 18. The highly magnified dorsointernal seta and the setal fossa on the article of the female specimen. (9,880×).


1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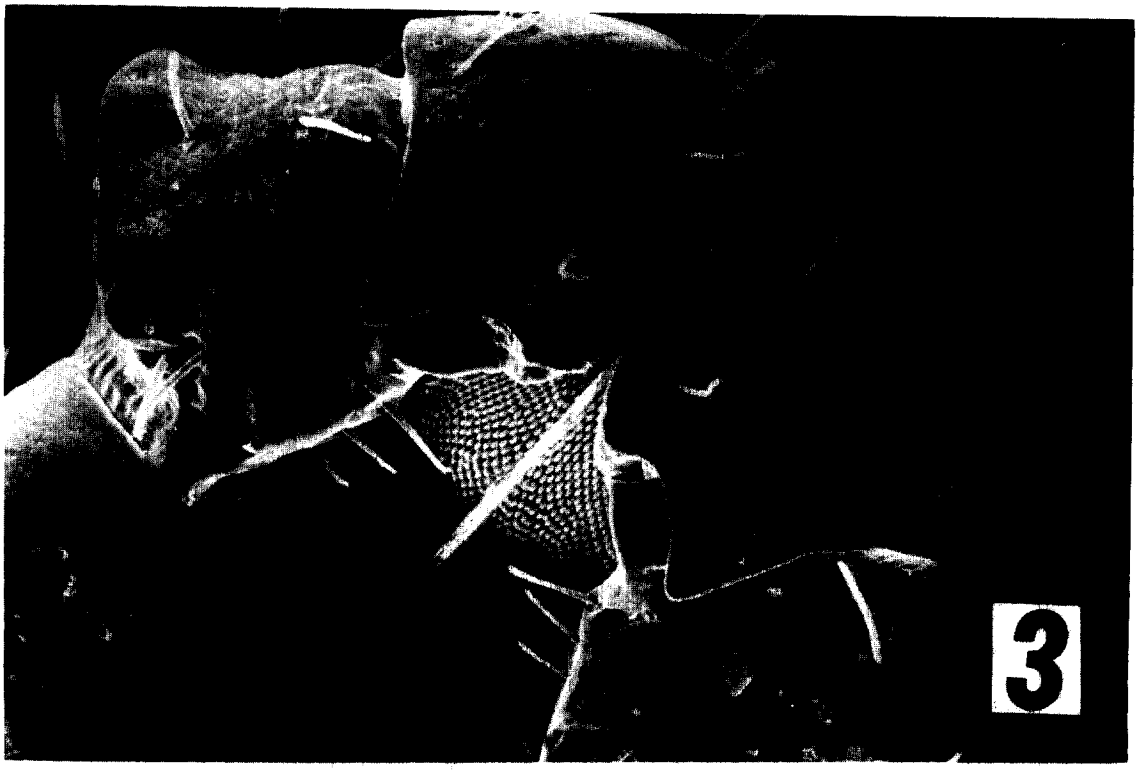
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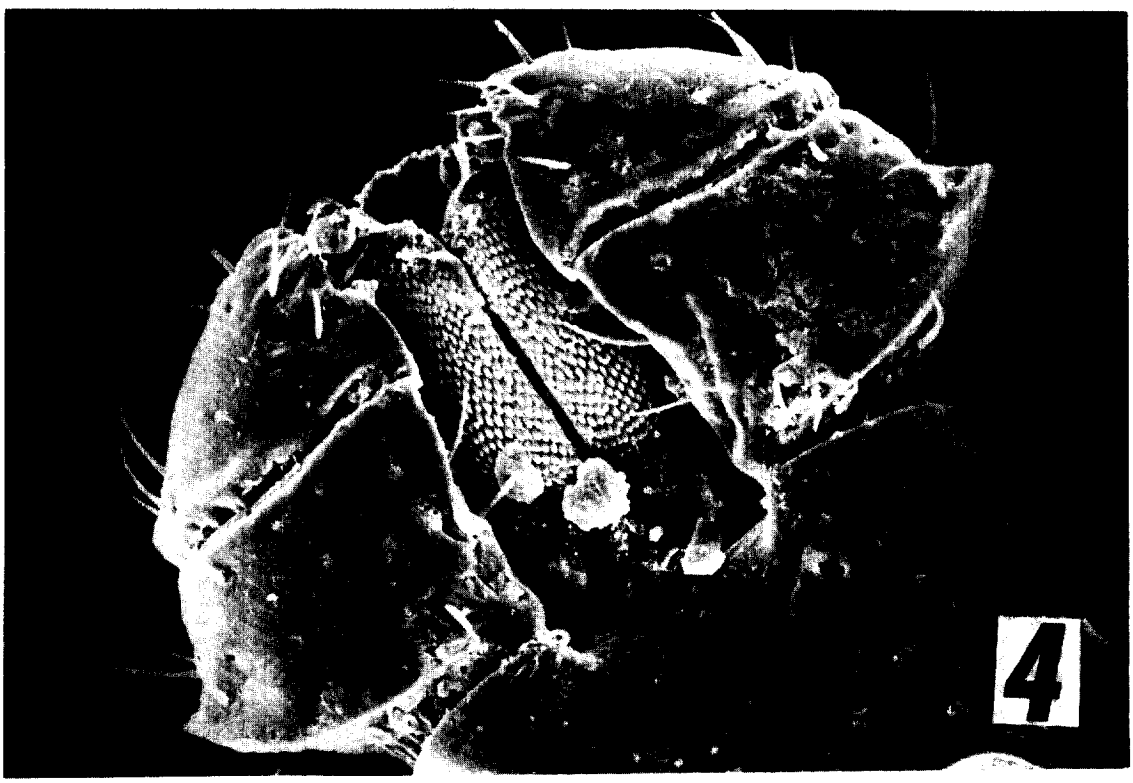
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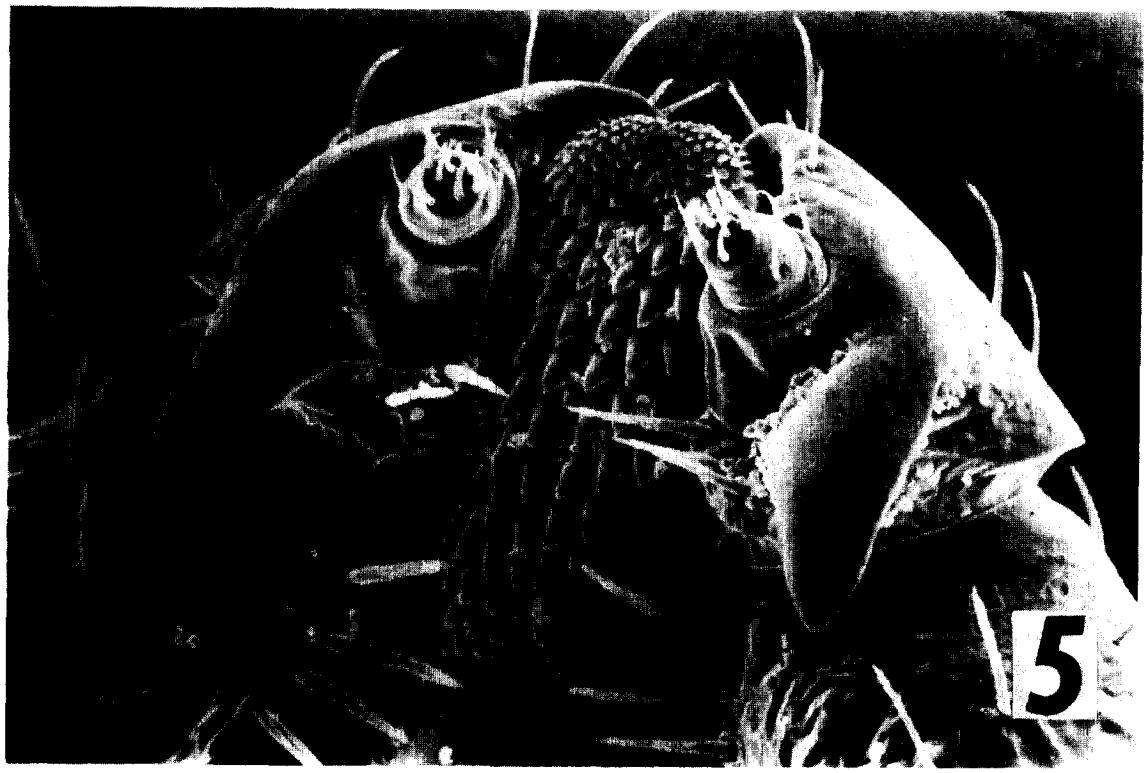
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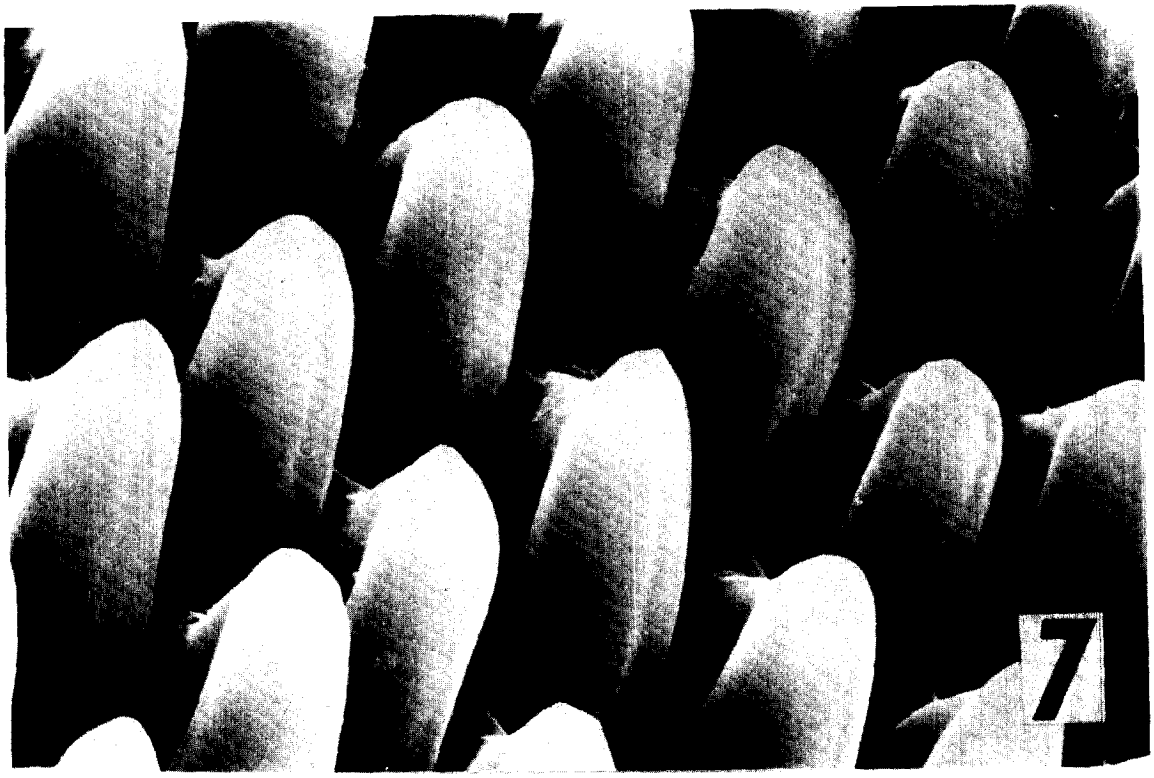
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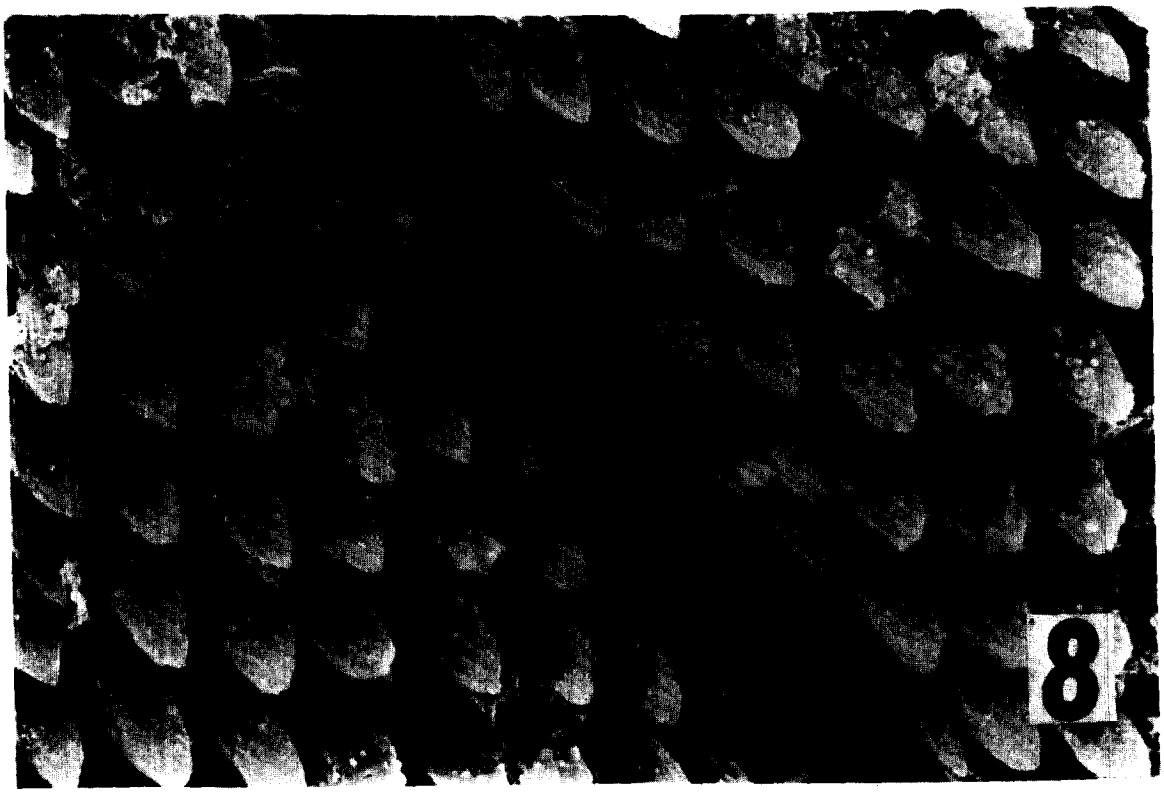
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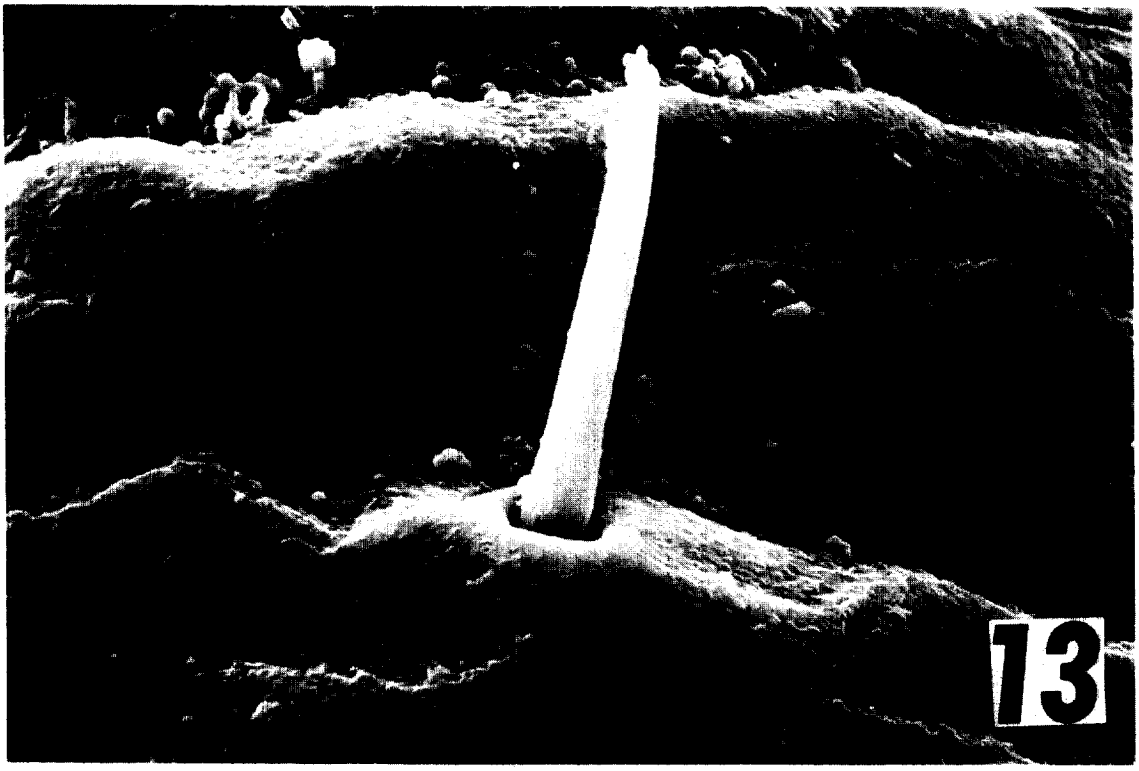
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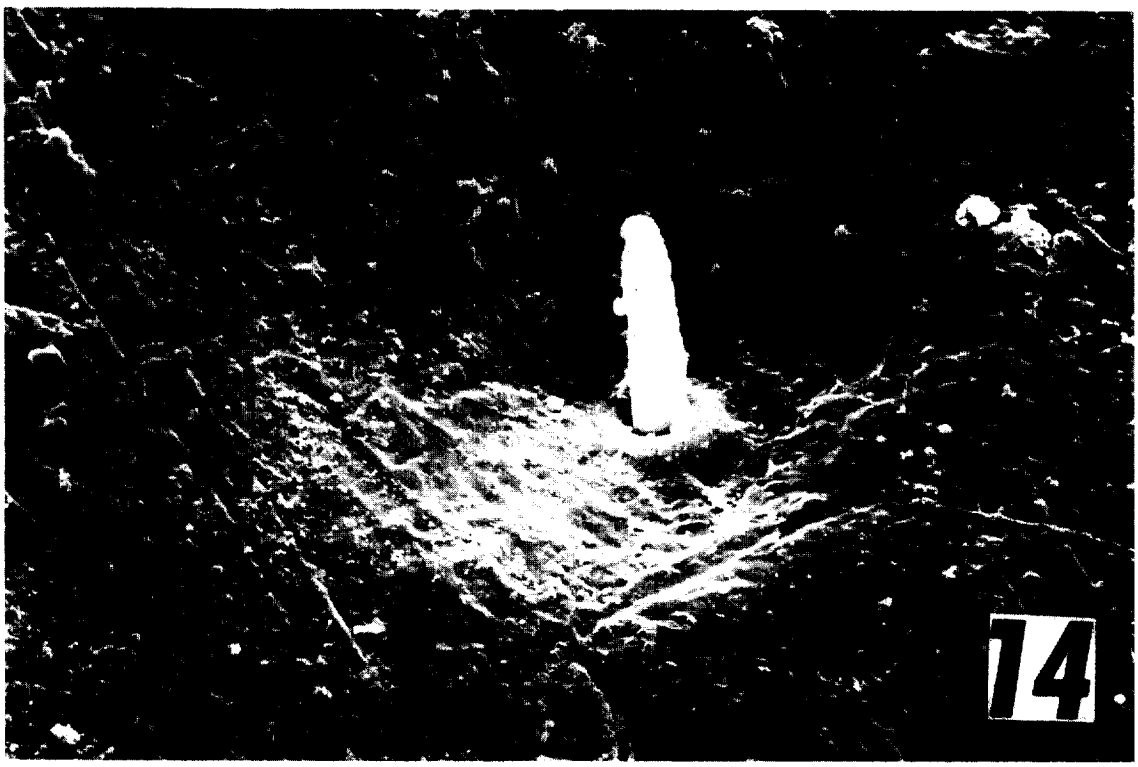
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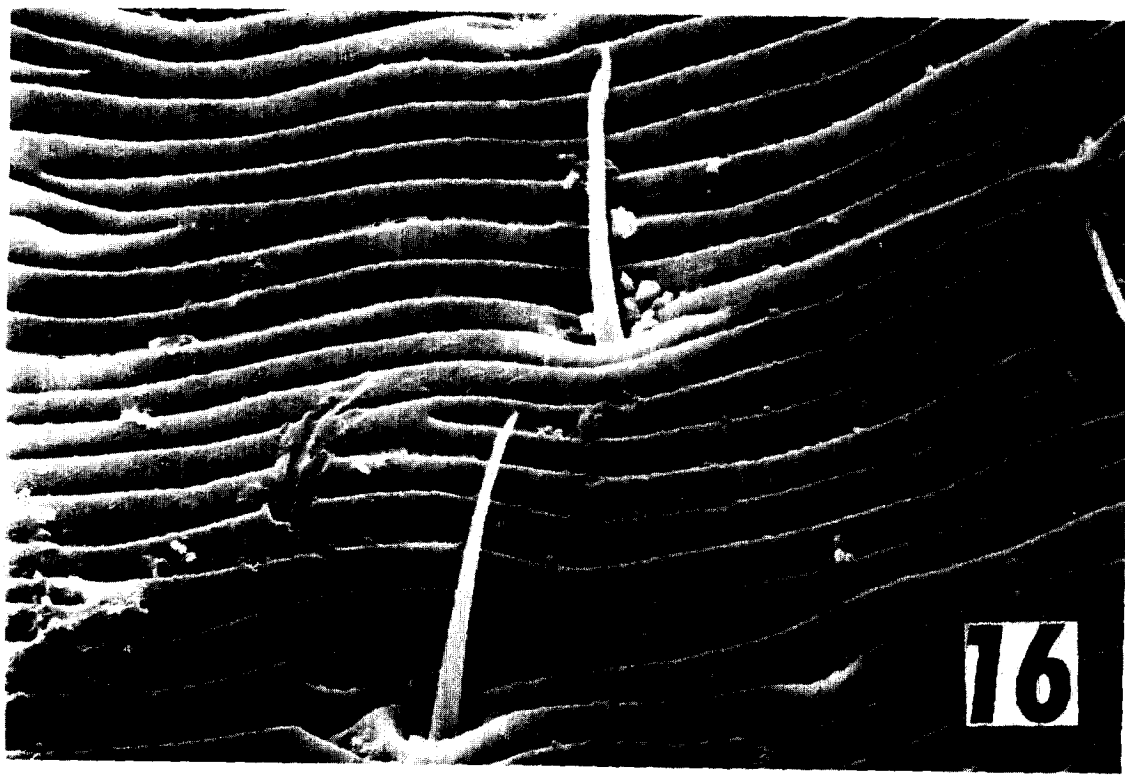
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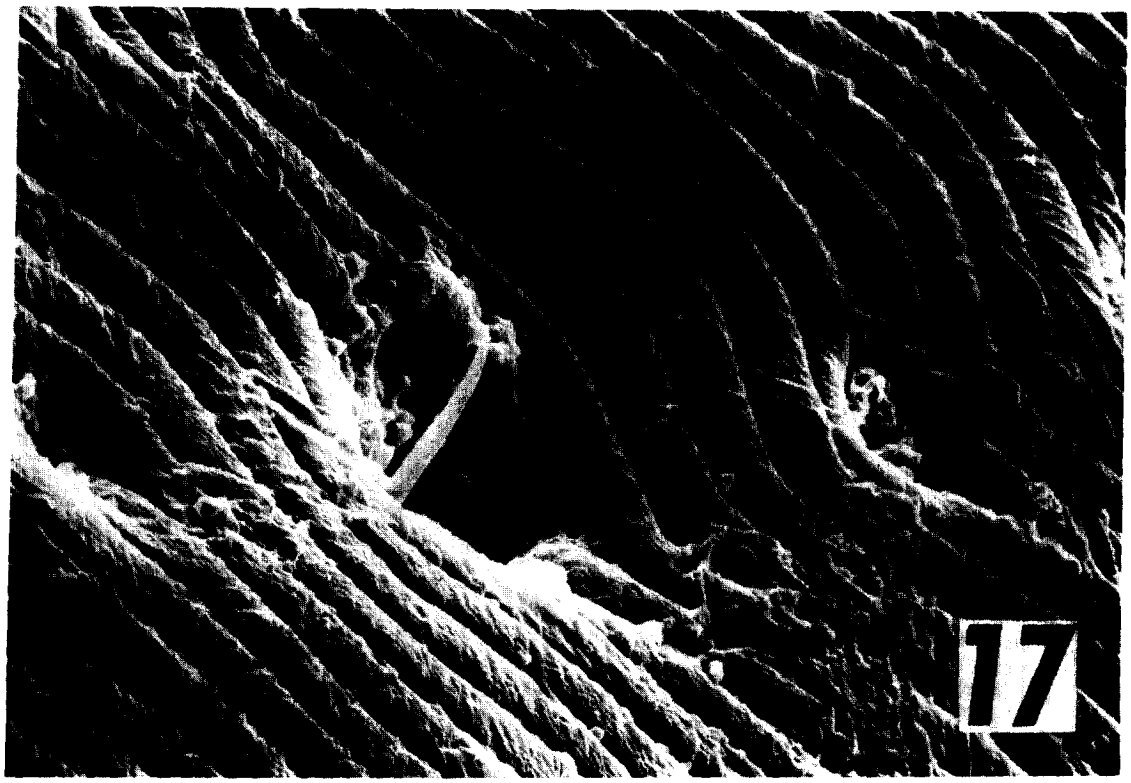
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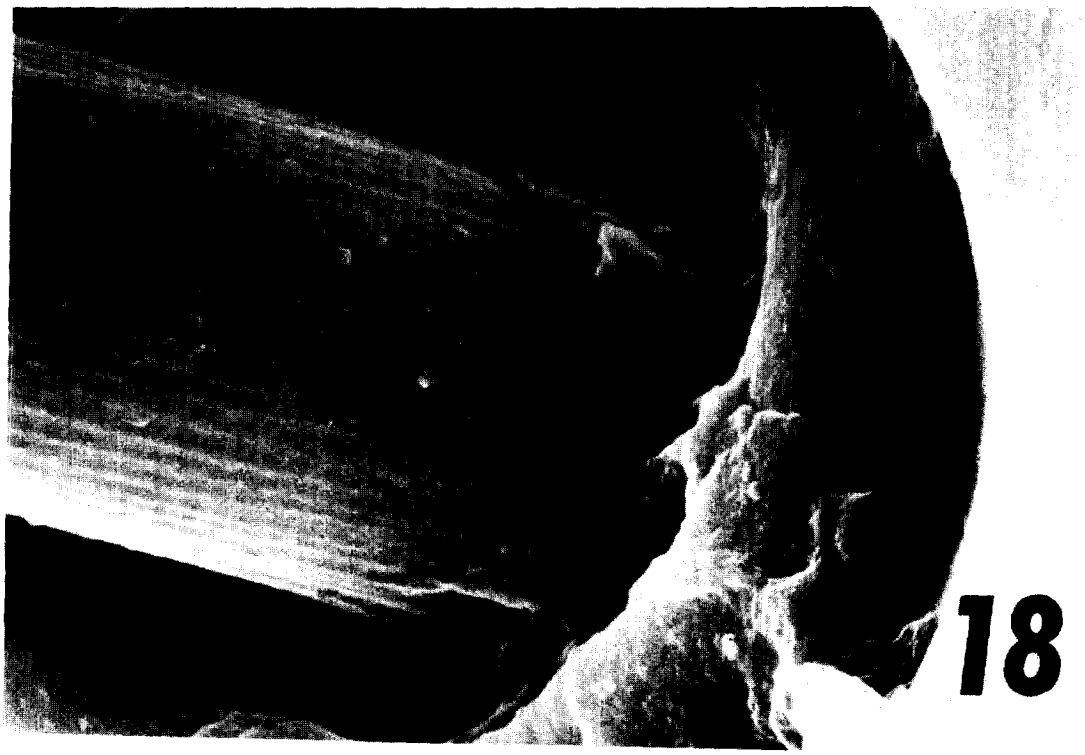
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