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ULTRASTRUCTURE OF THE ESOPHAGEAL GLAND IN ADULT FOWL
1 - ACINAR SECRETORY CELLS

(With 8 Fig.)

By

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التركيب المجهرى الدقيق لغدية المرئ فى الفراخ البالغه
١ - الخلايا المفرزه الكيسيه

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اجرى هذا البحث بغرض دراسة التركيب المجهري الدقيق لغدية المرئ في ستة فراخ بالغة من كلا الجنسين.

اوضحت الدراسة ان الخلايا الكيسية تكون اما خلايا اسطوانية كبيرة او هرمية الشكل. وتملأ هذة الخلايا بكمية وفيرة من الحبيبات الافرازية المخاطية ذو اشكال متباينة تظهر علي هيئة مادة خيطية دقيقة ذو عتامة الكترونية تحتوي علي لب مركزي او لا مركزي اكثر عتامة.

واظهرت الدراسة ايضا ان هذة الحبيبات الافرازية لها قابلية للاندماج معا مكونة كتلة من المادة الافرازية.

هذا وقد درست عملية تخليق وتطور الحبيبات الافرازية في الشبكة الاندوبلازمية الخشنة وكذلك جهاز جولجي.

واوضحت الدراسة ايضا ان كل من الشبكة الاندوبلازميه الخشنة وجهاز جولجي عادة ما ينضغطا موازيا للحافة الوحشية للخلايا المفرزة المحتوية علي كمية كبيرة من الحبيبات الافرازية. هذا ولوحظ وجود كمية قليلة من المتقدرات (ميتوكوندريا) والريبوزومات .

SUMMARY

The ultrastructure of the esophageal glands was examined in 6 adult fowls of both sexes. The acinar cells were large columnar or pyramidal in shape. Abundant mucous secretory granules of variable morphology filling the acinar cells were observed. The secretory granules contain electron dense fine filamentous material with centrally or eccentrally located more electron density core. These secretory granules show a propensity for fusion together forming a mass of secretory material. The processes of synthesizing and developing the secretory granules in RER and Golgi-apparatus have been described. RER and Golgi-apparatus were always appeared compressed and parallel to the lateral border in cells containing large amount of secretory granules. Few mitochondria and free ribosomes were observed.

Key words: Esophageal gland, Fowl.

INTRODUCTION

Although the secretions of the esophageal glands of fowl are very important for passing the food materials and protection of the esophagus, only histological *(SCHREINER, 1900; BRADLEY and GRAHAME, 1960; FARNER, 1960; KROELLING, 1960; SAJONSKI and SMOLLICH, 1972; SCHUMMER, 1973, HODGES, 1974; BANKS, 1993)* and histochemical *(ALLENSPACH and HAMILTON, 1962; HINSCH and BUXBAUM 1965; HINSCH, 1966; SALEM, 1991)* investigations were done. Concerning the ultrastructure of these glands, *ALLENSPACH and BERLIN, 1971*, were described the Golgi-complex in the newly hatched chick, however, in adult fowl, the ultrastructure of these glands was lacking in the available literature.

The aim of this work was to clarify the ultrastructure of the secretory acinar cells of the esophageal glands in the adult fowl.

MATERIAL and METHODS

Small pieces of esophageal tissue from 6 healthy normal adult fowls of both sexes (Gallus gallus domesticus) were taken

immediately after vascular perfusion with a fixative solution, and prepared for electron microscopical examination. Small pieces of mucosa including esophageal glands were carefully removed from other esophageal tissue in the fixative solution.

Perfusion fixation was performed with 4% glutaraldehyde in 0.1 M cacodylate buffer (pH 7.2) for two to four hours after washing with saline solution. Postfixation of the small pieces of mucosa in 1% Osmic acid in 0.1 M cacodylate buffer (pH 7.2) for 2 hours was followed by dehydration in aceton. The materials were embedded in Durcupan (FLUKA) and sectioned by using LKB ultratome. Ultrathin sections were mounted on copper grids, stained with uranyl acetate and lead citrate (*REYNOLDS, 1963*) and examined in Jeol 100 CXII electron microscope.

RESULTS

The secretory acini of the esophageal glands of adult fowl were found in the lamina propria and opened by short ducts on the surface of the esophageal mucosa. They were composed of large columnar or pyramidal mucous cells. Their nuclei were basally displaced by the accumulated mucous secretory granules filling most the cellular cytoplasm (Fig. 1 a,b).

The mucous secretory granules were varied in form and amount from one cell to another. Steps of synthesizing and developing the secretory granules were observed. The secretory materials were appeared as homogenous darkly stained accumulated substance in enlarged peripheral portions of the RER cisternae (Fig. 2). Developing secretory granules have been firstly seen in the central area of Golgi-apparatus as vacuoles of different sizes containing homogenous lightly stained content (Fig. 3). Away from Golgi- apparatus and towards the apical cytoplasm, the secretory granules were appeared larger and their content was become more darker. Later in their development, an electron dense core was appeared in many secretory granules which was centrally located or adhered to their limiting membranes. At higher magnification, the mucous substance filling the secretory granules was appeared as structureless fine filamentous material which was become more electron dense in the core (Fig. 4 a,b). These secretory granules were showed propensity for fusion together, their limiting membranes were disappeared at points of contact between the adjacent secretory granules, forming a continuous mass of secretory material. At the cell apex, the mucous secretory granules releasing their content by exocytosis into the acinar lumen have been observed (Fig. 4a).

Apically, some acinar cells (Fig. 1 a,b) were provided with few short microvilli and attached to each other with zonula occludens and zonula adherence (Fig. 5a). Few and short lateral cytoplasmic processes extending into a somewhat narrow intercellular space to interdigitate with those of the neighbouring cells were also appeared. Desmosomes connecting between the lateral cell membranes of the adjacent secretory acinar cells, as well as between them and the basal myoepithelial cells were fewer (Fig. 5b). The mucous secretory cells were also showed irregular basal border attaching with the basal lamina with hemidesmosomes.

Generally, the organoids of the acinar cells were best seen in those that had relatively few accumulated secretory granules. The cisternae of rough endoplasmic reticulum were filled with homogeneous electron dense material. They were scattered in the cytoplasm around the nucleus or inbetween the secretory granules. In cells which were filled with the secretory granules, the RER cisternae were appeared to be compressed somewhat parallel to the lateral border of the cells (Fig. 2 & 6). The Golgi-apparatus was well-developed and consisted of flattened closely packed semicircularly arranged saccules and associated vesicles. It was located in the supranuclear region (Fig. 3) or compressed laterally parallel to the cell membrane in those, which were filled with mucous secretory granules (Fig. 7 a & b).

Sparse mitochondria (Fig. 8) of crista - type were always found in the cytoplasm of the acinar cells in close association with the cisternae of RER. Ribosomes as well as few lipid droplets were observed.

The large basally displaced nuclei were often ovoid or irregular in shape. They were contained usually a large amount of electron dense heterochromatin attaching to the nuclear envelope or scattering in the karyolymph. They were also showed domenstrative nucleoli. The outer nuclear membrane was studded in some places with ribosomes (Fig. 6). Nuclear pores interrupting the nuclear envelope have been observed (Fig. 3).

DISCUSSION

This investigation displays columnar or pyramidal mucous secreting cells forming the acini of the esophageal glands in the adult fowl. They possesed typical mucous secretory granules. Their content were formed of very fine structurless filamentous material which became more electron dense in the central cores. These granules resemble those found in the cat

submandibular *(SHACKLEFORD and WILBORN, 1970)* and sublingual glands *(TANDLER and POULSEN, 1976)*. The filamentous structures were interpreted as mucin molecules *(SHACKLEFORD and WILBORN, 1970)*, while the electron dense cores appear to be concentrated protein with highly ordered substructure *(LAVKER, 1969)* which lack the high density of anions common to the rest of the molecules of the secretory granules *(ALLENSPACH and BERLIN, 1971)*. *MOTTET (1970)* stated that they may represent a segregation of the mucin molecules within the secretory droplets. Our observations demonstrated that the content of the secretory granules synthesized in the RER and Golgi-apparatus. Similar findings have been reported by *KRSTIC (1984)* in the goblet cells of the digestive tract which produce a mixture of glycoprotein and protoglycans. In addition, *HILL (1971)* stated that the esophageal gland secretion possesses a lubricatory function. Similar to that mentioned by *ROHEN and LUETJEN-DRECOLL (1990)* the esophageal glandular secretion not only provides the esophageal canal with a protective coat, but also facilitates the passage of food boli during digestion.

The esophageal gland secretory granules showed a high propensity for fusion forming a continuous mass of secretory material in the cell apical portion that makes easy the discharge of content by exocytosis at the apical border. Similar observations were recorded by *MEYRICK and* REID *(1970)* and *TANDLER and POULSEN (1976)*. However, *SHACKLEFORD and WILBORN (1970)* observed that the secretory ganules in cat submandibular glands maintain their individual integrity until extrution at the cell apex.

The distribution of both RER and Golgi-apparatus is dependent upon the amount of accumulated secretory granules within the cell. They were compressed and lie parallel to the lateral cell border in cells filled with the secretory granules. These results suggest that the secretory cells store partly large amounts of their products awaiting its secretion in secretory vesicles. They release rapidly their content to the exterior by exocytosis when they are stimulated by an extracellular signal. Similar regulated secretion takes place in the pancreatic acinar cell *(PALADE, 1975 and BURGESS and KELLY, 1987)*.

Few desmosomes were found between the lateral cell membranes of the adjacent mucous secreting cells as well as between them and the myoepithelial cells. However, *ALLENSPACH and BERLIN (1971)* could not observe the desmosomes between the adjacent secretory cells of the esophageal glands in the newly hatched chick.

In accordence with *ALLENSPACH and BERLIN (1971)* these esophageal mucous glandular cells may be considered in many recpects similar to the goblet cells of the intestine, where they accumulate and release their content as secretory droplets.

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LEGENDS

Fig. 1 a,b: Electron micrograph of an acinus of the esophageal glands of the fowl (a) & their lining mucous cells (b). (L) lumen; (Mv) microvilli; (Sg) secretory granules; (My) myoepithelial cell. X a: 2,800 b: 4,000.

Fig. 2: Electron micrograph of the mucous cells of the esophageal glands. (arrow) enlarged peripheral portion of RER cisterna; (Sg) secretory granules, (arrowheads) electron dense cores; (D) Desmosome; (ls) intercellular space, (RER) laterally compressed rough endoplasmic reticulum. X 14,000.

Fig. 3: Electron micrograph of a mucous cell of the esophageal glands. (Ga) semicircularly arrangend Golgi saccules; (RER) rough endoplasmic reticulum; (Sg) secretory granules,. (N) Nucleus; (arrowheads) nuclear pores. X 10,000.

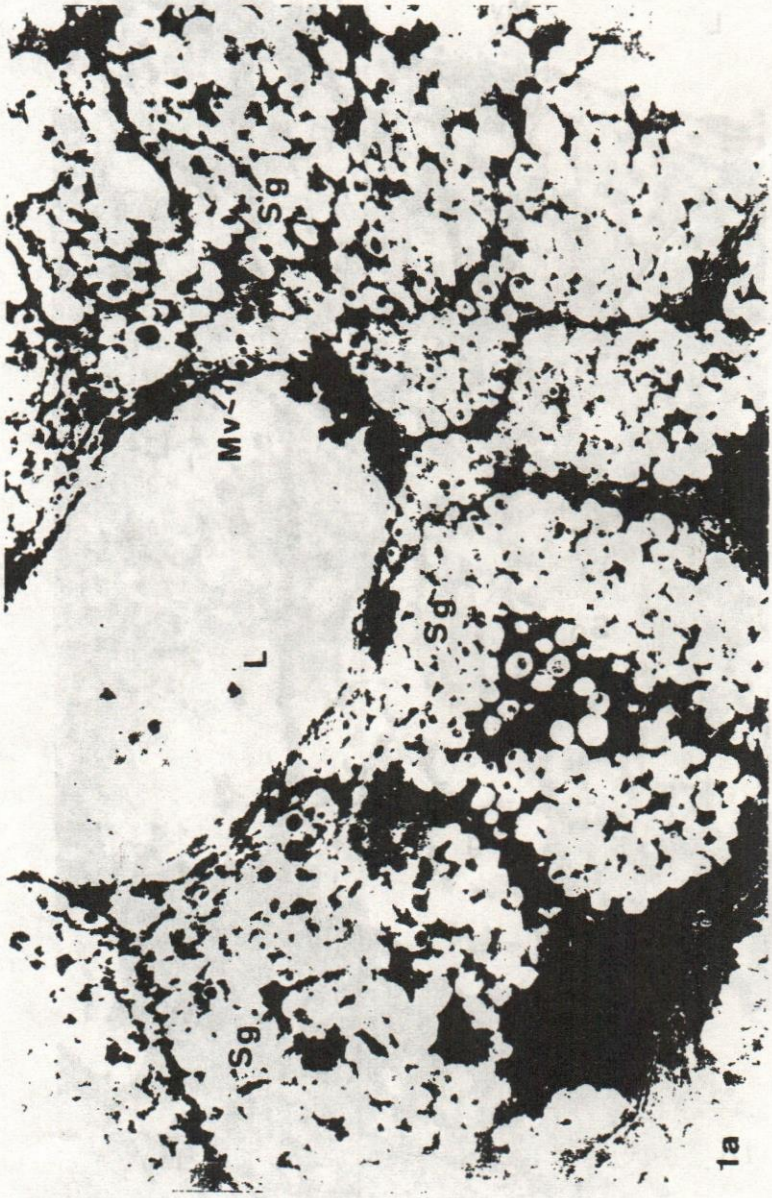
Fig. 4 a,b: Electron micrograph of a mucous cell of the esophageal glands showing (Sg) secretory granules with their filamentous content containing electron dense core (arrowheads) as well as propensity for fusion (arrow) and releasing process by exocytosis into the acinar lumen (L). (Mv) microvilli. X a: 40,000, B: 27,000.

Fig. 5 a,b: Electron micrograph of mucous cells.
a)- the apical surface show (Zo) zonula occuldence; (Za) Zonula adherence: (ls) intercellular space.
b)- Desmosome (D) between myoepithelial cell process (My) and the basal border of the mucous cells; (BL) Basal lamina (N) nucleus; (Sg) secretry granules. X a: 20,000, b: 10,000

Fig. 6: Electron micrograph of the mucous cells. (RER) laterally compressed rough endoplasmic reticulum cisternae; (ls) intercellular space; (Sg) secretory granules, (arrowheads) electron dense core. X 20,000.

Fig. 7 a,b: Electron micrograph of the mucous cell (a) and high magnification of the marked area (b) showing: The laterally compressed Golgi-complex (Ga); (Sg) secretory granules; (ls) intercellular space; (N) nucleus; (RER) rough endoplasmic reticulum. X a: 14,000, b: 50,000.

Fig. 8: Electron micrograph of the mucous cells of the esophageal glands showing: The sparse mitochondria (M) in association with (RER) cisternae; (Sg) secretory granules; (N) nucleus; (arrowhead) outer nuclear membrane studded with ribosomes; (ls) intercellular space. X 10,000.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L
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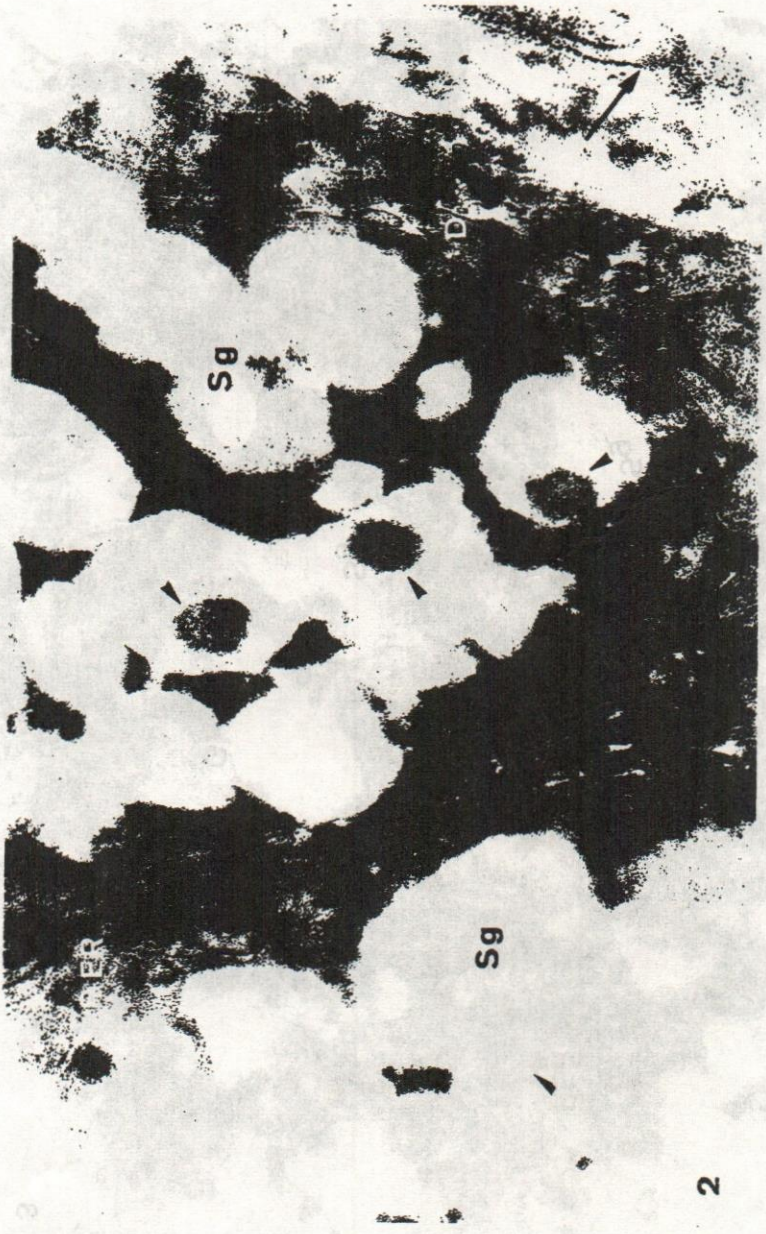
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N
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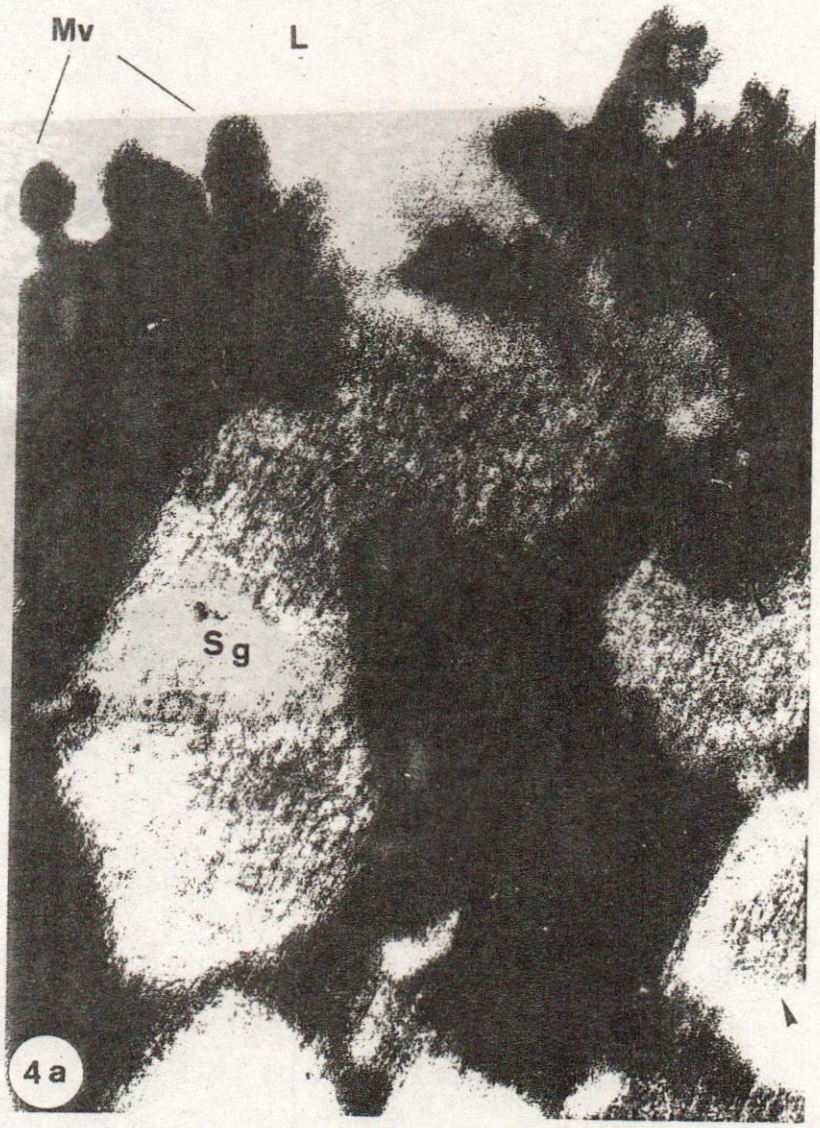
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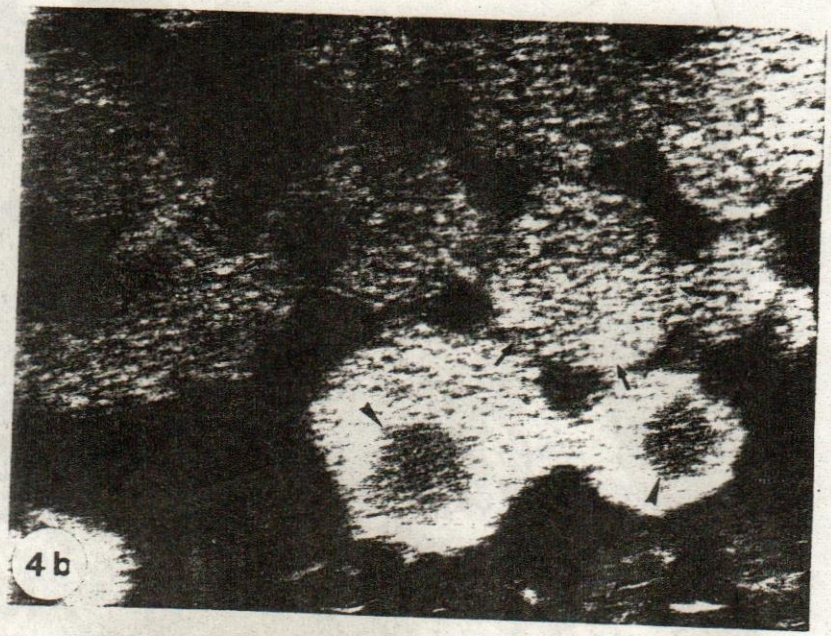
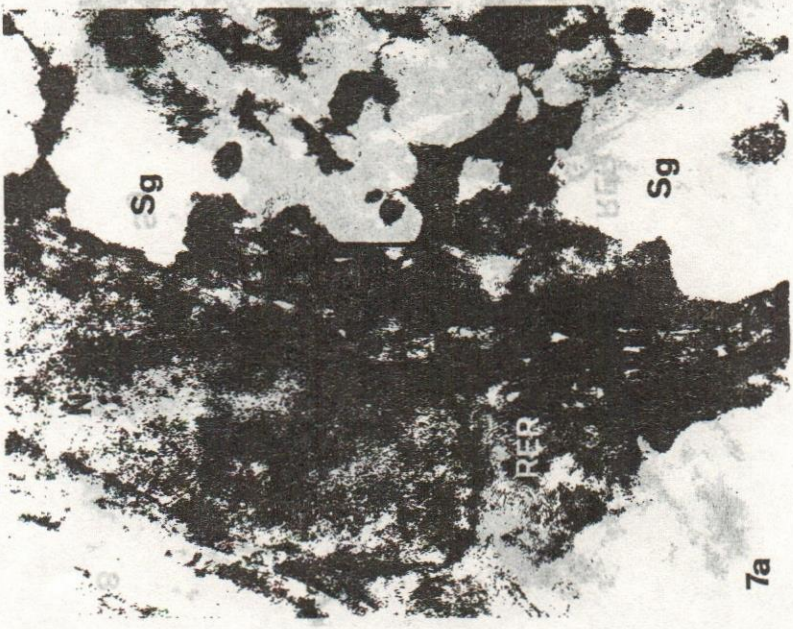


4b


Sg
Sg
5b
5a

6


N
RER
7b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RER
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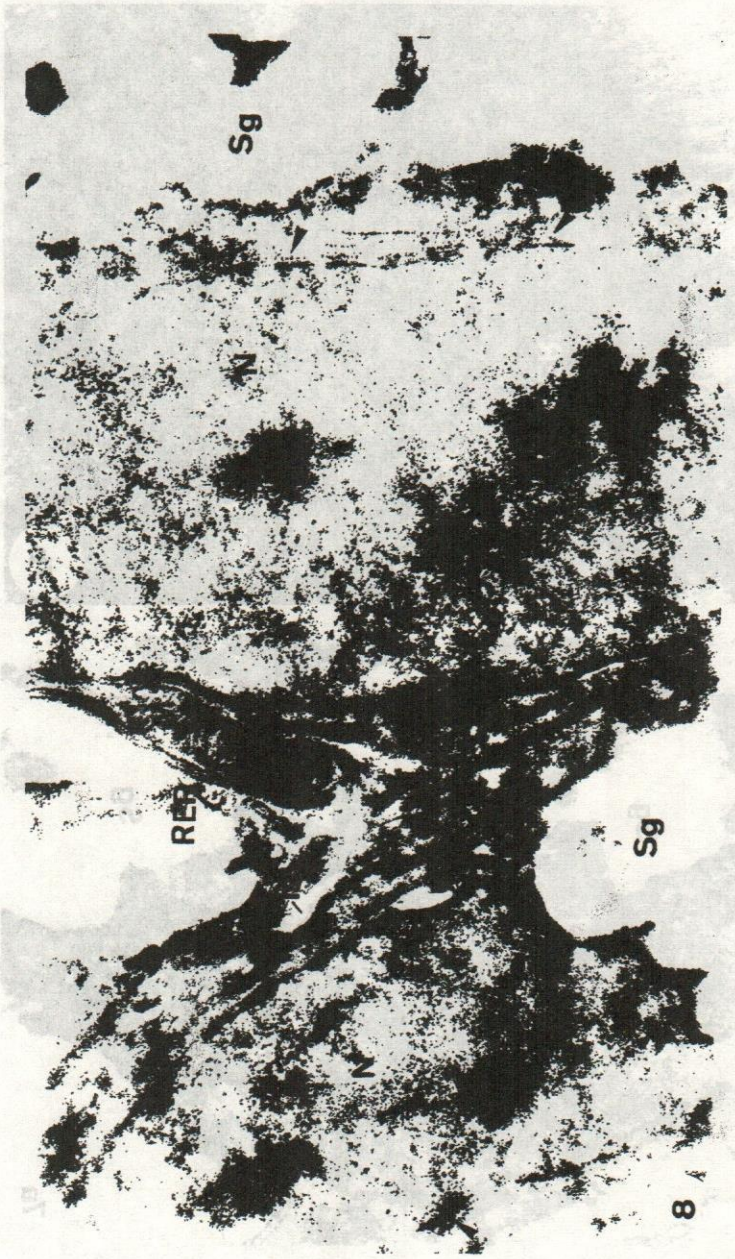
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