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SCANNING ELECTRON MICROSCOPY OF PSORIATIC HUMAN EPIDERMIS

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Abstract. Scanning electron microscopy of psoriatic epidermis has revealed two prominent patterns of surface ultrastructure of the stratum corneum; regular arrays of "pore-like" structures, and villus-like structures. It is also found that connected and unconnected desmosomes are retained in the apparently widened intercellular space between keratin cells.

The scanning electron microscope employs secondary electrons scattered from the specimen surface rather than specimen transmitted electrons, making possible the observation of cell surfaces at direct magnifications of up to 140 000 with a resolution of 150 Å and a depth of focus permitting three dimensional visualization. The development of this new tool provides a unique opportunity for the ultrastructural study of normal and pathological cell surfaces. I report here preliminary surface fine-structure.

MATERIAL AND METHODS

5 mm punch biopsies of typical psoriasis vulgaris lesions exhibiting erythema with scaling were obtained from the left abdominal area of a 74-year-old Japanese female (B-219), from the extensor surface of the forearm of a 73-year-old Japanese female (B-235), and erythema lesion, erythema with silver scale lesion, as well as normal appearing skin from the lateral side of the arm near the elbow of a 66-year-old Japanese male (B-243).

The specimens were fixed in 6.25% cacodylate buffered glutaraldehyde, pH 7.2, at 4°C, for at least 2 hours, dehydrated in a graded series of ethanol solutions and air dried. The dehydrated tissue was exaporation-coated with gold metal to approximately 100 Å thickness and then examined under the Japan Electron Optics Laboratory Co. JSM-2 scanning electron microscope.

RESULTS AND DISCUSSION

The transmittance electron microscope currently in use has revealed that the normal stratum corneum is composed of multiple layers of keratin cells which are losing their intra-cytoplasmic organelles and intercellular connections, the desmosome-tonofilament complexes, as they progress from the keratohyaline layer to the keratin layer.

The scanning electron microscope reveals that the stratum corneum is composed of a mosaic of individual keratin cells having 15 μ in each linear border (Fig. 1). These cells may exhibit two prominent patterns of surface ultrastructure in addition to a relatively flat surface pattern. As seen on the right, the surface of the keratin layer can exhibit a regular array of "pore-like" structures or depressions. On the upper left, villus-like structures are regularly distributed over the cell surface. The diameter of these structures averages 400 mμ and they are regularly distributed at an interval of 200 mμ (Fig. 2). The villus-like structures are approximately 400 mμ in diameter and show a spacing of 200 to 400 mμ (Fig. 3). The intercellular space, in which connected and unconnected desmosomes are seen, is clearly visible (Figs. 4 and 5). These desmosomes correspond in size and distribution interval to the desmosomes seen in the stratum corneum by transmission electron microscopy.

It has been assumed by many investigators of cutaneous permeability and absorption that the principal route of trans-epidermal absorption is directly through the keratin cells rather than through the intercellular space (2). It appears

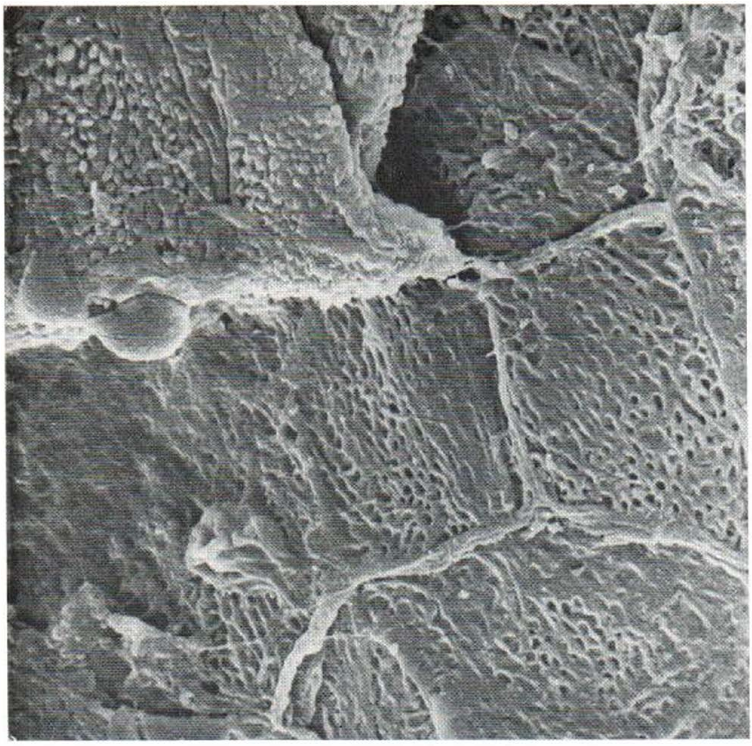

Fig. 1. Surface ultrastructure of psoriatic keratin layer revealing regularly arranged mosaic of individual keratin cells which exhibit pore-like structures (*right*) and villus-like structures (*upper left*). × 3 100.

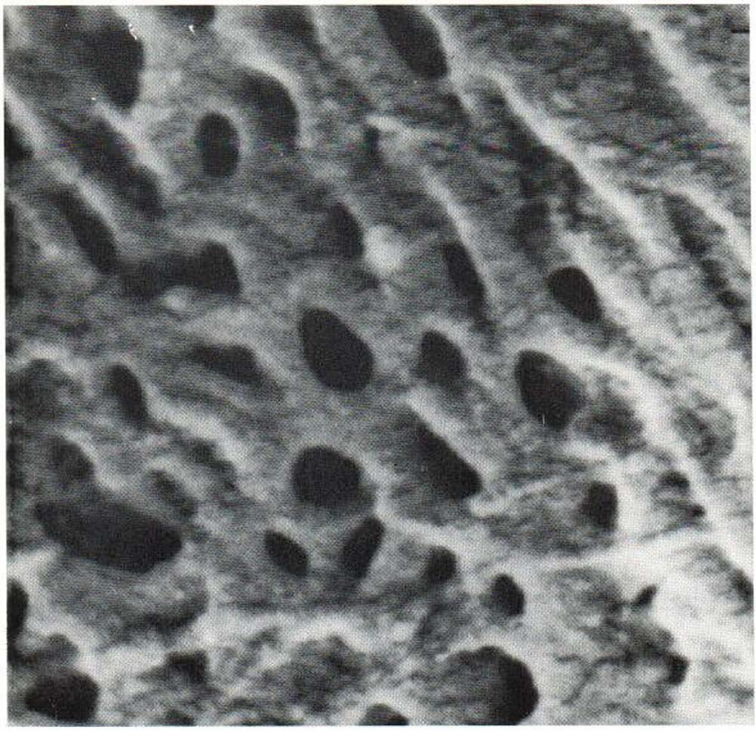

Fig. 2. Higher magnification of pore-like structures seen in Fig. 1. The pores average 400 mμ in diameter and are distributed with an interval of 200 to 400 mμ. × 31 000

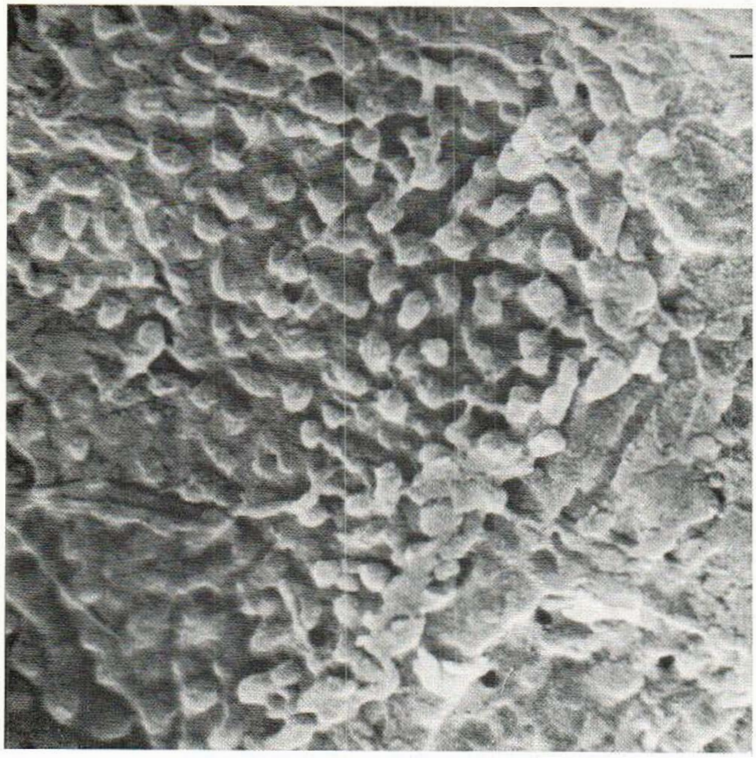

Fig. 3. Higher magnification of villus-like structures seen on psoriatic keratin cells. These structures are approximately 400 mμ in diameter with a spacing of 200 to 400 mμ. × 10 800.

from these studies of the three-dimensional fine structure of the keratin layer that the barrier function of the stratum corneum may be altered in various disease states. It has been shown by Scott (5) and Malkinson (2) that Zn^{65} labeled zinc chloride and C^{14}-testosterone penetrate psoriatic epidermis at an enhanced rate compared with normal epidermis. Furthermore, the migration of mercuric chloride through the stratum corneum by way of the intercellular spaces in a maze-like pattern, has recently been shown by Silberberg (6) using transmittance electron microscopy. The present findings of apparently enlarged intercellular spaces in the keratin layer, and the presence of "pore-like" structures in the keratin layer cell membranes, offer visual support to these findings. Fig. 6. reveals the surface structure of the silver-white scales of psoriasis. In comparison with the psoriatic keratin surface, my preliminary observation of normal human keratin layer shows regularly arranged mosaic fine structure (Fig. 7). A recent report of the normal surface fine structure of the horny layer of the epidermis of a 39-year-old Japanese man (1) and of a 29-year-old German male (4) also demonstrated a similar surface pattern.

It is found that the stratum corneum of human epidermis maintains distinctly organized fine surface structures. These topographical features, which may vary according to the physiological

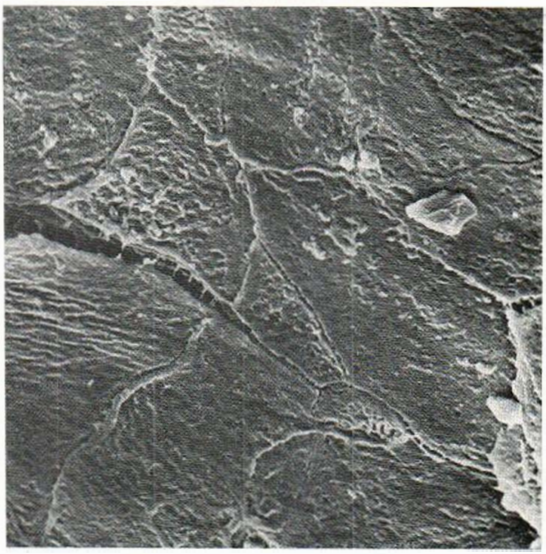

Fig. 4. Intercellular space between relatively flat surfaced psoriatic keratin cells showing remaining desmosomes. × 2 200.

Fig. 5. Closer view of intercellular space which retains connected and unconnected desmosomes. × 10 400.

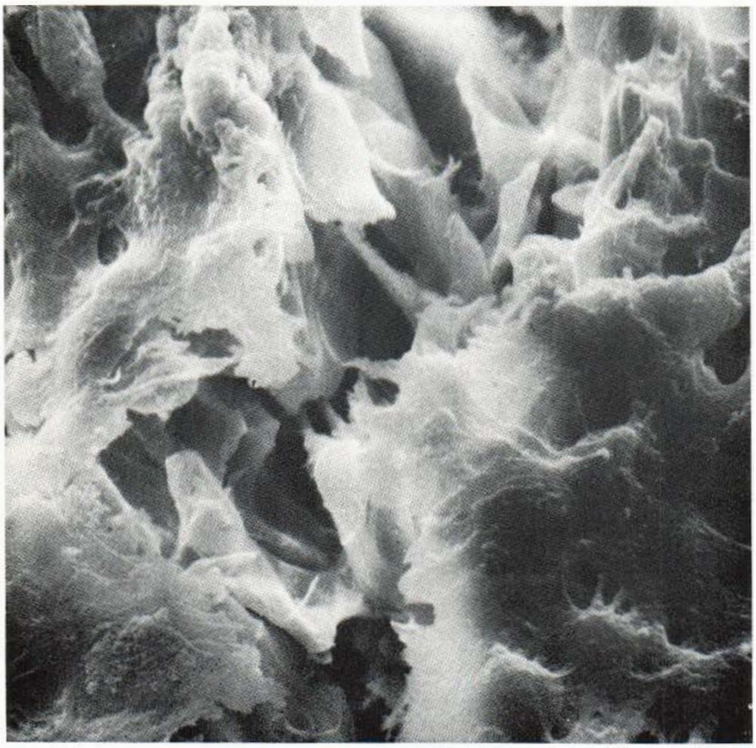

Fig. 6. Surface fine structure of the silver-white scales characteristic of psoriasis. × 3 000.

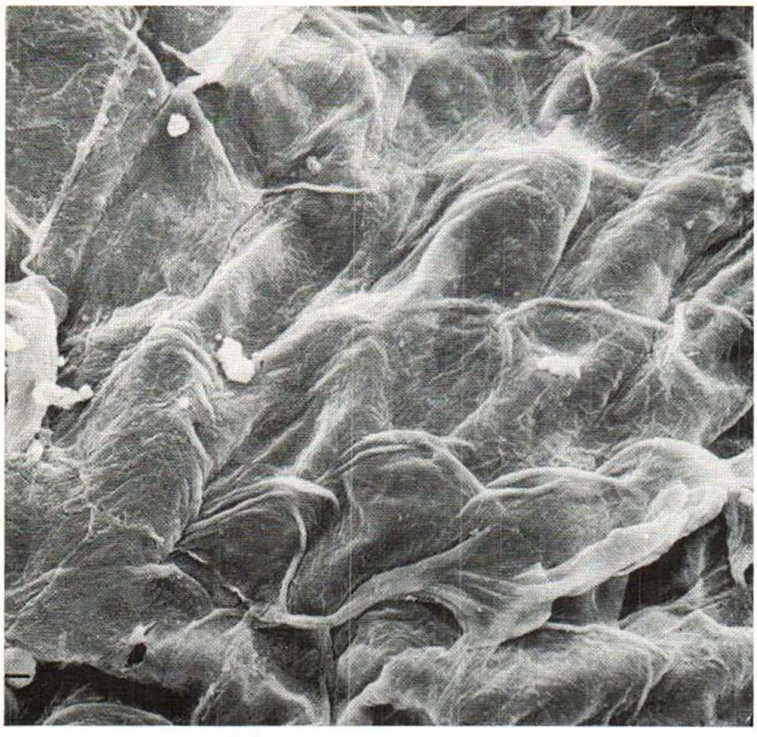

Fig. 7. Scanning electron microscopy of the normal human epidermal surface of chest skin from a 67-year-old female. × 970.

and pathological status of the epidermis, can now be visualized with the scanning electron microscope.

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