

REPLICA REFLECTION OF NORMAL SKIN AND OF SKIN WITH DISTURBED KERATINIZATION

Kirsti Kuokkanen

From the Department of Dermatology, University of Oulu, Oulu, Finland

Abstract. A replica series prepared easily with silicone rubber impression material from normal skin and skin with disturbed keratinization is presented here. The replica reflects the skin surface pattern in which the ridges and furrows vary according to the anatomical structure and function of the epidermis. Thickened and hyperkeratotic skin shows a stronger replica pattern. This is most clearly seen in congenital ichthyosiform erythroderma. The loosening of the scales or horny pieces along the epidermal ridges is also reflected by the replica.

Several different methods have been developed for the investigation of skin surface patterns.

In addition to scientific research, impressions of dermatoglyphics are of great significance in criminal investigation (2). Besides racial characteristics, some diseases, for instance chromosomal disturbances, are revealed by dermatoglyphics (7). Broken papillary lines in dyskeratosis follicularis Darier, visible in "finger-prints", are known in the field of dermatology (10).

Paper impressions of skin outside the regions of the dermatoglyphics do not give satisfactory results. Neither can this kind of impression be magnified. The impression method developed in dentistry was adapted to dermatological use by Sarkany (9) in 1962. He took a primary impression of the skin with a silicone rubber plastic and used it to form a secondary replica with clear nail varnish. He then studied the translucent replica under a microscope using oil immersion and reached 650-1 000-fold magnification. According to Sarkany it was more advantageous to photograph the replica than the skin itself, for the definition of the microphotograph was unsatisfactory in deeper cutaneous layers due to the refraction of the rays of light (9).

Cseplák & Marton (1) made elastic negatives

using similar stomatological material. The elastic negatives were made into plastic impressions (1). Goldman et al. (4) prepared replicas using paraffin wax, polyvinyl alcohol, silicone rubber, latex rubber and acrylic resin and examined them in the scanning electron microscope (4). The above-mentioned researchers presented examples of the impressions of healthy palmar, brachial and axillary skin in their report.

Different kinds of warts, skin affected with tinea versicolor and skin ulcers were recorded as visible diseases in the replica.

A replica series of normal skin prepared with silicone rubber impression material and also the reflection of disturbed keratinization in the replica are presented in the following.

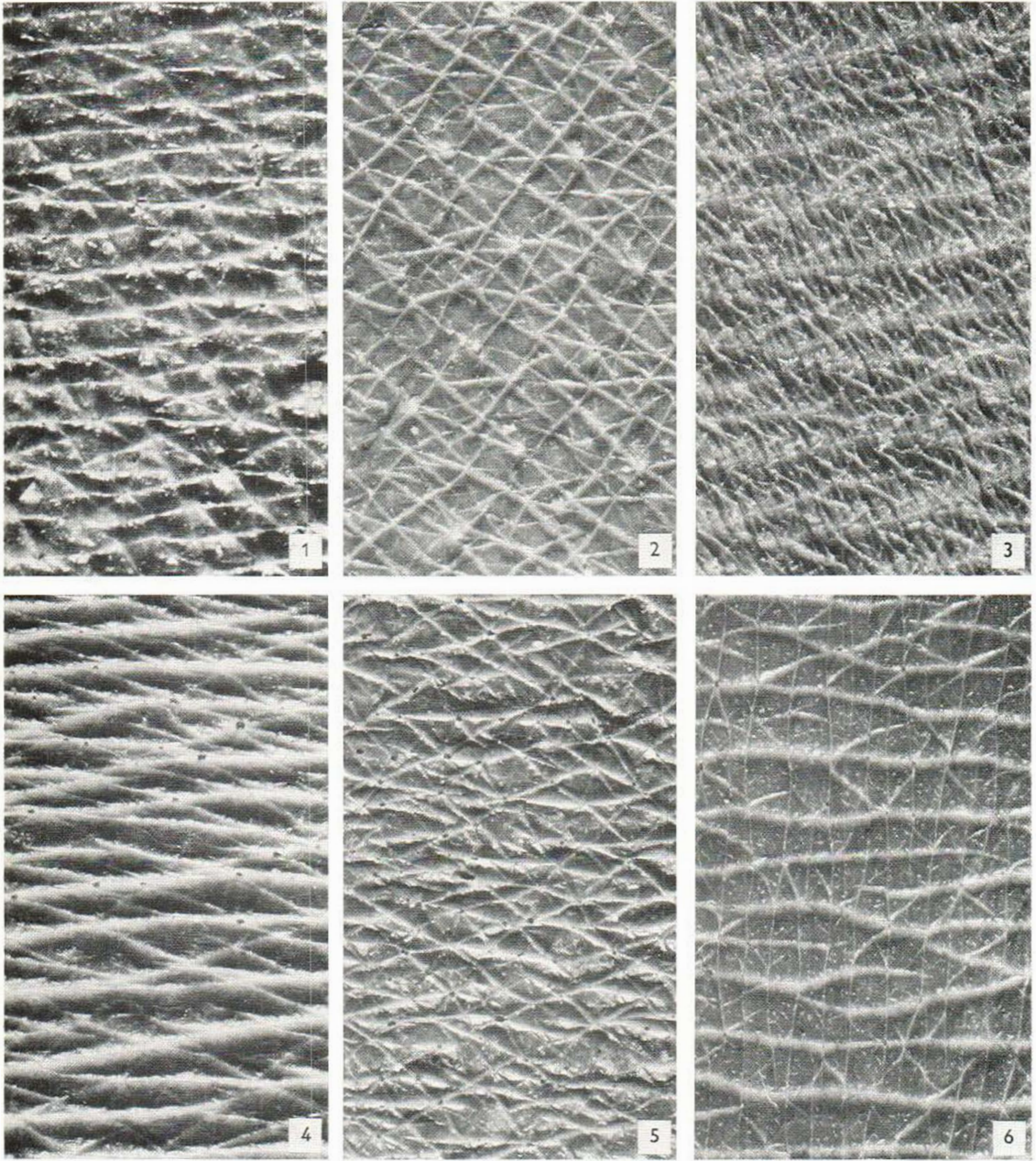
METHODS

A given amount of blue, liquid impression paste Xantopren® (blau dünnfließend; Farbenfabriken Bayer A.G., Germany) and about 10 to 12 drops of hardening substance are mixed together. The mass is poured onto a glass slide and pressed against the skin. The material dries in a few minutes, loosening easily from the skin and adhering to the glass slide. The replicas can be directly photographed at different magnifications. The positives present the primary impression of the skin. Secondary replicas can also be prepared according to the method of Sarkany (9). The film negatives may be examined by projecting them onto a screen. As the following pictures are compared with each other, it must be taken into consideration that the magnification is 1:10 in pictures 1 and 21 and 1:7 in the remainder.

CASE REPORTS AND RESULTS

Case 1

Altogether 15 impressions were taken from different sites of the skin of a healthy 23-year-old



Figs. 1-6. Replica series of normal skin showing regular, honeycomb-like arrangement of epidermal ridges. 1, The skin of the cheek (1 : 10). 2, The skin of the extensor surface of the forearm (1 : 7). 3, The skin of the ante-

cubital fossae (1 : 7). 4, The skin of the wrist (1 : 7). 5, The skin of the extensor surface of the thigh (1 : 7). 6, The skin of the ankle (1 : 7).

woman in order to compare impressions taken from diseased skin with normal material. The impressions were taken from the following regions of the skin: forehead, cheek, neck, extensor surfaces of the upper arm and forearm, ante-cubital

fossae, wrist, upper part of the back, abdomen, extensor surfaces of the thigh and leg, popliteal fossae, patellar skin, ankle.

The replica of the normal skin displays a regular, honeycomb pattern of epidermal ridges.

The pictures chosen from the specimens (Figs. 1-6) show differences between the structure of the replica pattern from the small-checked skin of the cheek and the large-checked epidermal ridges of the wrist, ankle and thigh. The orifices of pilosebaceous and eccrine sweat duct units are seen as small openings between and at the crossings of the ridges.

Case 2

A 12-year-old girl suffering from autosomal dominant ichthyosis vulgaris. The symptoms included fine, flourey scaling with follicular hyperkeratosis, most pronounced on the extensor surfaces of the extremities. The palms were slightly, but diffusely hyperkeratotic.

Histologically, mild hyperkeratosis and almost absent stratum granulosum were observed.

According to the predilection sites of the skin symptoms, seven impressions were taken from the following areas: extensor surfaces of the upper arm and forearm, palm, upper part of the back, abdomen, extensor surfaces of the thigh and leg.

Reflection of the disturbed keratinization was seen in the replica in the epidermal pattern which became more coarse and irregular and also contained larger squares. When the skin impression of the extensor surface of the forearm (Fig. 7) is compared with that of normal skin (Fig. 2), impressions caused by follicular hyperkeratosis are observed in addition to the irregularity of the epidermal ridges. Scales are small and well defined and loosen at their edges along the epidermal ridges. These changes can be seen more clearly in the impression of the extensor surface of the thigh (Fig. 8). The orifices of pilosebaceous and eccrine sweat duct units seem to be fewer in number than normal.

The skin pattern of the replica of the ichthyosis palm (Fig. 9) corresponds to normal, though slightly pronounced.

Case 3

A ten-year-old boy suffering from sex-linked ichthyosis. Clinically, pronounced, large scales were observed especially on the extensor surfaces of the extremities. Follicular hyperkeratosis did not occur.

Pronounced hyperkeratosis and thickening of

the stratum granulosum were observed histologically.

Seven impressions were taken from the following regions of the patient's skin: the extensor surfaces of the upper arm and forearm, neck, upper part of the back, abdomen, extensor surfaces of the thigh and leg.

It was observed that the honeycomb pattern of the impression of the skin of the back, in which mild scaling was observed, was still rather regular, the small angular scales loosening along the epidermal ridges (Fig. 10). In the replica of skin of the leg, however (Fig. 11), the surface pattern is irregular and the scales are large, loosening only along the more pronounced ridges.

Case 4

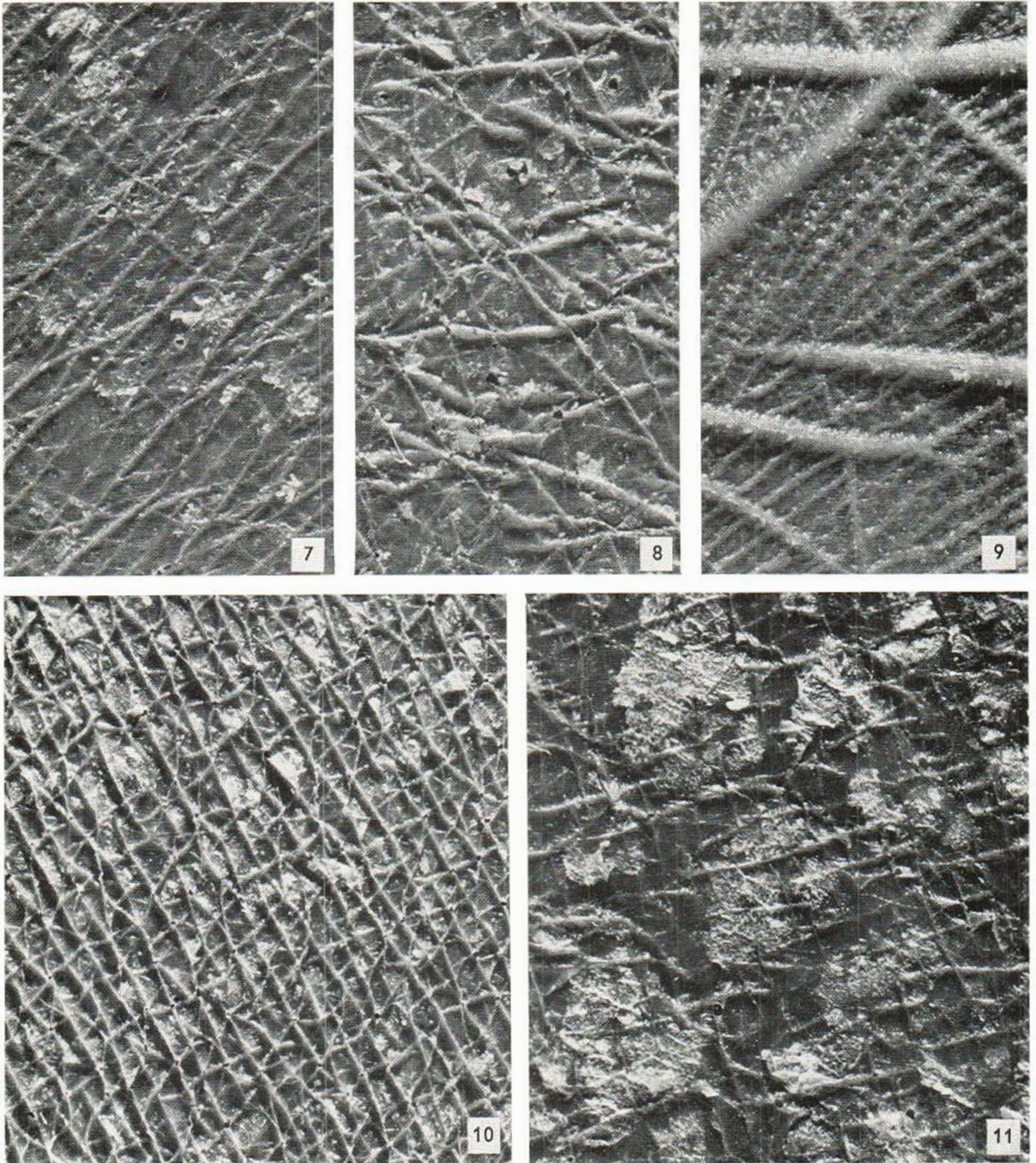
A 14-year-old boy suffering from the disseminated phenotype of congenital ichthyosiform erythroderma associated with palmoplantar hyperkeratosis. The skin of the patient was thicker than normal throughout the trunk, but the actual preferred sites of hyperkeratosis were observed in the flexures, the palms and the soles.

Typical degeneration of granular cells was seen in the histological picture.

Eight impressions were taken from the patient's skin from the following sites: ante-cubital fossae, wrist, palm, upper part of the back, abdomen, popliteal fossae, extensor surfaces of the knee and ankle.

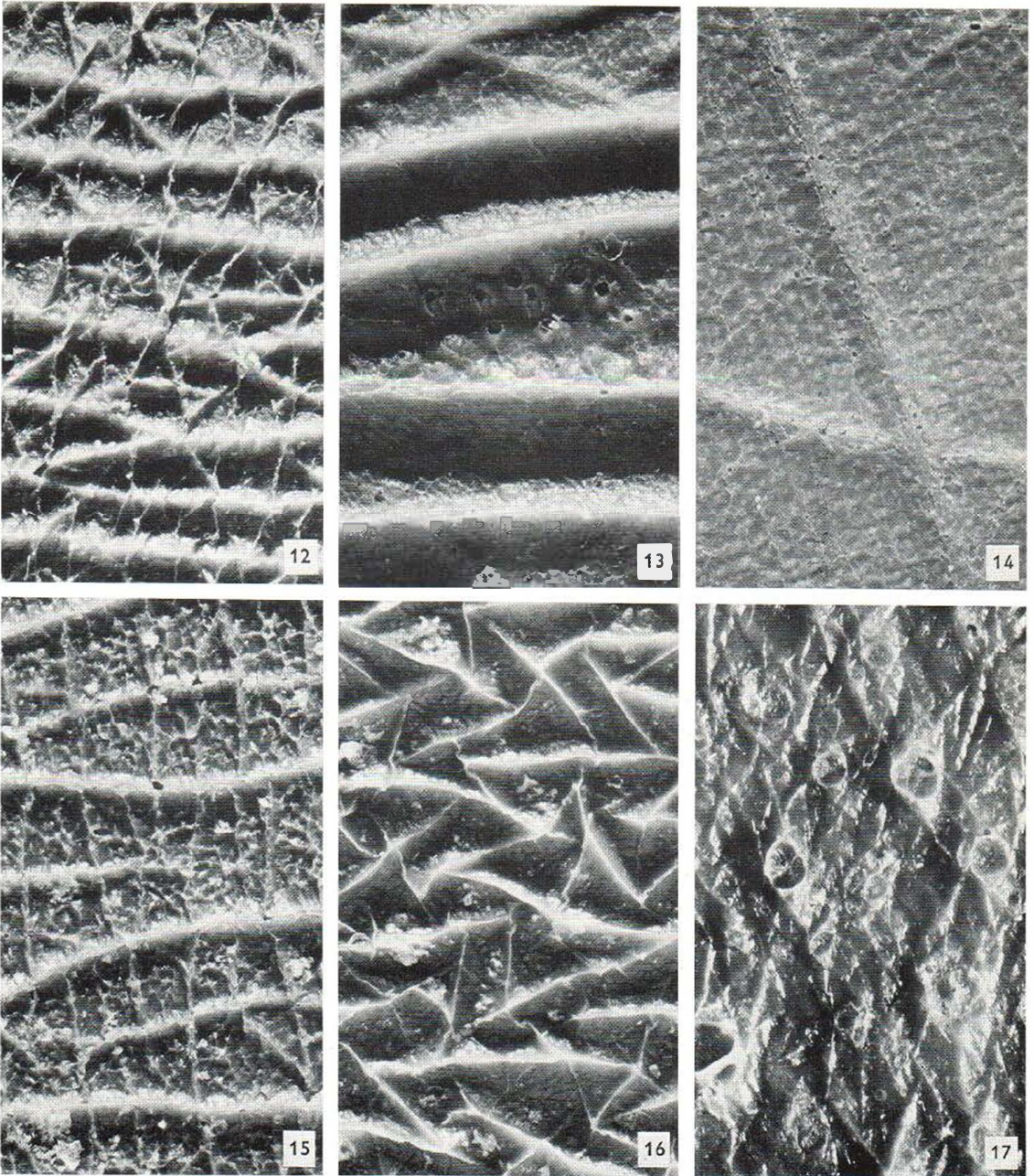
The replica pattern of the ante-cubital fossae (Fig. 12) is regular compared with normal skin (Fig. 3) but is more coarse and has large squares. This difference is more clearly visible in the skin impression of the wrist (Fig. 13). In normal skin, these folds form in the flexural position of the wrist and open in the extensional position. Thus they cannot be seen in the replica as the impression material is tightly pressed against the skin (Fig. 4).

Due to thick palmar hyperkeratosis the dermatoglyphics are weakly developed; the main lines of the palm, on the contrary, are deep and strongly pronounced. This can also be seen in the replica (Fig. 14). It can be compared with the palmar pattern of a patient suffering from autosomal dominant ichthyosis vulgaris (Fig. 9) with a normal, though slightly pronounced palmar pattern.



Figs. 7-9. Hyperkeratosis of the skin surface causes irregular arrangement of epidermal ridges in replica pattern of autosomal dominant ichthyosis vulgaris. The loosening of small scales along the ridges can be seen (case 2). 7, The skin of the extensor surface of the forearm (1:7). 8, The skin of the extensor surface of the thigh (1:7). 9, Ichthyosis palm with accentuated markings (1:7).

Figs. 10-11. The scales are large and angular especially on the extensor surfaces of the extremities in sex-linked ichthyosis. Loosening of the scales along epidermal ridges is visualized in the replica (case 3). 10, The skin of the upper back (1:7). 11, The skin of the extensor surface of the thigh (1:7).



Figs. 12-16. The replica series of congenital ichthyosiform erythroderma show accentuation and growth of epidermal ridges and furrows caused by strong hyperkeratosis which is most prominent on flexure surfaces of the skin (case 4). 12, The skin of antecubital fossa (1 : 7). 13, The skin of the wrist (1 : 7). 14, The palmar skin with accentuated

main lines and poorly developed smaller dermatoglyphics (1 : 7). 15, The skin of the ankle (1 : 7). 16, The patellar skin (1 : 7).

Fig. 17. Replica of the skin of the cheek with marked follicular hyperkeratosis of a patient with keratosis follicularis spinulosa decalvans (case 5) (1 : 10).

Also in the skin impression of the ankle (Fig. 15) taken from the extensor surface, in which the strongest flexion takes place, squares are

larger than normal. Here slight loosening of hyperkeratosis can be seen, with small pieces loosening along the epidermal ridges. In the im-

pression taken from the patellar skin (Fig. 16) an especially beautiful pattern is seen; it is angular and edged, resembling a labyrinth.

Case 5

A 14-year-old boy with keratosis follicularis spinulosa decalvans (6). Attached to each other, follicular horny plugs are observed in the skin of the face and neck. Furthermore, partial alopecia of hair was observed as well as inflammation of the conjunctiva and the cornea of the eye.

Impressions from the skin of the patient were taken from the following sites: forehead, cheek, neck, upper part of the back, abdomen, extensor surfaces of the upper arm and thigh.

Follicular keratinization was reflected in the replica pattern of all replicas, being most pronounced in the skin of the cheek (Fig. 17), in which impressions caused by horny plugs are seen. They have grown in number and shape compared with normal skin of the cheek (Fig. 1).

DISCUSSION

Replicas, easily prepared from plastic mass, display exactly the surface patterns of the skin in which the ridges and furrows vary according to the anatomical structure and the function of the epidermis.

Due to hyperkeratosis of the epidermal surface the squares become larger and more prominent, especially in the impressions taken from the predilection sites of the disease and is seen most clearly in congenital ichthyosiform erythroderma. The patient with congenital ichthyosiform erythroderma had histologically typical epidermolitic hyperkeratosis (3) and suffered from the disseminated phenotype of the disease, associated with very strong palmoplantar hyperkeratosis (8). The palmar hyperkeratosis also caused specific changes in the replica pattern. At times, loosening of hyperkeratosis in small discs or pieces occurred in the flexures. In the replica they seemed to loosen along the epidermal ridges.

Autosomal dominant ichthyosis vulgaris and

sex-linked ichthyosis differ from each other not only on the basis of inheritance but also on the basis of differences present in the clinical and histological pictures of the disease (5). A different type of scaling is also evident in the skin impressions. In sex-linked ichthyosis, in which scales with a diameter of 1 cm can sometimes be seen clinically in the predilection sites, large angular scales are seen to cover several smaller furrows and loosen only along stronger epidermal ridges in the replica.

REFERENCES

1. Cseplák, G. & Marton, T.: Neu Verfahren zu Dokumentierung der Oberfläche gesunder und kranker Haut. *Arch Klin Exp Derm* 228: 414, 1967.
2. Cummins, H. & Midlo, C.: Fingerprints, Palms and Soles. An introduction to dermatoglyphics. Dover, New York, 1961.
3. Frost, Ph. & van Scott, E. J.: Ichthyosiform dermatoses. *Arch Derm (Chicago)* 94: 113, 1966.
4. Goldman, L., Wahl, J., Rockwell, R. J., Meyer, R., Franzen, M., Owens, P. & Hyatt, S.: Replica microscopy and scanning electron microscopy of laser impacts on the skin. *J Invest Derm* 52: 18, 1969.
5. Kuokkanen, K.: Ichthyosis vulgaris. A clinical and histopathological study of patients and their close relatives in the autosomal dominant and sex-linked forms of the disease. *Acta Dermatovener (Stockholm)* 49: suppl. 62, 1969.
6. — Keratosis follicularis spinulosa decalvans in a family from northern Finland. *Acta Dermatovener (Stockholm)* 51: 146, 1971.
7. Penrose, L. S.: Finger-prints, palms and chromosomes. *Nature* 197: 933, 1963.
8. Rehtijärvi, K.: Clinical variations in congenital ichthyosiform erythroderma. *Proc 18th Meet Scand Derm Ass*, p. 184, 1968.
9. Sarkany, I.: A method for studying the microtopography of the skin. *Brit J Derm* 74: 254, 1962.
10. Schönfeld, W.: Darierische Krankheit. In *Lehrbuch der Haut- und Geschlechtskrankheiten*, p. 273. Georg Thieme Verlag, Stuttgart 1959.

Received November 1, 1971

Kirsti Kuokkanen, M.D.
Department of Dermatology
University of Turku
Turku 3
Finland