

**Blank I H.** Factors which influence the water content of the stratum corneum.

*J. Invest. Dermatol.* 18:433-40, 1952.

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The amounts of water held by the stratum corneum when in equilibrium with environments of varying relative humidity were determined. The relative humidity is a major factor in regulating the water content of this tissue *in vivo*, and its physical characteristics are a function more of its water content than its lipid content. [The SCI® indicates that this paper has been cited in over 205 publications since 1955.]

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July 9, 1987

Keratinized epithelium, such as a callus on the foot, remains soft and flexible as long as it remains on the foot but becomes hard and brittle when removed. This change cannot be due to the loss of any natural fats but is due simply to the loss of water. Therefore, neither I nor anyone else should have been surprised when we observed that dry callus did not soften when put in petrolatum or any other oil but softened in minutes when placed in water. (The callus I put in petrolatum in 1952 is still brittle.) Thus, the softening action of emollients, which are usually emulsions of oil and water, is due to water. Any relief of roughness of the skin is due mostly to oil.

For this concept of the mechanism of the action of emollients on the skin, I received the fifth special award of the Society of Cosmetic Chemists. Subsequently, cosmetic manufacturers began marketing "moisturizers," and dermatologists began using new methods and new therapeutic agents for the treatment of dry skin.

In the 1950s, at a meeting of dermatologists in a large Chicago convention hall, I was discussing the role of water in the therapy of dry skin. I had decided to break a piece of dry callus that had been in petrolatum for days, in front of the microphone, and I hoped that the "snap, crackle, and pop" would be heard throughout the hall. Apparently I was so nervous about this stunt that on three occasions between Boston, Chicago, and the lecture hall I forgot to take the callus in the ointment jar. When I finally

did bring the jar and opened it at the podium, I could not find the callus; it was stuck to the inside of the lid. I located it in time and, indeed, the "snap" was heard throughout the hall.

To my knowledge this paper presented the first data on the amount of water in human stratum corneum as a function of the humidity of the environment. It has long been known that the amount of water in wool, a keratinized tissue, is a function of the relative humidity of the environment.<sup>1</sup> (Wool dealers, who sold their wool by weight, hoped to sell on humid days.) Back when wool dealing was more frequent, it was commonly stated that water was a good plasticizer of wool.

From this paper and a subsequent one on the same subject,<sup>2</sup> we concluded that the major barrier against the diffusion of water from the viable epidermis through the stratum corneum and into the environment was at the base of the stratum corneum. We thought that throughout most of its thickness the stratum corneum's water content would be a function of the environmental relative humidity and, therefore, that it would be dry and brittle at low humidities. We now know that this is incorrect; the environment influences ("dries out") only the outer two or three cell layers; most of the stratum corneum is moist. The error in interpretation of our data that led to this misconception was recognized and subsequently corrected.<sup>3</sup>

Much has been learned about the effect of the water content of the stratum corneum on its barrier capacity. A wet stratum corneum has a lower electrical resistance, thus making a person more susceptible to electric shock. Hydrated stratum corneum is a better barrier against the entrance of infrared radiation. Viable bacteria that reach the cutaneous surface colonize it more readily, and fungi invade it more easily, if it has a high water content.<sup>4</sup> Molecules move more readily through a hydrated stratum corneum;<sup>5</sup> therefore, toxins and small molecular weight allergens can penetrate into the skin more rapidly. Endogenous hydration of the stratum corneum under an occlusive dressing accelerates the penetration of topically applied drugs. This concept is currently in use in the transdermal delivery of systemic drugs. Water moves more rapidly through hydrated stratum corneum, and, from *in vitro* experimental data of this type, *in vivo* transepidermal water losses and water concentration profiles of the stratum corneum have been calculated.<sup>6</sup>

From simple observations large concepts develop.

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