



To Anne and Florian
Youth – Power – New goals

P.J. Frosch and A.M. Kligman (Eds.)

Noninvasive Methods for the Quantification of Skin Functions

*An Update on
Methodology and Clinical Applications*

With 33 Tables and 210 Illustrations

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Foreword

More than 10 years ago, I had the chance to visit the university hospital in Münster, Germany. At the outpatient clinic there, I accidentally met a young dermatologist who was devoted to the study of the quantification of irritated skin during his busy daily clinical work. I sensed immediately that this Dr. P. Frosch was conducting his research with the ideals and enthusiasm which were so familiar to me. Soon we found that we shared a similar past experience; we both had begun our careers in dermatological investigation with the same mentor. For me it was more than 25 years ago that I first met Dr. Kligman, Professor at the University of Pennsylvania in Philadelphia, USA. I reminisced that I had been greatly shocked by his initial question “As a dermatologist, do you want to study living or dead skin?” because, at that time and even today, whenever we cannot collect enough information about the skin with the naked eye, it is common practice to histologically examine a skin sample that is invasively removed from living tissue. Many dermatologists still would never think of studying the living intact skin itself noninvasively with the aid of existing advanced technologies to assess its structural and functional properties. At that time Dr. Kligman intended to build up a system of evaluating the skin from various aspects, using methods that had been unduly neglected in the past and introducing various technological instruments. He used to say that such a system would eventually make it possible for a blind person to be a dermatologist. Greatly influenced by his enthusiasm, many young researchers engaged in intensive research activities with him, later to become successful in various places in the world. Therefore, after achieving great many things with his ardent academic mind, it is quite natural for Prof. Peter Frosch, who is now flourishing in this field, to edit such a unique book with AMK.

We are now able to evaluate the living skin with various established technological methodologies as fully described in the part I of this book; they are now available anywhere in the world. In many fields they far exceed even immunohistochemical techniques in their ability to provide precise and profound information about the skin's functions. In fact, recently numerous important findings have emerged for applications of these techniques in the study of both healthy and diseased skin, as extensively described in the part II. These sections will certainly serve to facilitate the design and analysis of the future investigations of eager readers.

Almost 15 years have passed since the Society for Bioengineering and the Skin was founded by Prof. R. Marks in Cardiff. In the fall of 1992, we organized its 9th International Symposium in Sendai, a city in northern Japan. To our great surprise,

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more than 400 people from all over the world came to the far end of Asia to attend this meeting. We will never forget our confusion on the first morning at the reception desk, faced with such an unexpectedly large number of participants. Of course, we ran out of printed programs and had to hastily copy more to meet the demand.

Thus, I think that many of us are now greatly in need of an additional breakthrough. Although these new noninvasive methodologies are still a rapidly developing field, they hold great promise in the future, as predicted by Dr. Kligman. Any dermatologists or scientists who study the skin and who eagerly hope to make further progress in their clinical and basic studies should become familiar with these techniques. I think that this is a book that will provide them with fresh information.

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Preface

Until recently dermatology was a purely “visual field” – skin lesions were described in a beautiful way with much love for morphologic details. This descriptive phase in the evolution of dermatology has lost its dominance with the introduction of modern quantitative techniques in every field, from microbiology to immunology. Molecular biology has provided stunning insights into the pathogenesis of skin diseases.

On the other hand, cutaneous physiology has been a stepchild in investigative dermatology for many years. Measurements of skin temperature, sebum production and transepidermal water loss were crude and used techniques which were complicated, expensive, and time-consuming. Lack of reproducibility was an inevitable result. The literature was confusing and contradictory. It is only in the last decade or so that quantitative instrumentation has become available. Perhaps the seminal event was the introduction of the evaporimeter by Nilsson for the measurement of transepidermal water loss. Initially developed to monitor water loss in premature infants, the convenience and reliability of this tool was quickly realized by investigators everywhere. This development spearheaded the age of noninvasive techniques whereby the skin is not perturbed by the measuring probe. Evaporimetry has many applications: assessment of skin damaged induced by detergents and irritants, impairment of the barrier function in chronic diseases such as psoriasis, monitoring of wound healing, response to treatments and many others.

New instruments have rapidly appeared which will change the way dermatologists study disease processes. We now have an impressive set of tools to study skin functions: skin blood flow by Laser-Doppler velocimetry, visualization of the compartments of skin by ultrasound techniques, determination of skin elasticity by a variety of devices which measure the skin's ability to restore itself after deformations, quantification of erythema by colorimetry, sebum pore patterns, etc. Great advances have been made in the characterization of the surface relief using image analysis. Dry skin, a disagreeable burden to the patient in cold weather, can finally be quantified by a simple but effective technique of applying adhesive discs to remove scales. In addition to Laser-Doppler other methods can complement studies of the microcirculation such as measurement of transcutaneous oxygen pressure, heat flow colorimetry or imaging by fluorescence. Some of these techniques are still investigational and not commercially available. However, it is only a matter of time until these will be in the hands of investigators everywhere. Moreover, these procedures will soon reach the bedside for monitoring patients.

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This book provides a broad survey of current techniques which are having a strong impact on dermatological investigation. Readers who have not followed the bio-engineering literature will surely be impressed by the variety of instruments now available to evaluate skin functions. The time has passed where looking at and feeling the skin were our sole means of deciding whether it was normal or abnormal.

One of us (AMK) not so long ago prophesized that the day would come when ingenious instrumentation would make it possible for a blind man to become a dermatologist. That goal is still to be attained but there is no doubt that all of us are “seeing” a good deal more than was thought possible a short while ago.

P. J. Frosch

A. M. Kligman