

# THE BIOLOGICAL ACTION OF PHYSICAL MEDICINE

CONTROLLING THE HUMAN BODY'S INFORMATION SYSTEM



JAN ZBIGNIEW SZOPINSKI



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By

JAN ZBIGNIEW SZOPINSKI MD, PhD

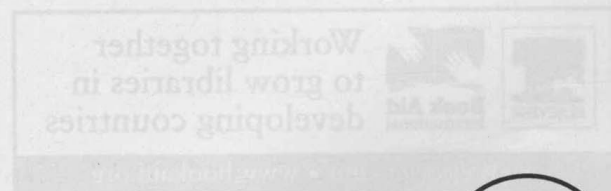
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# Preface

## ABOUT THIS BOOK

This evidence-based manual of modern physical medicine is written primarily for physiatrists (specialists in physical medicine) and also for all the other medical doctors interested in this specific field of medicine; according to the American Association of Academic Physiatrists, a medical doctor must be trained in physical medicine in order to direct a comprehensive rehabilitation team of health professionals that may include physiotherapists, occupational therapists, psychologists, speech therapists, social workers, and others. It has to be emphasized, however, that in the United States and some other countries physical medicine is combined with medical rehabilitation into one specialty, so the term "physical medicine" has become a synonym in those locations for rehabilitation. In European countries, by contrast, physical medicine and medical rehabilitation are two separate medical specialties; physical medicine is sometimes combined with balneology and climatology (in Germany and Poland), but not with medical rehabilitation. This book is devoted to "genuine" physical medicine (see Section 1.2 in Chapter 1), not to medical rehabilitation.

Nevertheless, physical medicine can be useful across the spectrum of medical disciplines. Neurologists should benefit from this book; they are trained to make proper diagnoses in their scope of expertise, but on many occasions there is not much they can offer to their patients even when it comes to the treatment of such common conditions as persistent migraine, neuralgia, neuropathy, or severe back pain. Anesthesiologists, especially those who specialize in chronic pain management, should find this book useful as well. Physicians can extend their effectiveness, because not all medical problems can be helped sufficiently by using pharmaceuticals alone. Rheumatologists, ophthalmologists, ENT specialists, and other professionals will learn that many problems in their respective fields of expertise can be managed more effectively with physical therapies. Even general practitioners will find this book helpful in their family practices; more efficient GP practices will, in turn, ease the burden of hospitals.

This book should also be of interest and help to physical therapists and those physiotherapists who are engaged with physical medicine. It will definitely be of benefit to all of the so-called alternative or complementary health practitioners who often use certain methods of physical medicine without sufficient scientific background. Neurophysiologists, biophysicists, and biomedical engineers might also find the content of this publication worthwhile.

A great deal of controversy and sometimes prejudice still surrounds physical medicine in general and so-called reflexive therapies in particular. Some of these therapies are even regarded as "alternative" or "complementary" medicine, leading valuable research articles in the field to be automatically rejected by renowned medical scientific journals. On the other hand, the public in general fully recognizes the value of physical medicine, and medical practices specializing in this field are in demand. Due to the shortage of such professional services in many countries, however, in almost every shopping mall various electrical, mechanical, thermal, and other therapeutic and pseudo-therapeutic devices are offered, sometimes at high prices. Also, various homegrown healers all over the world widely advertise their suspicious diagnostic and therapeutic services. Naturally, all these unproven devices and services give physical medicine a bad name.

The main reason for the existing situation seems to be the fact that most physical medicine methods have gained acceptance, but their mode of action is still not fully clear. There have been various attempts to explain all the particular types of "Western" physical therapies: thermotherapy, hydrotherapy, phototherapy, ultrasoundtherapy, electrotherapy, and magnetic field therapy. However, all of these theories, which can be found in existing manuals of physical therapy and in instruction manuals of various therapeutic devices, in fact produce more questions than answers. On the other hand, traditional Far Eastern beliefs concerning the so-called bioenergetic therapies are unacceptable from a scientific point of view. There is no unified, convincing, and scientifically acceptable physiological theory to date that can be universal for all methods of physical medicine and is in accordance with the contemporary state of biological and medical knowledge.

In order to address this complicated situation, since the early 1980s our successive research teams conducted an independent comprehensive research program aimed at bringing some scientific order to still chaotic medical discipline. This evidence-based approach resulted in the specific structure of this book. In order to substantiate claims, the first part reviews relevant research and in this way creates scientific foundations for practical aspects, both diagnostic



and therapeutic, that are discussed in the second part. The idea is that readers who familiarize themselves with the first part will subsequently find all the right answers to all the potential questions of the field on their own. For practical reasons, the less important research is summarized briefly, whereas crucial research is described comprehensively with all the details so that it can be easily checked and confirmed by other researchers.

It is worth mentioning that the whole program of research conducted over the last 30 years and described in this book was funded from the limited private resources and performed "after hours" by groups of enthusiasts who saw great potential within the program. There are many wonderful people who contributed to this research in various ways and who deserve the highest possible gratitude. However, because it would be an endless list, allow me to mention here at least those who made the most significant impact on this project. First, I want to thank Prof. Gerard Jonderko, former head of the 4th Department of Internal Medicine at the Silesian Medical University (Katowice, Poland), who not only taught me medicine but also infected me with a passion for scientific research. I also want to thank the late Prof. Zbigniew Garnuszewski, a great European expert in classical acupuncture, who shared his outstanding knowledge with other "Western" doctors. I am most grateful to the late Prof. Tadeusz Mika and Prof. Gerard Straburzynski, my postgraduate teachers of physical medicine. I thank Prof. Stefan Wegrzyn, former head of the Institute of Informatics at the Silesian Technical University (Gliwice, Poland), and his team of outstanding electronic and computer engineers for building the first automatic prototype of the organ electrodermal diagnostics (OED) machine. I am grateful to the Polish Ministry of Health for organizing and sponsoring my scientific trips to the leading acupuncture centers in China, Korea, and Mongolia as well as the National Institute of Reflexotherapy in Moscow. I want to express my gratitude to the South African Government for financial assistance with the preparation, patenting, and certification processes of the OED device's final model. Finally, my highest appreciation goes to my former research partner, electronic engineer Tadeusz Sierak, with whom I set the foundations for the current research program, and to my current research partner, Georg Philip Lochner, whose groundbreaking research (described in his M.Eng. dissertation) led to the comprehensive molecular explanation of the skin reversible electrical breakthrough effect and rectification phenomenon.

*Jan Zbigniew Szopinski*

# List of Abbreviations

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AC	alternating current
AP	acupuncture point
Cit.	cited in
CNS	central nervous system
DC	direct current
ELF-MF	extremely low frequency – magnetic fields therapy
IR	infrared radiation
LLLT	low level laser therapy
LRP	low resistance point
OED	organ electrodermal diagnostics
OPA	organ projection area
PP	pressure point
PSSO	pain syndrome of spinal origin
TENS	transcutaneous electrical nerve stimulation
TP	trigger point
UV	ultraviolet radiation

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The real voyage of discovery consists not in seeking new landscapes but in having new eyes. *Marcel Proust*

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PHYSICAL MEDICINE: GENERAL AND HISTORICAL BACKGROUND

CHAPTER

1

Introduction

Things of nature, including the human body, are a mixture of chemical reactions and physical phenomena. In practice, this means that medicine should explore equally both ways, i.e. chemical one and physical one, for diagnostic penetration and therapeutic intervention. On the diagnostic side, proportions are still preserved: physical methods, including basic physical examination, X-ray, magnetic resonance imaging (MRI), ultrasound and nuclear diagnostics, electrocardiogram (ECG), electroencephalogram (EEG) etc., are in use along with various chemical laboratory tests, but when a strong trend is observed in contemporary medicine to treat everything in the chemical way. This is mainly due to spectacular pharmacological achievements in the 1940s and 1950s: since then, medical students have been trained predominantly in biochemistry and very little in biophysics. This has resulted in a situation in which medical doctors in general do not speak the same language as engineers, despite the fantastic achievements of technical sciences in more recent years. Currently most medical practitioners seek to see pathology exclusively in chemical aspects, ignoring the fact that, for example, the nervous system's mode of action can be explained much better by physical sciences than by chemical reactions. A gap has been created in contemporary medicine between what we have now and what we could achieve, taking into account vast progress in technique and physical sciences.

Historically, physical therapies are as old as humankind. At a very early stage, people discovered

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...of spa treatments, and some of them (notions spas) are still in use today. In their terms, in addition to certain forms of hydrotherapy, therapeutic massage was also practiced. An auto-massage of painful body parts comes almost as a reflex after any injury; but in ancient Greece and Rome, massage was in use not only as a therapy but also for "sports medicine" purposes. There is also evidence that ancient Greeks applied electric fishes to painful areas of their bodies, creating in this way the first form of electrotherapy. In the Middle East, "Turkish steam baths" were introduced, combining elements of both thermotherapy and mechanical stimulation.

Physical therapies played a particularly positive role when early "pharmacotherapy" often brought more harm than good (e.g., an overuse of mercury and blood-letting in medieval Europe). In the 16th century, Paracelsus (real name: T.B. von Hohenheim, 1493–1541) displayed a great deal of interest in magnetotherapy. In 1776, the American doctor E. Perkins built a magnetic field therapy device for pain relief. Also in the 18th century, the first electrophysiological experiments by Galvani (1737–1798) and the creation of the first electric cell by Alessandro Volta (1745–1800) prompted immediate experiments with electrotherapy. In 1831, M. Faraday (1791–1867) discovered the phenomenon of the electromagnetic induction and in this way made possible the use of "faradic current" in electrotherapy. At the end of the 19th century, J.A. d'Arsonval (1851–1920) and N. Tesla (1856–1943) discovered high-frequency currents, which are of utmost importance in contemporary electrotherapy. In the 20th century, high-frequency electrical and magnetic fields were introduced to medicine (shortwave and microwave diathermy).

Discoveries of infrared (F.W. Herschel, 1800) and ultraviolet radiation (J. Ritter and W.G. Wollaston, 1801) are the milestones in phototherapy. In 1895, Danish doctor N.F. Papan (1860–1904)



## 1.1 PHYSICAL MEDICINE: GENERAL AND HISTORICAL BACKGROUND

Things of nature, including the human body, are a mixture of chemical reactions and physical phenomena. In practice, this means that medicine should explore equally both ways, i.e. chemical one and physical one, for diagnostic penetration and therapeutic intervention. On the diagnostic side, proportions are still preserved: physical methods, including basic physical examination, X-ray, magnetic resonance imaging (MRI), ultrasound and nuclear diagnostics, electrocardiogram (ECG), electroencephalogram (EEG), electromyogram (EMG), etc., are in use along with various chemical laboratory tests, but when it comes to therapy, a strong trend is observed in contemporary medicine to treat everything in the chemical way. This is mainly due to spectacular pharmacological achievements in the 1940s and 1950s: since then, medical students have been trained predominantly in biochemistry and very little in biophysics. This has resulted in a situation in which medical doctors in general do not speak the same language as engineers, despite the fantastic achievements of technical sciences in more recent years. Currently most medical practitioners seek to see pathology exclusively in chemical aspects, ignoring the fact that, for example, the nervous system's mode of action can be explained much better by physical sciences than by chemical reactions. A gap has been created in contemporary medicine between what we have now and what we could achieve, taking into account vast progress in technique and physical sciences.

Historically, physical therapies are as old as humankind. At a very early stage, people discovered the therapeutic effects of heat, cold, solar radiation (heliotherapy), and water application (hydrotherapy). Descriptions of early heliotherapy and hydrotherapy can be found in the writings of two famous ancient doctors: Hippocrates of Cos (460–380 B.C.) and Asclepiades of Bitinia (120–56 B.C.). In China, cold baths were used for fevers as early as 180 B.C. Ancient Romans created foundations for spa treatments, and some of their famous spas are still in use today. In their famous “terms,” in addition to certain forms of hydrotherapy, therapeutic massage was also practiced. An auto-massage of painful body parts comes almost as a reflex after any injury; but in ancient Greece and Rome, massage was in use not only as a therapy but also for “sports medicine” purposes. There is also evidence that ancient Greeks applied electric fishes to painful areas of their bodies, creating in this way the first form of electrotherapy. In the Middle East, “Turkish steam baths” were introduced, combining elements of both thermotherapy and mechanical stimulation.

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used ultraviolet emitted by a self-constructed lamp for treatment of skin TB. Albert Einstein's (1879–1955) quantum theory created a basis for the development of the laser technique. Low-power lasers were introduced to physical medicine in the 1960s.

In 1880, the Curie brothers discovered a piezoelectric phenomenon, leading to the possibility of the use of ultrasounds in medicine. Since 1951, ultrasound therapy has become one of the most popular methods of physical medicine.

Observations made by the Silesian farmer V. Priessnitz (1799–1851), followed by the scientific research of W. Winternitz (1835–1917), created foundations for modern hydrotherapy. German priest S. Kneipp (1821–1897) went even further, recommending various forms of hydrotherapy combined with a hygienic lifestyle, diet, and exercises for almost any disease, including syphilis and other infectious conditions.

The early 20th century still belonged to physical medicine, with the proliferation of famous Swiss and other European spas—for example, Baden-Baden, Karlovy Vary, and many others—in which various diseases including arthritis, peptic ulcers, coronary heart disease, asthma, and even TB were treated with physical therapies. Hot wrappings were widely applied for poliomyelitis.

However, the most amazing development in physical medicine came from the Far East. It seems that ancient Chinese doctors discovered that certain, sometimes remote, skin spots become tender in the case of a disease of a particular internal organ. This tenderness disappears after the organ is cured. The doctors must have presumed that a connection exists between these spots and the related organs, so they started to stimulate these skin areas therapeutically not only with deep point massage (Tien-An/Shiatsu) but also with needles (acupuncture) and heat (moxibustion). Observing the good clinical effects of these procedures, they developed a fundamental principle: “all the tender skin areas should be stimulated.” Over time, precise acupuncture maps were created, and the points corresponding to the same organs were connected with the artificial lines called meridians. Having no physiological and very little anatomical knowledge, Eastern practitioners adapted their general dualistic cosmic theory of the antagonistic vital energies “yang” and “yin,” which apparently circulate in the human body along the meridians, in order to explain how acupuncture works.

More recently, the French doctor P.M.F. Nogier, working in North Africa, observed locals treating their domestic animals, including horses and camels, by cauterizing particular zones on the animals' ears. He examined human ear auricles and concluded that a particular area would become tender when a related internal organ is diseased. In this way, he created the first maps of auricular organ projection areas and originated the concept of the auricular homunculus with the shape and position generally similar to the early fetus. He also employed this discovery for therapeutic purposes by inserting small acupuncture needles or applying laser radiation at these points.

Interestingly, traditional Southern African healers who have never heard of acupuncture perform therapeutic procedures of so-called *scarifications* by making superficial incisions at particular skin areas close to a diseased organ. For example, small cuts are made on the chest to alleviate bronchial asthma and around the stomach or the knee to reduce persistent pain in these areas.

There must be something special about acupuncture; after six thousand years, it is still in use for a number of conditions. Hundreds of research articles published in various peer-review scientific journals indicate the high clinical effectiveness of this oldest system of physical medicine. Among the international journals dedicated specifically to medical acupuncture are: the *Journal of Traditional Chinese Medicine*, *Medical Acupuncture*, and *Deutsche Zeitschrift fur Akupunktur*.

These days, "Western" and "Far Eastern" methods of physical medicine work together; specific skin areas are stimulated not only mechanically with needles, stitches, cupping, or point massage, but also chemically (injections, plasters, or creams), with ultrasound, laser, and other forms of phototherapy, with cold/heat (thermotherapy), and with magnetic fields and various forms of electrostimulation—from the transcutaneous electrical nerve stimulation (TENS) to the short-wave/microwave diathermy. Most of these therapies have gained acceptance from mainstream medicine, but their mode of action is still not fully elucidated.

## 1.2 PHYSICAL MEDICINE: CONTROVERSY ABOUT DEFINITIONS

*Physical medicine means the medical management of diseases and disorders using various forms of physical energy.* Many medical disciplines use physical methods in their daily practice. For instance, surgeons in general use electrocoagulation, laser knives, and cryosurgery; neurosurgeons in particular use radiofrequency rhizotomy; psychiatrists use electro-convulsive therapy; cardiologists use defibrillation; and dermatologists use lasers. Medical rehabilitation uses electrostimulation for paralyzed muscles, and chiropractors use manual manipulation for spinal problems. Certain physical treatments have even become official medical specialties on their own: for example, oncological radiotherapy. However, *there is a group of so-called reflexive therapies, which use various forms of physical energy to stimulate and control the body's own self-defense mechanisms and systems. Because of their very specific mode of action, these therapies emerge as a separate discipline of clinical medicine: reflexive physical medicine.* Typical reflexive therapies include: thermotherapy (heat or cryostimulation), phototherapy (infrared, ultraviolet, or laser), ultrasoundtherapy, electrotherapy (direct or via electromagnetic energy), magnetotherapy and mechanical nerve stimulation (acupuncture, reflexive massage, cupping, or high-pressure hydrotherapy). Chemical stimulation of the skin's nervous receptors by the use of various injections (even bee stings), plasters, compresses, and creams also belongs to the same category, because respective chemical substances are utilized in this case as nervous stimuli and not as medications of their own. We must always remember that, for example, in the case of electrotherapy it is not the electrode and in the case of acupuncture it is not the needle which cure the problem; these are just tools to stimulate and control the body's own powerful self-defense mechanisms and systems. After all, the human body is, in fact, the best possible "pharmaceutical factory," which under nonpathological circumstances is able to synthesize any needed substance.

Certain traditional indications for reflexive physical medicine—for example, ischemic heart disease, hypertension, peptic ulcer disease, diarrhea, urinary tract infection, impotence, etc.—are no longer indications for reflexive physical medicine due to tremendous progress in contemporary pharmacology. However, there is a wide range of pathological conditions for which reflexive therapies should be still the first choice. For instance, these therapies are particularly well suited to treating severe back pains, even after multiple failed spinal surgeries. They are known to be very successful when it comes to treatment of persistent headaches, neuralgias



(intercostal, trigeminal, or postherpetic), neuropathies (for example, diabetic), phantom pains, reflex sympathetic dystrophy, Reynaud syndrome, chronic rhinitis/sinusitis, Meniere syndrome, tinnitus, hearing loss due to acoustic nerve damage, Bell's palsy, glaucoma, macular degeneration, atonic urinary bladder. They can be visibly effective as a supportive treatment of Parkinsonism. Reflexive physical medicine is traditionally used for various kinds of arthritis, ankylosing spondylitis, acute gout, and sports injuries; it can be very useful in the case of chronic respiratory tract diseases. Those more radical reflexive therapies, especially electroacupuncture and cryostimulation ( $-70$  to  $-160$  degrees Celsius), can be successfully used even in acute problems: for example, status asthmaticus, atonic uterus, renal colic, esophagospasm, severe migraine, or postoperative pains. Electroacupuncture can be also by far the most successful treatment for nicotine addiction.

Of course, it is good in practice that physiatrists (specialists of physical medicine) know various physical therapies useful in rehabilitation—for example, traction, spinal manipulation (“manual medicine”/chiropractic), electrostimulation of muscles, or radiofrequency rhizotomy. However, these treatments belong to the medical rehabilitation specialty (or even neurosurgery), and nerve blockades and intra-articular injections are respectively the domains of anaesthesiology and orthopedic surgery. *What really constitutes the difference between the specialty of physical medicine and other medical disciplines, which also use certain physical treatments, are reflexive therapies. Therefore the term “physical medicine” should be used with regard to reflexive physical medicine rather than, for example, medical rehabilitation.*

It is also important to distinguish between the terms physical medicine and physiotherapy. Physical medicine comes from physics, in contrary to the term physiotherapy, which originates from the Greek “physis”—nature—and should be reserved mainly for “physiological” therapies such as exercises (kinesitherapy, biokinetics, water exercises, etc.). Whenever any therapeutic devices stimulating the sensory nervous system are used, it should be called physical medicine, with the respective medical specialists involved regarded as physiatrists and other respective therapists regarded as physical therapists. For prophylactic, therapeutic, and rehabilitative purposes, balneotherapy uses certain natural materials, for example, mineral waters, peloids (resembling mud), and therapeutic gases. Treatments are usually applied in the form of the bath (sometimes inhalation), combining both the elements of physical medicine (heat or hydrotherapy) and the pharmacotherapy, with the leading therapeutic factor being the chemical composition of specific substances absorbed through the skin. If mineral water is used internally in specific dosages and at specific times, it is called krenotherapy. Climatotherapy includes natural elements of physical medicine: for example, thermotherapy and heliotherapy (solar radiation).



## 2

# Investigations of the Physiological and Morphological Foundations of Reflexive Physical Medicine

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FIGURE 2.1 Typical structure of the human skin: 1) stratum corneum; 2) epidermis; 3) dermis; 4) sebaceous gland; 5) sweat gland; 6) Krause-type corpuscle; 7) hair; 8) Meissner-type corpuscle; 9) Vater-Pacini-type corpuscle; 10) sensory nerve.



## 2.1 ANATOMICAL STRUCTURE OF THE SKIN

Various forms of physical energy, used in physical medicine to stimulate and regulate the body's own powerful self-defense mechanisms and systems, are usually applied to the skin. Therefore it is important to properly understand the anatomical structure of the skin (see Figure 2.1).

The skin consists of distinct principal layers: the epidermis, the dermis, and the subcutaneous layer. The dermis and subcutaneous layer contain the vascular and nervous components of the skin as well as the sweat glands, sweat ducts, and hair follicles. The epidermis contains no blood vessels and is entirely dependent on the underlying dermis for nutrient delivery and waste disposal via diffusion through the dermoepidermal junction. The epidermis is a stratified squamous epithelium consisting primarily of keratinocytes in progressive stages of differentiation from deeper to more superficial layers. As keratinocytes divide and differentiate, they move from this deeper layer to the more superficial layers. Once they reach the stratum corneum, they are fully differentiated keratinocytes devoid of nuclei and are subsequently shed in the process of epidermal turnover. Cells of the stratum corneum are the largest and most abundant of the epidermis. The stratum corneum consists of approximately 15–20 layers of corneocytes (flattened cells filled with keratin, originally keratinocytes) that are surrounded by lipid lamellae, consisting typically of five stacked lipid bilayers (see Figure 2.2).

From the physical medicine point of view, it is important that the stratum corneum has been shown to be by far the most important electrical current barrier (94). Tape stripping of the skin has shown that when the stratum corneum is removed, the rest of the epidermis and dermis can be modeled as a resistance of only 500 ohms. The stratum corneum and the appendages, which traverse it, are therefore primarily responsible for the electrical properties of the skin.

Skin appendages such as sweat glands and hair follicles traverse the stratum corneum. Sweat ducts are approximately 10  $\mu\text{m}$  in diameter and account for approximately 0.1% of the skin surface. Sweat ducts are presumed to act as shunt pathways for electrical current through the skin.

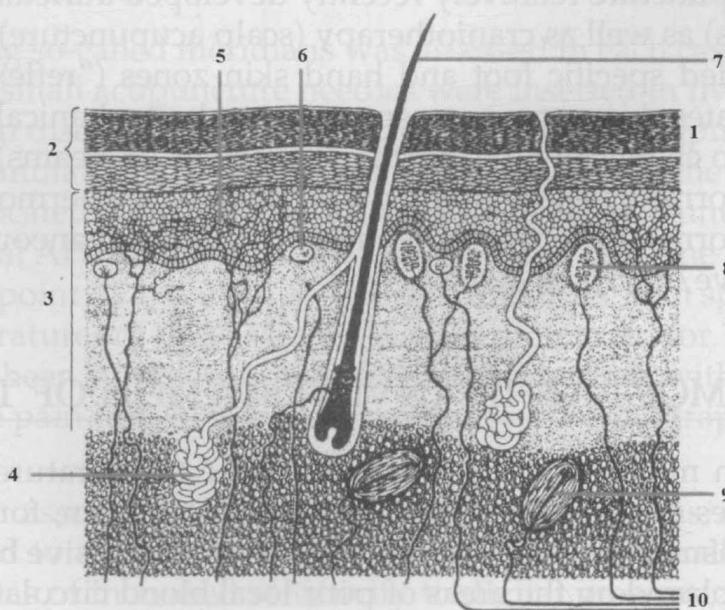


FIGURE 2.1 Typical structure of the human skin. 1: stratum corneum, 2: epidermis, 3: dermis, 4: sebaceous gland, 5: free nerve ending, 6: Krause-type corpuscle, 7: hair, 8: Meissner-type corpuscle, 9: Vater-Pacini-type corpuscle, 10: sensory nerve.