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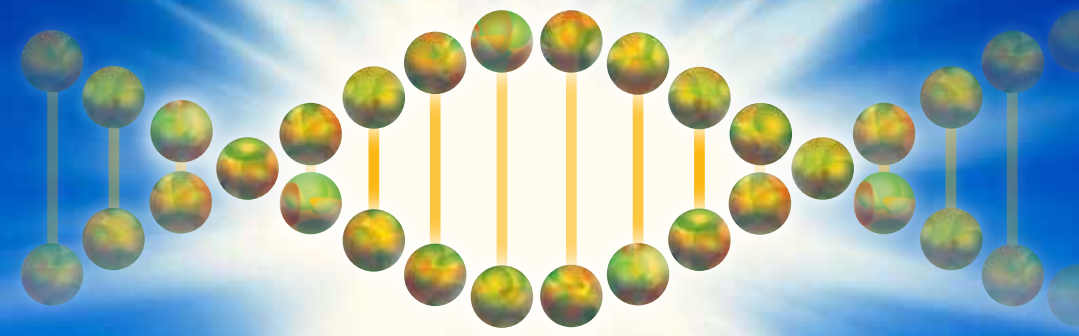
—Harrie Vink, Chairman of the Natural Health Foundation

THE MEDICINE OF LIGHT

Harnessing the Healing Power of Light-Based Therapies to Overcome Cancer, Pre-Cancer, and Chronic Diseases

Andrei V. Reshetnickov, PhD
and **M. Nathaniel Mead, MSc**



Foreword by Keith I. Block, MD, author of *Life Over Cancer*

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Message of Love and New Beginnings
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A MESSAGE OF LOVE AND NEW BEGINNINGS

"Photomedicine is the future of health and healing."

My original vision in supporting this book's publication was to help create new life when another life, one very dear to me, had passed away. This was the life of my beloved wife Marijke. In the spring of 2003, we learned that Marijke had advanced lung cancer. Soon after her diagnosis, the oncologist informed us that she had precious little time left to live. The only established therapy available at the time, an intensive chemotherapy regimen, could perhaps prolong her life for a few weeks, but with a virtual guarantee of many severe side effects and the potential for major complications, some of which were themselves life-threatening.

We were both stunned. I tried my best to fight off the despair but felt numb with shock and disbelief. My dear, beautiful wife, now with cancer—this simply could not be happening. After receiving the news, she and I sat for 15 minutes in total silence. Each of us had always shared the belief that we could overcome any obstacle and that, together, we could face any challenge, no matter how difficult. But this diagnosis was the greatest challenge we had ever faced. Our world was falling apart. I could only begin to imagine what she was feeling.

Those were the longest 15 minutes I've ever experienced. It was Marijke who finally put an end to the silence. She stood up and, with a sparkle of determination in her eye, asked the physician for a copy of her medical records. She told him that she had no intention of giving up and submitting herself to a course of treatment that offered such a dubious chance of success, and that she would instead prefer to explore other possibilities for beating this disease.

After contacting everyone we knew who might have connections in the medical world, and making many phone calls to clinics around Western Europe, we reached a physician in Eindhoven, a large city in the southern part of the Netherlands. This doctor had lost his son to lung cancer a few months earlier, and he did not hesitate to offer us his firm opinion as to the most promising treatment strategy for Marijke.

"Your best option at this point is Photodynamic Therapy," he said. "With all the other therapies for advanced lung cancer, your prognosis is poor; your probability of survival is minimal. Photodynamic Therapy, in my opinion, offers you the best chance for beating this terrible disease."

Always in a winning mood, Marijke and I went on the Internet and visited many websites that focused on Photodynamic Therapy (PDT). We soon came across the name of Dr. Andrei Reshetnickov, the inventor of several photosensitizing drugs, such as radahlorin, now trademarked as Bremachlorin® and clinically approved in Russia as Radachlorin®. He is also one of the inventors of a patented clinical approach to Photoimmunotherapy, or PIT, and recent research suggests that PIT is a promising medical breakthrough for overcoming cancer. It helps better reveal cancer and infections to the immune system.

I strongly encourage everyone—particularly those from the medical-scientific community—to read the interview with Dr. Reshetnickov in Chapter 7.

In reading about his work, we became excited about the possibilities for using this agent. As it happened, he was to appear soon afterward at a seminar in The Hague. This was a meeting of the Dutch Association for Orthomolecular Oncology on PDT on August 23, 2003.

I resolved to go and meet with Dr. Reshetnickov. After hearing his presentation, I could see that this was a man who had something important to share with the world. I began to feel a renewed sense of hope. "If you will help us, I will help you," I told Andrei. That was how we began to interact with each other, and I have been communicating with this brilliant Russian scientist ever since.

Unfortunately, Marijke's tumor had already increased in size to the point where it was impinging on blood vessels to her heart.

This was a dangerous situation, and the oncologists recommended that she undergo chemotherapy to help shrink the tumor as quickly as possible—and that this would be necessary before she began the experimental treatment. We did as they suggested. Although the treatments greatly suppressed her immune system and adversely affected her heart as well, it did reduce the size of the tumor so that she could start the PDT.

The light-based therapy took place over the next few months in Ireland. We saw with our own eyes how the treatment worked and how well Marijke responded. After a series of PDT sessions, her lung tumors were greatly reduced in size, and then continued to shrink well beyond what had been accomplished with chemotherapy.

By the time she started the light-based treatments, however, the tumor burden in her body was quite extensive. Although the PDT was effective in shrinking the cancer, the tumor broke down too rapidly, releasing a tidal wave of toxins. Because her heart and immune system had taken such a beating from the chemo, she could not cope with the tumor breakdown process. This led her to experience a great deal of fatigue and weakness. Her heart had become extremely weak, calling for electro-shock stimulation therapy as a desperate last measure.

Tragically, Marijke's body had become too weakened by the disease and the chemo treatments, and she was unable to endure the release of tumor toxins. On November 5th, 2003, she died at the tender age of 54.

In the months that followed, I reflected back on what we had witnessed during Marijke's encounter with PDT. It occurred to me that, had she been able to receive this powerful treatment option sooner, she might well have had a better chance of overcoming her cancer. Alas, she had come to the therapy too late in her disease process—when she was already at a point of critical tumor mass.

What appeared to be the end was, in fact, a new beginning. Since the passing of my beloved wife, I've met many cancer patients who used PDT as their primary treatment, but with much more favorable results. These individuals were more fortunate than Marijke because they had been introduced to the treatment much sooner in the course of their disease. In many cases, they were treated straight away with PDT instead of having the intensive conventional treatments first.

Through my subsequent discussions with Andrei, I could clearly see that Bremachlorin® was a promising tool for battling cancer. I learned that if you're able to break down the tumor using PDT—at a rate similar to that with which it grew in the body—there would be a much greater probability of treatment success. This strategy, particularly when combined with targeted support for anti-cancer immunity, could prove to be the best way to overcome cancer, and there is a growing body of research to support this perspective. This is also why I believe we should support the development of photosensitizers that can detect cancer at a much earlier stage.

In the course of my discussions with Andrei, as well as meetings with other PDT experts and research scientists, I made the decision to set up the Natural Health Foundation here in the Netherlands. The original purpose of this non-profit organization was to promote and support the development of new photo- and radio-sensitizing agents to help doctors diagnose and treat cancer at a much earlier stage.

Over the past ten years, the NHF has supported clinical research in Russia resulting in the successful introduction of Bremachlorin® as a safe and highly effective photosensitizing medicine. This research has sought to assess the therapeutic potential of this drug for the following conditions: (1) early stomach cancer, (2) bile duct cancer (cholangiocarcinoma/Klatskin's disease), (3) central lung cancer, (4) thyroid adenomas, (5) periodontitis, (6) sinusitis, (7) tonsillitis, (8) glaucoma (cystic blebs), and (9) photoimmunotherapy. One of the clinical trials was recently presented at the International Photodynamic Association World Congress in Seoul, South Korea, and another at CIRSE, the world's largest Interventional Radiology congress in Barcelona, Spain. The findings were quite impressive and well received by all attending the conference.

At the Seoul conference, Dr. Vladimir Romanov, principal investigator of the stomach cancer clinical trial, presented a series of cases demonstrating the efficacy of Bremachlorin-PDT. Some of these cases, recorded at Clinical Hospital 119 in Novogorsk, Russia, are shown in this book. Bremachlorin® is infused into the blood and then selectively accumulates in the stomach tumor over three to seven hours. What makes this agent so powerful is its unique combination of three components that result in profound therapeutic effects at the cellular level.

Upon treating the entire stomach with laser light, the Bremachlorin® is activated, resulting in the tumor's complete destruction after a single treatment. This elegant light-based strategy enabled many patients in the trial to save their stomachs and their lives as well. (You can find a complete summary of Dr. Romanov's study in Chapter 4.)

The NHF has also supported the study of new generation photosensitizers as well as products for early cancer diagnosis. Regarding these products, it has been said that cancer is far more curable when the disease is detected early. To this end, the NHF has supported the research and development of a new photodynamic diagnostic test. This entails an innovative MRI contrast agent that selectively accumulates in tumors.

Photomedical agents are currently being tested in laboratory experiments at a Dutch academic hospital, and the NHF seeks funding support for phase III clinical trials of early stomach cancer to obtain marketing authorization for Bremachlorin® as a medicine in the Netherlands. If Bremachlorin-PDT had been available in the time that my mother faced a diagnosis of stomach cancer many years ago in the 1960s, I feel certain that she would never have had to undergo major surgery, and that, ultimately, her life would have been spared. We cannot turn back the clock after losing a loved one, but we can do a great deal to help those who are still alive and facing the same terrible disease.

Despite the many challenges that lay ahead, I feel immensely gratified and heartened by the progress made by our foundation over the past decade. The foundation will continue to bring greater awareness to bear on the healing and curative powers of immuno-PDT and in particular PIT, an approach that trains the patient's immune system to better expose and ultimately eliminate cancer cells. With the help of such powerful light-based therapies, as well as with the agents currently under development, physicians will be in a much stronger position to ultimately cure cancer.

The purpose of this book is to help increase awareness regarding the healing powers of light. I believe that photomedicine is the future of health and healing. It is our hope that this book will inspire many people—patients, doctors, and scientists alike—to consider these wonderful therapeutic tools, which work in harmony with the body's

innate healing mechanisms. In my opinion, this book should be on the desk of any physician interested in overcoming life-threatening diseases and in the future direction of medicine.

For more information or to offer your support, please visit our websites, www.photoimmune.org and www.supportnaturalhealth.org. A full color version of the book is also available as an ebook on Kindle, and ongoing updates and reviews will be published on the photoimmune.org website. Net proceeds from the sales of this book will go to supporting studies of the light-based diagnosis and treatment of cancer.

With your support, we will continue to guide and facilitate research and educational efforts with the goal of helping all humankind through the use of light-based therapies and other innovative treatment options. Let us go forth and support the healing of those in need.

Harrie Vink
CHAIRMAN OF THE NATURAL HEALTH FOUNDATION

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CHAPTER 1

A New Light on Medicine

Imagine for a moment that you've stepped out onto a lush green meadow on a brilliant summer day. The world around you is awash in sunshine, casting a golden glow on the landscape. The sunlight warms your skin and lifts your mood. It literally lights up your day, even as it gives new life to the grasses and wild flowers around you. As you take in the radiant beauty of this pastoral scene, it seems wholly natural to feel wonder and gratitude for the life-giving gift of sunlight.

Now imagine that this sunlight is doing something even more wonderful: It reacts with a natural plant substance that has accumulated in abnormal or mutated cells inside your body. The reaction triggers the destruction of those aberrant cells, and by doing so helps ward off cancer and other kinds of disease while bolstering your health and longevity in the process.

Though this scenario may sound like some scientist's far-fetched fantasy—perhaps even harking back to the laser beams envisioned in science fiction novels—it now has considerable support from medical science. And believe it or not, a version of this same phenomenon already takes place in your own body every time you go out in the sun.

Here's how this occurs. Your body cells are normally producing a substance called protoporphyrin IX, or Pp-IX. This is a pigment derived from another compound naturally found in the body, one that goes by the name of 5-aminolevulinic acid (5-ALA). In addition to producing Pp-IX and other porphyrins, 5-ALA plays a key role in the formation of hemoglobin, the specialized protein that carries oxy-

gen throughout your body. (As you will see shortly, ALA has held a central place in the evolution of light-based treatments and diagnostic methods.)

Now, as your blood circulates through your liver and skin, it leaves Pp-IX in those tissues. What makes this substance so valuable is that it's constantly working on your behalf to protect your health. It does so with nothing more than the sun's rays. Simply put, Pp-IX absorbs the sun's energy, then transmits that energy to oxygen molecules, which, in turn, kill any undesirable microbes that happen to have sought refuge in your skin.

It is largely thanks to this natural compound—along with some essential help from the sun—that your skin is able to clear itself of potential disease-causing factors on a constant basis. Given that the skin is the body's largest organ, it makes good sense that we humans would have evolved such a protective mechanism.

By the way, if you happen to accumulate too much Pp-IX, your skin becomes far too sensitive to light, resulting in considerable pain and discomfort. In fact, this is the basis for a rare inherited disorder known as Erythropoietic Protoporphyria. Treatment for the disorder includes avoiding regular exposure to sunlight, wearing protective clothing, and using special sunscreens that block out the longer wavelengths of light (the shorter wavelengths are what cause sunburn and can be protected against with the help of normal sunscreens).

Now, under healthy conditions, your body generates just the right amount of Pp-IX, and this in turn absorbs just the right amount of energy from sunlight in order to keep your skin free of infections. As it turns out, various types of skin cancer also can be eliminated with the combination of Pp-IX and light. In Chapter 2, we'll show you how, by exploiting this elegant principle, skin cancers as well as precancerous conditions can be cured without the need for surgery.

Indeed, it was this understanding of Pp-IX that led medical scientists in the 1980s to develop an effective treatment for two of the most common forms of skin cancer in the West, basal cell carcinoma and squamous cell carcinoma. The scientists learned that if they applied a cream that increased the skin's production of Pp-IX, they could effectively eliminate these skin cancers. Even in those early

studies, the complete response rate for basal cell carcinoma was found to be 90 percent after a single treatment.[1] (Note: The rate of synthesis of Pp-IX is determined by the rate of synthesis of the substance called 5-Aminolevulinic acid, or ALA, mentioned earlier in this section. Thus the medical cream that is used to increase production of Pp-IX for skin cancer treatment contains ALA.)

The Power of Photosensitizers

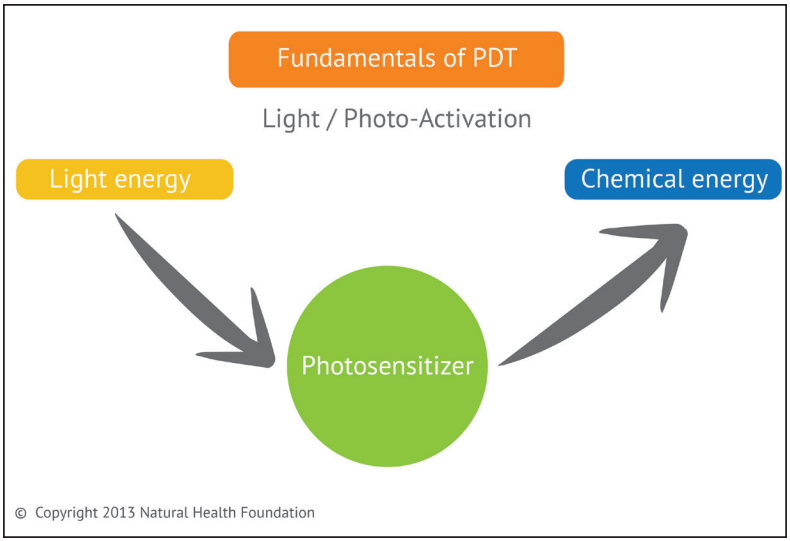
Thanks to the study of Pp-IX and other light-sensitive substances, or *photosensitizers*, we now know that the healing benefits of light extend far beyond the well-known connections between sunlight and vitamin D.[2] The term *photosensitizer* comes from the Greek word *phōs*, meaning "light," and the Latin *sens*, meaning "to feel." Thus, a photosensitizer is a substance that "feels the light." These special compounds literally sensitize the targeted cells to light, rendering them vulnerable to the destructive power of light's energy.

So how does a photosensitizer accomplish this marvelous feat? To begin with, it captures and absorbs the light's energy. This is very similar to what happens in green plants through the process of photosynthesis: The chlorophyll molecule that accounts for the green color of plants captures the sun's energy and then converts this energy into a usable, chemical form. Sunlight strikes the chlorophyll molecule, and the magic of photosynthesis unfolds from there.

In a similar way, the photosensitizers used for healing purposes are able to harvest the energy from light. They then transfer and convert that energy into a form that can knock out cancer cells, bacterial cells, and other abnormal cells linked with disease.

Now, as you might expect, photosensitizers are naturally abundant in the plant world. This makes sense on an intuitive level, since all green plants and algae are constantly absorbing and transferring the sun's energy throughout the day. As we mentioned above, plants already use chlorophyll (and other natural pigments) to accomplish this fundamental light-harvesting process, which forms the basis for our entire food chain as well as the source of all the oxygen we breathe.

With the discovery of photosensitizers, scientists have taken this life-giving principle of light energy transfer and applied it to the realm



of medicine. One of the earliest photosensitizers came from the study of Pp-IX, the natural skin compound we introduced earlier. But many other light-sensitive substances have been discovered and used with ever-greater therapeutic effectiveness. The best photosensitizers build up quickly in abnormal or diseased tissues and leave normal, healthy tissues largely untouched.

The Science of Light Medicine

For cultures the world over, light has been a symbol of beginnings and rebirth, as well as of cleansing and healing. In western poetry and philosophy, light is a symbol of love, hope, and wisdom. In Buddhism, the "enlightened" state of being has been described as one of insight and compassion.

And yet, our knowledge of the physical properties of light, as well as what it can do for the human body, is a relatively new science. Even as we continue to understand how light and other forms of energy can impact our health, there is still much to be learned about how this magnificent element can be harnessed to bring about therapeutic results and prolong life after a diagnosis of cancer or other serious disease.

Efforts by scientists to create new light-sensitive compounds from plants and other natural sources have fueled a whole new direction in medicine, one that has come to be known by various names: photodynamic therapy, photochemotherapy, and photoimmunotherapy (see glossary for definitions). These approaches are increasingly recognized as promising options for the treatment of cancer and other major health challenges.

THE POETRY OF LIGHT

"What light is light, if Silvia be not seen?"—William Shakespeare

"From within or from behind, a light shines through us upon things, and makes us aware that we are nothing, but the light is all." —Ralph Waldo Emerson

"To me every hour of the light and dark is a miracle." —Walt Whitman

"But I also say this: that light is an invitation to happiness, and that happiness, when it's done right, is a kind of holiness, palpable and redemptive." —Mary Oliver

"Beauty is not in the face; beauty is a light in the heart." —Kahlil Gibran

"Light, be it particle or wave, has force: you can rig a giant sail and go. The secret of seeing is to sail on solar wind…" —Annie Dillard

"The light of the morning, Heaven's mountains adorning: In particles bright, the jewels of light." —William Blake

What these approaches all have in common is the use of a photosensitizer that becomes selectively concentrated in mutated or unwanted cells, with minimal if any effects on normal, healthy cells. In the presence of light and oxygen, a reaction is triggered inside the abnormal cells, ultimately causing their demise. Different types of indoor light source—LEDs (light-emitting diodes), infrared, or ultraviolet lamps—have been used in order to achieve specific therapeutic effects.

The light-based approach already has proved effective against several cancers for which conventional treatment has largely failed. (In Chapters 2 and 4, you'll have a chance to learn about which cancers in particular have responded best to light-based therapies.) The advantages are obvious. First, as a consequence of the accumulation of certain plant compounds within abnormal cells, the cancer cells are selectively targeted and often destroyed or modified upon light exposure, while normal tissues are largely spared. A report in the 15 March 2013 issue of *Current Medicinal Chemistry* cited a number of natural plant compounds that could accomplish this impressive therapeutic feat.[3] This tumor-specific effect stands in sharp contrast with that of chemotherapy, which tends to create much indiscriminate damage, harming healthy and unhealthy tissues alike.

Moreover, when properly administered, light-based therapies are virtually free of toxic side effects. This too poses a dramatic contrast with modern chemotherapy and radiation treatments. With chemotherapy, for example, cancer patients often suffer even more from the toxic side effects of the drugs than from the disease itself. It is an added burden that can greatly compromise one's quality of life, ultimately limiting the ability to maintain good health and immunity.

Another key benefit of this light-based approach is that the immune system is activated in specific ways so that it can recognize the presence of cancers and infections. Just as importantly, the immune system now becomes far more active against these diseases, providing an indirect way to eliminate the abnormal cells—or to eliminate any residual cells that may be left over after the more direct lines of attack are tried. By clearing the body of cancer and other abnormal cells, this approach can help stave off the return of more aggressive disease later on.

We've just provided you with a glimpse of some of the ways that

light-based therapies are already beginning to transform the field of medicine. We believe this treatment strategy will help overcome certain pressing problems that now baffle many medical experts, such as resistance to antibiotics and chemotherapy drugs. In time, the strategies we describe in this book should greatly reduce the already colossal financial burden posed by cancer as well as many infectious diseases.

And as you'll see in later chapters, there are other exciting ways to tap into the medicine of light. For example, once the photosensitizer has accumulated in abnormal cells, those cells will actually "light up" or gleam brightly upon exposure to certain types of light. This phenomenon, known as *flourescence*, can be used for the purposes of both diagnosis and monitoring of the disease. When a surgeon removes a tumor, the area around that tumor will fluoresce (or glow), enabling the surgeon to more completely cut out or excise any diseased tissue that otherwise would be hidden from view.

Last but not least, recent studies suggest this approach can be effective in reversing the all-too-pervasive problem of clogged arteries, thus helping to ward off cardiovascular disease, the number one killer disease in the European Union, Russia, the United States and many other westernized countries.

Light Therapy From Ancient to Modern Times

We are creatures of light. From the time the morning sun rises in the East, light exerts a profound influence on our health and well-being. According to medical records from ancient India, Egypt and China, humans have been cognizant of the healing powers of light for more than 5000 years. It's quite possible that these healing energies were understood and appreciated long before then, though available documents can only shed light on our recent history.

As implied above, our primary focus in this book is on how certain substances, when taken into the body, can amplify or enhance the healing effects of light. This area of medicine is broadly referred to as *photomedicine* or light medicine. As a medical science, photomedicine officially began in the 1880s. This field encompasses the positive and negative effects of light on human health and functioning. Its more recent evolution has included the use of light for diagnostic purposes, and the use of both lasers and non-laser light for therapeutic purposes.[4]

Our primary focus throughout this book will be on an application of photomedicine known as photodynamic therapy. As already mentioned, *photo* comes from the Greek word for light. The *dynamic* part refers to the therapy's ability to transmit light energy for the ultimate destruction of abnormal cells. Thus photodynamic therapy, or PDT, can be viewed as a targeted approach to light-based therapy, whereby the light is able to selectively strike and destroy mutated cells (either precancerous or cancerous cells) as well as microbes linked with infectious disease. In its very first usage in the early 1900s, the term was specifically applied to light's ability to immobilize living organisms (protozoa).

The historical basis for PDT actually dates back at least 3000 years, when healers in ancient Egypt and India used plants to enhance the healing effects of light. In those early days, individuals with vitiligo-like skin lesions were treated with a plant compound that scientists now refer to as psoralen. In more specific terms, psoralens are a group of natural furanocoumarins. These days, they are commercially derived from Ammi majus, a plant native to Egypt. Abundantly found in vegetables like celery, parsley and parsnips, psoralen is a weak photosensitizer that sensitizes the skin to the sun's rays. When the ultraviolet radiation of the sun strikes the psoralen in the skin, the white patches and other skin problems disappear.

The more recent practice of *heliotherapy*, or sun therapy, probably had its roots in early Greek medicine, around 400 BC. *Helios*, the Greek word for "sun" or "sunlight," was the most ancient of the sun gods.Apollo, another sun god for the ancient Greeks and Romans, drove his chariot of fiery horses across the sky to give light to the world. He was also the god of medicine and healing. As with the sun gods of the Aztec and Inca empires of the Americas, Apollo could bring sickness and deadly plagues but also had the ability to cure.

The Greek physician Hippocrates, widely regarded as the father of western medicine, actually recommended heliotherapy for a range of physical and mental ailments. Though we lack detailed records of how Hippocrates used the sun for medicinal purposes, it seems that he did at least recognize the importance of sunlight for emotional well-being and possibly even for combating some skin infections.

UV LIGHT AND PSORALEN:
Oldest Medical Treatment on Record?

Thousands of years ago, humans learned that consuming certain plants (e.g., parsley, parsnip, carrots and celery), followed by sun exposure, could produce a skin reaction similar to sunburn. Those plants were rich in the natural compound psoralen, and the reaction produced in the skin is now understood to be a photodynamic reaction.

Even today, psoralen plays a role in the treatment of vitiligo, an ancient disease in which white patches or white spots appear on the skin, due to a loss of normal pigment. This is a distressing and potentially disfiguring condition, especially for individuals with darker skin. Currently affecting about 1-3 percent of the world's population, vitiligo's overall appearance and unpredictable course can be socially and psychologically devastating.

Due to the complexity of the disorder, a variety of light-based treatments have been recommended for vitiligo following the observation that sun-exposed lesions on the skin often acquired a more normal appearance during the summer months. Today's physicians continue to use a combination of psoralen and ultraviolet-A (UV-A) light therapy to treat the localized forms of this condition. The approach is known as *photochemotherapy*—quite a fancy term when you consider the treatment's ancient, humble origins. The first modern application of psoralen-based photochemotherapy was in Egypt in 1948, using a purified 8-methoxypsoralen followed by sunlight exposure.

For the more diffuse manifestations of this skin disease (i.e., those affecting larger areas of the body), ultraviolet-B (UV-B) light therapy is considered to be the "gold standard" treatment of choice.[5] Both UV-A and UV-B can be obtained by sunbathing; however, whereas the UV-A can be transmitted through glass, UV-B requires direct, outdoor exposure to the sunlight.

Heliotherapy's modern resurgence took place in the 1800s, when European doctors started using red light therapy. This approach, the first well-documented exploration of what came to be known as phototherapy or light therapy, was carried out in rooms with red glass windows, mostly for the treatment of itchy eruptions of rubella and other skin disorders. Individuals suffering from depressive disorders also seemed to respond well to red light therapy. (Light therapy is now an established treatment for depression, regardless of the season or whether they have Seasonal Affective Disorder, or SAD. One advantage this therapy has compared with antidepressant drugs is that the benefits tend to appear more quickly. Also, the combination of light and medication has proven to be more effective and faster than either alone.)

From the late 1800s to about 1940, heliotherapy became popularized throughout Europe as a treatment for tuberculosis—especially when the disease also affected the bones, joints and skin. We now know that prolonged exposure to sunlight can lead to the destruction of the bacteria that cause tuberculosis, but in those early days the offending organisms hadn't yet been identified. Nevertheless, TB-infected children were sent out to special hospitals and encouraged to spend as much time outdoors as possible. Many of these children came from dark and dingy city slums, so that exposing their skin to sunshine would have helped them eliminate the bacteria. In a book titled *The Sun Cure* (*La Cure de Soleil*, in French), French physician Dr. Auguste Rollier claimed that heliotherapy's success in these cases depended on the duration and intensity of sunlight, as well as the specific condition being treated.

Of course, in the northern latitudes and colder climates, sunlight is often limited. For this reason, artificial light sources (some of which are referred to these days as "sunboxes") were sought that could closely approximate the sun's rays and beneficial effects. Among the best-documented early examples was the Finsen lamp created by physician Niels Ryberg Finsen of the Faroe Islands (near Denmark). This ultraviolet lamp allowed treatment throughout the year; moreover, its rays could be focused on specific parts of a patient's body. The lamp's greatest success was in the treatment of tuberculosis of the skin (lupus vulgaris), for which Finsen won the Nobel Prize in 1903.

In the early 20th century, sunbathing was deemed to be the best treatment modality not only for tuberculosis, but many other infectious diseases as well. Other conditions successfully treated with heliotherapy included acne, eczema, anemia, colitis, sciatica and asthma, among others. With the discovery of penicillin in 1938, however, big business rushed headlong into the mass production of antibiotics, and heliotherapy quickly became a thing of the past.

Photodynamic therapy was discovered quite by accident at the end of the nineteenth century. In 1898, a Munich university student named Oscar Raab was observing the effects of light on paramecia, tiny organisms that are naturally present in freshwater and clearly visible only with a microscope. Here's what he observed:

- Upon exposure to light, and in the presence of the dyes, the paramecia would begin to slow down in their movements.
- Some died prematurely when the light exposure was prolonged, but again only in the presence of the dyes. Without those dyes, the tiny creatures were unaffected by the light.
- In the absence of light, the dyes had no effect whatsoever. This so-called "dark experiment" proved that it was neither the light nor the dye alone, but rather their combination that made the difference.

Raab's professor, Herman von Tappeiner, later identified the orange dye acridine and the pigment eosin as the substances that sensitized cells to the destructive effects of light. He subsequently demonstrated that their cell-killing power also required the presence of oxygen. Just as fire requires oxygen to exist, it seemed that light required oxygen to exert its special effects on these living cells.

This was the conclusion von Tappeiner offered in his classic 1907 treatise on PDT in which he referred to the light-based effects on infections and cancers as *Photodynamische Wirkung*. When the photosensitizer was combined with light and oxygen, a toxic reaction resulted in the exposed cells. He proposed that this reaction could be the basis for treating various diseases—including infections, skin tumors, and some non-cancerous skin conditions.

[From the opening of Chapter 1— support us by buying the book!]