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A brief report on the history of phototherapy☆

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Abstract From ancient times, light has played a significant role in the treatment of diseases. The modern discoveries (eg, ultraviolet radiation) and modern inventions (eg, the electric generator or the electric lightbulb), as well as balneologic experiences of the treatment with sunlight, contributed to the transition from heliotherapy to artificial light phototherapy at the end of the 19th century.

Nils Ryberg Finsen (1860-1904) was the founder of modern phototherapy. He is famous for applying an electric carbon arc torch in treating patients with lupus vulgaris using ultraviolet radiation. Subsequently, phototherapy using artificial light sources gained importance in the treatment of skin diseases with a noninfectious etiology. William Henry Goeckerman (1884-1954) chose an ultraviolet B light to treat psoriasis. Improvement in the effectiveness of dermatologic phototherapy occurred in 1947, when methoxypsoralen was isolated. During the 20th century, phototherapy was applied to new therapeutic areas, such as neonatology, psychiatry, and ophthalmology.

Introduction

Phototherapy has been used since antiquity as a treatment for various ailments. Through exposure to sunlight, a person could be treated for anything from locomotor disorders to a variety of skin diseases. Heliotherapy has been the longest used form of phototherapy and was the only form until the mid-19th century.

The earliest registered information on use of heliotherapy in the treatment of skin diseases comes from the 15th century BCE. The belief in the healing properties of sunlight was associated with the ancient cult of the sun (Figure 1), wherein sun therapies were applied in ancient Egyptian, Chinese, and Hindu medicine.[1,2] The Ebers Papyrus[3] (c 1550 BCE) recorded the treatment of vitiligo, in which skin lesions were covered with *Psoralen corylifolia* and *Ammi majus* extracts and subjected to sunlight.[4-6] There was also a technique of treatment with colors in ancient China, in which colored sheets of paper were used to direct sunlight for treating men and moonlight for treating women.[4,7]

The beginnings of modern phototherapy

Modern scientific discoveries and technologic inventions created the basis for the application of artificial and modified

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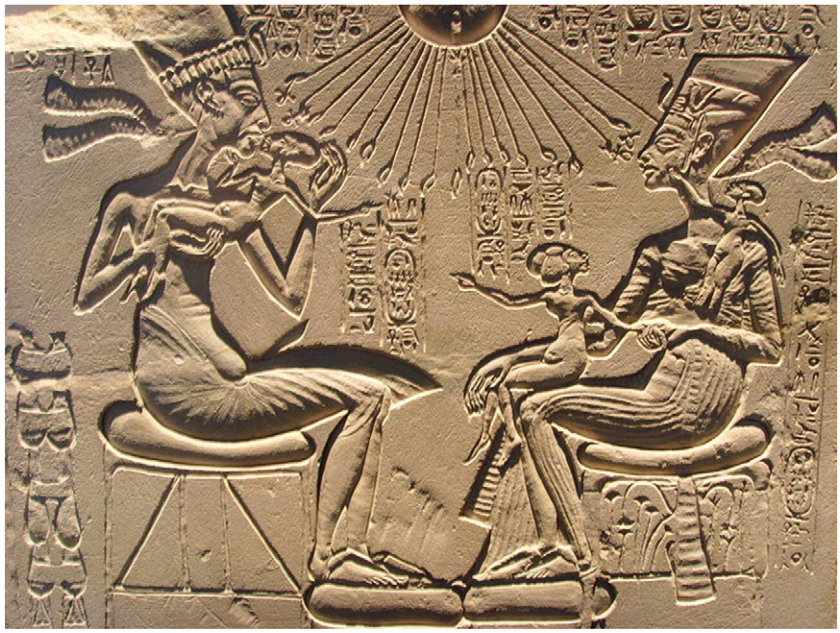

Fig. 1 Ancient Egypt: Akhenaten, Nefertiti, and their three daughters in the sunlight. (Source: http://www.kenneymencher.com/pic_old/fertile_crescent_egypt/lesson_9_akhenaten_egypt.htm. Accessed August 9, 2015.)

light sources in phototherapy. Undoubtedly, these achievements included those by Isaac Newton (1642-1727), who split a light beam into seven basic colors using a prism and discovered of the so-called color wheel; the discovery by Friedrich Wilhelm Herschel (1738-1822) of the sun's infrared spectrum in 1800; and the independent discovery of ultraviolet radiation[8] in 1801 by Johann Wilhelm Ritter (1776-1810) and William Hyde Wollaston (1766-1828). Michel Eugène Chevreul (1786-1889) expanded on Newton's theory of seven colors by formulating in 1830 the concept of simultaneous contrast. He described the phenomenon of an interaction of two colors, side by side, changing human perception. This contrasting effect is more distinct when it becomes the interaction between complementary colors (eg, blue and yellow).[9]

Such achievements could not be fully applied in phototherapy without the advancement of research on electricity and the creation of artificial light sources. Hans Christian Oerstedt (1777-1851) discovered that electric current creates a magnetic field (1777-1851). Michael Faraday (1791-1867) later described electromagnetic induction as a source of electric power and built both the first electric generator and the first electric motor. Subsequently, Thomas Alva Edison (1847-1931) invented the electric lightbulb and the battery as a source of electric power.

In the same historic period, attempts were made to scientifically explain the positive influence of light on the human organism. The first modern scientific publication on the effects of light and color on human health was written in the early 19th century by the German poet and writer Johann Wolfgang von Goethe (1749-1832). In 1810, he published a work on the perception of color vision and the influence of light and colors on the human emotional state.[10] This is considered the first work on the psychology of colors, although it includes many erroneous assertions, like the thesis on light's homogeneity inherent in the polemics of Newtonian optics. Goethe thought that Newton was wrong with reference to the view that colors arise from light's decomposition into tiny particles called corpuscles after emerging from a prism. Goethe underlined that colors arise from the interaction of light and dark, and light is indivisible into any particles.

Scientific reports in the second half of the 19th century also pointed to the healing properties of sunlight. In this context, it is essential to mention a publication on the bactericidal properties of sunlight[4,11] and its therapeutic properties in cases of rickets.[6,12]

Activities of sanatoria, using natural solar radiation, were an important element in the historic process of creating contemporary phototherapy. The end of the 19th century saw the development of these "sun sanatoria." They became the centers for heliotherapy and hydrotherapy. Attempts were made to combat the tuberculosis epidemic by associating phototherapy with climatic treatment (ie, therapy by bathing in cold or warm water and walking in the fresh air).[13] Pioneers in this therapeutic trend included the so-called sun apostle Arnold Rikli (1823-1906)[14] (Figure 2), Oskar Bernhard (1861-1939), and August Rollier (1874-1954). From 1855, balneotherapy might have included light treatment, as found in the Alpine Bed in Slovenia[15]; Rikli applied the principle that "water is good, the air is better, and most of all the sunlight." Bernhard promoted heliotherapy in the beginning of 1899 at a private clinic in St. Moritz, Switzerland, while Rollier applied climatic treatment in combination with phototherapy for treating tuberculosis of the bone, beginning in 1903 at a sanatorium in Leysin, Switzerland.[16]

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