

# History

## Early lamp developments for phototherapy in dermatology

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### Introduction

In 2004, we remember the hundred-year anniversary of Niels Ryberg Finsen's (Finsen) death (1860–1904). This Danish physician was one of the first to develop lamps and lenses for the treatment of skin diseases, in particular, skin tuberculosis (Lupus Vulgaris), for which he was awarded the Nobel Prize in 1903 (1).

With this article we intent to shed some light on the early development of lamps as well as review contemporary literature. The article will begin with the Finsen Medical Light Institute (FMLI), which Finsen founded in Copenhagen, Denmark, 1896 and where he treated skin tuberculosis with concentrated light. After that success he turned to other diseases like lupus erythematosus discoides and alopecia areata (2).

We have chosen to describe the time when the sun was ousted by electrical lamps. Primarily lamps were developed at the FMLI, in the late 19<sup>th</sup> century, but soon after others became interested and a rivalry began between the Finsen-Reyn lamp and

the German Kromayer lamp. We want to show general tendencies and the thoughts behind the development in early light therapy.

### From sunlight to electrical light

The transition from the use of sunlight to the sole use of electrical lamps was crucial to the further development of lamps. With the electric light it became easier to control the intensity and type of radiation.

Based on private donations, Finsen opened the FMLI in Copenhagen, in August 1896. Here he intended to treat skin tuberculosis with sunlight and electrical light. Sunlight depended on the weather, and Finsen soon realised, that it was not as reliable as electrical light (specially in a temperate climate). Further more, one could easier control the amount of light coming from an electric source. But in 1896 electricity was still very

expensive, whereas sunlight was right at hand, and in the warm season still more powerful than any electrical lamp available. In time, Finsen planned to develop better electric lamps, and so end the sunlight treatment era.

Finsen hired young girls, called "Elves of Light"(3), to monitor the treatment of each patient. Outside they treated the patients with concentrated sunlight through lenses made of glass held together with a frame of metal, usually brass. Inside, Finsen constructed a Carbon Arc Lamp (Fig. 1), by which it was possible to treat four people at a time.

With time, Finsen's treatment depended more and more on electrical light alone, but exactly when the use of sunlight ended at FMLI is uncertain. Finsen wrote that the use of sunlight therapy was completely abandoned by 1901 (4). However, in 1903 he wrote that the use of sunlight had



*Fig. 1.* Treatment of skin tuberculosis with the Finsen Carbon Arc at FMLI 1897 (a). Picture from Medical Museion, University of Copenhagen.

been almost completely abandoned (5). This contradiction raises the question whether the use of sunlight was in fact completely abandoned by 1901 or whether it, though on a smaller scale, was in use around 1903. It is possible that Finsen, affected by the competition from other manufactures, exaggerated the use of electric light in order to make the Finsen Light Treatment seem more efficient.

### **The development of lamps at the Finsen Medical Light Institute**

The success of Finsen's treatment of skin tuberculosis gave rise to scientific attention concerning light therapy and treatment of skin tuberculosis in general. Old methods such as surgical removal, use of a caustic ointment and experiments with the new X-rays, were abandoned.

A general demand for new types of lamps was rising. Smaller lamps, with the same intensity, would make it possible to treat patients at home, so that patients would not have to make the long journey to Copenhagen or other similar central institutes abroad.

In 1901, Sofus Bang, personal friend and colleague of Finsen at FMLI, made a hand-held iron-lamp (Fig. 2a) (6). Contrary to Finsen's lamps, which were based on carbon arc technology, Bang's lamp was based on a new principle with a water-cooled iron electrode. Bang was attending a conference in Hamburg in 1901, as

a representative of the FMLI, when he, in continuation of a lecture on the Finsen treatment, presented his new lamp.

When Finsen saw a print of the lecture, he wrote to Bang, stating that his tests of the iron-lamp proved it inefficacious compared to that of his own. In a letter back to Finsen, Bang disagreed. Furthermore Finsen blamed Bang for writing in a German journal, that the Bang-lamp combined with a French lamp from "Lortet and Genoud" made up the most efficient kind of treatment (7). Finsen believed his own lamps to be the best, and in his letter he described Bang with words such as "untrustworthy and lack of truthfulness" (8). The words were harsh. When Finsen called on Bang's resignation, Bang accepted and left his position (and the patent for his lamp) at the FMLI.

The affair was briefly hinted at, in the report from the FMLI 1900-1905, where the FMLI disassociated themselves from Bang's lamp as well as the French one (9). The French lamp was, as an example of a new foreign invention, given a poor review, on the very same pages as that of the similarly poor review of Bang's lamp.

Shortly thereafter (1903) Finsen himself, working with Axel Reyn, constructed a new lamp (Fig. 2b). The Finsen-Reyn lamp fulfilled the demands of a smaller and more efficient lamp. But the market had expanded and many new manufactures had appeared. One of them was the German physician Ernst Kromayer.

### **The Finsen-Reyn lamp versus the Kromayer lamp**

When Kromayer, in 1906, invented and made public his mercury lamp, later known as the Kromayer lamp, it was the beginning of a strong debate on the efficiency of Kromayer's lamp versus the Finsen-Reyn lamp (Fig. 2c) (10). Both lamps had lenses of quartz and were believed to produce ultraviolet light. The Finsen-Reyn lamp and the Kromayer lamp were both used in the treatment of diseases other than lupus vulgaris. However, in order to reduce the huge amount of literature on the subject, the following analysis will start with the debate regarding the treatment for lupus vulgaris.

In 1908, Kromayer wrote a reply (11) to the FMLI's reaction to his lamp. It was unusual because his defence was based on the studies of a Danish physician from the FMLI, Dr Johannsen, whose study contested the effect of Kromayer's new lamp. But Kromayer argued that Johannsen, for his comparative study of the Kromayer lamp and the Finsen-Reyn lamp, had used three times higher energy for the Finsen-Reyn lamp, than the amount generally used. When Kromayer adjusted the results accordingly, they were in favour of the Kromayer lamp. Based on this Kromayer emphasised that even studies made at the FMLI proved the superiority of his lamp. Johannsen's study showed that FMLI did not support the Kromayer lamp. But never the less, Kromayer did not only disagree with Johannsen's study, he even argued that it actually supported the use of his lamp.

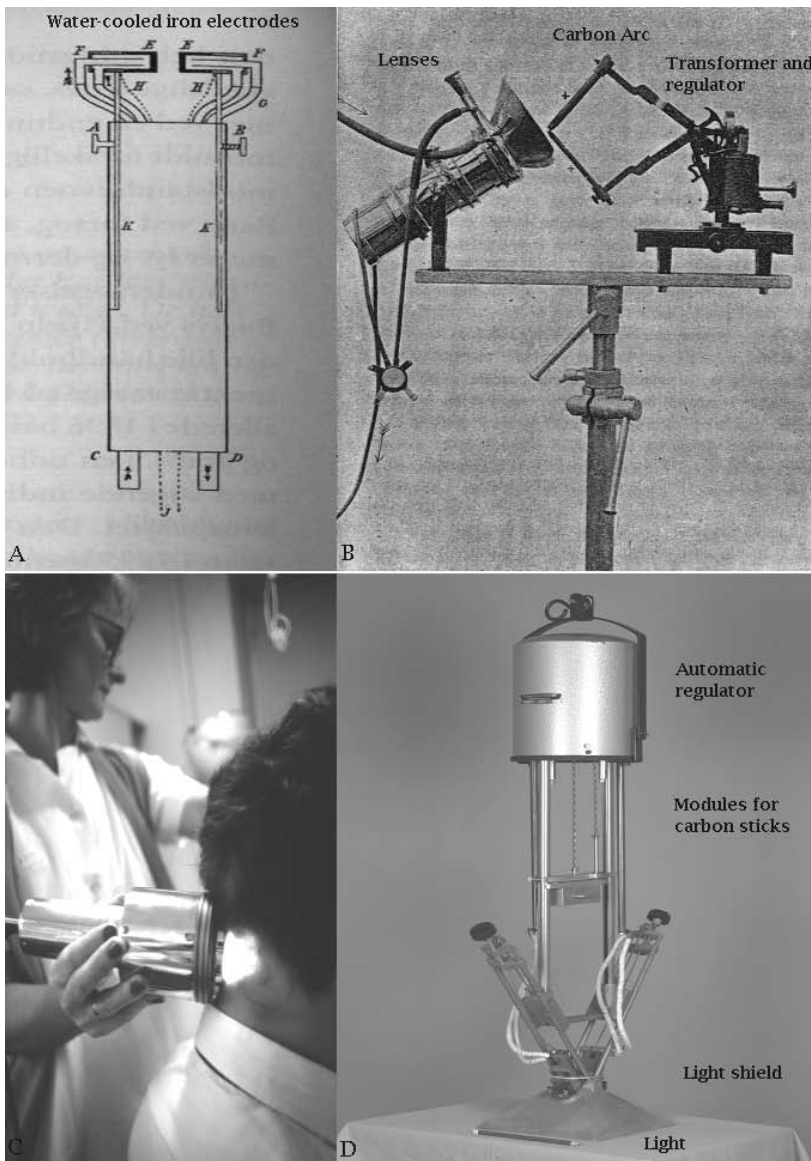


Fig. 2. Drawing of Sofus Bang's iron-lamp developed at FMLI 1901 (A), the Finsen-Reyn lamp developed at FMLI in 1902 (B), the Kromayer lamp developed by Ernst Kromayer in 1906, later hand-held model for contact treatment (C) and the carbon arc Finsen-Lomholt lamp developed at FMLI in 1928 (D). The Finsen-Lomholt lamp was hung up in the hook, seen above in the picture, with light coming out from below.

Apparently, the FMLI's acknowledgement of his lamp, was important to Kromayer.

Later that year, Dr Vilhelm Maar's study of the two lamps efficiency in the deeper parts of the skin, at

the FMLI, was published. Maar stated, that the Kromayer lamp still had enthusiastic followers, but that their numbers were decreasing (12). Furthermore, he did not comment on Kromayer's previous criticism of the studies on the Kromayer lamp,

conducted at the FMLI. Maar's study on rabbits showed that the Kromayer lamp, contrary to the Finsen-Reyn lamp, caused pain and necrosis of the skin. It apparently did not penetrate as deep into the skin as the Finsen-Reyn lamp, and did not have the same good effect. According to Maar, Kromayer himself was aware of the short depth of penetration, and to meet this problem, he had constructed a Kromayer lamp, in which the light passed through a blue filter. However, Maar's study showed that this did not strengthen the power of penetration, only weakened it. Same year (1908) the article was published in "Archiv für Dermatologie", and so the message was spread. Again, later that year, Dr Jansen from the FMLI published a German article, agreeing with Maar's results (13). Later that year, Kromayer published another article in which he complained about the lacking response to his criticism of the studies at FMLI (14). In continuation of this, he recommended that new studies should be conducted at FMLI.

Kromayer quickly responded to the FMLI criticism of his lamp, whereas the scientists at the FMLI, did not even bother to mention Kromayer's criticism of their studies. Not until 1936 did another scientist at the FMLI, Svend Lomholt, mention Kromayer's work (15). However, he still did not respond to the criticism of the studies conducted at FMLI, at that point almost 30 years earlier. Lomholt himself had in 1928 developed the Finsen-Lomholt lamp, a new and improved version of the Finsen lamp (Fig. 2d).

## **The scientific environment of the time**

The FMLI had become the model on which many new institutes for light treatment were founded all over the world, some closely connected to the mother institute in Copenhagen. As for example Queen Alexandra's Light Department for the Treatment of Lupus at the London Hospital, which was founded when the Danish Princess, and later English Queen, Alexandra, donated Finsen Carbon Arcs to the London Hospital. The English physician, James Sequeira, worked at Queen Alexandra's Light Department in London, and believed that the Finsen-Reyn lamp was superior to the Kromayer-lamp (16). Finsen lamps were also used in as far-away places as for example Berlin, Breslau, Hamburg, Cairo and New York (17).

Dr Jungmann worked under Professor Lang in Vienna, where a Finsen-room had been built in 1900, and Jungmann himself went to Copenhagen to study Finsen therapy there. He later supported Finsen in the conflict with Kromayer (18). He was very critically towards Kromayer and suggested certain improvements to the Kromayer lamp (19). Later he wrote of good results with the Finsen-Reyn lamp as well the improved Kromayer lamp, but he still stated that the results of the previous years of treatment supported the Finsen-Reyn lamp and not the Kromayer lamp (20). Also Dr Josef Jadassohn, assistant and later Professor in the Dermatologische Klinik in Breslau, was positive towards Finsen's therapy and critical toward

Kromayer's (21). The later, Dr Felix Lewandowsky, who worked under Jadassohn in Breslau, also supported Finsen at the expense of Kromayer. He noted that Kromayer's supporters were his students (22). However, he did not recognize that he himself also supported his mentor.

Other institutes had risen independently of the FMLI, as an alternative to Finsen treatment, offering other kinds of treatment. In 1913, the German physician Professor Dr Scholtz, operating from his own clinic in Königsberg (founded in 1906 and recognised as a university institute), wrote a paper, in which he preferred to use the Kromayer lamp instead of the Finsen-Reyn lamp in his own combination treatment, which consisted of a combination of Kromayer therapy, X-rays and only on rare occasions Finsen therapy (23).

## **Conclusion**

The references above prove the harsh scientific environment of the time and point to the existence of a kind of hierarchy within the scientific environment. The story of the Finsen-Reyn lamp versus the Kromayer lamp does not seem to be a relationship between equals, but more like one between brothers - the FMLI being the big brother and Kromayer a younger brother! Furthermore, analysis of the literature suggests that the ties between the individual scientists overruled any ties of nationality.

The rivalry between the Finsen-Reyn lamp and the Kromayer lamp, was not only apparent at the time of the invention of the two lamps, but continued throughout the following decades. A number of articles, books and reports prove that. Apparently not everyone agreed with the results of the FMLI. Finsen therapy as well as Kromayer therapy played a significant role in the treatment of skin-diseases, all the way up to the 60's. Kromayer's lamp worked by short wavelengths (UVC, UVB, UVA), while recent studies have shown that Finsen's lamps, first and foremost worked with UVA1 and longer wavelength (blue light) (24). As the references above show, Finsen wrote that his lamps worked with ultraviolet light and so the findings of this study contradicts Finsen's own conclusions. Despite their former dispute, we must therefore today consider the light therapy of Finsen and Kromayer as two different kinds of therapy.

## **References**

1. Roelandts R. The history of phototherapy: something new under the sun? *J Am Acad Dermatol* 2002; 6: 929-930.
2. Finsen NR. Beretning fra Finsens Medicinske Lysinstitut. *Meddelelser fra Finsens Medicinske Lysinstitut* 1900; III: 76-104.
3. Author's own translation from the Danish expression: Lyssalfer.
4. Reyn A, et al. Beretning fra Finsens Medicinske Lysinstitut for aarene 1900-1905. *Meddelelser fra Finsens Medicinske Lysinstitut* 1906; X: 105-140.
5. Finsen NR, et al. Lysbehandling ved Lupus Vulgaris. *Meddelelser fra Finsens Medicinske Lysinstitut* 1903; VI: 9-25.

6. Bang S. Eine Lampe für Lichttherapie nach einem neuen Prinzip. Deutsche Medizinische Wochenschrift 1901; 4: 681-682.
7. Lyngbye J. Lyssagen - Niels Finsen og hans team på Finseninstitutet. Copenhagen, Gyldendal 2003: 117.
8. Hessenbruch A, et al. Banishing darkness and disease, in Henry Nielsen and Keld Nielsen (eds), Neighbouring Nobel - The history of thirteen Danish Nobel Prizes. Århus, Århus Universitets Forlag 2001: 318-344. Author's own translation from Danish: Upaalidelighed eller Mangel paa Sandruelighed.
9. Forchhammer H, et al. Beretning fra Finsens Medicinske Lysinstitut for aarene 1900-1905. Meddelelser fra Finsens Medicinske Lysinstitut 1906; X: 105-140.
10. Kromayer E. Quecksilberwasserlampen zur Behandlung von Haut und Schleimhaut. Deutsche Medizinische Wochenschrift 1906; 1: 377-380.
11. Kromayer E. Die Bisherigen Erfahrungen mit der Quarzlampe. Monatshefte für Praktische Dermatologie, 1908; 46: 20-29.
12. Maar V. Finsen-Reynlampens og Kvartslampens Dybdevirkning - Festskrift ved indvielsen af Finseninstituttets Klinik for indre Sygdomme 1908. Copenhagen, O. C. Olsen & Co 1908: 49.
13. Jansen H. Histologiske Untersuchung der durch Kromayers Quecksilberlampe erregten Lichtenzündung. Archiv Dermatol Syph 1908; 9: 53-65.
14. Kromayer E. Finsen-Reyn- kontra Quartz-Lampe. Archiv Dermatol Syph 1908; 92: 169-172.
15. Lomholt S. Kortfattet Oversigt over Straalebehandling af Hudsygdomme samt over de almindeligste andre fysikalske Behandlingsmetoder. Denmark, G. E. C. Gads Forlag 1936: 3-69.
16. Sequeira JH. Seven years experience of the Finsen Treatment. The Lancet 1908; I: 715.
17. Finsen NR. Beretning fra Finsens Medicinske Lysinstitut. Meddelelser fra Finsens Medicinske Lysinstitut 1900; III; 76-104
18. Jungmann A. Klinische Ausführungen zur Kromayerschen Quecksilberquartzlampe. Archiv Dermatol Syph 1909; 97: 9-18.
19. Jungmann A. Ärztlicher bericht aus der Heilstätte für Lupusranke. Germany, K.U.K. Hof und Universitäts-Buchhändler 1911: 5.
20. Jungmann A. Prognose und Therapie der Hauttuberkulose. Strahlentherapie 1912; 1: 2-50.
21. Jadaschon J. Ueber die Behandlung der Hauttuberkulose. Med Klein 1913; 9: 1149-1153.
22. Lewandowsky F. Die Tuberkulose der Haut. Berlin, Verlag Julius Springer 1916: 246-281.
23. Scholtz B. Die Behandlung des Lupus. Z Ärztl Fortbild 1913; 7: 201.
24. Møller KI, et al. How Finsen's light cured lupus vulgaris. Photodermatol Photoimmunol Photomed 2005; 21: 118-124.