

# Image Transmission and Selenium: Adriano de Paiva and Initial Steps in the XIX Century

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Sound transmission, in the form of the telephone, was invented by Alexander Graham Bell et al. in the seventies of the XIX century. Inspired by this development, Adriano de Paiva published in 1878 the idea of the transmission of images at a distance using electricity and selenium. His proposal was based upon earlier work by Jöns Jacob Berzelius, who identified the selenium element in 1817, and of Willoughby Smith, who in 1873 identified a peculiar property of this material—its conductivity dependence upon incident light. The 1878 paper of Adriano de Paiva is the first publication proposing to benefit from the properties of selenium in order to achieve electrical image transmission at a distance and, in the words of the author, enable ubiquity—the transmission of sound and image anywhere in real time. This encyclopedia entry delves into the early steps of electrical image transmission, concisely presenting the protagonists and controversies of scientific priority, and mentioning the impact of those pioneering contributions, still mentioned today, approximately one and a half centuries later.

image transmission

selenium

television

## 1. Introduction: The Man, the Facts

Events that occurred in the second half of the XIX century concerning the initial steps of image transmission at a distance are not a minor curiosity, since the evolution of the subject led to developments, including television, that strongly contributed to the evolution of the world in the XX century. This encyclopedia entry focus on the role of a Portuguese academic, Adriano de Paiva, as a pioneer of the idea of benefiting from the light-sensitive properties of selenium in the context of image transmission at a distance.

Adriano de Paiva de Faria Leite Brandão, known in scientific circles as Adriano de Paiva, was born in Braga in 1847 and passed away in Porto in 1907. He was admitted into the Universidade de Coimbra and obtained a bachelor's degree in Mathematics in 1866 and a doctor of philosophy degree in 1868. From 1876, he was a full professor (*lente proprietário*) of Physics at the Academia Polytechnica do Porto and in 1881 he became a corresponding member of the Academia Real das Sciencias de Lisboa (ARCL). In 1877, he was created count of Campo Bello by the King of Portugal D. Luís I, and became 'Par do Reino'. He was a member of the Société Internationale des Electriciens, and a founding member of the Sociedade d'Instrucção do Porto.

After about a century and a half since the beginning of his activities at the Porto Polytechnic Academy, Adriano de Paiva is often cited as a pioneer of the idea of transmitting images remotely using selenium, which he presented in an 1878 article in the journal *O Instituto* <sup>[1]</sup>, published in Coimbra. His subsequent publications reflect his efforts to

have his scientific priority recognized, namely an 1880 article in the same journal [2], and a brochure also published in 1880 and circulated internationally [3].

The following is a reproduction from [4] of some paragraphs that describe the author's proposal, in the translation into English published as a part of [3]: "..... *the mechanism of the telescope which we predicted [..... :] A camera obscura, placed on the site of the observations, would represent in a way the ocular camera. Upon a plate at the bottom of this camera the images of exterior objects would be depicted, with their respective colors and particular accidents of illumination, affecting thus diversely the different portions of the plate. All that is wanting therefore, here, is the discovery of the method of operating the transformation, by no means impossible, of this energy absorbed by the plate, into electric currents, which should subsequently reproduce the images. ....*" ([3], pp. 45–46). And, a few paragraphs ahead, "..... *the experiments we intended to make, and which we shall still attempt to realize, consisted in the employment of selenium as the sensitive plate of the camera of the telectroscope. This body possesses the remarkable property, recently discovered, of, —when interposed in an electric circuit which passes through a galvanometer, —making the needle of the latter deviate sensibly whenever a luminous ray incides on the selenium, and this deviation varies with the color of the light. ....*". The paper of de Paiva does not include figures depicting the envisioned system, nor does the author discuss possible details of the receptor. It is, however, clear that the camera should be composed of a number of selenium elements, each one connected to an electric cable for the transmission of the respective signal. The paper finishes with the vision of ubiquity finally achieved, via the worldwide spread of such electric cables enabling image transmission between any two points.

The initial publication, in 1878, in Portuguese language and in a journal without wide circulation, limited the impact and circulation of his innovative idea. And when he sought to redress the situation by publishing the 1880 brochure [3], others had in the meantime published related ideas. Thus, the impact of de Paiva's idea was weakened. Even in Portugal, Francisco da Fonseca Benevides, despite having signed in 1881 the scientific opinion regarding the admission of Adriano de Paiva as corresponding member of the Academia Real das Sciencias de Lisboa (now Academia das Ciências de Lisboa), mentions de Paiva in [4] without acknowledging his scientific priority, and in other works related to selenium he does not mention de Paiva ([5][6]). A. Sousa Pinto redressed this situation in 1907, recognizing Paiva's scientific priority in an article on the evolution of the use of selenium in image transmission [7]. Internationally, de Paiva was mentioned by relevant figures such as Paul Nipkow in 1885 [8], and was not ignored in the USA, see, for example, the 1916 article by F. C. Brown in the *Proceedings of the Iowa Academy of Sciences* [9]. In the mid-XX century, however, he was sometimes forgotten, notably in works on the history of technology—C. Singer's (and T. Williams') monumental *A History of Technology* in 7 vols. plus consolidated indexes [10], does not mention Adriano de Paiva.

At the end of the XX century, André Lange devoted attention to Adriano de Paiva, in his very well-researched site '*Histoire de la television*' [11], making facsimiles of the main documents easily available. Lange's references to de Paiva benefited, as he explicitly acknowledges, from the inputs of Manuel Vaz Guedes, who at the Faculdade de Engenharia da Universidade do Porto (FEUP, an institution descendant of the Academia Polytechnica do Porto) had studied Adriano de Paiva's contribution in detail [12][13][14] (a site kept by FEUP collects M. Vaz Guedes' works on history of electrical engineering, focused on Portugal, <https://paginas.fe.up.pt/histel/> (accessed on 10 November

2024)). Today, it is common for de Paiva to be associated with the initial steps of long-distance image transmission, and now it is less common for this reference to be omitted, as in Ivy Roberts [\[15\]](#), though her book [\[16\]](#) includes de Paiva' 1880 brochure in an appendix listing sources.

In addition to the scientific and technical journals, newspapers were understandably interested by the novelty of image transmission. The first mention of the subject may be a visionary article in *The Sun*, a New York city newspaper, signed using the pseudonym 'Electrician', and lacking scientific underpinning [\[17\]](#). After proposals for using selenium were already public, the topic became a matter of interest for the media, and, for example, the Porto newspaper *O Commercio do Porto* included in 1879 two related articles [\[18\]](#)[\[19\]](#).

Clearly, Adriano de Paiva's proposal was a pioneering step in the direction of television. His 1878 article is occasionally associated with the 'invention of television', namely in internet blogs and other media. This description is, however, deemed inadequate by Manuel Vaz Guedes, who published an evaluative judgment resulting from a careful analysis of relevant information [\[12\]](#)[\[13\]](#), taking into account the many hurdles that had to be overtaken in subsequent decades before a moving image could finally be transmitted at a distance.

The development, in recent decades, of academic interest in media implies that the name of Adriano de Paiva also circulates in media studies, as exemplified by Doron Galili in 2020 [\[20\]](#). Another area of academic reflection that has developed in recent decades is gender studies, and references to Adriano de Paiva are also found there, notably by Sarah Arnold in 2021 [\[21\]](#).

Outside of academic environments, professor Adriano de Paiva, the first count of Campo Bello, **Figure 1**, contributed to the social life of his time, notably in several associations, and to the political life of Portugal given his status as 'Par do Reino'.



**Figure 1.** Adriano de Paiva (adapted from [\[Z\]](#)).

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