The Siemens Artificial Eye and the Commencement of Television Research

The Metropolitan Opera: Live in HD is a series of transmissions to movie theaters worldwide. It began on December 30, 2006 and is still going strong. At left is an image, shot by Peg Clifton, of the marquee of a cinema in Charlottesville, Virginia in 2009.

Without the "HD" part, the Metropolitan Opera actually began transmitting operas live to movie theaters on December 11, 1952. At right is a portion of an image of a 1952 marquee from the Metropolitan Opera Archives.

When was the idea of transmitting operas live—pictures and sounds—first proposed? It was no later than 1877. On March 30 of that year, *The Sun* in New York City published a letter by someone using the pen name "Electrician." The letter described a television-like device called an "electroscope" (unrelated to the charge-indicating instrument). "Both telephone and electroscope," Electrician wrote, "applied on a large scale would render it possible to represent at one time on a hundred stages in various parts of the world the opera or play sung or acted in any given theatre."

It's not just opera television. Today's era of solid-state image sensors and flat-panel TVs was preceded by the era of camera tubes and picture tubes, which was preceded by the era of mechanical television. Before even that there were experiments and proposals. The word *television* was coined in 1900 to describe them all. A letter (below) published in *English Mechanic and World of Science* on February 7, 1879 even claimed success "in transmitting built-up images of very simple luminous objects."

AN ELECTRIC TELESCOPE.

[15374.]—It may be of interest to your readers to know the details of some experiments on which I have been engaged during the last three months, with the object of transmitting a luminous image by electricity.

To transmit light alone all that is required is a battery circuit with a piece of selenium introduced at the transmitting end, the resistance of which falling as it is exposed to light increases the strength of the current, and renders a piece of platinum incandescent at the receiving end thus reproducing the light at the distant station.

By using a number of circuits, each containing selenium and platinum arranged at each end, just as the rods and cones are in the retina, the selenium end being exposed in a camera, I have succeeded in transmitting built-up images of very simple luminous objects.

An attempt to reproduce images with a single circuit failed through the selenium requiring some time to recover its resistance. The principle adopted was that of the copying telegraph, namely, giving both the platinum and selenium a rapid synchronous movement of a complicated nature, so that every portion of the image of the lens should act on the circuit ten times in a second, in which case the image would be formed just as a rapidly-whirled stick forms a circle of fire. Though unsuccessful in the latter experiment, I do not despair of yet accomplishing my object as I am at present on the track of a more suitable substance than selenium.

Denis D. Redmond.

Belmont Lodge, Sandford, Dublin.

Redmond's letter indicates he began work in 1878. Respondents to his letter indicated that they had had similar ideas. One, Frederick Glew, wrote "that this subject has occupied my attention since October, 1877...." He was not alone in reporting on television work in that year.

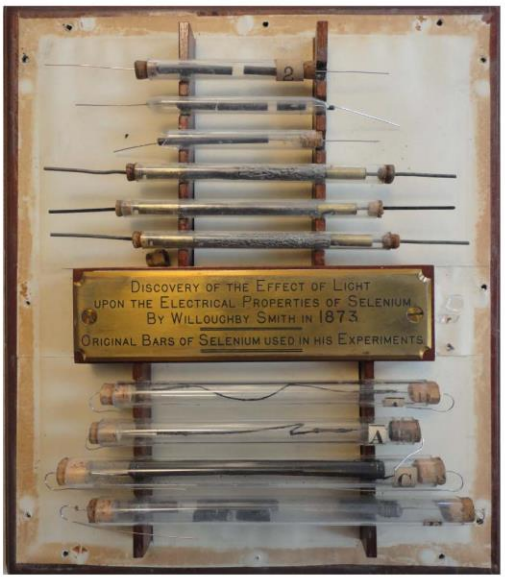
A witnessed page of a notebook of George R. Carey indicates that he started work on television in January 1877. William Sawyer told *Scientific American,* in "Seeing by Electricity," published on June 12, 1880, that he had witnesses to 1877 work,

too: "Early in the fall of 1877, the principles and even the apparatus for rendering visible objects at a distance through a single telegraphic wire were described at No. 21 Cortlandt Street, in this city, to James G. Smith, Esq., formerly superintendent of the Atlantic and Pacific Telegraph Company, I believe, and Messrs. Shaw and Baldwin, telegraph constructors, also, I believe, now connected with the Continental." *Scientific American Supplement,* on April 9, 1881, in a story by Constantin Senlecq about his "télectroscope," said it "was invented in the early part of 1877...."

Carey, Glew, Sawyer, and Senlecq all wrote later that their work had started in 1877. Adriano de Paiva, in an article dated February 20 published in *O Instituto* in Portugal in 1878, beat the others' publication dates, and historian George Shiers, in "Historical Notes on Television Before 1900," in the *SMPTE Journal* in March 1977, gave 1877 to de Paiva, too, "by inference" (i.e., that the work he reported in February must have started the previous year). And, in its December 14, 1877 issue, *English Mechanic* printed a letter by John Cammack, in which he wrote, "Amongst the wonders yet to be accomplished, and which are, in my opinion, within the scope of such powerful minds as those of Professors Thomson, Marey, Tyndall, &c., are the reproduction of written characters, and, indeed, of any possible motion, at any distance—say, across the Atlantic, and of light at a distance."

So five inventors reportedly began work on television in 1877, and at least two people more (Electrician and Cammack) commented on it that year. There has been no year since then without some discussion of television. Before 1877, however, there was nothing—not even a hoax, spoof, cartoon, fantasy, or other fiction. Why the sudden change?

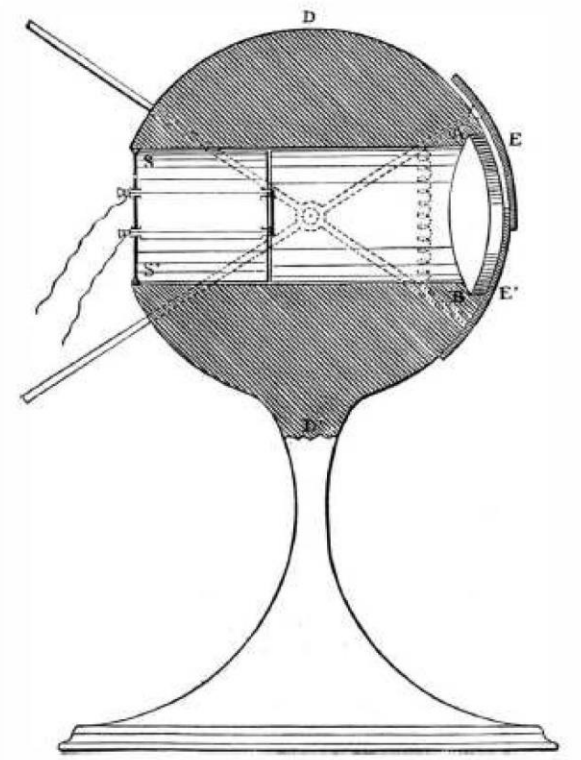
One reason for the interest in television was almost certainly the success of Bell's telephone the previous year. As Louis Figuier wrote on the subject in his *L'année scientifique et industrielle* [The Scientific and Industrial Annual] for 1877, "Le télectroscope serait à la vision ce que le téléphone est à l'ouïe" [The telectroscope is to vision as the telephone is to hearing]. But there was another reason, too: William Siemens's "artificial eye." Carey cited a December 1876 report on it as his direct inspiration. Figuier, de Paiva, and Senlecq all mentioned it, too, as did a later researcher, Carlo Perosino.



Many people are familiar with the discovery of the photoconductivity of selenium by Joseph May and Willoughby Smith in 1872, the experiments that proved it, and the reporting of it to the Society of Telegraph Engineers early in 1873. That society's successor, the Institution of Engineering and Technology, still has the same selenium resistors (shown at left) in its archive. But that wasn't the first time someone had published information on the effects of light on electrical circuits; Edmond Becquerel reported it multiple times in 1839 in important journals in both France and Germany (and, strangely, didn't seem to think of applying it to image transmission even when he was later involved in the demonstration of a so-called "copying telegraph," what we might today call a fax machine).

Smith vigorously defended his 1873 report on the photoconductivity of selenium, leading to many researchers (Adams, Day, Draper, Gordon, Moss, Obach, Parsons, Sale) coming up with their own experiments over the next few years and publishing their results. One of those researchers was Werner Siemens, in Germany, in 1875. His brother William spoke of

Werner's work at a weekly evening meeting of the Royal Institution of Great Britain on February 18, 1876. He noted that among practical applications of the research would be a selenium-based photometer, which could measure light intensity. Then William Siemens added that he was about to demonstrate "a little apparatus which I have prepared." It was basically a photometer, but it was shaped like an eye, complete with lens and eyelids. That shape, and his calling it an "artificial eye," made what was probably the first connection between photoconductivity and vision.



Scientific American reported twice on the Siemens lecture. On May 6, 1876, an article headlined "Artificial Eyes Made Sensitive to Light" had this: "We wish we could add that it gives vision to the blind; but we cannot, though perhaps it contains a germ of promise in that direction." And, then, on December 9, 1876, an article headlined "Siemens' Sensitive Artificial Eye" provided more information, including the illustration at right, something that might be considered a single-pixel video camera.

That's what, by his own words, inspired Carey's research, and that's what was mentioned by Figuier, de Paiva, Perosino, and Senlecq. Perhaps it inspired others, too.

William Siemens based his artificial eye on his brother's photometer, and his brother's photometer, in turn, was based on Smith's report on the discovery of the photoconductivity of selenium. But, without the inspiration of the Siemens artificial eye, that discovery might have been like Becquerel's, just another interesting scientific characteristic.

It would still take roughly another half century before anyone's television work resulted in a recognizable video image of a human face, but at least the research that led to those recognizable images got started early, in 1877. William Siemens is best known for his work on steel-making furnaces, electric pyrometers, and even plant lights. To his many other achievements, we might also add inspiring the commencement of television research.

Courtesy of Mark Schubin