A Historical Vignette
“Be proud of yourself: you have a History!”

The pioneers of the sinus maxillaris diaphanoscopy (transillumination)

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Abstract. “The Pioneers of the maxillaris sinus diaphanoscopy (transillumination).” As soon as Edison’s lamp was introduced in Europe at the end of 19th century, three ENT surgeons emerged as the pioneers of maxillary sinus diaphanoscopy. Cozzolino was the first to introduce an Edison lamp through the mouth into the oropharynx to inspect the nasal fossae. Voltolini, by moving the lamp forward into the mouth, discovered the maxillary sinus diaphanoscopy. Heryng codified the clinical significance of the maxillary sinus diaphanoscopy.

Figure 1
Photo montage. On the left, diaphanoscopy of the facial sinuses from Maladies chirurgicales des fosses nasales by Bourgeois (1928). On the right, Le mois des vendanges by Magritte, the Belgian painter (1959).

Mit einer etwas kleineren Glühlampe, als diejenige ist, welche ich zur Durchleuchtung des Kehlkopjes gebrauche, kann man auch die Gesichtsknochen durchleuchten

[With a lamp that is slightly smaller than the one I use for the diaphanoscopy of the larynx, you can also transilluminate the sinuses of the face.]

R. Voltolini, 1888
Before the beginning: Edison’s lamp (Figures 1-5)

Figure 3. Part of a letter of patent awarded to Edison. In 1879, when the entire world used gas lighting, the 29-year-old Thomas Edison registered a patent for a vacuum glass bulb supplied by a low voltage electric current and containing a carbonised bamboo fibre that emitted a bright light when electrified. The bamboo was curved in a U shape, and connected to two platinum threads conducting electricity.

Figure 4. “The electric negro at Philadelphia exhibition”. At the exhibition of electricity held in Philadelphia (1884), the Edison Company presented its electric lighting system and had prospectuses distributed by a tall black man with a helmet on his head surrounded by an incandescent lamp. The lamp was connected to two conductors hidden under his garments, ending at two copper plates placed under the heels of his boots (from La Nature, 1885).
• Things really begin in Europe, ten years later: Heryng pays a tribute to Voltolini

In late 1889, in the Annales des maladies du larynx et des oreilles (volume 15, pages 736-737), the Pole Theodor Heryng published a paper he had read the same year at the Congress of Otology and Laryngology in Paris. He was the head of the laryngological service at St Roch Hospital in Warsaw, which was under Russian rule at the time. That paper was entitled “On the use of Edison’s lamp for the diagnosis of sinus empyema”.2

The following year, in January 1890, he continued with a more detailed paper “The electrical illumination of Highmore’s antrum in empyema”, marking the introduction proper of the maxillary sinus diaphanoscopy.3

However, as Heryng himself stated, the German Friedrich Voltolini from Breslau preceded him by about one year in a paper recording a lecture given on 26 October and 9 November 1888 about transillumination in the ENT field and in the rest of the body. The emphasis in ENT was primarily on the larynx and, incidentally, on the maxillary sinus: “Die Durchleuchtung des Kehlkopfes und andere Höhlen des menschlichen Körpers”.1

In his own paper, Heryng willingly acknowledged Voltolini’s pre-eminence in a passage that is a fine example of intellectual integrity. He wrote about diaphanoscopy: “... a painless method of exploration. I believe that it is now available to us because of the process developed by Voltolini recently. After using it in ten cases, I can certainly recommend it to my colleagues, as I did in my demonstration at the Medical Society of Warsaw on 19 February 1888. The credit is entirely due to Voltolini”.2

• Voltolini, a rhinologist in search of light

Professor Rudolph Voltolini from Breslau was born in 1819 and died there in 1889. He studied medicine in Breslau and then in Berlin. He devoted his time first to general medicine for a number of years.

In 1859, he perfected an oxyhydrogen lamp for illuminating the anatomical cavities. This type of lamp brought together hydrogen and oxygen obtained from water electrolysis. To create the oxyhydrogen light, it was necessary to use hydrogen and oxygen, which were stored in separate reservoirs, each of which were furnished with a pipe that ended in a jet directed at a piece of lime. The hydrogen was lit, and

Figure 5
– On the left, drawing of an “oxyhydrogen lamp with just one burner to make incandescent a cylinder of lime”, extract from a catalogue of the Charles Verdin company (1890-1895), fournisseur des laboratoires du Collège de France, de la Sorbonne, de la Faculté de Paris, du Museum et des universités et hôpitaux de France et de l’étranger. At top left, the cylinder of lime. At top right, there is the single burner; in the middle of the lamp, the two separate delivery pipes for the oxygen and the hydrogen (arrows).
– The illustration in the centre shows the Edison incandescent lamp (1878). It made a carbon thread in a vacuum bulb red-white. The two contacts at the base of the lamp are furnished with clips for two electric wires.
– On the right, a sign explaining that the room of a house is equipped with the Edison electric lighting. “Do not attempt to light with match. Simply turn key on wall by the door. The use of Electricity for lighting is in no way harmful to health and does not affect the soundness of sleep”. 
then the oxygen was introduced slowly until the lime was incandescent. Unfortunately, the risk of explosion was too great, so the oxyhydrogen lamp finally gave way to Edison’s lamp. It was this second type of lamp that Voltolini used in his description of his transillumination method.

In 1860, Voltolini was qualified in Breslau as a Privat Docent (a qualified teacher) in Laryngoscopy, Otoscopy and Rhinoscopy.

In 1868, he was appointed to Extraordinary Professor in this speciality. The chair was created especially for him on this occasion.

Voltolini also played an active part in German Protestantism; he was a delegate to the Independent Lutheran Church Synod. His father-in-law was a pastor in that same church, which had numbered, in an earlier age, Johann Sebastian Bach among its disciples.

In 1889, the year of his death, Voltolini’s obituary in the British Medical Journal declared that he was “without injustice” known as the father of rhinoscopy. The efforts he made to promote transillumination evoked here is further testimony to this, if any is needed. Voltolini was also responsible for the dissemination of a technique that was to affect subsequent generations even more: the use of galvano-cauterisation for diseases of the nose and of the larynx: “Anwendung der Galvanokaustik im Innern des Kehlkops und Schlundkopf” (Vienna, 1872).

However, his description of the nasal fossae was to appear in several subsequent papers. For example: “Die Rhinoskopie und Pharyngoskopie” (Breslau, 1879).

“Nasenpolypen und deren operation” (1880)

“Die Krankheiten der Nase und des Nasenrachenraums” (Breslau, 1888).

- The first steps taken by Voltolini in the company of the Edison lamp

The discovery of the transillumination of the maxillary sinus by Voltolini was not a random affair. It was preceded by extensive, patient and determined investigations of the effect of light on the visibility of the nasal fossae. Firstly, Voltolini used Czermak’s idea about the examination and the illumination of the larynx. He thought that it could be expanded to the examination of the nasal fossae. However, in 1879, Voltolini had not yet picked up on Edison’s discovery in the same year in the United States.

In 1879, he was still using the light of the sun directed at the external part of the nose, while examining the nasal fossae using a speculum.

Next, he directed the natural light into one of the nasal fossae, while inspecting the other side of them, allowing him to diagnose a perforation of the septum nasi.

Finally, he directed the light into both nasal fossae simultaneously while inspecting the lighted cavum nasi with an oral mirror.4,5

In 1888, as soon as the Edison lamp became available on the European market, Voltolini latched onto that new process to continue his work. He was to meet his death just one year later ...

In the beginning, his sole intention was to examine the nasal fossae from the anterior side, but lit from the cavum nasi by the famous lamp. He had made a long curved metal rod with a small lamp at the end. As pointed out above, this approach was intended for the examination of the nasal fossae only. However, Voltolini could not refrain from admiring, through the nasal fossae, the velum palate illuminated from the cavum nasi: So wie das Erglühen erfolgt, wird man staunen über die Schönen Effect, nämlich die Durchglühung des ganzen Gaumensegels bis an seinen Ansatz am harten Gaumen.

[As soon as lamp begins to glow, one is astonished by the beautiful effect produced by the transillumination of the whole velum palate as far as its attachment to the hard palate]. In this way, he succeeded in describing the structure of the tissues of the velum palate, and particularly its median raphe. He was also able to diagnose a syphilitic ulceration of the velum.4,5

- The difficulties of an examination with the electric light

Rapidly, however, Voltolini had to face several difficulties. Introducing a glowing carbon thread into the mouth of a patient was certainly not a small matter, even disregarding the risk of an electric shock:

“It is evident that, before introducing the lamp into the throat, it is important to verify first the effect of the incandescence. One needs to know how high one can raise

* In an anecdotic vein, it is worth pointing out that the oxyhydrogen light survived in the theatres under the name of “limelight” because it used Ca Carbonate (“limestone” in English), from which is derived the term les feux de la rampe in French. Gas lighting for that purpose continued until 1900.
the power of the battery, and how deeply its elements must be immersed in the solution of chrome. If this test was omitted prior to the introduction of the lamp into the throat, the possibility was present that the carbon filament in the lamp could take fire (in the patient’s throat). Once the preliminary test was performed, it was possible to introduce the unlit lamp through the throat into the naso-pharyngeal cavum, position it correctly and, only then, turn it on.5

At the end of the examination also, some precautions were required: “When withdrawing the lamp from the naso-pharyngeal cavum, you must first turn off the electric current, and then you let the lamp cool on the spot, in the cavum. Otherwise, the metallic shaft that covers the lamp and that has also heated up will burn the velum palate and the respiratory pharynx when the lamp is withdrawn from the mouth”.5

Elsewhere, Voltolini stressed the danger of an electric shock for the patient: “I put the lamp into the mouth of the patient... Then one turns on the lamp, which allows you to see the whole face as far as the eyes.

I take the opportunity to show you the effect of transillumination in a patient whose story is as follows: this is a 22-year-old moulder who suffered from a swelling of the left cheek at the level of the superior maxillary bone. He had also a swelling of the hard palate on the left side, in the anterior section of the oral cavity. At the same time, a tumour was visible in the left nasal cavity. When I examined the patient, the nasal tumour had a red, fleshy appearance. I was virtually certain that this was a sarcoma in Highmore’s antrum, which was pushing the walls of the latter in all directions. Some time previously, I had submitted a similar case to the perusal of Dr Fisher, who operated on the patient in my presence. The tumour filled the whole of the maxillary sinus, made the eye bulge, and penetrated into the left

Finally, it is worth pointing out that, in 1892, other authors such as Robertson were already complaining about the high price of electrical energy (already...): “Primary batteries would appear – at any rate in England – to be about tabooed, now that electric supply companies are so much ‘en evidence’ ... I have counted the cost and found the primary battery here represented by far less expensive than the current”.6

* A short time later, some German manufacturers were to propose, for the frontal sinus in particular, a metal shaft with a tube for irrigation during the examination.
nasal cavity... The patient operated on by Fisher was reduced to a state of the most complete marasmus. As my patient refused a resection of the kind proposed by Fisher, I treated him in another way. I used electrolysis with the aim of destroying the nasal tumour first. This being done, I wanted to see how the tumour behaved when it was transilluminated. So I introduced a smaller Edison lamp, like the one I used for the transilluminaton of the larynx, into the patient’s mouth, and I was not a little surprised and astonished to see the nose and the tumour completely transilluminated. I found it scarcely credible that I was looking at a sarcoma, because the nasal tumour had been so deeply hit by the point of my electrolytic fork; I must have pricked rapidly and vigorously. When, three days later, the patient returned to my surgery, he said that, during the previous night, something had come out of his nose and that a flow of liquid had almost flooded his bed. I now saw that the electrolysis had made such a large hole in the tumour that it was possible for me to introduce my little finger into Highmore’s antrum and to see the inside of it. It was now quite clear that I was looking at an empyema or a cyst of the sinus. The fact that the tumour let through light was now understandable: indeed, the contents of the antrum and of the supposed tumour were liquid in nature, and this lets the light pass through.”

You see here M. H. the patient, and the extent of the illumination produced by the incandescent lamp introduced into the oral cavity, lighting the whole face as far as the eyes and the nasal cavity. In fact, on the left side, the diseased part, the extent of the illumination is greater than on the right side, because there is now, on the left, a space that is pneumatised more because of the extent of Highmore’s antrum.

Moreover, you see now how the oral cavity is transilluminated through the opening that I made in the internal part of the nasal tumour, thanks to the smaller Edison lamp that I can introduce into Highmore’s antrum.

The supposed sarcoma of the nose was, in fact, the inferior turbinate of the nose, that had degenerated and been pushed forward to the opposite wall of the nasal fossa, in other words as far as the septum nasi. The turbinate had merged with this septum.1

• A paternity dispute: Vincenze Cozzolino’s protest

As early as 1889, at the congress of Paris, Vincenze Cozzolino, ENT Professor in Naples, reacted negatively in the form of a “discussion of Heryng’s communication”, claiming credit for the invention.7,8

It is a fact that, on 12 September 1888 at the congress of Otology in Brussels, Cozzolino had demonstrated his technique of “Anterior Rhino-tubo-pharyngoscopy with Posterior Lighting”; M. Cozzolino indique un procédé de rhinoscopie qui consiste à éclairer le nasopharynx au moyen d’une petite lampe à incandescence portée dans cette cavité à l’extrémité d’une tige coudée, on examine alors la cavité nasale par les procédés ordinaires de rhinoscopie antérieure. («Compte-Rendu du IVème congrès international d’Otologie, Bruxelles, 1888; séance du 12 Septembre au soir»). [Mr. Cozzolino described a rhinoscopy procedure consisting of illuminating the nasopharynx with a small incandescent lamp introduced into this cavity at the end of a bent rod, and then examining the nasal cavity with the usual methods for anterior rhinoscopy.]

This was a manœuvre that involved illuminating the cavum through the posterior part of the oral cavity and then inspecting the nasal cavities using a speculum.**

Cozzolino positioned the Edison lamp at the limit of the oro- and rhino-pharynx. He did not think to, and indeed he could not, transilluminate the maxillary sinuses in that way. It would have been necessary to position the lamp in a more forward position in the centre of the oral cavity and to look at the face! Cozzolino’s advance was to position the new Edison lamp at the back of the throat (oropharynx) and observe the results through the nose. He illuminated the nasal cavities using an artificial light source situated in the back of the throat. He did not transilluminate the facial sinuses using an intra-oral light source (Figure 7).

In 1889, Lubet-Barbon summarised the question nicely: Il semble acquis que si Cozzolino et Voltolini ont eu les premiers le mérite d’employer l’éclairage...
électrique pour explorer les fosses nasales, c’est bien à Heryng que revient l’honneur d’avoir vu que, lorsqu’il y a sinusite maxillaire, la joue du côté malade s’éclaire moins bien que celle du côté sain.

It seems clear that, although Cozzolino and Voltolini had the merit of being the first to use the electric light to explore the nasal fossae, Heryng deserves the credit for seeing that, in maxillary sinusitis, the cheek of the diseased side is illuminated less well than the cheek on the sound side.

However, Cozzolino’s ego was so great that, given the interval of 6 to 8 weeks in his favour, he stated in Paris in 1889:

Je réclame la priorité de ce moyen d’examen et cela surtout parce qu’au mois de Novembre dernier (1888), le professeur Voltolini de Breslau a fait connaître à la Société de Médecine Pratique de cette ville un mode d’exploration électrique par transparence du larynx et des autres cavités, telles que celles du nez et du pharynx nasal (not a word concerning the sinus) ... J’ai le premier fait usage et mentionné l’emploi de la lumière électrique. Voltolini n’est venu qu’après moi. [I lay claim to the discovery of this examination procedure, above all because in November of last year (1888), Professor Voltolini of Breslau informed the Society of Practical Medicine of that city of an electric exploration method involving the transparency of the larynx and other cavities such the nose and the nasal pharynx (not a word concerning the sinus)... I was the first to adopt and publish the use of the electric light. Voltolini came only after me.]

- The half-hearted initial reception for diaphanoscopy

In Vienna, the diaphanoscopy was rather poorly received. Lermoyer, in his 1894 book about ENT teaching in the Viennese hospitals, notes that people ignored the method, either deliberately or unintentionally, or even mock Heryng’s method.

It is said that the omnipotent Professor Schrötter informed Heryng that the diaphanoscopy was an “elegant childish thing”, and he wrote the same in his work published in about 1889 “Klinik der Kehlkopfkrankheiten”.

Professor Stork thought that rhinology was still a younger sister of laryngology and that it did not merit a great deal of attention.

Unfortunately, Lermoyer does not relate the views of Chiari, the
third man of the Viennese hospitals and a true rhinologist, about the method.

Zuckerkandl’s masterly work of 1895 was not a clinical one, but anatomical and pathological, and so it did not cover the diaphanoscopy.

In short, in Vienna, which was the ENT capital of the time, the reception of the technique was a fiasco.

- In Danzig (present-day Gdansk in Poland), it was totally rejected. Danzig was the capital of Western Prussia at the time and it was there that the German Konstantin Ziem (1850-1917), even as one of Voltoni’s former pupils in Breslau, proved to be a resolute opponent to the diaphanoscopy of the sinuses. He preferred to diagnose and to treat the sinusitis in one gesture by draining, rather than to lose time with transillumination, which he believed was a source of error. In 1895, Ziem expressed all his objections in a paper, the title of which shows his impatience: ‘Nochmals die Durchleuchtung der Kiefer – and Stirnhöhle’ [Once again that transillumination of the maxillary and frontal sinuses] (Monatsschrift für Ohrenheilkunde 12).

- In Wurzburg however, Professor O. Seifert, in his paper published in January 1889 in the “Sitzungberichte der Würzburger Phys. Med. Gesellschaft”, was more balanced: If I may state my judgement about the value of that method (Voltoni’s), further research will be required to prove that this approach can establish... that one can distinguish between a solid tumour of the nose and of the sinuses, and a cyst or an empyema (this was precisely the princeps case presented by Voltoni). What I can say here, is that I had the impression that this method is more than an elegant piece of childishness.

- Heryng’s sign has merited its place in posterity

Be that as it may, in spite of Voltoni’s evident merits, Heryng rightly has a pre-eminent place in the history of diaphanoscopy for two reasons: he detected Voltoni’s error of interpretation and he defined how the method should be used.

Let us read Heryng (Figures 8,9) again: It seems to me that Voltoni did not insist sufficiently on the most important symptom of the empyema, the dark mark formed by the affected side when lit by transparency; and that he confused the symptoms of the empyema with those of a cyst, which are actually different.... The tongue is pushed down firmly and the mouth is closed. Next, one makes the contact (of the current). Then the facial bones are completely illuminated as far as the orbits. In the normal condition, the light will be equally intense, and in the case of asymmetrical sinuses (ectasia, atrophy, pathological states - not specified), the intensity will vary according to the degree and the type of disease. I have already noted that, in cysts with a serous content, the light passes through easily; in solid neoplasms and in the empyema, the affected side remains dark. In double empyema, both sinuses remain dark:.

The essential has been said. From this point onwards, there will be a place for complementary signs only, which are admittedly sometimes still useful today. The time of the Distinguished Artisans of Diaphanoscopy will come. But that is another story...

On the left, the first model used by Heryng for diaphanoscopy: the electric spatula of Reiniger, made in Erlangen. It had the form of a Türck tongue depressor (one of the inventors of the laryngoscopy). The five-volt Edison lampl was attached at the top. In addition, there was a small mobile lingual plate in hardened rubber that was easily removable.

On the right, a Türck spatula in one piece to which the small Edison lamp has been attached (from Willemot J. “Birth and development of otorhinolaryngology in the history of medicine”, Acta Otorhinolaryngol Belg. 1981;35.)
References


