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The Otranto-Valona Cable and the Origins of Submarine Telegraphy in Italy

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Abstract

This work is born out of the accidental finding, in a repository of the ancient "Oliveriana Library" in the city of Pesaro (Italy), of a small mahogany box containing three specimens of a submarine telegraph cable built for the Italian government by the Henley Company of London. This cable was used to connect, by means of the telegraph, in 1864, the Ports of Otranto and Avlona (today Valona, Albania). As a scientific relic, the Oliveriana memento perfectly fits in the scene of that rich chapter of the history of long distance electrical communications known as submarine telegraphy. It is known that, thanks to the English, the issue of submarine electric communication had an impressive development in Europe from the second half of the nineteenth century on. Less known is the fact that, in this emerging technology field, Italy before unification was able to carve out a non-negligible role for itself, although primarily political. Particularly, two states took advantage of that: the House of Savoia in Piedmont and Sardinia and the House of Bourbon in Sicily and Puglia. Not having at the time, the means, the know-how and the money, but being aware of the strategic role of their own territories, the two dynamic Italian States were able to skilfully stipulate numerous agreements to lay out some underwater sections. The pacts were made mostly with France and England which had strong and driving needs to keep in contact, through the telegraph, with their colonial possessions. The House of Savoia was the first to use the new technology. Thanks to an agreement with France, in 1854 they began to lay out a submarine telegraph cable along the stretch connecting La Spezia to Corsica. After that, many more cables were laid with the active participation, besides the Sardinian States, also of the Kingdom of the Two Sicilies. This work will consider mainly the decade of 1854-1864, a period when the submarine telegraphy *business* began and developed in Italy.

Keywords

Submarine Telegraphy, Underwater Cable, Otranto, Valona

1. Introduction

Some time ago, the director of the Oliveriana Library of the city of Pesaro (Italy) asked for my help after the accidental finding, in a repository of the Library, about a small mahogany box containing three samples of a submarine telegraph cable (see Figure 1), built for the Italian government by the Henley Company of London. The director asked me to study them in order to investigate their story, which I did quickly and gladly. These cable samples were tangible witnesses that there was, in 1864, a submarine telegraph connection between the ports of the cities of Otranto and Avlona, the latter today identified with the city of Valona in Albania. This prompted me to examine the decade of 1854-1864 which, as it was known, marked the debut of submarine telegraphy in Italy. In this work I will retrace, although briefly, the events connected to the first submarine cables laid in the Mediterranean by the Sardinian States and the Kingdom of the Two Sicilies; the events which then culminated, during the Kingdom of Italy, with the laying of the Otranto-Valona cable, and it was historically remembered as the first telegraphic connection between Europe and the East.

2. The Beginnings of Submarine Telegraphy

Submarine telegraphy was born and developed at the beginning of the '50s of the Nineteenth century under the absolute supremacy of the English and of England, the only country in the world which was then able to implement this new communication technology (an above-ground telegraph cable, in terms of technology, was well different from a submarine one). They had, at the same time, strong planning skills and the availability of high-risk venture capitals[1]. As a

Figure 1. Pesaro Oliveriana Library: three pieces of the telegraphic cable used in 1864 in the submarine line Otranto-Valona. Source: by courtesy of Oliveriana Library, Pesaro.

[1]There were many unsuccessful attempts at laying the first submarine cables and a remarkable amount of capitals unravelled. In particular, we must mention the unsuccessful attempt to lay a transatlantic cable in 1858 with a loss of about 100,000 pounds from the company's shareholders and that of the Suez-Aden cable in the Red Sea, that was strategic in order to reach the Indies, attempted between 1859 and the beginning of 1860, which registered a loss of more than 160,000 pounds (Hugill, 1999: p. 39).

strong commercial and colonial expanding power, England absolutely needed to communicate both at longer distances and quickly with businessmen, countries, troops and colonies. The underwater cables, assured a quick and global communication as compared to the dilated delivering times of an average postal letter[2]. They allowed the solution of economic issues and helped to manage policies for the control of the colonial lands that could only happen through the quick dispatching of orders at a distance for public affairs and military operations. The impact of this new communication technology was extraordinary and England, which had started it, gained the greatest benefits and advantages during the whole Nineteenth century. When the English started to produce waterproof cables for underwater use, they had already developed, in the field of terrestrial telegraphy, the densest telegraph system in the world, adopting the technique of building telegraphic lines along railroads. Out of their on-the-ground experience, the English were, therefore, ahead of any other nation: they had world-class chemists, geologists, physicists, engineers and technicians to face a challenge that had been announced as much more complex and varied than terrestrial telegraphy. In the maritime and commercial field, then, they could count on a huge fleet spread out on a broad global network assuring them a continuous supply of raw materials for the industrial processing. This was also true for their monopoly of the gutta-percha, introduced in England in 1843: it was a particular natural rubber produced by trees from tropical regions, especially Malaysia and the Archipelago, which was essential for the development of the new cables as it gave the conductor, if conveniently treated[3], a long lasting and excellent isolation which prevented the electrical currents to be dispersed in the sea. These were the steps in the construction of these special cables[4]: first the core of the cord was processed by coating the conductor with one or more wrapping layers of gutta-percha[5]; next a filling consisting of a layer of tanned jute or pitched hemp was added[6]; fi-

[2]Giuntini wrote "An English merchant, prior to the implementation of the telegraph and to the opening of the Suez Canal, had to wait for six months before receiving a letter from Calcutta or Bombay. Once the telegraphic connection had been established, about 25 - 30 words per minute went through the line: [a] huge difference…" (Giuntini, 2011: p. 152).

[3]The fact that gutta-percha is thermoplastic at rather low temperatures, around 70˚C - 80˚C, allowed Werner von Siemens, in 1847, to devise a wire drawing machine which applied it hot directly on the surface of the conductor to create an insulating protective coating. This one, together with the conductor, that could generally reach a maximum of seven wires, later formed the core of the cable.

[4]After the pioneering attempts of the Siemens brothers in Germany, dating back to 1846, to isolate terrestrial telegraph cables and after Faraday's first experimental notes (Faraday, 1848: pp. 165-167) which showed the efficiency of the new insulating method, the industrial production of these special cables started in England soon after that of the terrestrial telegraph wires. The first iron and copper wires, insulated by gutta-percha casings, were produced by the London based *Gutta-Percha Company* which started its production in 1849 under the direction of the electrical engineer Willoughby Smith who, for the occasion, took advantage of appropriate machinery designed by Charles Wheatstone.

[5]Since the '60s gutta-percha, for its largest use, became very expensive and was mixed and fused together with caoutchouc coming from the tropical areas of South America. Another method was to coat the copper wires of the cables with several wraparound and alternated layers of gutta-percha and caoutchouc.

[6]This intermediate layer between gutta-percha and the metal shell avoided the corrosion of the gutta-percha itself, especially by iron.

nally the armouring phase started, that is the coating of the external surface, using a series of iron or steel wires applied in helical form to maintain the telegraphic cords with strong mechanical resistance[7]. The definitive positioning of the special marine cords implied, at the beginning, a widespread organizational line that was needed to solve remarkable technical problems such as: the sound to determine the morphology of the seabed[8], the consequent calculation of the slack[9], the transportation, the immersion of the cables through specific and equipped cable-laying ships[10], the techniques of sea repairs, up to a continuous monitoring, both from ground and from ship, of the good electrical conditions of the lead wires for the telegraphic transmissions[11]. Furthermore, knowledge of the brand new (by then) theory of signal transmission was necessary, especially in relation to the main issue of the attenuation and dispersion of the signal over long distances[12]. The presence of all these technical and scientific factors favoured the birth and development, in England, of a thriving industry, run by rich private capital companies; this industry, with an eye for business, could convey, for the whole second half of the Nineteenth century, that *know-how* of new technologies necessary to implement the submarine cords. These companies monopolised almost globally[13] both the designing/construction of the cables, and

[7]The shell consistency varied if the cable was a shore-end or a deep sea one. The shore-end cable had a much more robust and heavily armoured shell in order to resist damage from ships' anchors and prevent breakage problems, more frequent in low and rocky sea beds. There were also some issues connected to the marine fauna and particularly some corrosion problems of the shell (best protected if galvanized) and drilling problems of the jute and gutta-percha due to some crustaceans and rodent molluscs.

[8]This was a key aspect for a correct laying of the cable onto the sea bed. In general, rocky peaks had to be avoided as pivots because of the resulting formation of dangerous oscillating catenaries at the mercy of the underwater currents that could cut off the cables. Then there were whales, swordfishes, hammerhead fishes and other sea animals that could intercept the cords and cause damages. The risks were minimized when the laying was so accurate that the cable was always able to touch the seabed. The most favourable situation was when the sounded seabed was flat.

[9]The slack is the difference between the ship's journey and the total length of the cable laid on the seabed. A correct calculation of the slack avoids strong tensions, minimizes the risks of breakages and facilitates the detection of the faults as well as breakages for a quick repair.

[10]In practice this type of specialized vessel spreads only from the 70s of the Nineteenth century that is until the departure from the scene of the *Great Eastern*, the huge passenger steamer that had been turned into a cable-laying ship; it was protagonist, in 1866, of the transatlantic cable endeavour. Prior to this date brigantines, tug boats or merchant ships were used, which were modified with the addition of large basins to carry the cables and appropriate machinery for their laying.

[11]Besides the use of particularly perceptible galvanometers to verify the conductivity of the signal, the electrical measurements that were made were related to the capacity of the cable and to the resistance of the conductor and the insulating coating. Knowing these measurements along the whole laying area, and particularly their sudden variations, allowed to determine the distance from the landing posts and the damage.

[12]The problem of the delay of the transmission of electrical impulses in relevantly long submarine cables was initially discussed theoretically and experimentally by Michael Faraday. He correctly understood the functioning of a long submarine cable as an extended condenser where the central conductor acted as an internal shell and the metallic coating-together with sea water, both conductors-as an external shell. Only later on did William Thomson tackle and solve the complex theoretical and experimental problems of the low-frequency impulses inherent to submarine telegraphic transmission.

[13]Consider that in 1900 72% of the about 190,000 miles of submarine cables in the world belonged to English companies (Harding & Constantine, 1992: p. 16).

their equally important laying and maintenance[14]. The first attempt to lay a telegraphic cable[15] between England and France dates back to 1850, between Dover and Calais (see **Figure 2**), over a distance of about 30 km. The attempt failed because the cable was cut by a fishing boat's anchor. The following year the laying was successful (see **Figure 3**) and for the occasion the first submarine cable company was founded, the *Submarine Telegraph Company*[16] of the brothers Jacob and John Watkins Brett, engineers from Bristol. Between 1851 and 1857 the connections between England and the coastal countries increased in number: the English cables reached Ireland, Belgium, Holland and Denmark. At the same time, other countries started to connect: Sweden with Denmark in 1854, Constantinople with Verna in Crimea in 1855, the island of Kronštadt with St. Petersburg in 1856. In 1857 the adventure of the transatlantic cable laying began, which was to connect Ireland to the Island of Newfoundland and therefore Europe to America for a total distance of about 4000 km of cable. After many failed attempts, huge amounts of capital lost, alleged boycotting and other events, the definitive cable connection between the Old World and the New World succeeded only in 1866[17].

3. Submarine Telegraphy in Italy

In 1850 the English started addressing their already large terrestrial telegraphic know-how towards the much more complex submarine telegraphy; in Italy, just three years earlier, in the Grand Duchy of Tuscany, the first telegraphic terrestrial line along the Leopolda railway line between Livorno and Pisa had been inaugurated[18]. How backward our Country was in the technical and scientific field was more than evident. Apart from the Italian physicist Carlo Matteucci, few other people could boast a deep knowledge of the terrestrial telegraphic practices and techniques of pre-unified Italy, like for example the engineer Gaetano Bonelli[19], from 1853 General Director of the Electrical Telegraphs of the Sardinian State. The field of the brand new underwater telegraphy was even more

[14]This aspect too, together with the others, had a considerable weight in the flourishing market of submarine telegraphy. For most of the Nineteenth century, the English remained unsurpassable masters in repairing and implementing submarine cables.

[15]This first cable was not an armoured cable, it just had the gutta-percha coating covering up the copper wire.

[16]In 1858 this famous company became the *Atlantic Telegraph Company*, the great protagonist of the transatlantic cable endeavour.

[17]In literature we can find many reconstructions of this titanic endeavour. In Italy a quick and concise reconstruction is the one made by Franco Soresini (2001: p. 3-79).

[18]The author of this first line and, generally, of the introduction of terrestrial telegraphy into Italy was Carlo Matteucci (1811-1868), physicist and politician of significant value, who had already begun to be interested in telegraphic transmissions since 1844. Appointed by Leopoldo II, as early as 1846, director of the electric telegraphs of Tuscany, Matteucci was the author, in Italy, of one of the very first electrical telegraphy manuals (Matteucci, 1850: pp. 1-205). In 1860 he was appointed Senator and General Inspector of the telegraph lines of the Kingdom of Sardinia.

[19]By the Milan born engineer Bonelli (1815-1867), emigrated to Turin in 1848, we remember the *alarm telegraph* (1855) which allowed the driver of a moving train to be continually in touch with the stations (the first experiments took place between Turin and Moncalieri in 1856) and the *telegraph compositor*, an equipment that was able to transmit original dispatches, printed and autographed, at a distance, at telegraphic speed.

Figure 2. 28 August 1850. First attempt of laying the submarine cable between Dover and Calais by the steam tug Goliath, escorted by the government surveying vessel HMS Widgeon. Source: (Figuier, 1868: p. 189).

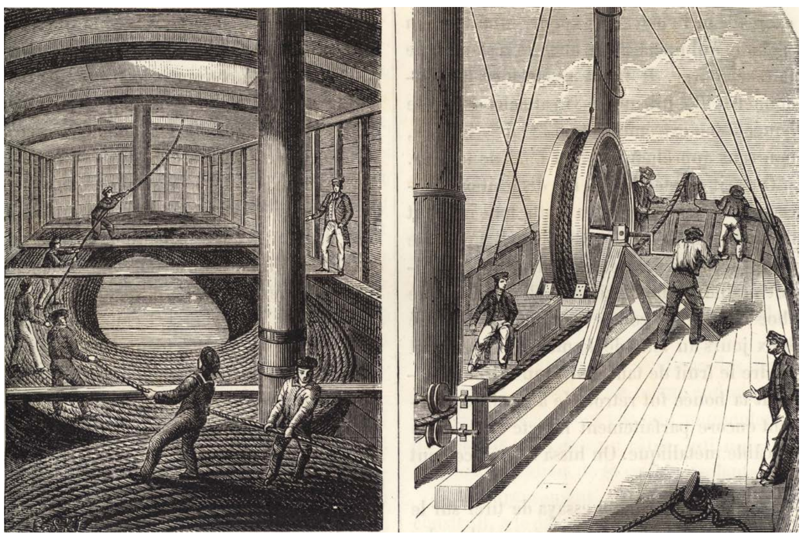

Figure 3. 25 December 1851. Laying of the submarine cable between Dover and Calais. Winding and unwinding of the submarine cable respectively in the hold and aboard of the cable-layer ship Blazer. Source: (Figuier, 1868: p. 191).

neglected, apart from some theoretical writings by some Italian scientists[20], and was mainly coming from England. However, because of its geographical outline which made it completely strategic along any route in the Mediterranean area, Italy could play a prominent political role in the laying of the first pre-unitary cables in the Mediterranean, a role that remained like that, for some years, even

[20]Among these we remember a communication by Francesco Zantedeschi, written together with Adolphe Quetelet (Zantedeschi-Quetelet, 1869: pp. 1-7), and by Macedonio Melloni, as well as some letters with Faraday (1854) and a note on the underground and underwater telegraphic conductors (Melloni, 1854).

after the unification[21]. Notably, the strong colonial interests of England and France, that had some privileged routes in the Mediterranean to reach their possessions, pushed these countries to ask Italy to sign many agreements to lay underwater cables. Thanks to their strategic positions, two pre-unitary States benefited the most: the House of Savoy in the Kingdom of Sardinia and the Bourbons in the Kingdom of the Two Sicilies. The former would allow France to reach Algeria[22] through Sardinia; the latter to reach Malta[23] and the Indies[24]. At first these favourable conditions gave the two Italian States enormous profits from the transit charges of the English and French dispatches towards their colonies; but then things worsened dramatically around 1870, when France and England did not need to pass through foreign territories anymore: they were able to build submarine stretches straight to their colonial possessions[25], eliminating, in fact, all the commercial advantages that had been gradually accumulating with the laying of the first pre-unitary submarine telegraph lines.

4. The First Cable in the Mediterranean

In Italy, thanks to an agreement between France and the Piedmont Government, the laying of the first submarine telegraph cable in the Mediterranean area took place in 1854, to connect La Spezia to Corsica. John Watkins Brett, the person who had completed the first connection between England and France (1851), expressly created an Anglo-French company[26], a joint stock, whose original purpose was to connect France and England to Algeria and the Indies, respectively[27]. To implement these projects and reach the Northern African coastlines all the way to Bona (today Annaba, Algeria), Brett's company had to stipulate two agreements, respectively, with the French State and with the Savoy Kingdom, for the construction of a mixed route of terrestrial and submarine telegra-

[21]An element that cannot be overlooked, which helped Italy maintain this role was the incapacity, in this period, to solve technical problems related to laying in very deep and long stretches of water. These problems were in great part fixed after the success, in 1866, of the laying of the transatlantic cable; but it is indisputable that, since the failed attempt of 1854 to connect Sardinia to Malta, the English intentions to become autonomous in the Mediterranean by laying long and demanding cables were greatly scaled down. Striking examples were the failure in laying the transatlantic cable in 1858 and the Suez-Aden cable in the Red Sea, in the years 1859-60 (hinted at in footnote 1). This latter, made by the *Red Sea and India Telegraph Company*, turned out to be for the English a technical and economic disaster of great proportions.

[22]The French colonization of Algeria began in 1830 and continued for more than 132 years.

[23]Since 1800, under the English protectorate, and 1814 as part of the British Empire, for its position halfway between Gibraltar and the Suez Canal, Malta had played an exceptional role in the Mediterranean theatre for the English colonial politics, especially as an outpost to access the Western Indies.

[24]As we will see, by the end of 1859, the Bourbons and the Ottoman Turks started to connect their territories via a submarine cable along the Otranto canal in the Adriatic Sea; the Ottoman government committed to build three great terrestrial telegraphic lines, one of which was directed towards the Indies.

[25]In 1870 the French were able to connect directly with Algeria through the submarine cable Marseille-Bona. In the same year the English became autonomous for the construction of two very important submarine stretches: the Falmouth-Gibraltar-Malta (1869) and the Suez-Bombay (1870) which, linked to the new stretch Malta-Alexandria of Egypt (1868), directly connected England to India without crossing foreign lands and so without having to pay any transit charge.

[26]It was the *Compagnie du télégraphe électrique sous-marin de la Méditerranée pour la Correspondance avec l'Algérie et les Indes*.

[27]Which never happened.

phy capable of connecting the continent to the southern coast of Sardinia and then, through an underwater cord, to the Algerian coast. In detail the telegraphic route was organized like this: it started from Genoa, by then already connected to France, in order to reach a place in the gulf of La Spezia (the mouthof the river Magra near the small Fortress of *Santa Croce*); then, through a submarine cord, it reached *Cap Corso*, in the north of Corsica; then it crossed the island until the *Bocche di Bonifacio* and again, through a second underwater cord, Corsica was connected to Sardinia. Finally, starting from Santa Teresa, it crossed Sardinia along a route that passed through Gallura up to *Tempio Pausania* and then to Sassari, Macomer, Oristano and Cagliari (in the area of the port) until it reached *Capo Teulada*[28], the final support station for the submarine cable that had to be laid towards the African coast (see **Figure 4**). In the agreement with Piedmont, Brett committed to building the whole connection within eighteen months since the agreement passed into law[29] including the terrestrial stretches[30] and the laying of three submarine ones-"at his own expenses and risk" and to providing the whole maintenance of the lines. Moreover, for the La Spezia-Cagliari stretch, Brett, again at his own expenses, committed to leaving the management of the operations to the Director of the Electric Telegraphs of the Sardinian Government, and to implanting, "in addition to the wires for his own uses, two specific wires available exclusively to the Sardinian government"[31]. In financial terms, the House of Savoy gave Brett usufruct of the station for fifty years[32] and an annual income of 5% on the capital employed by the Company for the whole work, which added up to 120,000 pounds, equal to "three millions of new liras of Piedmont"[33].

[28]As we will see, Brett later decided to move this station to Capo di Spartivento.

[29]The agreement, stipulated on 5th February 1853, was approved and was passed into law by the Piedmont Government on 19th March 1853 (Bellono, 1853: pp. 179-186).

[30]As for the materials, from a test report written in 1858, we learn that the telegraphic wires were made of iron of "first rate quality, number eight, 4-millimetre thick and duly galvanized"; the poles had been, for the most part, injected with copper sulphate and the insulation, although simple, was "sufficient to guarantee it, because it had been done with extreme care".

[31]To complete the work, in the agreement with the French Government, Brett included the request to let two wires for exclusive use of the Sardinian Government pass through Corsica (the same thing was requested by the French with the passage of two wires along Sardinia for their exclusive use). This way Piedmont reserved the right to maintain the control of their own lines and of the dispatches flow on the whole stretch; part of these dispatches-the government's and the telegraph administrative ones-had to be exempted from transit charges. Moreover, at their own discretion, they could put up any intermediate telegraph station and any side branch needed "for the internal service of the island of Sardinia". The works were slow and the two wires became effective in Sardinia only at the half of 1855, in time though to give a very useful service to the island on the occasion of the outburst, that year, of a cholera epidemic.

[32]After this period the whole line, terrestrial and submarine (with the exclusion of the terrestrial stretch in Corsica), became property of the Sardinian State. Later on things went differently. Due to the bankruptcy of the *Mediterranean Extension Telegraph Company*, in 1870 the Government of the Kingdom of Italy bought the whole Sardinian telegraph equipment from the bankrupt company, for an amount equal to 110,000 Italian liras (Gazzetta Ufficiale del Regno d'Italia, 1870: p. 1).

[33]The financial commitment was heavy, but the Sardinian Government counted on increasing the dispatch flow and amortizing the agreed payment of 150,000 liras per year to Brett's Company as a guarantee of the invested capital, thanks to the activation of the whole line towards Africa and the Indies, as well as to Malta. This in fact did not happen because of the many difficulties the Company had to face to connect Sardinia to the African coast and to Malta.

Figure 4. The telegraph line established in 1854 between the Sardinian States and Algeria. Source: (Marzolla, 1857).

The works began in 1853 but soon some problems arose while building the telegraphic stretch Cagliari-Capo Teulada because of the not so-good "technical and economic situation of that part of the island"; so Brett asked France and the Sardinian Government to move the last station from *Capo Teulada* to *Capo di Spartivento*[34]. By virtue of this new decision, which delayed the end of the works from the initial 19th September to the end of December 1854[35], on 17th February 1854 a second convention was stipulated[36], which completed and changed the one passed into law on 19th March 1853. The first laying of La Spezia-Cap Corso, of about 120 km, took place on 20th July 1854 by means of the English vessel *Persian* and ended after four days. For the occasion, a six-conductor wire was selected[37], built by *Kuper & Co.* at Greenwich. The wires, positioned in a circle, were covered by layers of gutta-percha and surrounded by tarred hemp; everything was then armoured by 12 iron wires (7 mm in diameter) wrapped in a coil for a total weight of 800 tons (see **Figure 5**). A few days later, the 15-km laying along the *Bocche di Bonifacio* was successfully completed. These two submarine cables worked well until 1864, then some damages compromised their functioning. More complex and troubled was the laying of the third cable, between *Capo Spartivento* and Bona, in Algeria, for a distance of about 200 km. There were three attempts, the first two, under Brett's direction, failed, the last one was

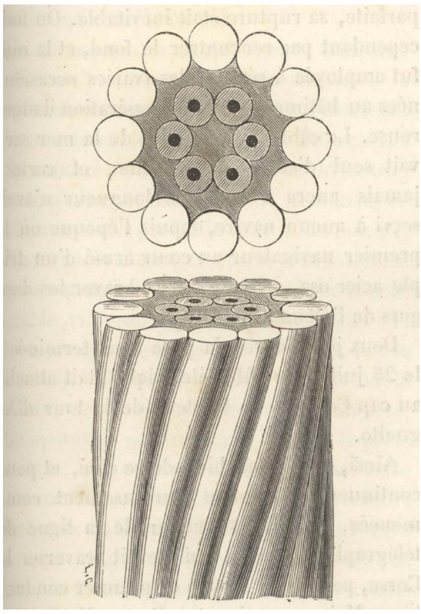

Figure 5. 1854 cable used for the connection between Piedmont and Corsica. The cable core had six insulated wire conductors enclosed in a protective twelve-iron armouring wires. Source: (Figuier, 1868: p. 205).

[34]Following this change, the whole Sardinian line, from Santa Teresa up to Capo Spartivento, became 371 km long.

[35]Actually the line started to work again only in April 1855, and the definitive test of the whole line, required by the Sardinian Government, took place in January and February 1857 and had a positive result.

[36]This latter agreement was followed, in the later years, by many others whose purpose was to set and point out several issues, mainly the rules for the construction of new terrestrial and submarine telegraphic stretches, for the operation, maintenance and custody of the whole telegraph line, and also to determine the interests accumulated by the Company out of defaults, interruptions of service etc.

[37]This cable was tested in England and Charles Wheatstone made a lot of experiments with it. The results were presented to the *Royal Institution* and published in 1855 (Wheatstone, 1855: pp. 328-333).

successful. The first laying, from Spartivento, began on 25th September 1855. The *Result* was chosen as cable-laying ship: it was a sailing boat, dragged by the French steamer *Le Tartare*, with about 230 km of cable on board, for a total weight of little more than 1500 tons. This choice was not a great one, since the vessel was not that manoeuvrable and this caused many problems when the cable was laid. Another great difficulty was due to the remarkable depth of that stretch of sea, which could be 2800 - 3200 meters deep. This problem came up on the second day, 40 miles away from Cagliari. In that stretch of sea the cable, which had reached a depth of 1640 meters, speeded up in a way that the machines were not able to stop and so it snapped. A second attempt was made the following year, on 6th August 1856. It went as bad, but that time a much lighter four-conductor depth cable was used: it displayed a very interesting technical variation which had already been experimented in 1855 by Charles William Siemens. This variation consisted in replacing the traditional single copper wire with four flexible small cords that were less subject to breakage, each one made of 4 copper wires woven and covered by two 5.5 mm-thin layers of gutta-percha that were "maybe the slightest thickness of gutta-percha ever used in submarine cables" (Jona, 1896: p. 15). The four small cords were then wrapped in tarred hemp and covered in an armour of 18 iron wires for the cable used at sea and an armour of 12 thicker iron wires-for the one used on the coast. In September 1857, the laying was attempted for the third time. The significant criticism received for the waste of money of the two previous failed attempts, prompted Brett to contract the whole operation out to a third party and to plan it with extreme care. This time, as for the laying, they decided to reverse the route, from Algeria towards the Sardinian coast. As a starting point they chose *Cap de Garde*, a small Tunisian town close to Bona, where a temporary telegraphic station was set up inside *Fort Génois*, a fortress by the edge of the cliff, built in ancient times by the Genovese to protect their coral fishery. Brett subcontracted the English company *Newall* & *Co.* of the Scottish engineer Robert Stirling Newall and his partner Charles Liddell, railroad engineer, both for the construction of the cable, which was made up of four small cords armoured with iron wires[38], and the laying operation, which, of course, had to be "at his own risk and peril". Moreover Mr. Brett and Mr. Newall set up a telegraph station on board of one of the very first vessels specifically designed to transport and lay submarine cables, the English cable-laying ship *Elba*[39]. The staff of German telegraph operators was guided by the engineer Werner von Siemens, director of the Prussian telegraphs and one of the pioneers of submarine telegraphy. Siemens and his staff had to

[38]The structure of the cable was the same of the one used in the second attempt.

[39]It was a propeller-driven cargo ship of about 1000 tonnages. It was made and soon used by Newall in 1855 to lay a cable between Varna and Balaklava. The cargo ship has a state of the art system, created by Newall in 1853, to drive the cable out of the basin (see **Figure 6**). The mechanism was made of a central cone where there was, as a skein, the underwater cord and by a series of coaxial rings with a decreasing diameter from bottom to top, and which could be adapted, with a telescopic movement, to the skein height (Wilkinson, 1908: p. 294, pp. 298-299). The *Elba* had also a powerful ribbon brake that could be activated manually, particularly apt for deep-sea laying. The presence of Werner Siemens on this vessel made it possible to equip it, following his advice, with a dynamometer to measure the cable tension.

supervise the instrumental operations and especially test, moment by moment, during the crossing, the insulation of the cable[40] which was constantly in communication with the *Fort Génois* station. Dragged by the Sardinian steamer *Monzambano*, the *Elba* set sail on 7th September from *Cap de Garde*, escorted by two warships, the French steam frigate *Brandon* and the Sardinian corvette *Ichnusa*, heading to *Capo Spartivento*. On the *Elba*, besides Siemens, Newall, Liddell and Brett, there were two boards in order to check the operations, a French board, led by the French engineers Delamarch and Brainville, and the other of the *House of Savoy*, led by Cavalier Bonelli, director of the Sardinian telegraphs. Two days later, when the *Elba* reached the Sardinian coast, Newall realized that, due to the great depths, there was not enough rope on board to reach *Capo Spartivento*. Following Bonelli and Siemens's advice, Newall and Liddell decided to go on towards *Capo Teulada* with a lighter single-conductor cable, but, about two miles from the coast, the cable broke off. They then decided to wait for a new cable to come from England for some more weeks; the cable arrived on time and so the laying was successfully completed on 30th October 1857[41] at a location close to *Capo Spartivento*. This connection did not last long and never worked well[42] In 1860, there was an attempt to pull out the cable[43] hoping to find out the breakage and fix it, but that operation failed. On November 1860, it was already not working and it was never reactivated again (Galletti & Trompeo, 1862: p. 626).

5. The Bourbons' First Cables

1857 also marked the beginning in India with a series of uprisings and hostile acts against the *British East India Company* and the English colonial power, which went down in history as *the Sepoy Mutiny* or India's first war of Independence. These events compelled the English to locate a quick and efficient means of communication, in order to get in touch with their main Asian colony. The telegraph turned out to be the most appropriate way to have a conversation and issue orders at a distance; in order to reach the Persian Gulf, the English necessarily had to cross the Mediterranean, since they would not pass through the lands of the Ottoman Empire as it was then considered politically unreliable. They needed to identify a short route to reach Malta first, then design a cable which, through Alexandria in Egypt and Suez, reached the Red Sea, and finally

[40]On the Elba there were 350 tons of deep-sea cable, with a 25 mm diameter, and a coastal cable, 20mm. diameter. According to Jona "Siemens even measured the time the current took to propagate from one end to the other of the cable, and studied the effects of induction among the different wires" (Jona, 1896: p. 16).

[41]For a detailed reconstruction of this laying, check the following reports: (Giornale delle Strade Ferrate, 1857: pp. 238-239. This is a summary of a wider account by Bonelli); (Ailhaud, 1858: pp. 209-219). This is a detailed description by the inspector of the French telegraph lines, Monsieur François Ailhaud); (The Railway News and Joint-Stock Journal, 1864: p. 19).

[42]As soon as the laying was over, Siemens realized that two of the four wires did not carry the signal. In about a couple of years also the other two failed.

[43]The attempt was made by Fleeming Jenkin. He pulled out 75 miles of cable, half of which was by the African coast and half by the Sardinian side.

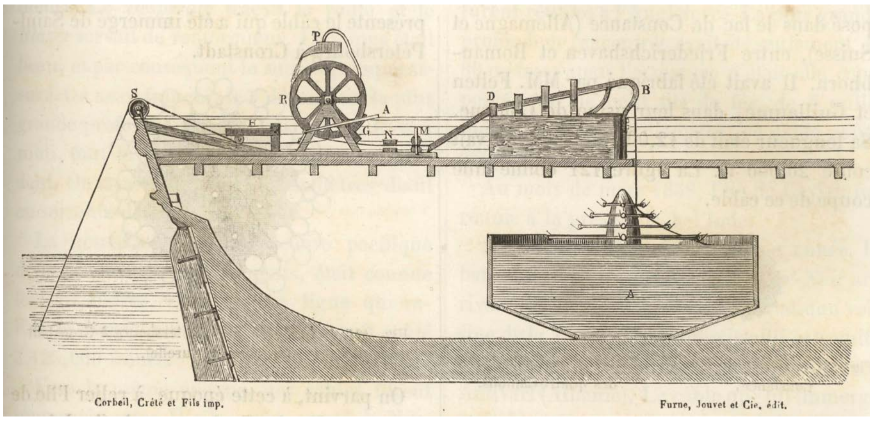

Figure 6. Outline of the immersion system in the cableship Elba for the laying, in 1857, of the cable between Algeria and Sardinia, (see note 39). Source: (Blavier, 1874: p. 111).

Aden[44] up to Karachi and Bombay. The English, already in 1857, had tried to reach Malta through the new connection France-Sardinia implemented by Brett's company. Brett himself was asked to lay a submarine cable between Sardinia and Malta, but this endeavour, contracted out to the *Newall* & *Co*, was anything but easy due to its long stretch, about 930 km, and the depth of the sea. The cable only worked for a little longer than two years, so in 1859[45] Malta was isolated again. This is when the Bourbons cleverly took advantage of the British colonial needs: they were aware of the strategic geographic role of their dominions, and hoped to cash in rich earnings from the transit charges; so they facilitated the flow of telegraphic dispatches towards the East. At first the idea was to intercept the huge flow of British mail to and from the Asian colonies, exploiting the direction that was going through the Italian ridge, straight to the Persian Gulf and which saw Malta as the closest outpost to the Sicilian coasts. Later, thanks to a political agreement with the Ottoman Empire, the Bourbons opened a new flow of mail further eastwards, towards the Indies, on an overall shorter, mostly terrestrial route. These strategies started to become effective only at the beginning of 1858 when, with the development of the telegraph system in Sicily, began a year earlier[46], there was the need to connect Calabria to Sicily and, therefore, the latter to Europe through a submarine cord. During that year, thanks to the determined work of Jacopo Bozza, a valuable entrepreneur and technician who had won the tender for the whole Sicilian telegraphic network[47],

[44]To support the Suez-Aden cable project, started in 1858, the Red Sea Telegraph Company was set up, supported by the English Government. The idea was to reach India through the Red Sea. Werner Siemens, of the Siemens et Halske, took part in the laying to check out the electrical part, in the years 1859-60. The project turned out to be a technical and financial disaster: pretty soon the cable did not work and the losses, as already mentioned, were huge.

[45]On 23rd March 1859 an Australian newspaper, *The Argus*, announced that the telegraphic transmissions between Sardinia and Malta had ceased.

[46]In the Kingdom of the Two Sicilies the first electro-telegraphic line was Naples-Gaeta, inaugurated in July 1852. Later the Bourbon telegraphic network developed towards north until Terracina, the junction with the papal telegraphic network, and especially towards south, in the direction of Puglia and Calabria. The Naples-Reggio Calabria connection became operational only in 1856. The following year the telegraphic service started in Sicily as well.

two cables were laid along the canal of Sicily which, among breakages and repairs, lasted until November 1860. Both were assigned to Bozza and it is a wonder how for some months they were even successful[48] since submarine cable laying was then a complex practice only the English had the operational monopoly of, together with a full and efficient technical know-how. The first laying along the Reggio-Messina Strait was in January 1858, between the *site of the Church of Cannitello* (Reggio) and the *second tower of Ganzirri* (Messina) for a route of about 3 km. For the purpose, Bozza used a submarine cable that had previously been purchased in London by the Bourbon Government as early as 1855, and which had remained in the warehouse of the Arsenal of Naples waiting for its profitable use[49]. The connection worked for 9 months, then it was repaired, but, in April 1860, it broke down again and was abandoned. There was a second laying on 2nd June 1858 on a longer cross route connecting the *Cittadella* of Messina to the *new fort* in Reggio for a total distance of about 11 km. Bozza had purchased the single conductor hawser, about 20km long, in England by the *Glass, Elliot & Company*[50]. It worked until November 1860, then it was abandoned[51] and, until 10th April 1861[52], they went back to crossing the strait by boat. Meanwhile, the project of the telegraphic cord in the strait and the works of the Sicilian telegraphic system along the coastal stretch of the island had convinced the English and Neapolitan Governments to negotiate, since the half of 1857, the possibility to lay a submarine cable between Malta and the Eastern coast of Sicily to connect the small island to the Continent and to England. A first mediation, started by Giovanni de Normann[53], was not successful and the submarine cable

[47]The telegraphic route was made along the whole coast of the island. The works started in the first months of 1857 and by the end of that year the network was almost completed. The dispatches from all working stations arrived in Messina from where they were sent to Reggio by boat.

[48]Bozza carefully prepared both operations. He had to turn the warship brigantine "Principe Carlo" into a cable-laying ship, and anticipated all the expenses "at his own risk and cost". The two laying operations were carefully monitored by a board of the University of Naples, appointed by the Government, made up of Luigi Palmieri, Giuliano Giordano and Raffaele Napoli. The board had to control the successful result of all the laying operations and to draw the final reports to certify the amount of money to refund Bozza.

[49]This was a cable with three conductors, about 4 miles long, quite heavy, around 9 tons per mile, purchased by the *Glass, Elliot and Company* at the Government's expense.

These renowned constructors, between 1854 and 1862, built and immersed about 25 submarine cords, some of which very long, and almost all of them working. Many of these were built and immersed in the Mediterranean, for example those between Italy and Corsica, between Malta and Sicily and between Otranto and Corfu (Rivista Contemporanea, 1863: p. 128).

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[51]The problems were caused by the nature of the rocky seabed of the *Strait* and by the strong currents that caused frequent breakages of the cables. To have an idea of the difficulties they encountered, just think that, between 1858 and 1882, no less than 19 cables were laid and then broke down in the S*trait*!

[52]In that year the Government laid two new single-conductor cables, which however broke down the following year. In 1863, to avoid the strong currents, a cable was laid outside the strait, on a longer route, between the villages of *Bagnara* (Calabria) and *Torre Faro* (Sicily). This cable worked well for over twenty years.

was positioned only two years later, in 1859[54], by the attorney of the *Mediterranean Extension Telegraph Company*, Captain Augusto Hamilton, soon after the definitive breakage of the submarine connection between Sardinia and Malta. This connection turned out to be precious for England. As a matter of fact, from 1859 to 1861, the only way to exchange dispatches with Malta was across the Italian peninsula. In 1861 then, the English, thanks to a 841-km submarine cord built by the *Glass*, *Elliot and Company*, activated the line Malta-Tripoli-Benghazi-Alexandria in Egypt[55], which could send a dispatch comfortably to Suez, embark it and reach India by ship. (**Figure 7**)

6. The Otranto-Valona Cable

Around the second half of 1858, the House of Bourbon was able to design a second access towards the East, shorter and cheaper, thanks to the telegraphic stretch that from Ariano station, located east of Naples, headed to Puglia. Even on this occasion Jacopo Bozza played a major role: a man of exceptional talent who, besides having good knowledge of terrestrial telegraphy construction techniques, could boast operational skills, rare at that time, even in an emerging industry such as that of submarine telegraphy. This determined technician and entrepreneur, after securing, in 1857, the tender of the Sicilian telegraphic network (Mantovani, 2016: pp. 121-134), was also selected for that of the Pugliese telegraphic line, the following year. The new line connected Foggia to Barletta and then went on along the Adriatic coast in the direction of Bari, Brindisi and Lecce until it reached the outer Eastern tip of Southern Italy, at the station of Otranto. This city was Italy's easternmost point and, in a beeline, the telegraph station closer to the Turkish coasts, particularly to the ancient city of Avlona (or Valona) in Ottoman Albania, currently Valona. This proximity encouraged the Neapolitan Government to negotiate with the Ottomans for the construction of a submarine telegraph stretch joining Otranto to Valona and that could continue, according to specific agreements, in the Ottoman territory along two main routes[56]: to the north towards Cattaro, a connecting station for the Austrian telegraph lines; to the east in the direction of Constantinople. If the latter headed towards the Persian Gulf and the Indies, the former, besides Cattaro, had also the significant advantage of reaching Europe without passing through the Papal

[53]De Normann was a mechanical engineer with the rank of First Navy Lieutenant at Ferdinand II's service. On 18th July 1857, with a decree the King gave De Normann, the authorization to lay a telegraphic submarine cable between Capo Passero and Malta (Collezione delle leggi, 1857: pp. 34-37).

[54]Ferdinand II's decree of concession for the laying, manufacturing and operation of a cable for submarine telegraphic communication between Malta and "a location to be determined between Capo Passero and Alga Grande"-later located at Scicli-is dated 2nd May 1859 (Collezione delle leggi, 1859: pp. 180-186). The about 100 km-long cable was armoured and had one conductor for a weight of about 3 tons per mile (Report of the joint committee, 1861: p. 11).

[55]This line, although with various interruptions which were easily repaired, kept on working until 1868 when it was replaced by the direct line Malta-Alexandria in Egypt.

[56]A third direction from Valona led further South to the city of Arta, at the border with Greece, in order to intercept the dispatches coming from that country as well. They hoped that the Greeks might stretch their lines from the Gulf of Corinth to Arta, but the intervention of Austria ruined the negotiation between the Greek and the Neapolitan Governments.

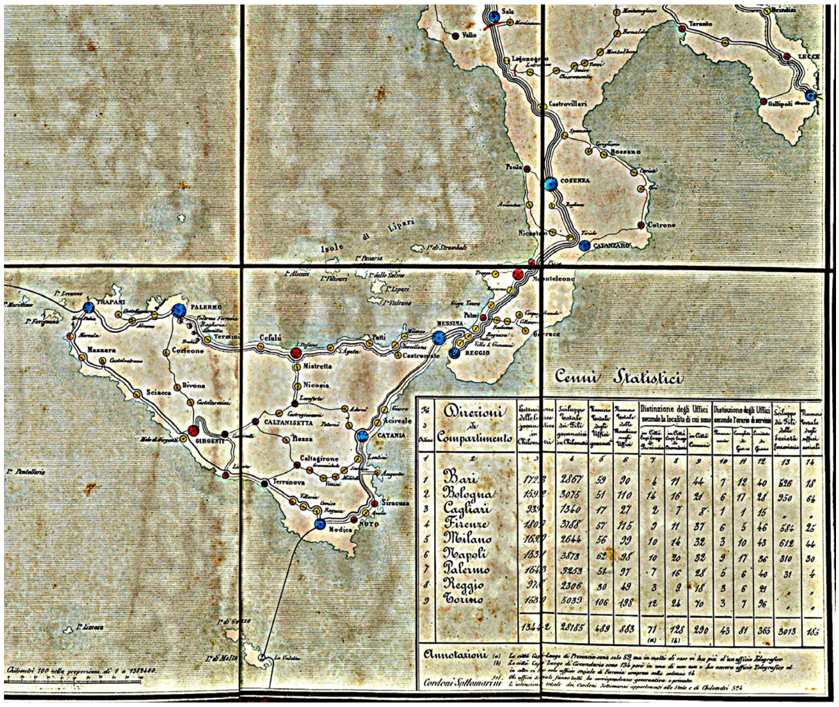

Figure 7. The telegraph system in Sicily in 1865. Detail from "Carta delle Linee Telegrafiche del Regno d'Italia", Turin 1865. Source: private collection.

States. During the works for the Pugliese lines, Bozza had often suggested that the Neapolitan Government needed to be connected to Europe avoiding the Pontifical telegraphic line whose only access junction towards the North of Europe was the station of Terracina. The Neapolitan Government's reasons were of political and economic nature and more than valid: the Papal government had refused to open other telegraphic lines in its territory; these lines might have cut the routes of the Neapolitan dispatches from and to the north of Italy and helped save on transit charges[57]. Mail to and from Naples had to go through the Pontifical cable that from Terracina had been laid towards Rome, and then on to Foligno, Ancona, Rimini and Bologna, therefore along a quite long route giving the Papal administration rich daily earnings coming from the transit charges of the dispatches. The Bourbons, who were aware of the heavy fiscal oppression the Government of Rome was imposed on them, tried two possible ways out, according to Bozza's suggestion: they proposed the Tuscan Government to connect their respective telegraphic systems through a submarine cable that would join Gaeta to Orbetello; at the same time, they got in touch with the Ottoman Government in order to open up a submarine telegraphic connection along the strait of Otranto. The Tuscan Government's answer was not long in coming and was not judged, in terms of convenience, acceptable; on the other hand, the S*ublime Porte* (also known as the Ottoman Porte) readily accepted the Neapolitan

[57]Namely Naples suggested to the Roman Government that Foligno and Rieti were connected, and that they opened a line towards Viterbo. The first solution, that continued towards L'Aquila, avoided the long route of the dispatches to Rome and Terracina; the second one, instead, as it cuts off the papal territories to the north, allowed a quick connection to the Tuscan telegraphic system.

proposal and Bozza was soon asked to go to Constantinople to negotiate and prepare an agreement between the two governments. After strenuous negotiations-among others, the Austrians strongly opposed the plan because they believed it threatened their earnings deriving from the transit charges-in October 1858 Bozza was able to successfully sign the agreement in the capital of the *Sublime* Ottoman State. The execution of the treaty was undersigned in Constantinople on 19th April 1859 and passed into law (Collezione delle leggi, 1860: pp. 48-63) in the Kingdom of the Two Sicilies on 15th February 1860 by Francesco II. The agreement stated that the Turkish administration committed to build three telegraphic lines starting from Valona: the first line, crossing Scutari, should have joined the Austrian lines at Cattaro; the second one, through the Monastir-Thessaloniki direction, would have reached Constantinople; the third one from Constantinople would have reached the borders of Russia at the city of Ismail. On their side, the Neapolitan administration, after sounding out and studying the sea stretch, committed to lay and maintain at their own expenses the submarine cable along the strait of Otranto. In particular, the administration had to provide for the maintenance of the submarine rope (breakages or failures of different kinds) by hiring two engineers who had to stay permanently at the telegraph station of Valona[58]. The telegraph cable was actually positioned by Bozza in the Otranto canal before the passing of the agreement into law, which happened on 28th November 1859, through a steamer commanded by the frigate captain of the Bourbons' Royal Government Edoardo D'Amico (De Luca, 1860: p. 263; De Cesare, 1908: p. 195). The cable that was used was light, with one conductor, 119km long and covered an 82-km-long stretch of sea. It worked for about a year. On 23rd December 1860 the cable was already out of service and, because of the political events of the time, its repair was not even attempted and so it was abandoned. Throughout 1860 it was mainly used for experiments and service alerts because meanwhile the Ottoman Government had not yet built the terrestrial telegraph lines promised in the agreement. Still in 1861, the Ottoman Government was behind in the operations, especially for the line that had to reach Thessaloniki and continue to Constantinople; therefore, the new telegraphic administration of the Kingdom of Italy, before fixing the submarine connection with the Ottoman coast, thought well of starting to negotiate with the Turkish government for a new telegraphic agreement which was signed on 16th January 1862. It was ratified by H. M. Vittorio Emanuele II on 23rd February 1862, and the exchange of the ratifications took place in Constantinople on 9th April of the same year. In this agreement (Ministero degli Affari Esteri, 1865: pp. 76-79) Italy committed to repair the Otranto-Valona submarine telegraphic connection and the Sultan of the Ottoman Empire Abdul Aziz committed to activating the Valona-Constantinople telegraphic line up to Ismail. The agreement provided for the presence of two telegraphic stations in Valona, one Turkish and the other Italian[59], each with its own Morse machines, located in the same building "à faci-

[58]The station had to be equipped with four telegraphic machines, Morse system, two of which "working in translation" to constantly transmit and receive dispatches from and to Constantinople and to and from the Austrian lines.

liter les opérations combinees du service mixte" (Ministero degli Affari Esteri, 1865: p. 77) and permanently open to the service. The ratification of the new agreement suggested that the Italian telegraphic administration tried to repair the cable which had been out of service since 1859: starting from 1862 and through 1863, some costly attempts were done for this purpose, but to no avail. In 1863, in anticipation of a new laying, a new submarine telegraphic cord was ordered by the Italian Government. The contract was awarded to the London factory of the telegraphic engineer William Thomas Henley (c. 1813-1882) as documented by the existing brass plate[60] (see **Figure 8**) in the box containing the three telegraph cables mentioned at the beginning of this work, kept at the Pesaro Oliveriana Library. In order to build and lay the cable[61], Henley made arrangements with the Italian Government for a sum of 375,000 Italian lira. The distance to be covered from Otranto to Valona was calculated in about 85 km, slightly more than the 1859 laying; so it was necessary to add a 42% slack and use a much longer cable, of about 121 km. The laying started on 28th January 1864 from the Valona side by means of the cargo ship *Semaphora*, but many technical difficulties were encountered[62]. In August of the same year, the steamer *Caroline* replaced it and completed the laying[63]. The cable started to function on September 1st, 1864. It was a good quality cable and it worked for more than four years with no problem. As for the technical structure of this telegraphic cord, we know about it, thanks to the memento preserved in the Pesaro Oliveriana Library. The memento is, in fact, an elegant mahogany box, with a crystal cover: three different pieces of cable are preserved inside of it, respectively, for shore end, coast and open or deep sea (see **Figure 1**), used by Henley in the above mentioned 1864 laying. The analysis of the three samples has revealed that the conductor consisted of seven copper wires overlapped and intertwined, covered by a casing of gutta-percha and by some layers of tarred hemp soaked in tannin. Above this structure and in order to protect it, the cable was wrapped by an armour of 12 wires of galvanized iron that had different diameters for the shore end or open sea stretches. The armour was in turn wrapped in an external bandage of tarred

[59]The Italian telegraphs station could not be over six units, including the engineers hired to repair the cable. Thanks to a new agreement, this station, which weighed on the managing budget of the line, was suppressed in 1866 and its service given to the staff of the Turkish station; in Valona only one Italian engineer was left and his duty was to check the cable from the docking to the city and the electrical measurements of the line.

[60]The engraving on it says: OTRANTO & AVLONA SUBMARINE TELEGRAPH CABLE CONSTRUCTED FOR THE ITALIAN GOVERN[T] BY W. T. HENLEY LONDON.

[61]A clause of the contract stated that the cable, once the laying was complete, had to work properly for at least three months.

[62]E. D'Amico so described the difficulties they encountered: *bad weather, the imperfect action of some equipment, mostly of the brakes, which had to calibrate the descent of the cable in the sea, had as a consequence that the cable, once in deep sea and dragged by its own weight, hastily descended into the sea, and the brakes that were not able to hold it, so that the cable on board had completely descended into the sea, soon after we were halfway the Otranto canal* (D'Amico, 1886: p. 95).

[63]As it has been already pointed out, this first laying was not done in the best way. In particular, the cable, out of an excess of slack, went down in deep locations with such coils that it was bent in different spots. These damages were the basis of a slow but gradual decline of the electrical conductivity of the cable.

hemp saturated with mineral tar to preserve it from the corrosive action of salt sea water (see **Figure 9**).

This cable started to show some problems only since 1869, but it was always repaired. The first two interruptions happened respectively on 11th March 1869 and on 17th November 1870, in the proximity of Valona; they were both repaired within a month and the connection was restored. The most serious problem came up in 1872 for a malfunctioning of the insulation of the cable[64] which happened in a very deep spot, far from the coastlines. Such malfunctioning, at first of small scale not compromising telegraphic transmissions, started gradually to exacerbate in time, until 1878, when the transmissions were completely interrupted. The operations to fix the cable soon turned out to be particularly difficult, due to the great depth that had to be reached. On June 1878, there was an attempt to repair it, but with no success. At that time, the Italian Ministry of Communications and the Ministry of Naval Service did not have any appropriate ship available[65] to implement such an operation. They asked the French administration to make one of their steamers available, the *Charente*[66], which had adequate staff and machines for the maintenance. The restoration works of the submarine telegraph connection[67] started in the first days of October 1878 under the supervision of the General Inspector of Telegraphs, Salvatori (1879: pp. 1-51) and ended successfully within a month[68]. Salvatori himself was the protagonist,

Figure 8. Informative plate placed in the telegraphic box preserved in the Pesaro Oliveriana Library. Source: by courtesy of Oliveriana Library, Pesaro.

[64]Still according to D'Amico, as a consequence of the hasty descent of the rope to the bottom of the sea during the 1864 laying (note 63), the armour was damaged. In practice the contortion of the cable had let the slow and gradual coming out of the conductor from the gutta-percha.

[65]We shall have to wait until 1887 for the Royal Italian Navy to have, on engineer Giovanni Battista Pirelli's own initiative, a proper cable ship unit, the *Città di Milano*. With this important cargo ship, the *Pirelli & Co.* would perform, under Emanuele Jona's direction, 33 maintenance and submarine cable laying campaigns over a span of 33 years.

[66]Already two years earlier, the same steamer had helped the Italian administration fix a similar failure in the strait of Messina.

[67]To assist the work of the French steamer, the Italian minister made the *Chioggia* available, a steam schooner of the Royal Italian Navy.

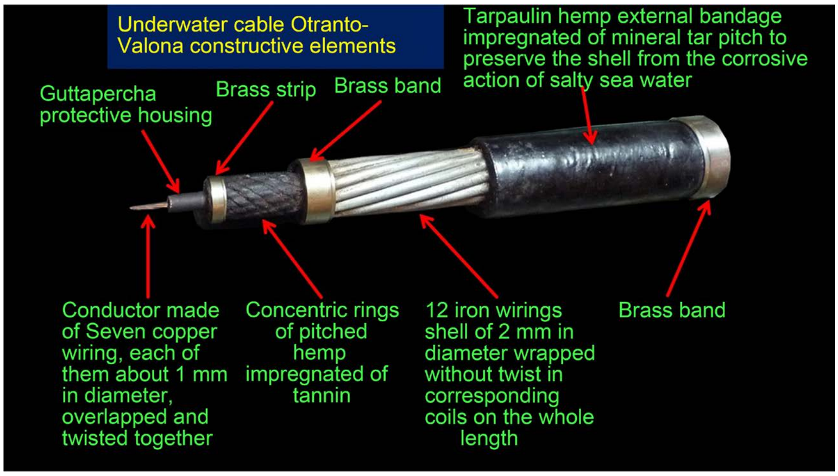

Figure 9. Structural components of the telegraph cable Otranto-Valona.

in 1883, of a new restoration work on the same line, again for an insulation malfunctioning[69]. In 1885, after an agreement with the Italian Royal Navy, the Milan based *Pirelli*[70] & *Co.* took charge of the maintenance of the Otranto-Valona cable. Since then and until 1896 the line failed four more times, but it was always repaired just fine by the electrical engineer Emanuele Jona (Morando, 2007: pp. 27-48), a first-rate technician of the newly established company Pirelli-Cavi and a rising star of the newly-born Italian industry of submarine cables.

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[68]To rent the *Charente* the French did not request any financial compensation; the whole operation cost the Italian administration 60,000 liras (Relazione a S. M. del Ministro del Tesoro, 1878: p. 1).

[69]This time the Italian administration rented a steamer, the *Retriever*, from the powerful and well established English company of submarine cables *Eastern telegraph* in charge of the maintenance of the cables in the Mediterranean. The operation lasted nine days and consisted in pulling out and replacing 35 km of the old cable with a new one provided by the same company.

[70]This important company, established in 1872, had owned, ever since 1878, a large plant in Milan for the processing of caoutchouc and gutta-percha in various industrial applications. In 1886 the company opened a second plant at San Bartolomeo, in the gulf of La Spezia, to armour the electrical wires coated in gutta-percha that were already produced in the Milan plant. Since then the Pirelli & Co. has successfully been in the *business* of manufacturing and laying the submarine telegraphic cables in the Mediterranean.

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