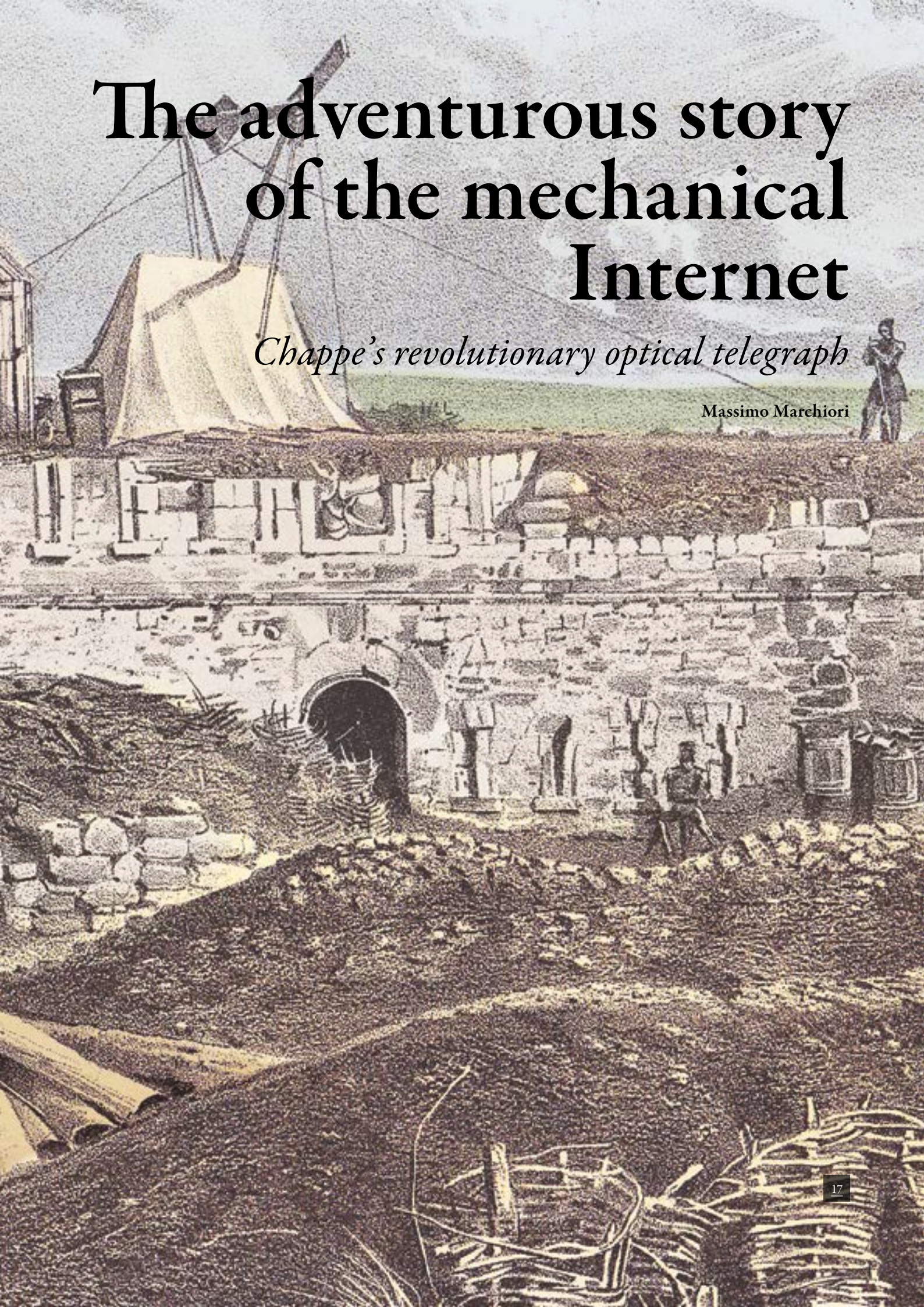
The adventurous story of the mechanical Internet

Chappe's revolutionary optical telegraph

Massimo Marchiori



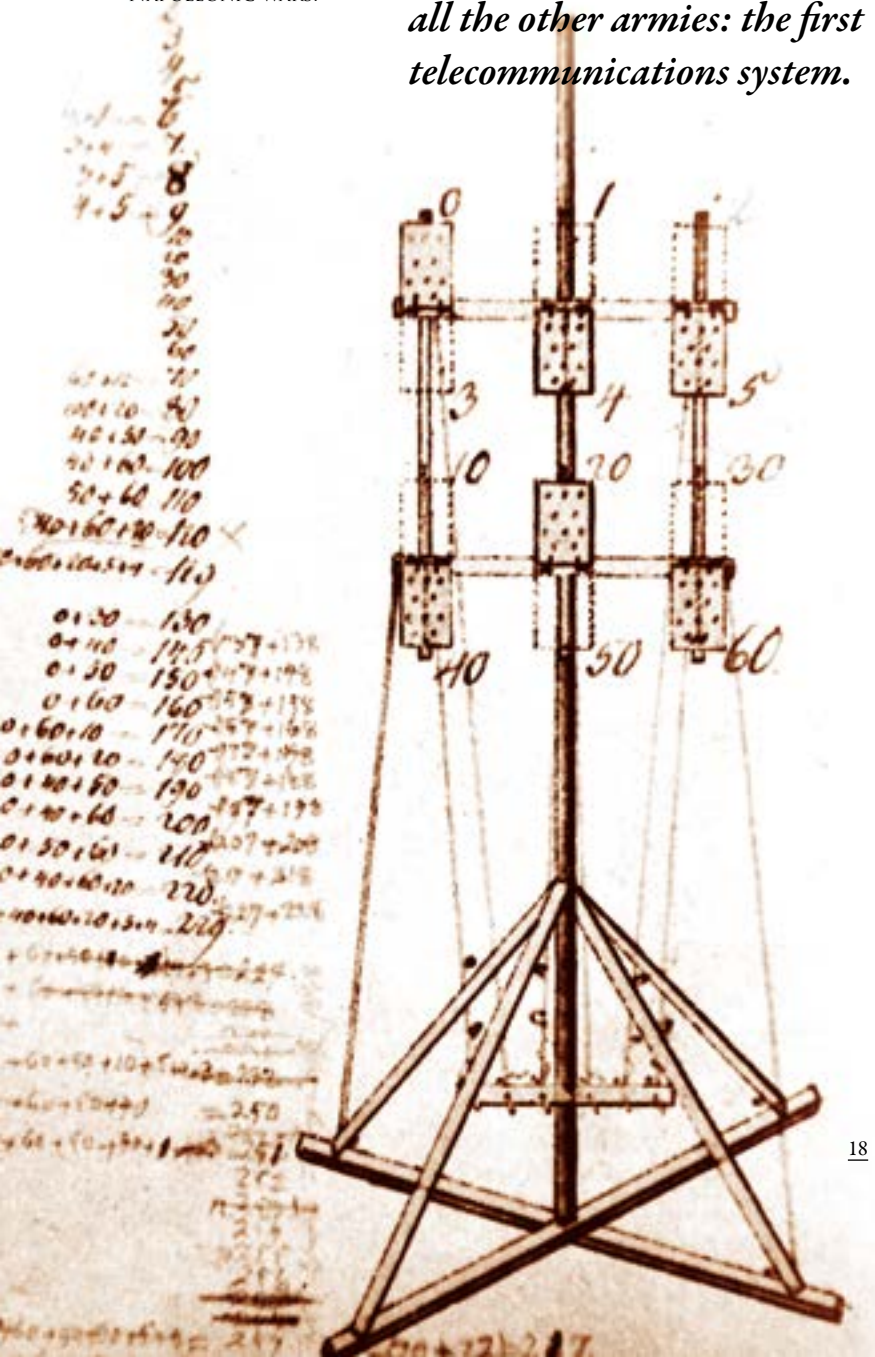
17 Nella guerra di Crimea il 9 settembre 1855, dopo la presa di Sebastopoli un telegrafo Chappe venne allestito sulla cima Korlinoff. Nel 1845 era stato già trasmesso il primo dispaccio col telegafo elettrico.

During the Crimean War, on 9 September 1855, after the capture of Sebastopol, a Chappe system was set up on the Malakoff. In 1845 the first dispatch had been sent by the electric telegraph.

18 Disegno di telegrafo ottico durante le guerre napoleoniche.

Drawing of an optical telegraph used during the Napoleonic wars.

"I may lose a battle, but I shall never lose a minute." Napoleon's famous phrase contains the key to his success – time. The French emperor explained further: "Strategy is the art of using time and space well. I am less interested in the latter than the former: I can recapture space but never time." Napoleon possessed and used something of fundamental importance that gave him an enormous time advantage over all the other armies: the first telecommunications system.



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It is generally believed that the first telecommunications system was the electric telegraph invented by Samuel Morse: this electric cable carrying information then developed into the telephone and the modern Internet. In Napoleon's day, Morse was still a child and his invention had not seen yet seen the light. For years, however, the world had actually already had a telecommunications system, the first real step towards "connected humanity".

That system was called the "telegraph", and it was the first true telegraph, even described by Alexandre Dumas in the *Count of Monte Cristo*:

"Yes, a telegraph. I had often seen one placed at the end of a road on a hillock, and in the light of the sun its black arms, bending in every direction, always reminded me of the claws of an immense beetle, and I assure you it was never without emotion that I gazed on it, for I could not help thinking how wonderful it was that these various signs, standing out against the grey of a cloud or the blue of the sky, should be made to cleave the air with such precision, as to convey to the distance of three hundred leagues the ideas and wishes of a man sitting at a table at one end of the line to another man similarly placed at the opposite extremity, and all this effected by a simple act of volition on the part of the sender of the message."

This strange telegraph functioned in a world where there were still no electric bulbs or other appliances. It was the first ever telecommunications system and so important that in our own age it has been renamed the "mechanical Internet". The technology is similar to modern telecommunications because it is wireless and therefore obviates problems of rivers, trees and tricky terrain, unlike Morse's telegraph which involved laying a cable between those wanting to communicate. This astonishing electricity-less technology has a secret: it uses light – that part of light which our eyes can see.

The idea of using light to transmit information is nothing new and goes back to time immemorial: from smoke signals to signs placed in watchtowers visible from a great distance. One of the earliest examples is described by Aeschylus in *Agamemnon*: when Troy was captured, the news was spread by lighting fires in ten signal towers specially built to announce the anticipated victory.

In the 4th century BC an initial crucial

breakthrough was made: the Alexandrine engineers Cleoxenus and Democleitus invented the *pyrsia*, a system based on two signallers each with only two mobile torches which, according to the way they were held, transmitted the letters of the alphabet.
This technology was fairly advanced but nothing much came of it, i.e. it did not become a true telecommunications system. Mail still travelled on horseback or by ship, and this was fast enough: humanity still didn't feel the need for instant communications. And when required, communications were very simple – all that was needed was a fire. In 1455, for example, Scotland's line of defence had a communication system with four fires: one lit fire signified that the English had been sighted, while the level of danger increased up to four fires, which signalled the enemy's imminent arrival. In 1588 it was the English who were warned of the arrival of the Spanish Armada by a series of fires from the Portsmouth coast to London. Primitive means for primitive information requirements.
The centuries passed and inventors rediscovered the ancient secrets of telecommunication. In the 15th century some Benedictine monks re-elaborated the ancient Greek *pyrsia* with the name *steganografia trithemiana*. In 1646 the Jesuit Athanasius Kircher published his seminal treatise *Ars Magna Lucis et Umbrae*, which in addition to various inventions such as the projector, described a telecommunications experiment that he called *cryptogamia catoptrica*, again based on the principles of the *pyrsia*.
Then in 1684 Robert Hooke gave a lecture at the Royal Society in London, illustrating his latest invention, the first effective telecommunications system, also because it employed a fundamental discovery which scientific progress had recently made available: the telescope. Thanks to the telescope, used instead of normal human vision, signalling relay stations could be set very far apart, even as far as 50 to 60 km. According to Hooke, the transmis-

19 La ricostruzione, a Stoccolma, del telegrafo dell'inventore svedese di origini finlandesi, Abraham Niclas Edelcrantz (1754-1821). Lo scienziato sviluppò, modificandola, l'idea di Chappe.

The replica of the telegraph designed by Abraham Niclas Edelcrantz (1754-1821) in Stockholm; the Swedish inventor of Finnish origin devised a system based on Chappe's idea.

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20 "Scotland Forever!", la carica degli Scots Grey contro l'esercito di Napoleone nella battaglia di Waterloo. Dipinto di Elizabeth Thompson (Lady Butler), 1881.

Scotland Forever!", the Scots Grey charge Napoleon's army at the Battle of Waterloo, painting by Elizabeth Thompson (Lady Butler), 1881.

21 La statua dedicata a Claude Chappe. L'opera di Louis Emile Macé - Boulevard Saint Germain, in una foto del 1910 circa - venne fusa dai tedeschi durante l'occupazione.

The statue of Claude Chappe by Louis Emile Macé once on Boulevard Saint Germain, Paris, photograph, around 1910; the sculpture was melted down by the Germans during the occupation.

22 La tomba dell'ingegner Claude Chappe al cimitero Père-Lachaise.

Claude Chappe's gravestone in Père-Lachaise Cemetery.

23 La chiesa di Saint Pierre a Montmartre, utilizzata come supporto del telegrafo; la prima torre in assoluto in Francia, allestita nel 1794. Camille Pissarro (1863, collezione privata).

The church of Saint Pierre at Montmartre was used to support the first telegraph tower built in France in 1794, painting by Camille Pissarro (1863, private collection).

sion time was practically instant, and with two or several stations, the time employed would always be very brief: two or a handful of seconds. And, with a little practice, he added, there could be rapid communications even between Paris and London.
Hooke also mentioned the important issue of security in telecommunications. While using visual signals was handy and wireless, anyone could see the message. He thus had another idea and became the first person in history to use encrypted wireless communications by means of a secret code which enabled him to vary the meaning of the signalled signs when translated into letters.
So in 1684 everything was ready and, thanks to the telescope, telecommunications were possible and highly advantageous. But despite this, nothing further happened, and Hooke's new technology remained latent since no one took it up. Clearly the world still didn't need or want to be connected at high speed. And another century passed before there were some fresh developments.
As often happens in crucial moments in history, change can come about thanks to one individual's genius and passion. In this case it was Claude Chappe, a Frenchman. Claude had a famous astronomer uncle from whom he had caught his passion for telescopes. One day at school he constructed a rudimentary system for signalling messages with a pole and a ruler, which his brothers were able to see from home through a telescope. And so a piece of child's play marked Claude's life for ever. Time passed and he perfected his semaphore system, convinced that it could become a real communications system. But, as had usually been the case until then, the rest of the world was not convinced: what was the point of a telecommunications network? An exceptional event was required, and on the crossroads of history, one did happen – the French Revolution in 1789. The new government, which had to fight other states bent on restoring the monarchy, needed all the help possible. In 1791 Chappe managed to build a simple telecommunications system with two stations, one in the town of Brûlon, where he lived and the other in Parcé, ten kilometres away. The following year, Ignace Chappe, one of Claude's four brothers, became a member of the Legislative Assembly in Paris. He put forward his brother's idea: a telecommunications network that would give a considerable advantage, especially in circumstances when speed of action was essential. The Assembly, which later became the National Convention, was sceptical, however, and asked Claude for proof that this new technology really worked.
In the span of a year, Chappe constructed

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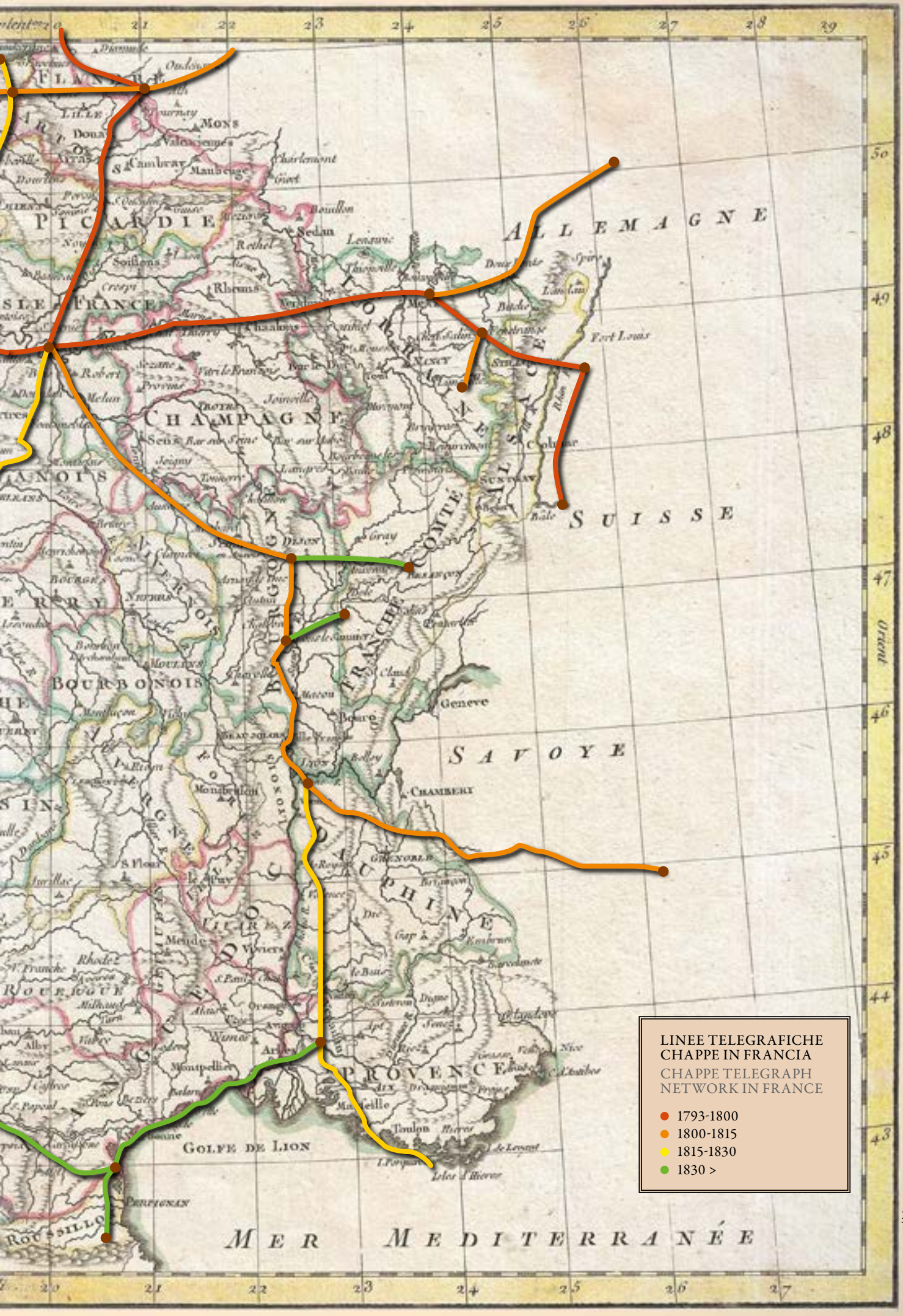
CARTE GENERALE
DE FRANCE
divisée
par Gouvernements
Projettée et assujettie aux observations
Astronomiques
par M. Bonne, Mtre de Mathém.
A PARIS
Chés Lattré, Graveur, rue St. Jacques,
à la Ville de Bordeaux. 1771
avec Priv. du Roy.
LA MANCHE
OCÉAN
Occident
BRETAGNE
NORMANDIE
MAINE
ANJOU
TOURAINE
POITOU
ANGOUMOIS
SAINTONGE
PERIGORD
GUIENNE
GASCOGNE
ESPAGNE
Boulogne
Fecamp
le Havre
Rouen
Bayeux
Caen
Alençon
Rennes
Nantes
Belle Isle
I. d'Ouessant
I. Jersey
I. Grenesey
I. de Ré
I. d'Oleron
La Rochelle
S. Jean de Luz


LINEE TELEGRAFICHE
CHAPPE IN FRANCIA
CHAPPE TELEGRAPH
NETWORK IN FRANCE
1793-1800
1800-1815
1815-1830
1830 >
ALLEMAGNE
SUISSE
SAVOYE
PROVENCE
DAUPHINÉ
CHAMPAGNE
PICARDIE
BOURBONNOIS
FRANCHE COMTÉ
MER MEDITERRANÉE
GOLFE DE LION
Orient

24 **Dimensione della rete Chappe sviluppatasi in Francia.**

The extent of the Chappe telegraph network in France.

25 **La placca dedicata all'inventore del telegrafo nel 150 anniversario della Rivoluzione francese. Parigi, 20° municipio.**

The plaque to the inventor of the telegraph, raised on the 150th anniversary of the French Revolution, 20th arrondissement, Paris.

a line with three stations joining up three cities in the outskirts of Paris: a total of 25 kilometres. The semaphore signalling system was developed from the toy that he had constructed at school and followed the same principles: some rods were joined together so that they could be arranged in various positions and combinations. Claude reflected at length and realised that an essential feature for success was that the signal had to be made quickly. Therefore there could be no heavy unwieldy apparatuses – simple light rods were more than enough. Moreover, atmospheric problems had to be taken into account: you couldn't rely on good weather – there could be rain, snow or wind. Therefore broad surfaces, such as panels or flags were to be avoided and light thin ones adopted – this was the winning formula.

Claude's system of rods had a total of 256 different combinations, of which some were used for service communications: unexpected incidents, communication errors, atmospheric problems and synchronisation. They formed a thoroughgoing communications protocol, and we find the same logic today in the Internet and mobile phones.

The system was successfully tried out on 12 July 1793. The National Convention was satisfied and two weeks later the French State Telegraph was set up, with Claude Chappe at its head. He was even given the equivalent of an official limousine – a state horse.

He was first asked to construct a telecommunications network from Paris to Lille, where the French army was stationed: a whole 190 kilometres. Chappe managed to complete the work in a year and opened the line on 16 July 1794. Returning to Hooke's ideas on security, a code book of combinations was used and changed every week. In this way no enemy, even when the stations were visible to all, could understand the signalled messages.

The telegraph line turned out to be of key importance for Revolutionary France. Only a few weeks later, on 16 August, it transmitted the news that the city of Le Quesnoy had been recaptured, and two weeks later also the city of Condé. Similarly, the news of the Austrians' capture of Condé-sur-l'Escaut reached Paris only an hour after the fall of the city.

By now the usefulness of the new semaphore technology was clear to all, and Chappe was given more resources and the job of extending the telecommunications network.

The first network was gradually taken as far as Brussels, in the wake of the victorious French army. A second line was completed in 1796, from Paris to Landau, using

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a more complex system of rods with as many as 823,543 possible combinations. This was the black beetle mentioned by Dumas in the *Count of Monte Cristo*.

Meantime, the rest of the world didn't wait on the sidelines: the news of this new technological wonder spread. The British Government constructed telegraph lines from the Admiralty Office to several points on the coast, such as Deal and Portsmouth. At the prompting of local engineers, Chappe's system was redesigned using apparently more visible fixed panels instead of rods. The upshot was, however, that there were fewer combinations of panels (36) and therefore the British Telegraph was much slower. Moreover, the panels were too heavy and at the mercy of wind and snow. The cumbersome system could not be fixed on high stations and therefore distances between them had to be reduced, making them less effective.

As we said at the beginning of this article, Napoleon immediately grasped the great potential of the telegraph and his government promoted a vast extension of the telecommunications networks. Thus, for example, ahead of the invasion of Italy in 1809, he built a special line from Paris to Milan, which later extended as far as Venice.

Claude Chappe's telegraph had now conquered the world and survived subsequent historical events. With the fall of Napoleon and the advent of the Restoration, the telegraph passed to the state ministry. When Napoleon briefly returned to power, the telegraph transmitted the news to Paris and the whole of France. Similarly, it was the telegraph that informed the French at home of the final rout at Waterloo.

By the end of 1840, all European states, and most world states, including the USA, had their own telecommunications networks. The French network alone had as many as 556 relay stations, covering an overall distance of 4,800 kilometres, linking up 29 major cities and employing over 3,000 people.

The world had changed, and the world wished to be better connected to quench its thirst for information. And that's why, the advent of a new telegraph – Morse's invention – had such sweeping effects. The world was ready for telecommunications and wanted more. In 1846 even the French government began to construct this new system based on electricity rather than telescopes. And in 1852 the Mechanical Internet sent its last message as its successor took over. Electricity had triumphed. ¶

26 **Una delle 62 stazioni della linea di telegrafi ottici dell'Impero prussiano. Stampa, metà XIX secolo.**

One of the 62 stations in the Prussian optical telegraph line, print, mid-19th century.

27 **Battaglia di Austerlitz, Napoleone a cavallo con il suo esercito François Gérard, 1810 - Reggia di Versailles.**

The Battle of Austerlitz: Napoleon leading his army on horseback, painting by François Gérard, 1810, Palace of Versailles.

27