

# Editorial – Telecommunication and Globalization in the Nineteenth Century

Roland Wenzlhuemer\*

**Abstract:** »Editorial – Telekommunikation und Globalisierung im 19. Jahrhundert«. Telecommunication systems dematerialize the information that they transmit and, thereby, detach the flow of information from the movement of material carriers such as people or goods. The immediate effect of such a dematerialization is a substantial gain in transmission speed, which has often been styled as the principal characteristic of telecommunication. Of far greater significance – at least from an analytical perspective – is, however, the relative gain in information transmission speed as against the speed of movement of people or goods. Flows of dematerialized information work along a completely new logic. It is one essential constituent of this logic that wherever telecommunication networks reach information outpaces material transport and can, therefore, be used to efficiently coordinate, control and command such material movement. The telegraph as the first fully-fledged telecommunication system pioneered this qualitative change and introduced a new rationale to global communication – and, therefore, ultimately to globalization processes of the nineteenth century.

**Keywords:** telecommunication, globalization, dematerialization, telegraph.

## Telecommunication

In the first volume of his seminal three-volume work *The Information Age: Economy, Society and Culture* Manuel Castells begins his chapter on “The Information Technology Revolution” with a quotation from Stephen Jay Gould’s *The Panda’s Thumb*.<sup>1</sup> There, Gould states that

[g]radualism, the idea that all change must be smooth, slow, and steady, was never read from the rocks. It represented a common cultural bias, in part a response of nineteenth century liberalism to a world in revolution. But it continues to colour our supposedly objective reading of life’s history [...]. The history of life, as I read it, is a series of stable states, punctuated at rare intervals

---

\* Address all communications to: Roland Wenzlhuemer, Cluster of Excellence ‘Asia and Europe in a Global Context’, Heidelberg University, Karl Jaspers Centre, Voßstraße 2, Gebäude 4400, 69115 Heidelberg, Germany; email: wenzlhuemer@asia-europe.uni-heidelberg.de.

<sup>1</sup> Manuel Castells, *The Rise of the Network Society* (Malden, MA: Blackwell Publishers, 1996): 29.

by major events that occur with great rapidity and help to establish the next stable era.<sup>2</sup>

Castells uses the quotation from Gould to illustrate his own starting point when thinking about the so-called Information Age:

[A]t the end of the twentieth century, we are living through one of these rare intervals in history. An interval characterized by the transformation of our 'material culture' by the works of a new technological paradigm organized around information technologies.<sup>3</sup>

Castells believes that such a punctuation of the previous equilibrium has occurred in the 1960s and 1970s and was made possible by the coincidence of several economic, socio-cultural and technological developments mainly in North America and the Western world. For instance, he refers to "the revolution in information and communication technologies"<sup>4</sup> starting in that particular period and made possible by the invention and improvement of the microprocessor. Indeed, we have been communicating faster and further ever since. Transmission and computational capacities have multiplied in the last decades. Storage facilities have become larger (in capacity, not in size), faster and more efficient. A truly global communication network has evolved. And yet, all of this does not necessarily imply a qualitative transformation. As Frank Webster has put it: "If there is just more information, then it is hard to understand why anyone should suggest that we have before us something radically new."<sup>5</sup> Webster's argument is of central importance for everyone who aims to understand the role of evolution and revolution, of continuity and change in the development of technologies. Because sometimes quantitative capacity improvements can under specific circumstances lead to qualitative changes. In the case of Manuel Castells' information revolution, technological improvements such as the microprocessor have made at least two principal developments possible: first, the handling of much more information per time and, as a consequence of this, the digitalisation of more and more different forms of information – which in turn is a prerequisite for the digital manipulation, multiplication and transmission of information; and second, the on-demand availability of information that can be accessed by users at any time and from any (connected) place in the world. At least these two traits distinguish late twentieth-century information technologies from their predecessors.

---

<sup>2</sup> Stephen Jay Gould, *The Panda's Thumb: More Reflections in Natural History* (Harmondsworth: Penguin, 1980), 226.

<sup>3</sup> Castells, *The Rise of the Network Society*, 29.

<sup>4</sup> Manuel Castells, "Informationalism, Networks, and the Network Society: A Theoretical Blueprint," in *The Network Society. A Cross-Cultural Perspective*, ed. Manuel Castells (Cheltenham, UK; Northampton, MA: Edward Elgar, 2004), 15.

<sup>5</sup> Frank Webster, *Theories of the Information Society* (London: Routledge, 2002), 21.

Other criteria that have frequently been styled as distinguishing characteristics of modern information technologies – such as their network character or the ability to transmit information fast over great distances – have been present long before. In this regard, the information revolution of the twentieth century has only allowed for quantitative progress. And, as a matter of fact, the same can be said for the development of communication technology in the nineteenth century. Telegraphy, for instance, is a network technology and derives many of its distinct traits from this fact. Its preceding communication technologies, however, have also relied on networks of some sort. Any efficient postal or messenger system, for instance, is organised as a network – comprised of nodes, connections and, of course, relays and switches at the most important nodes. Actually, it is hard to dream up a communication system (designed to connect more than just a few people) that does not have at least some network characteristics. Therefore, telegraphy has neither been the first network communication technology in human history nor has it been the last. And just as well, the telegraph has not been the first medium to transmit information fast over great distances. As Yrjö Kaukiainen has shown in his ground-breaking work, global information transmission has massively increased in speed many decades before a global submarine telegraph network started to emerge.<sup>6</sup>

And still, the emergence of the telegraph also had a decisive qualitative impact on global communication. It became an essential component and motor of globalization in the middle of the nineteenth century. Electric telegraphy was the first fully mature telecommunication technology and as such made possible the dematerialization of global information flows. The word “telecommunication” was first used by Edouard Estaunié (1862-1942) in his *Traité pratique de télécommunication électrique* published in the year 1904.<sup>7</sup> Composed of the Greek *τηλε* (*tele*) for “distant” and the Latin *communicatio* for “connection,” the term, in the literal sense of the word, denotes the conveyance of information over a great distance, that is, a distance that cannot be covered by face-to-face communication. In the narrower sense of the word, however, only such means of communication qualify as telecommunication that dematerialize the transmitted information. Technically, several early systems of communication that have made use of acoustic (e.g., drums) and optical (e.g., smoke signals, beacons) means of transmission fall into this category. Most of these techniques, however, suffer from severe limitations of range or practicability when transmitting more complex information. Thus, the most common definition of the word “telecommunication” usually excludes such pre-electric means of negotiating distance and applies the term solely on techniques of transmitting,

<sup>6</sup> Yrjö Kaukiainen, “Shrinking the World: Improvements in the Speed of Information Transmission, c. 1820-1870,” *European Review of Economic History* 5 (2001): 1-28.

<sup>7</sup> Edouard Estaunié, *Traité pratique de télécommunication électrique (télégraphie – téléphonie)* (Paris: Charles Dunod, 1904).

emitting or receiving information via electric, electromagnetic or optical (that is, fibre-optical/laser) systems.

## Dematerialization

Following this definition,<sup>8</sup> the electric telegraph is the first fully-fledged telecommunication system and, of course, ushered in a substantial increase in communication speed over large distances. And yet, it is conceptually far more important to look at the essential quality that has made this increase possible in the first place – the dematerialization of long-distance communication. The telegraph allowed for encoding information in electric impulses that could then be sent along a conductor – usually a wire or a set of wires. The transmission of information had eventually been detached from the movement of people or things<sup>9</sup> – both of which consist of matter and, therefore, adhere to certain rules of material movement. The immediate consequence of this is an increased speed of communication in absolute terms. In plain words, it took less time than ever before to transmit a message from a place A to another place B. This is the quantitative improvement that dematerialization brought about. The punctuation of the equilibrium that we are looking for, however, rests in the aforementioned detachment from material carriage and, thus, in the relative increase of transmission speeds towards material carriers. The flow of information was separated from the flow of people or goods and now worked along a completely new logic. It is one essential constituent of this logic that wherever the telecommunication network reaches dematerialized information outpaces material transport and can, therefore, be used to efficiently coordinate, control and command such material movement. The following brief examples illustrate

---

<sup>8</sup> It could certainly be argued that this definition should be widened in order to accommodate the optical telegraph as well. Although information was transmitted visually, the optical telegraph first made it possible to convey reasonably complex messages within the network. It is, in this respect, the direct forerunner of electric telegraphy. The optical telegraph pioneered several of the essential traits of telegraphy, but only with the emergence of the electric telegraph could the technology reach the technological maturity necessary for the large-scale erection of first national and then transnational telecommunication networks. In this context maturity means that the technology reached a degree of manageability, reliability and cost efficiency that made it appeal to potential users beyond the state. In this respect, electric telegraphy offered a number of distinct advantages over its optical counterpart. The distance between relay stations could be much higher and extend beyond human sight. There was no need for a line of sight between relay stations and, therefore, the electric telegraph would work in impracticable terrain, at night or during periods of bad weather. And of course, the optical telegraph could send information across rivers, lakes or the sea only, if both shores were within optical range of each other. The electric telegraph also had a higher information throughput than the optical telegraph. All this drastically reduced the personnel and the costs involved in telecommunication and made telegraphy a more reliable and affordable affair.

<sup>9</sup> In rare cases, animals, e.g., homing pigeons, can act as communication carriers as well.

the qualitative advance and accordingly the punctuation in the equilibrium that was brought about by dematerialization.

*Telegraphs and railways:* One of the factors behind telegraphy's swift expansion in Great Britain was its early symbiosis with the railway. Shortly after the invention of their five-needle telegraph, the British inventor-entrepreneur couple Charles Wheatstone and William Fothergill Cooke successfully convinced the managers of several London railways to let them erect telegraph lines along sections of the railway routes. While it seemed immediately obvious how the telegraph system would benefit from the railways' right of way, it initially took some time and effort to demonstrate the potential use of the telegraph for the railway companies. The technology first had to reach a certain degree of maturity, affordability and reliability. Being successfully employed on the lines of the Great Western Railway and the London & Blackwall Railway, the telegraph eventually proved incredibly useful for the management of "ancillary single lines where traffic did not justify double track, by enabling them to be operated safely and efficiently."<sup>10</sup> In other words, as the railway itself in many cases was the fastest means of communication available at the time, it had been next to impossible to manage single track railway lines for use in both directions in a way that would ensure both efficiency and safety. The special virtue of telegraphic communication from the perspective of the railway manager rested in its detachment from material transport that had already reached its practical apogee in the form of the railways. Telegraphs were useful not because they allowed the railway operators to communicate fast, but because they allowed them to communicate faster than the fastest moving means of material communication (excluding impractical means such as carrier pigeons or horse couriers in relay).

*The Salt Hill murder and other crimes:* The famous and often-cited case of the murderer John Tawell and his capture by the police also exemplifies the changing relation between railway transport and communication brought about by telegraphy and works along the same logic lined out in the previous paragraph. However, while the first example demonstrated merely how the railways internally benefitted from the new communicative qualities ushered in by the telegraph, the case of John Tawell shows how society as such could be affected by the detachment of information from material flows. On the evening of New Year's Day 1845, Tawell poisoned his mistress Sarah Hart with prussic acid at her house in Salt Hill near Slough. Witnesses saw him leave the house after the murder dressed like a Quaker. On 3 January 1845, the *Times of London* reported on the murder including several statements of people involved in the case.

---

<sup>10</sup> Jeffrey Kieve, *The Electric Telegraph: A Social and Economic History* (Newton Abbot: David & Charles, 1973), 33.

The Rev. E. T. Champnes, vicar of Upton-cum-Chalvey, examined. – Hearing of the suspicious death of the deceased, and that a person in the dress of a Quaker was the last man who had been seen to leave the house, I proceeded to the Slough station, thinking it likely he might proceed to town by the railway. I saw him pass through the office, when I communicated my suspicions to Mr. Howell, the superintendent at the station. He left for London in a first-class carriage. Mr. Howell then sent off a full description of his person, by means of the electric telegraph, to cause him to be watched by the police upon his arrival at Paddington.

Mr. Howell, of Slough station, deposed as follows: – The prisoner left for town last night by the 7 42 train. I despatched orders by the telegraph to have the prisoner watched on his arrival at Paddington. A few minutes afterwards an answer was returned, stating that the suspected party had arrived, and that sergeant Williams had left the terminus in the same omnibus for the city. (*Times of London*, January 3, 1845).

John Tawell was later apprehended at a London coffee house. He was brought to trial, convicted of murder and eventually publicly hanged on 28 March 1845 (*Times of London*, March 29, 1845). The murder case caused quite a public stir in London for a variety of reasons – not the least of which can be found in Tawell's unusual and, to say the least, colourful life that lent itself readily to the purposes of the newspapers. Another factor, however, can be identified in the particulars of his apprehension that would not have been possible (at least not so quickly and smoothly) without the telegraph. Once on the train to Paddington, Tawell would usually have had a considerable head start against his pursuers as no signal could have been given to the train or Paddington station. Travelling by the fastest possible means of transport, he would have reached London long before anyone there could have heard about him or his crime. Only dematerialized communication through the telegraph allowed for the message to actually overtake its train-travelling subject.

*Tramp shipping:* In the realm of international shipping, the telegraph had a very similar impact to what we have already heard about railway coordination. Once a ship had left its European home harbour and was heading for the Americas, Africa, Asia or Australia, it was out of reach and, thus, out of control of its owners. This was of particular concern in what is known as tramp shipping, that is, when ships do not have a fixed route (like liners do) but respond flexibly to market opportunities and, thus, ports of call in a region. In a paper delivered at the “Cross-Connexions” conference in London in 2005, Birgitte Holten compared three examples of trade transactions between European or North American merchant houses and Brazilian coffee exporters as to their organization and efficiency. The first case took place in 1845 before the time of intercontinental telegraph links. Holten writes:

After dispatching the ship, the merchant had little other choice than to sit patiently down and wait for news of its return. [...] This was an expensive, time-

consuming and unsophisticated manner of trading. The existence of agents or exporting firms in the ports – in Rio from the early 1820's – facilitated the purchase of the cargo. But if the agents did not possess the wished qualities in stock, or if the ship had arrived at a period when stocks in general were exhausted – if the harvest had been small or rain hindered the mule trains to arrive from the interior, the only option for the ship was to lie idle in the harbour awaiting new arrivals. If stocks were really running low or the qualities were very inconvenient, the master of the ship would have to improvise, loading the ship with the qualities at hand or other goods to at least gain some freight, or he would decide to make an unforeseen supplementary voyage, such as going to the Cape Verde Islands in ballast to fetch a cargo of salt. References to this kind of voyages unplanned and unwished for exist from a period as late as the mid-1860s.<sup>11</sup>

The only control that the owner or merchant could exert over the ship rested in equipping the captain or sometimes an accompanying supercargo with detailed instructions covering every imaginable eventuality.

Holten's other two cases stem from the years 1874 (with a transatlantic cable in place but no direct link between Europe and South America) and 1893 respectively. While by 1874 the headquarters' control over their ships had improved only marginally but general information on world markets and business conduct was more widely available, by 1893 South America had been directly linked to the global telegraph network for years. Information about local market conditions could reach the European merchant house headquarters within days or hours only rendering it feasible to make decisions centrally and to cut into the leeway of both captain and supercargo present *in situ*.

The trading methods had experienced a profound change in this less than half century we are contemplating here. The need for equipping a ship, contract a supercargo and commit huge sums of money in a risky enterprise did not exist anymore. Instead, each single operation in the commodity chain had become separated, divided out to a smoothly shifting series of minor actions. What made this change possible was the telegraph.<sup>12</sup>

As can be seen from these examples, the qualitative transformation of global communication brought about by electric telegraphy stems mainly from the relative increase in transmission speed in comparison to material movement and only to a far lesser degree from the acceleration in absolute terms. Of course, I am aware of the various terminological and semantic difficulties arising with the use of the word dematerialization. Neither from a purely philosophical nor from a natural scientific viewpoint is the use of the term sufficiently exact as it implies the complete escape from the realm of matter as such. This, however, is not how I suggest to use the word. Neither does it refer to the phi-

---

<sup>11</sup> Birgitte Holten, "Telegraphy and Business Methods in the Late 19th Century," (paper presented at the conference Cross-connexions: Communication, Society and Change, London, November 11-13, 2005): 3-4.

<sup>12</sup> Holten, "Telegraphy and Business Methods," 19.

losophical concept of materialism, nor does it want to withstand scrutiny from post-Newtonian physicists. I use the term for the very reasons for which we still employ Newtonian physical laws and calculations in everyday life: because it is exact and yet simple enough to describe what happened to information transmission from the viewpoint of a historian. It stands for the translation of information into acoustic, optical or – most importantly – electric impulses instead of using tangible (that is, material) carriers. That telegraph lines, for instance, are quite tangible, too, does not oppose this definition as the line (or the cable) itself, once put in place, does not move in order to convey a message but merely provides the path along which information travels. In this respect the telegraph line is to communication what roads or railway tracks are to transport: not the message, only the medium.

## Globalization

Technically, dematerialization merely frees information transmission from a number of (Newtonian) physical constraints from which all material movement suffers. The carrier of dematerialized information does not have a mass (if we ignore the infinitesimal mass of moving electrons for now). It is thus not limited by physical inertia. There are, of course, other limitations. Here only a few can be named. Electric current needs a conductor through which it can travel. And such a conductor has to be put in place before any information can be transmitted. Accordingly, criteria such as geographical distance or topography at least initially still do play a certain role in dematerialized telecommunication. Furthermore, for most of the nineteenth century telegraph lines had relatively small transmission capacities and could transmit only comparatively simple electric impulses. The laying of telegraph cables over long distances was a complicated, costly and, therefore, almost monopolized affair during the nineteenth century. Initial investments were high. And most of the cables were controlled by a cartel. Accordingly, the cost for sending an intercontinental telegram was exorbitant for most of the century. Access to global communication was, therefore, mainly a privilege of the state, of internationally operating businesses, of the press or of very affluent private persons. In combination with the limited line capacities, such high costs rewarded brevity in telegraph messages and gradually gave rise to what we all know as telegram style – an abbreviated, grammatically creative language that treasures shortness over all other virtues (including sometimes comprehensibility<sup>13</sup>).

These are just a few eclectic examples of particular limitations and characteristics of the technology that in combination formed the technological rationale of electric telegraphy. Many more such traits (and their consequences)

---

<sup>13</sup> See the article of Deep Kanta Lahiri Choudhury in this volume.



could be named (for instance, the usage of a code system based on the Latin alphabet or the creation of a new and unique urban social class of telegraph messenger boys<sup>14</sup>) and will be frequently referred to in the course of this volume. The complex technological rationale of telegraphy affected and influenced the path of globalization in the nineteenth century beyond merely accelerating the process. It favoured some places and some actors or groups of actors over others. It impacted on social and cultural practice and helped to bring about new global asymmetries. Ultimately, the technological rationale of telegraphy changed the rules of what can be called the global sphere – the unlocalizable *space of flows*<sup>15</sup> that shaped so much of late nineteenth- and twentieth-century globalization – by detaching global communication space from spaces governed by material movement (see the following article in this volume). And, of course, in doing so it fundamentally transformed contemporary perceptions of time and space.

Telegraphy and its technological rationale co-shape globalization processes because they directly affect the very constituents of globalization: global exchanges, movements, transfers, flows – whichever term one prefers. Here I give but a few examples that will recur on the following pages: the telegraph changed the nature of news reporting; it impacted on business and administrative language (and via this detour ultimately on language in general); it separated the global flow of short and decisive information from that of more profound background information; and, of course, it created new asymmetries and divides by the uneven structure of its network and other access barriers. In short, the telegraph – representing the first fully-fledged system of telecommunication – transformed the nature of many forms of global interaction and introduced a new logic, new actors, new places and new practices to the process. This volume seeks to highlight the complex role of telecommunication and its networks in nineteenth-century globalization processes – a role that has often been reduced to furthering imperial control and international business. The contributions in this special issue do not ignore these two traditional perspectives but primarily seek to illuminate new and previously understudied aspects of the relation between telecommunication and globalization.

This short piece and the following article form the introductory section of the special issue and seek to conceptualize the relation between telecommunication and globalization. While here I have tried to identify the principal new qualities of telecommunication (and in particular of telegraphy) and their transformative power, “Globalization, Communication and the Concept of Space in Global History” suggests a new conceptual understanding of space that will

---

<sup>14</sup> See Gregory Downey, *Telegraph Messenger Boys: Labor, Technology, and Geography, 1850-1950* (New York: Routledge, 2002).

<sup>15</sup> Castells, “Informationalism, Networks, and the Network Society,” 36-37.

ultimately make it easier for us to gauge the significance of changing patterns of global interaction.

The second section is primarily concerned with the impact of global submarine telegraphy on imperial control and administration. In “A Double-Edged Sword: Communications and Imperial Control in British India” Daniel Headrick discusses the intended and unintended consequences of erecting a telegraph network in British India. While the telegraph on the one hand readily lent itself to imperial purposes, it also became important for the formation of an Indian consciousness. Headrick convincingly argues that swift communication makes both globalization and fragmentation possible. Daqing Yang’s “Telecommunication and the Japanese Empire: A Preliminary Analysis of Telegraphic Traffic” is a study of information flows within the Japanese Empire and presents rare statistical evidence in order to trace these flows. Yang shows that the pattern of information flows clearly reflects factual power relationships within the empire. In “The Uses and Limitations of Telegrams in Official Correspondence between Ceylon’s Governor General and the Secretary of State for the Colonies, circa 1870-1900” Paul Fletcher analyses the transformative impact of a new means of communication on the nature of communication itself. Using Ceylon as a case study, he is able to show that the allegedly all-powerful telegraph was used less often than we might expect in administrative correspondence and occupied a very awkward place in the British colonial administrative episteme. Javier Márquez closes the section with his article on “Telecommunications and Colonial Rivalry: European Telegraph Cables to the Canary Islands and Northwest Africa, 1883-1914.” While telegraphic communication might not have been a fundamental constituent of daily imperial administrative routine, Márquez discusses early twentieth-century diplomatic disconcertments regarding cable access to the Canary Islands. This case illustrates the importance of telecommunication from a geostrategic perspective.

The third section deals with the impact of telecommunication systems on the public sphere. In “Of Codes and Coda: Meaning in Telegraph Messages, circa 1850-1920” Deep Kanta Lahiri Choudhury looks at how the use of the telegraph as a medium changed the language of the message and ultimately often its meaning. Choudhury shows how the need to be short as well as the use of codes and ciphers could garble the contents of telegraph messages and how such corruptions were discussed by contemporaries. Gordon Winder’s contribution has the title “Imagining World Citizenship in the Networked Newspaper: La Nación Reports the Assassination at Sarajevo, 1914.” He illustrates how in a world connected by submarine telegraph cables and an international news agency cartel, three newspapers in different parts of the globe report very differently on the same globally significant event. The article, therefore, emphasizes the role of the local even in times of tight global connections. Amelia Bonea also focuses on the reporting of a globally relevant event – the Austro-Prussian War of 1866. “The Medium and Its Message: Reporting the Austro-

Prussian War in the *Times of India*” investigates how the international transmission of news via the telegraph impacted on newspaper reporting in India. Short headline information about the war was published quickly in the *Times of India*. The more substantial correspondents’ reports arrived days, sometimes weeks later and were published along the more current information received by telegraph. The result was an odd mixture of new and older news that rearranged the reported event according to the demands of the medium and was hard to follow for the reader. Michael Mann’s article on “The Deep Digital Divide: The Telephone in British India, 1883-1933” examines the emergence of a telephone network in India. Mann shows that the global distribution pattern of telephone access was highly asymmetrical and basically reproduced global power structures. “‘The Path to Freedom’? Transocean and German Wireless Telegraphy, 1914-1922” by Heidi Evans closes this section. It looks at the German government-funded news agency Transocean that distributed news by wireless telegraph with the aim of supporting German foreign policy. In her case study, Evans manages to show how the medium of wireless telegraphy co-shaped its message.

The fourth and final section looks at the social networks behind telecommunication systems. Simone Müller’s article “The Transatlantic Telegraphs and the Class of 1866 – the Formative Years of Transnational Networks in Telegraphic Space, 1858-1884/89” examines the group of entrepreneurs, engineers and adventurers behind the laying of the first transatlantic cable. Müller conducts a prosopographical network analysis and highlights the strong ties between the individual group members. She argues that the *Class of 1866* was an epistemic community in its own right. Lynne Hamill closes this section with her article on “The Social Shaping of British Communications Networks prior to the First World War.” She argues that nineteenth-century communication networks grew out of existing social and business networks, and supports this point with two case studies about the telegraphic connection between Britain and India, and the British telephone network respectively.

All contributions of this special issue on *Global Communication* share the common goal to study the relation between systems of telecommunication and globalization processes beyond the recurring theme of imperial control and global business.

## References

- Castells, Manuel. “Informationalism, Networks, and the Network Society: A Theoretical Blueprint.” In *The Network Society. A Cross-Cultural Perspective*, edited by Manuel Castells, 3-45. Cheltenham, UK; Northampton, MA: Edward Elgar, 2004.
- Castells, Manuel. *The Rise of the Network Society*. Malden, MA: Blackwell Publishers, 1996.

- Downey, Gregory. *Telegraph Messenger Boys: Labor, Technology, and Geography, 1850-1950*. New York: Routledge, 2002.
- Estaunié, Edouard. *Traité pratique de télécommunication électrique (télégraphie – téléphonie)*. Paris: Charles Dunod, 1904.
- Gould, Stephen Jay. *The Panda's Thumb: More Reflections in Natural History*. Harmondsworth: Penguin, 1980.
- Holten, Birgitte. "Telegraphy and Business Methods in the Late 19th Century." Paper presented at the conference Cross-connexions: Communication, Society and Change, London, November 11-13, 2005.
- Kaukiainen, Yrjö. "Shrinking the World: Improvements in the Speed of Information Transmission, c. 1820-1870." *European Review of Economic History* 5 (2001): 1-28.
- Kieve, Jeffrey. *The Electric Telegraph: A Social and Economic History*. Newton Abbot: David & Charles, 1973.
- Webster, Frank. *Theories of the Information Society*. London: Routledge, 2002.