

The Social Shaping of British Communications Networks prior to the First World War

*Lynne Hamill**

Abstract: »Die soziale Prägung der britischen Telekommunikationsnetzwerke vor dem Ersten Weltkrieg«. This paper applies concepts from the social sciences to the evolution of communications in Britain before the First World War: the social shaping of technology, social networks and the distinction between short and long term effects. Two cases studies relating to communications in nineteenth century Britain – the telegraphic link to India and phones – are then examined in the light of these concepts. It is argued that communication networks grow out of existing social/business networks, which in turn reflect previous communication and transport networks, and that the main immediate effect of a new mode is to increase communication with existing contacts while in the longer run, new practices develop.

Keywords: telegraph, submarine cables, telephone, India, social networks.

Introduction

This paper applies concepts from sociology and economics to the evolution of communications in Britain from the 1840s to the First World War. From sociology, I take the concepts of the social shaping of technology and social networks, from economics, the distinction between short and long term effects. These are then applied to two cases studies:

- The creation of a telegraphic link between Britain and India.
- The growth of the phone network in Britain before the First World War.

Section 1 describes the three concepts. Sections 2 and 3 present the case studies and section 4 concludes.

1. Concepts

This Section first defines social shaping, then distinguishes between short and long term effects and finally discusses social networks. On the basis of this discussion, the section concludes with two hypotheses.

* Address all communications to: Lynne Hamill, Department of Sociology, University of Surrey, Guildford GU2 7XH, UK; e-mail: lynne@hamill.co.uk.

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Social Shaping

To explain social shaping, it is necessary to start with the idea of technological determinism. Technological determinism means that technology changes because of scientific advance or under its own momentum and that these changes have implications for society. Gordon Marshall described technological determinism as

[a] theory of social change, characteristically one of evolutionary progress or development in which productive technique obeys a logic or trajectory of its own and in the process acts as the principal determinant of institutions and social relationships.²

Daniel Headrick puts it rather more bluntly: “what can be done, will be done.”³ Technological determinism rests on the assumption that technological change comes from outside society.⁴ However, technology is not exogenous: it does not simply appear and then society adapts to it. Society creates technology and decides if and how to use it.

New technology is not adopted simply because it is available. In 1934 Joseph Schumpeter argued that

[t]he economic best and the technological perfect need not, yet very often do, diverge, not only because of ignorance and indolence but because methods which are technologically inferior may still best fit the given economic conditions.⁵

More recently Donald MacKenzie and Judy Wajcman stated that “technological reasoning and economic reasoning are often inseparable.”⁶

In other words, the knowledge of a good new technology is a necessary but not sufficient condition for its development. The economic conditions must be right, too – and the economic conditions are in turn determined by the social, political and cultural conditions. For example, it is argued that the high level of British labour costs, together with the cheap energy, explains why Britain industrialized in the eighteenth century and that higher labour costs in nineteenth century America than in Britain resulted in labour-saving technology being more highly valued there.^{7,8}

² Gordon Marshall, *Oxford Dictionary of Sociology* (Oxford: Oxford University Press, 1998).

³ Daniel Headrick, *Technology: A World History* (Oxford: Oxford University Press, 2009), 144.

⁴ Donald MacKenzie and Judy Wajcman, “Introductory Essay and General Issues,” in *The Social Shaping of Technology*, ed. Donald MacKenzie and Judy Wajcman (Buckingham: Open University Press, 1999), 5.

⁵ Joseph Schumpeter, *The Theory of Economic Development*, 2nd ed. (1934; Harvard: Harvard University Press, 1961), 15.

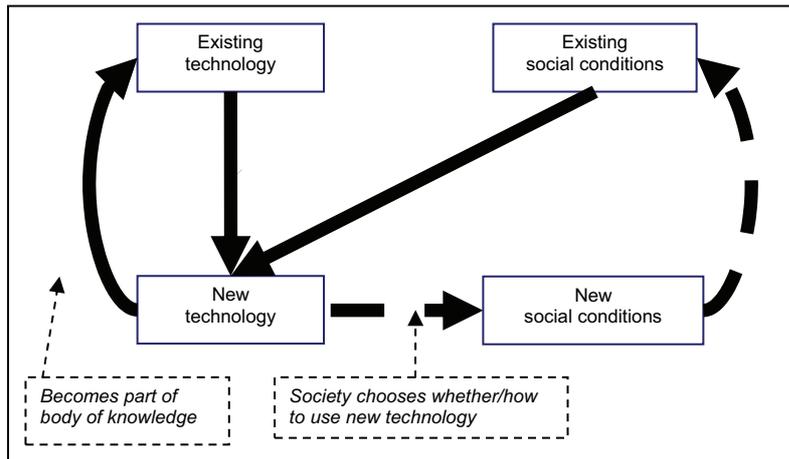
⁶ Donald MacKenzie and Judy Wajcman, “Introductory Essay and General Issues,” 12.

⁷ Robert Allen, *The British Industrial Revolution in Global Perspective* (Cambridge: Cambridge University Press, 2009), 15.

⁸ Donald MacKenzie and Judy Wajcman, “Introductory Essay and General Issues,” 14.

To sum up: society may adapt to technology but society also shapes what technology is created and how it is used. Of course, technology does shape society, too. They share a symbiotic relationship, in which they depend on each other. Thus technology is socially shaped. Innovations arise from existing technology and social conditions; their adoption is determined by those social conditions, which have in turn been shaped by earlier technology. It is a dynamic system, with feedback loops, as illustrated in figure 1.

Figure 1: Schematic View of the Social Shaping of Technology



The Short Term versus the Long Term

In economics, a distinction is drawn between what can be changed in the immediate future, the short run, and what is fixed the short run but can be changed in the long run. For example, Schumpeter pointed out that no matter how many more horse-drawn carriages were built they would never constitute a railway: in the short term you can build another carriage but only in the long term can a railway network be created.⁹ The railway “accelerated and enlarged the scale of previous human functions, creating totally new kinds of cities and new kinds of work and leisure.”¹⁰ When a new mode of communication is introduced, in the short term it is used to do what people have done before, but more quickly or at less cost. Basic economics implies that this means people will communicate more. In the long term, when more things can change, peo-

⁹ Joseph Schumpeter, *Theory of Economic Development*, 64n.

¹⁰ Marshall McLuhan, *Understanding Media* (1964; Corte Madera, CA: Gingko Press, 2003), 20.

ple organise their lives or their businesses differently. Amanda Root argued that transport and communication modes create complex, non-linear patterns that can create new social connections.¹¹ Such changes do not happen overnight; they can only happen in the long term.

Social Networks

The study of networks is currently much in vogue in academia but interest in networks, under the name of graph theory, can be traced back to Euler in the eighteenth century.¹² A network comprises nodes and links, and the characteristics of those nodes and links determine the nature of the network. Nodes can be things or people and the links can be any relationship between the nodes. There are many ways of categorising networks. For example, Duncan Watts distinguished between “symbolic” networks, which can be thought of as “network representations of abstract relations between discrete entities” and “‘interactive’ networks, whose links describe tangible interactions that are capable of transmitting information, influence or material.”¹³ Here, I focus on the distinguishing features of just three types of networks: transport, communication and social.

Communication and transport were once synonymous because communication depended on transport. The two diverged with the arrival of optical telegraphy in the 1790s and, more certainly, electrical telegraphy in the 1840s.¹⁴ I follow the *Oxford Dictionary* and use the term communications to refer to the movement of information and transport to refer to the movement of people.

Looking first at transport networks, even within transport, there are different types of networks. A railway network comprises physical links, the tracks, which connect the nodes, the stations: the rail network can be described in terms of the length of its tracks and the number of its stations. In contrast, a shipping network comprises ports and routes. While ports are nodes that exist physically, the routes are not: they are representations on a map of paths fol-

¹¹ Amanda Root, “Transport and Communications,” in *Twentieth Century British Social Trends*, ed. A.H. Halsey and Josephine Webb (London: Macmillan, 2000), 437-468.

¹² Mark Newman, Albert-Lazlo Barabasi and Duncan Watts, *The Structure and Dynamics of Networks* (Princeton: Princeton University Press, 2006), 1-3.

¹³ Duncan Watts, “The ‘New’ Science of Networks,” *American Review of Sociology* 30 (2004): 243-270.

¹⁴ Daniel Headrick, *When Information Came of Age: Technologies of Knowledge in the Age of Reason and Revolution, 1700-1850* (Oxford: Oxford University Press 2000), 193; Richard Ling and Birgitte Yttri, “Hyper-Coordination via Mobile Phones in Norway,” in *Perpetual Contact: Mobile Communication, Private talk, Public Performance*, ed. James Katz and Mark Aakhus (Cambridge: Cambridge University Press, 2002), 139-169; Jonathan Sterne, “Transport and Communication,” in *Thinking with James Carey: Essays on Communications, Transportation, History*, ed. Jeremy Packer and Craig Robertson (New York: Peter Lang, 2006), 119.

lowed by ships. Thus a shipping network is measured in terms of the number of ports served, rather than the length of the routes.

Turning to communication networks, there are again different types. The postal service is an organisation that enables communication through transport networks. The telegraph and fixed-line phone networks comprise physical links, like the railway network. For example, a phone network was recently described in terms of the number of exchanges and processor units – its nodes – and kilometres of copper wire and optical fibre – its links.¹⁵

However, the physical infrastructure of communication and transport networks must be distinguished from their use. The infrastructure represents the macro level.¹⁶ At the micro level communication is the interaction between individuals. Likewise, travel is an activity that people undertake, while transport is the network that enables them to travel.

A social network is conceptually different. It is generally recognised that the idea of a social network can be traced back to Georg Simmel¹⁷ and although the concept of a social network was used in various anthropological, sociological, and psychological studies, Elizabeth Bott was probably the first to use the term in 1957.¹⁸ In a social network, the nodes are people and the links represent relationships between people. There are, of course, many different types of relationships between people and so there can be many different types of social networks, ranging, for example, from kinship and affection to business and political. But howsoever the links are defined, social networks emerge from interaction between people.

However, in a social network, there are no physical links other than those provided by the communications and transport networks. Emile Durkheim argued:

It is not true that society is made up only of individuals; it also includes material things, which play an essential role in common life. The social fact is sometimes so far materialized as to become an element of the external world. For instance, a definite type of architecture is a social phenomenon; but it is partially embodied in houses and buildings of all sorts which, once constructed, become autonomous realities, independent of individuals. It is the same with the avenues of communication and transportation.¹⁹

¹⁵ BT, *Annual Report 2006: Our UK Network Today*, <<http://www.btplc.com/report/report06/Businessreview/12a.htm>> (accessed 22 November 2009).

¹⁶ Sterne, "Transport and Communication," 127.

¹⁷ See, for example, Barry Wellman, "Structural Analysis: from Method and Metaphor to Theory and Substance," in *Social Structures: A Network Approach*, ed. Barry Wellman and S. D. Berkowitz (Cambridge: Cambridge University Press, 1988), 22-23.

¹⁸ Elizabeth Bott, *Family and Social Network* (1957; London: Tavistock Publications, 1971), 59n.

¹⁹ Emile Durkheim, *Suicide: A Study in Sociology* (1897; Florence, USA: Routledge, 2002), 278.

More recently, John Urry asked, “[S]urely there are no social networks, only material systems that realize communications, movements and the ‘occasioned encounters’ that characterise networks?”²⁰ Social networks are, however, more than transport or communications networks because much communication does not take place through any network, that is, the use of a communications network only reflects part of the underlying social network.

As Keith Sawyer put it, these physical communication and transport networks “always socially emerge from historical processes.”²¹ But those processes are different. Transport networks are developed by organisations, public or private, taking decisions to supply a service based on the perceived demand. Thus transport links are built between centres of population. To the extent that people travel to visit other people – rather than to visit places – then travel is determined by social networks. If a service is not used, the link will eventually be abandoned; if it is used, the links may be expanded. To expand, however, the railway company has to acquire more rolling stock and employ more staff, and maybe even lay more track. These things take time. Thus users, and their social network, to an extent determine the transport network, but only in the long term, as defined above.

At the macro level, the builders of communication networks do the same as the builders of transport networks in that they facilitate the links. But in the case of communications, the links are made by people interacting: it is people who send letters for instance. This is particularly marked in the case of phones, where, at the local level, it is the users rather than the infrastructure owners who determine the network. People subscribe to the network and then a link is made from the exchange to their home or office. This leads on to a very important characteristic of electronic-based networks. No one will subscribe to a communication network unless they can use it to contact others in their social network. In other words, reciprocity is required. This is most clearly seen in the case of the phone network: put plainly, there is no point having a phone if no one you know has a phone. In contrast, the railway network can be used to visit a person with no expectation that the visit will be returned. The telegraph system falls somewhere between railways and phones in this context: to the extent that a telegram forms part of an ongoing conversation, there is an expectation of a reply. Thus social networks can be said to shape communication networks in an immediate fashion.

²⁰ John Urry, “Small Worlds and the New ‘Social Physics,’” *Global Networks* 4, no. 2 (2004): 109-130.

²¹ R. Keith Sawyer, *Social Emergence. Societies as Complex Systems*. (Cambridge: Cambridge University Press, 2005), 221.

Hypotheses

Out of the above discussion of the social shaping of technology, the difference between short and long term effects and networks, I propose two key hypotheses:

- Communication networks grow out of existing social and business networks, which in turn reflect previous communication and transport networks.
- The immediate effect of a new mode of communication is to increase contact with the existing social network. In the longer run, new practices develop which may change the social and business network and in particular, increase its size by making it easier to maintain contact.

I now illustrate these by two case studies.

2. Case Study: the Creation of a Telegraphic Link between Britain and India

The development of the telegraph network can be divided into two phases: the building of land lines and the laying of submarine cables.²² “[L]and telegraphy had been a reality for two decades before underwater telegraphy came of age.”²³ First, I briefly set out the development of land lines in Britain and India respectively. Then I explore the linking of the two systems and finally look at how this link was used.

Telegraph in Britain

From 1796 an optical telegraph system was built in Britain to link naval bases to London. While messages could be sent from Deal on the south coast to London in a minute, it could only be done when visibility was good.²⁴ Several people experimented with using electricity to send messages.²⁵ However, it is generally recognised that the electrical telegraph was invented in Britain by William Cooke and Charles Wheatstone (although it is reported that Cooke was inspired by Baron Schilling’s design that he saw in Heidelberg in 1836).²⁶

²² Robert Kubicek, “Empire and Technological Change,” in *The Oxford History of The British Empire. The Nineteenth Century. Vol. III*, ed. Andrew Porter (Oxford: Oxford University Press, 2001), 251.

²³ Daniel Headrick, *The Tools of Empire* (Oxford: Oxford University Press, 1981), 157.

²⁴ Ben Marsden and Crosbie Smith, *Engineering Empires: A Cultural History of Technology in Nineteenth-Century Britain* (Basingstoke: Palgrave Macmillan, 2005), 187.

²⁵ *Ibid.*, 187-189.

²⁶ *Ibid.*, 189.

By 1839, the first electrical telegraph was operational, running along the railway from Paddington in central London to West Drayton.²⁷ By 1845, the Admiralty had a line from London to Gosport (near Portsmouth).²⁸ The Electric Telegraph Company was established in 1846.²⁹ By 1847, the last British optical telegraph line was closed.³⁰ The 1846 Electric Telegraph Act permitted the Government to take possession of the lines for security reasons (to use modern parlance) and this it did in 1848 to move against the Chartists.³¹ Thus the importance of the telegraph to the government was clear very early in its development.

As well as being of importance to the government, it was also important to business, especially in the City of London. By 1851, the prices from the Paris Stock Exchange were known on the London Stock Exchange on the same day³² and by 1854, the majority of telegrams related to business, in particular, the stock exchange.³³

Although by 1857, “most large towns in Britain were linked”³⁴, the industry within the UK was nationalised because, according to the Preamble of the Telegraph Act 1868 “many important Districts” were not covered and it would be a “great Advantage to the State, as well as to Merchants and Traders, and to the Public generally” if it were taken over by the Post Office.³⁵

Telegraph in India

Britain had been involved in India since the mid-eighteenth century and although Britain’s Empire stretched across the globe by the mid-nineteenth century, India arguably was its most important colony.³⁶ However, until 1858 its governance was in effect left to the English East India Company.³⁷ The East India Company had established a telegraph line from Calcutta (“the eastern post and centre of administration”) to Kedgerie on the Bay of Bengal by 1852, to Agra by 1853, and by 1855 there were also lines to Madras and Bombay.³⁸ So by 1856, there were nearly 7 thousand kilometres in a star shape reaching

²⁷ Ibid., 194.

²⁸ Jeffrey Kieve, *Electric Telegraph: A Social and Economic History* (Newton Abbot: David & Charles, 1973), 37.

²⁹ Marsden and Smith, *Engineering Empires*, 196.

³⁰ Ibid., 187.

³¹ Kieve, *Electric Telegraph*, 50.

³² Ibid., 51.

³³ Ibid., 119.

³⁴ Marsden and Smith, *Engineering Empires*, 197.

³⁵ Kieve, *Electric Telegraph*, 231.

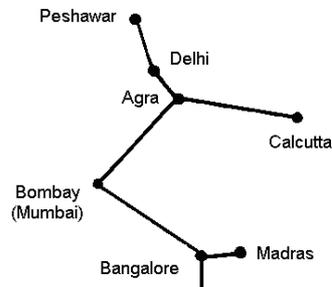
³⁶ Niall Ferguson, *Empire* (London: Penguin, 2004); Anton Huurdemann, *The Worldwide History of Telecommunications* (New Jersey: Wiley, 2003), 124.

³⁷ Ferguson, *Empire*.

³⁸ Marsden and Smith, *Engineering Empires*, 210-1.

from Peshawar in the north (now in Pakistan), through Bangalore in the south, to Bombay in the west and Calcutta in the east (figure 2).

Figure 2: Sketch Map of the Indian Telegraph System about 1855³⁹



This network played an important role in the quelling of the Indian Mutiny in 1857.⁴⁰ The Mutiny resulted in many deaths on both sides and was blamed on the policies of the East India Company.⁴¹ As a result, in 1858 the British Government took over the governance of India with the Government of India Act.⁴² Improving communications between Britain and India therefore became a priority.

Linking Britain to India

“There have historically been three routes to India”⁴³:

- “[A]cross Syria to Mesopotamia, then down the Euphrates and the Persian Gulf to the Arabian Sea”, offering easy sailing but political difficulties with the Ottoman Empire.
- “[A]cross Egypt, down the Red Sea and across the Arabian Sea,” which offered “fewer political difficulties” but difficult sailing through the Red

³⁹ Based on Christina Harris, “The Persian Gulf Submarine Telegraph of 1864,” *The Geographical Journal*, 135, no. 2 1969: 169-190; J. A. Bridge, “Sir William Brooke O’Shaughnessy, M.D., F.R.S., F.R.C.S., F.S.A.: A Biographical Appreciation by an Electrical Engineer,” *Notes and Records of the Royal Society of London*, 52, no. 1 (1998): 103-120; Hurdeman, *Worldwide History of Telecommunications*, 113-114; Marsden and Smith, *Engineering Empires*, 211.

⁴⁰ Ferguson, *Empire*, 168.

⁴¹ See, for example, D. Washbrook, “India, 1818-1860: The Two Faces of Colonialism,” in *The Oxford History of The British Empire. The Nineteenth Century. Vol. III*, ed. Andrew Porter (Oxford: Oxford University Press, 2001), 415-6.

⁴² Ferguson, *Empire*, 154; Robin Moore, “Imperial India, 1858-1914,” in *The Oxford History of The British Empire. The Nineteenth Century. Vol. III*, ed. Andrew Porter (Oxford: Oxford University Press, 2001), 424.

⁴³ Kubicek, “Empire and Technological Change,” 252-5.

Sea. (The Suez Canal was opened in 1869 although its usefulness was limited until “it was deepened and steamships were built that could use it efficiently”.) The distance from Plymouth to Bombay via Suez is almost 10 thousand km; to Calcutta, almost 12 thousand km.

- “[T]he Cape Route round Africa” was favoured by the East India Company in the early nineteenth century because it was safe, involved no transshipments and no need to negotiate passage; however, it was very long – the distance from Plymouth to Bombay by this route was nearly 17 thousand km and to Calcutta, 18 thousand km.

The time taken to communicate with India had already dropped dramatically during the nineteenth century before the electrical telegraph due to improvements in transport:

- By sailing ship. In 1820, travelling from London to Calcutta by sailing ship, took 5-8 months. “Up to the 1830s, when an Englishman corresponded with someone in India, his letter, carried around Africa on an East Indiaman, took five to eight months to reach its destination.”⁴⁴ Because the prevailing winds in the Indian Ocean are south-westerly from April to September and north-easterly from October to March, sailing to India meant leaving in the spring and returning in the autumn⁴⁵: a reply to a letter could take some two years.⁴⁶
- By steamship. By 1825, the journey from Falmouth to Bombay was 113 days in a steam-assisted ship.⁴⁷ In the 1830s mail could be sent on steamships from London in 100 days or so.⁴⁸
- By multi-modal means. Since the mid-1830s, efforts had been made to speed up communication with India⁴⁹ by combining ship, optical telegraph and train. A message from Bombay to London took four weeks.⁵⁰

By the 1850s a message from London went by train across France, by steamer to Alexandria and from Alexandria to Cairo, by camel to Suez, then by steamer to Bombay or Calcutta, where it arrived thirty to forty-five days after leaving London. The answer took an additional thirty to forty-five days, for a round trip total of two to three months.⁵¹

⁴⁴ Headrick, *Tools of Empire*, 130.

⁴⁵ Ferguson, *Empire*, 25.

⁴⁶ Headrick, *Tools of Empire*, 130.

⁴⁷ Kubicek, “Empire and Technological Change,” 252-5.

⁴⁸ Howard Robinson, *Britain's Post Office* (Oxford: Oxford University Press, 1953), 183.

⁴⁹ Headrick, *Tools of Empire*, 19, 23.

⁵⁰ Harris, “The Persian Gulf Submarine Telegraph of 1864.”; Huurdeman, *Worldwide History of Telecommunications*, 124.

⁵¹ Headrick, *Tools of Empire*, 130.

This was “time more than sufficient for the loss of an empire.”⁵²

To link Britain and India telegraphically, there were two possible routes:⁵³

- Through the Middle East and via the Persian Gulf: this was technically easier as it relied more on landlines.
 - From Malta to Alexandria, then to Suez, down the Red Sea, via Aden, to Karachi: this was technically much more challenging but considered more secure because little crossed lands outside British influence.
- Both required submarine cables.

Submarine Cables

As early as 1840, it had been claimed that it would be practical to lay a submarine cable of some 20 miles from Dover to Calais although it was not clear how this could be achieved.⁵⁴ To lay submarine cables successfully required the following:

- Insulation against salty water
- Solving the problem of high attenuation (i.e., loss) of electrical signals over long distances. It was feared that it might not actually be possible.⁵⁵
- Managing the transport of cables. The very large loads of copper and insulation required large ships.
- Laying cable smoothly under water when there could be strong currents and the condition of the ocean floor was unknown.⁵⁶

A cable was laid from Dover to Calais in 1850 but failed after less than a week: a successful link was established in 1851 and by 1853, Britain was linked with Ireland and “more than 200 European Cities and Towns.”⁵⁷ In August 1858 a cable was laid linking Britain and America, but like its cross-Channel predecessors, it was short-lived. It was also very slow: a 99 word message from Queen Victoria took “from 10.50am...to 4.30am the next day” to send.⁵⁸ In October it ceased functioning having carried only 732 messages.⁵⁹

By 1858 there was a submarine cable linking Britain with Alexandria in Egypt and a cable linking Al Faw (near Basra) in Iraq to Karachi, which was then part of India, with a landing at the port of Bashir.⁶⁰ The Red Sea and India

⁵² General Sir R. Murdoch Smith, “Sketch of the History of Telegraphic Communication between the United Kingdom and India,” *Scottish Geographical Journal* 5, no. 1 (1889): 1-11.

⁵³ Marsden and Smith, *Engineering Empires*, 211.

⁵⁴ *Ibid.*, 199, 201.

⁵⁵ *Ibid.*, 205.

⁵⁶ Hurdemann, *Worldwide History of Telecommunications*, 95-97.

⁵⁷ Marsden and Smith, *Engineering Empires*, 203, 205, 220.

⁵⁸ *Ibid.*, 209.

⁵⁹ *Ibid.*, 209.

⁶⁰ Hurdeman, *Worldwide History of Telecommunications*, 125.

Telegraph Company proposed a telegraph line across Turkish territory then from Suez to Karachi, a total of some 5 thousand km.⁶¹ It cost £800,000 (some 65 million Euros today).⁶² The first section, Suez to Aden, just under half way, was laid in 1859 and Aden to Karachi was laid in 1860. However, it was eaten by worms and encrusted with growths, and although messages were sent through portions, no message ever got through the entire length.⁶³

There was pressure from “the Establishment” – the aristocracy, the Government and the City – to build a telegraph line to India. In July 1859, in the House of Lords, Lord Stanley of Alderley, previously President of the Board of Trade (1855 to 1858) and later Postmaster General (1860 to 1866)⁶⁴

presented a Petition from Bankers, Merchants, and others, in favour of the Establishment of direct Lines of Submarine Telegraphs between Great Britain and Her Majesty’s Possessions abroad. The noble Lord said the Petition emanated chiefly from the City of London, and was signed by the Lord Mayor, the City Members, several Aldermen, several large banking firms, and most of the great commercial and mercantile houses, who all agreed in representing the importance of our possessing telegraphic communication with our foreign possessions, independent of any other nation, and in praying their Lordships to adopt such measures as might, as far as possible, promote the establishment of direct lines of submarine telegraph between Great Britain and her possessions abroad, especially India.⁶⁵

As a result of the failures of the Indian and Atlantic cables, in December 1859, the British Government established a Committee to consider the “the whole question of the construction, laying and maintenance of submarine cables.”⁶⁶ This Committee comprised eight members: half representing the Government (belonging to the Board of Trade) and half, business (the Atlantic Telegraph Company). The Committee questioned anyone who had relevant experience and produced 35 volumes of evidence.⁶⁷ *The Report of the Joint*

⁶¹ Kieve, *Electric Telegraph*, 110.

⁶² Headrick, *Tools of Empire*, 159; Kubicek, “Empire and Technological Change,” 251-252; Marsden and Smith, *Engineering Empires*, 211.

⁶³ Edward B. Bright and Sir Charles Bright, *The Life Story of Sir Charles Tilston Bright, Civil Engineer* (London, 1899) cited in Harris, “The Persian Gulf Submarine Telegraph of 1864.”

⁶⁴ Robinson, *Britain’s Post Office*, 280.

⁶⁵ United Kingdom. *Hansard House of Lords Debate*, 19 July 1859, vol. 155 (1859), cc 5-11, <http://hansard.millbanksystems.com/lords/1859/jul/19/telegraphic-communication-with-the#S3V0155P0_18590719_HOL_9> (accessed 21 August 2009).

⁶⁶ Kieve, *Electric Telegraph*, 110-1.

⁶⁷ *Report of the Joint Committee Appointed by the Lords of the Committee of Privy Council for Trade and the Atlantic Telegraph Company to Inquire into the Construction of Submarine Telegraph Cables; together with the Minutes of Evidence and Appendix* (London, 1861). This is usually found in *Accounts and Papers; Thirty-five Volumes – (24) – Harbours/Post Office: Telegraphy/Session 24 January – 28 August 1860*. Vol LXII (1860), <http://atlantic-cable.com/Article/IAR/note01.htm> (accessed 22 November 2009); also, Kieve, *Electric Telegraph*, 111.

Committee Appointed by the Lords of the Committee of Privy Council for Trade and the Atlantic Telegraph Company to Inquire into the Construction of Submarine Telegraph Cables appeared in April 1861.⁶⁸ The Committee had found that only 3 thousand of the 11 thousand miles of submarine cables laid were working and most of these were in shallow waters, defined as less than 600 feet.⁶⁹ It concluded that the Red Sea line had failed due to

the cable having been designed without regard to the conditions of the climate or the character of the bottom of sea over which it had to be laid; and to the insufficiency of the agreement with the contractor for securing effectual supervision during manufacture and control of the manner of laying.⁷⁰

Nevertheless, the Committee were optimistic and reported that “most of the technical problems of submarine telegraphy had, either by scientific investigation or through painful trial and error, been solved” and would in future “prove as successful as it had hitherto proved disastrous.”⁷¹

The Committee’s work of bringing together the expertise and drawing out the lessons to be learnt contributed to a successful link with India being achieved in 1864. India was linked to the Ottoman system so that messages would travel to Constantinople and thereby through the European networks to London.⁷² This required a submarine cable of 1,450 miles in the Persian Gulf, along the coast of Beloochistan, that avoided deep water, and was, it was hoped, not susceptible to attack “from pirates and natives.”⁷³ It was “the first instance of any great length of cable being a complete and lasting success.”⁷⁴ Christina Harris argued, “this was not a simple, scientific achievement” but also a management and political achievement⁷⁵; this is confirmed by General Sir R. Murdoch Smith’s 1889 account.⁷⁶

Although the link worked, the service provided was poor: “messages on these lines had to be retransmitted 12 to 14 times, partly by operators with a limited command of any written language, let alone English. On average it took one week to send a telegraphic message.”⁷⁷ “The state of confusion in which the messages did or did not reach their destination was something appalling”: not only were the messages “mutilated” and delayed, but also they did not

⁶⁸ *Report of the Joint Committee*, <http://www.atlantic-cable.com/Books/1861JCR/index.htm> (accessed 22 November 2009).

⁶⁹ Marsden and Smith, *Engineering Empires*, 211.

⁷⁰ *Ibid.*, 212-3.

⁷¹ *Ibid.*, 212.

⁷² Murdoch-Smith, “Sketch of the History of Telegraphic Communication.”; Harris, “The Persian Gulf Submarine Telegraph of 1864.”; Kieve, *Electric Telegraph*, 111

⁷³ Kieve, *Electric Telegraph*, 111-2.

⁷⁴ *Ibid.*, 112.

⁷⁵ Harris, “The Persian Gulf Submarine Telegraph of 1864.”

⁷⁶ Murdoch-Smith, “Sketch of the History of Telegraphic Communication.”

⁷⁷ Hurdemann, *Worldwide History of Telecommunications*, 125.

arrive in date order.⁷⁸ Nevertheless, this pre-dates the more famous Atlantic cable, which was not successfully laid until 1866.⁷⁹

To achieve a better link required not just technical solutions – new relays had to be developed that could transmit very weak signals – but also political and business solutions. These were provided by the Indo-European Telegraph Company under the guidance of the Siemens brothers, William in London and Werner, Walter and Carl in Germany and Russia. Using a private company avoided the need for difficult diplomatic negotiations and agreement was quickly reached for an 11 thousand kilometre link, including upgrading earlier links. The line ran from London to Germany, then through Poland and Russia, with a submarine cable going under the Black Sea, then through Georgia, “Persia” and on to Karachi. In April 1870 the first message was sent from London to Calcutta. (Almost simultaneously another cable was also opened by the Eastern Telegraph Company to Bombay.)⁸⁰ Except for a failure due to an earthquake in 1871, after which contact was quickly re-instated, and except for an interruption from 1914 to 1921 due to the First World War as well as political upheavals, the Indo-European Telegraph Company’s cable remained in operation until 1931.⁸¹

Use of the Telegraph

General

Data on the use of the telegraph in Britain in the nineteenth century is scarce prior to nationalisation of the industry in 1868. Its very early use is best illustrated by examples rather than numbers.

- By 1843, the telegraph had been extended to Slough near Windsor, and its power of linking “the Establishment” was demonstrated by its use to announce the birth of Queen Victoria’s second son in Windsor Castle in 1844 that resulted in three special trains being run to take “notables” to the subsequent celebratory dinner in Windsor.⁸²
- By 1844, police at Paddington railway station were identifying known criminals boarding trains and sending the information on to their colleagues in Slough.⁸³
- In 1845 Lloyds of London sent its first telegram and by 1857, agents at European ports sent regular reports to London.⁸⁴

⁷⁸ Murdoch Smith, “Sketch of the History of Telegraphic Communication.”

⁷⁹ Kieve, *Electric Telegraph*, 115; Headrick, *Tools of Empire*, 159.

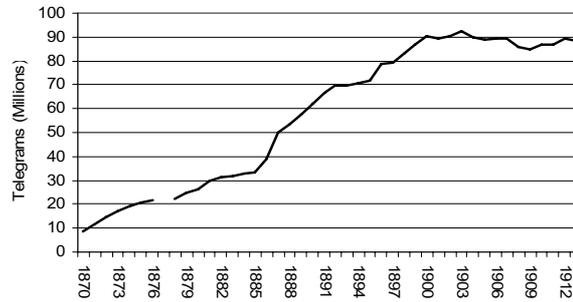
⁸⁰ Murdoch Smith, “Sketch of the History of Telegraphic Communication.”

⁸¹ Huurdemann, *Worldwide History of Telecommunications*, 125-128; Kubicek, “Empire and Technological Change,” 252.

⁸² Kieve, *Electric Telegraph*, 36-7.

⁸³ *Ibid.*, 39.

Figure 3: Telegrams Sent in Britain: 1868-1913⁸⁵



One of the major companies, the Electric and International Telegraph Company, sent 99 thousand messages in 1851, rising to 3.8 million in 1868 when five British telegraph companies transmitted some 6 million messages. Most of these messages were sent within the country but some 0.7 million, more than 10 percent, were international.⁸⁶ In Britain the telegraph was used largely for business rather than private matters, certainly in the early years, and even then only by larger firms and those dealing in speculation, such as stockbrokers, or in perishable goods. It was not used regularly by smaller businesses.⁸⁷ From 1870 to 1885, the number of telegrams sent trebled. In 1885, the price was reduced significantly⁸⁸ and by 1890 the number had sent trebled again to 90 million a year, where it remained until the start of the First World War (figure 3).

Britain and India

In the 1870s a letter might still take a month to reach Bombay, but a telegram could be sent and a reply received the same day: “messages could be telegraphed to Bombay and back in as little as 4 minutes.”⁸⁹ But in practice, most took longer. Nevertheless by 1880 there was a reasonable expectation that a telegram sent to India would be seen the next day⁹⁰ and by 1889, Murdoch Smith reported that messages from any part of the UK to any part of India took one and a half hours. This was in part due to the extension of the telegraph

⁸⁴ Hurdeman, *Worldwide History of Telecommunications*, 10.

⁸⁵ B. Mitchell, *British Historical Statistics* (Cambridge: Cambridge University Press, 1988), 564, 566.

⁸⁶ Kieve, *Electric Telegraph*, 68, 73.

⁸⁷ *Ibid.*, 129, 236; Robinson, *Britain's Post Office*, 200.

⁸⁸ Details in Kieve, *Electric Telegraph*, 289 and Robinson, *Britain's Post Office*, 204-5.

⁸⁹ Headrick, *Tools of Empire*, 130; Hurdeman, *Worldwide History of Telecommunications*, 106-7.

⁹⁰ Ferguson, *Empire*, 168-9; Kubicek, “Empire and Technological Change,” 260.

network in both Britain and India. Table 1 shows that the length of telegraph wires in Britain almost doubled from 1877 to 1893, and in India, trebled.

Table 1: Length of lines and wires in Great Britain and India: 1877 and 1893 (Km, thousand)⁹¹

	1877		1893	
	Lines	Wires	Lines	Wires
Britain	42	185	54	334
India	29	69	69	216

Given these improvements in service, it is not surprising that the number of messages sent increased dramatically, although the precise numbers reported differ:

- As soon as the link opened at the end of 1864, “a stream of telegrams at once poured in daily”⁹² and there were “on average 30 messages a day for India and ...a maximum of 175 during 1865, after the first land circuit to Calcutta opened, before the submarine lines were created.”⁹³
- However, Headrick reported that in 1870 only a “few dozen telegrams were sent” to India.⁹⁴ By 1888, some 1,000 messages were being sent daily to India.⁹⁵ Assuming 250 working days a year, this would amount to a quarter of a million. By 1895, it is reported that there were two million a year.⁹⁶

To send a telegram to India was, however, expensive: “a twenty word message on the first telegraph line to India cost 101 shillings”⁹⁷, or about 5 shillings a word. At that time a family could be kept on 20 shillings week: so this cost represented a month’s wages for a working man. By 1880, a message could be sent from Bombay to London for 4 shillings a word, 80 shillings for a twenty word message. A letter, though, could be sent for 4 pence, a third of a shilling.⁹⁸

⁹¹ Hurdeman, *Worldwide History of Telecommunications*, 140.

⁹² Murdoch Smith, “Sketch of the History of Telegraphic Communication.”

⁹³ *Distant Writing: A History of the Telegraph Companies in Britain between 1838 and 1868*, <<http://distantwriting.co.uk/companiesandforeigntraffic.aspx>> (accessed 22 November 2009).

⁹⁴ Headrick, *Tools of Empire*, 161.

⁹⁵ Murdoch Smith, “Sketch of the History of Telegraphic Communication.”

⁹⁶ Headrick, *Tools of Empire*, 161.

⁹⁷ *Ibid.*

⁹⁸ Robinson, *Britain’s Post Office*, 209.

The Impact

According to Headrick, the telegraph to India “transformed the daily routines of Anglo-Indian relations.”⁹⁹ For the government, the reason for linking Britain and India was to centralise control, and Kubicek reported that the British Foreign Office “used the telegraph as ‘the predominant means of communication’ and reduced ambassadorial discretion significantly.”¹⁰⁰ By 1870, the Foreign & Commonwealth Office (FCO) had its own telegraph lines, and officials even had lines to their homes. By 1860, there was a line to Queen Victoria’s Scottish residence, Balmoral.¹⁰¹ By the 1870s – probably earlier – there was a telegraph office in Osborne House, her residence on the Isle of Wight, and “messages from India could reach her in a matter of hours”.¹⁰² In 1885 the Colonial Defence Committee proposed “All-Red Route,” “An efficient and secure network of submarine cable communications...linking every part of the Empire without touching foreign soil.”¹⁰³

The telegraph brought about other changes, which must have affected the relationship between Britain and India.

- News reporting was transformed by Reuters and others.¹⁰⁴
- Military matters were affected, too. Because information could travel faster than people, the practice of publishing details of the departures of troop ships in effect put useful information into enemy hands and had to be discontinued from the Crimean War in 1854.¹⁰⁵ The telegraph also changed the “command and control” of warfare, by placing military commanders in reach of their respective governments.¹⁰⁶
- Businesses were transformed. Kieve noted that “[t]he cables were laid along principal trade routes,”¹⁰⁷ facilitating the start of “big business,” global finance: money markets and insurance.¹⁰⁸ The telegraph unified the commercial community and stimulated changes in the methods and organisation of distributive businesses both wholesale and retail. It made the

⁹⁹ Headrick, *Tools of Empire*, 161.

¹⁰⁰ Kubicek, “Empire and Technological Change,” 261.

¹⁰¹ Kieve, *Electric Telegraph*, 55.

¹⁰² Ferguson, *Empire*, 167.

¹⁰³ Peter Burroughs, “Defence and Imperial Disunity,” in *The Oxford History of The British Empire. The Nineteenth Century. Vol. III*, ed. Andrew Porter (Oxford: Oxford University Press, 2001), 336.

¹⁰⁴ For example, Marsden and Smith, *Engineering Empires*, 204 and Kieve, *Electric Telegraph*.

¹⁰⁵ Tom Standage, *The Victorian Internet* (London: Pheonix, 1999), 145.

¹⁰⁶ Kieve, *Electric Telegraph*, 239-40.

¹⁰⁷ *Ibid.*, 117.

¹⁰⁸ *Ibid.*, 237-8.

world market a possibility.... The telegraph was the essential medium of day-to-day communication, the post auxiliary.¹⁰⁹

It was noted above how the insurers Lloyds used the telegraph, but the telegraph transformed the shipping industry, making it more centralised.¹¹⁰ It enabled the development of the tramp steamer industry in which vessels were directed from one port to another by telegraph.¹¹¹ By the start of World War I, tramp shipping accounted for more than half of UK shipping.¹¹²

3. Case Study: the Telephones in Britain

Telephones improved on the telegraph by providing oral, synchronous communication and greater privacy, and their arrival marked the start of a long decline for the telegraph.

- "The period when the telegraph was in widespread use was brief. It declined rapidly when the telephone became available, especially after 1911."¹¹³
- "One cause of the progressive decline in the telegraph business after the mid-eighties was the growing competition of the telephone."¹¹⁴

It is, however, not possible to compare the number of telegrams and telephone calls prior to nationalisation of the telephone industry in 1912. But by 1913, there were already 10 times as many phone calls made as telegrams sent in Britain: 883 million compared to 88 million.¹¹⁵

It is difficult to get a complete picture before nationalisation in 1912 because there were then many phone companies. Phones were, however, slow to spread. By 1882, there was one phone for every 3,000 people in London; by 1890, the ratio was up to one in about 800 but it did not reach one per 100 until 1905.¹¹⁶ Adoption was slow due to high prices and poor regulation of the nascent phone industry.¹¹⁷ By 1910-12, there were some 600 thousand phones in Britain and a quarter to a third of these were in London.¹¹⁸

¹⁰⁹ Ibid., 236-7.

¹¹⁰ Byron Lew and Bruce Cater, "The Telegraph, Co-ordination of Tramp Shipping and Growth in World Trade," in *European Review of Economic History* 10, no. 2 (August 2006): 147-173, http://www.trentu.ca/economics/WorkingPapers/Lew_Cater_Telegraph.pdf (accessed 10 September 2009).

¹¹¹ Daniel Headrick, *Technology: A World History*. (Oxford: Oxford University Press, 2009), 112.

¹¹² Lew and Cater, "The Telegraph."

¹¹³ Kieve, *Electric Telegraph*, 236.

¹¹⁴ Robinson *Britain's Post Office*, 205.

¹¹⁵ Mitchell, *British Historical Statistics*.

¹¹⁶ C. R. Perry, "The British Experience," in *The Social Impact of the Telephone*, ed. Ithiel de Sola Pool (Cambridge, MA.: MIT Press, 1977).

¹¹⁷ Perry, "The British Experience."

¹¹⁸ Herbert Casson, *The History of the Telephone* (1910; Teddington: Echo Library, 2007), 87.

Herbert Casson claimed that telephone adoption in Britain was led by the aristocracy and the City of London.¹¹⁹ Once again, Queen Victoria was in the lead. Bell himself demonstrated the phone to her in 1878, following which a private line was strung to Windsor Castle¹²⁰. Initially, “private wires” were provided, which offered “exclusive communication between two or more fixed points, between offices, between homes and offices or even from the house to the stables.”¹²¹ This overcame the initial problem with such a communication network noted in the first section of this paper, namely the fact that there is no point having a phone unless others you know have phones, too. Other orders followed, most importantly, one from the bankers J.S. Morgan and Co.¹²²

Britain’s first public telephone exchange opened in Coleman St, London E.C., in August 1879 to serve eight subscribers. By the end of the year, two more had opened in London – in Leadenhall Street, E.C., and Palace Chambers in Westminster – with a total of some 200 subscribers.¹²³ Thus the public exchange network started in the financial centre, the City of London, and the centre of government. The first British phone directory was issued in April 1880 and lists a total of eight exchanges in London: to the original three had been added the Law Courts and exchanges in Chancery Lane, Bermondsey, Borough and East India Avenue in the Docklands. It is difficult to gauge exactly how many subscribers were listed because names appear in the alphabetical list that do not appear in the list by type of business. Almost all the names are of businesses with E.C. postcodes, that is, in the City of London. Table 2 analyses the 285 separate names listed by type of business. Of the merchants, many were involved in international trade, ranging from sugar to ostrich feathers. Of note are the following:

- Two were described in an 1884 London business directory as “East India merchants.”¹²⁴
- Two were dealing in sugar.
- The “Indian Rubber, Gutta Percha and Telegraph Works Co,” manufacturer of submarine cables.

Only one person appears to be listed: the Member of Parliament, Thomas Brassey, son of the famous railway engineer.¹²⁵ Overall it would appear that this was the same group who, a generation earlier, had promoted the telegraph.

¹¹⁹ Casson, *History of the Telephone*, 86.

¹²⁰ *Ibid.*

¹²¹ United Telephone Company, *List of Subscribers April 1885*, <<http://www.ancestry.co.uk>> (accessed 9 July 2007).

¹²² Casson, *History of the Telephone*, 86.

¹²³ BT, *Archives 1879*, <<http://www.btplc.com/Thegroup/BTsHistory/1851to1880/1879.htm>> (accessed 23 November 2009).

¹²⁴ *Business Directory of London 1884*. 22nd ed. London: Morris, 1884, <<http://www.historicaldirectories.org>> (accessed 19 November 2009).

Table 2: Analysis of entries in April 1880 Directory of the Telephone Company Ltd¹²⁶ (Supplemented with information from the Business Directory of London 1884¹²⁷)

<i>Type of business</i>	<i>Number</i>
Merchants/brokers/auctioneers	176
Finance (mostly stockbrokers)	45
Shipping	27
Legal	17
Other	20
<i>Total</i>	<i>285</i>

By April 1885, the *United Telephone Company* reported having 3,495 exchange subscribers, more than double the number two years previously. It claimed that it was “now supplying instruments to the Admiralty, the Metropolitan Police, the London Fire Brigade” as well as a long list of railway companies, newspapers, light companies and the “Exchange Telegraph Company” among others. It specifically gives two phone numbers for the House of Commons. It also announced that “a line from London to Brighton is now in working order” and promised that lines from London to Birmingham, Leeds and Manchester would follow as soon as possible. It reported that other companies had “in successful commercial operation” lines linking “many Northern Towns” including Liverpool and Manchester, Edinburgh and Glasgow and Newcastle and Sutherland. Furthermore, it offered the hope of longer links, reporting that in experiments conversations had been held over a distance of 1,000 miles in America and 1,500 miles in Australia.¹²⁸

By 1891, the opening page of the *List of Subscribers to the Metropolitan Exchange System* featured 18 names, from Abbott & Co to John & James Adam & Co, who had featured at the start of the April 1880 Directory.¹²⁹ Once again the list features those in the City – with an “E.C.” postcode in their address – and the shipping industry: for example

- the Aberdeen Steam Navigation Co;

¹²⁵ Bill Glover, “British Submarine Cable Manufacturing Companies,” *History of the Atlantic Cable and Undersea Communications*, <<http://atlantic-cable.com/CableCos/BritishMfrs/>> (accessed 19 November 2009).

¹²⁶ *The Telegraph Company Ltd Directory* (London, April 1880), <<http://www.ancestry.co.uk>>. (accessed 9 July 2007 and 19 November 2009).

¹²⁷ *Business Directory of London 1884*. 22nd ed. London: Morris, 1884, <<http://www.historicaldirectories.org>> (accessed on 19 November 2009).

¹²⁸ United Telephone Company.

¹²⁹ *National Telephone Company's List of Subscribers to the Metropolitan Exchange* (1891), <http://www.ancestry.co.uk> (accessed 9 July 2007).

- Mr A.C. Adam of Wandsworth who was described in the 1891 Census¹³⁰ as a ship owner from Aberdeen.

The aristocracy was represented by the Earl of Aberdeen: this was the seventh earl of Aberdeen, John Hamilton-Gordon (1847-1934) who became Governor General of Canada in 1893. Compared to 1880, though, new businesses have appeared: a railway guide company, a restaurant and a flooring company. And there is greater geographical dispersion with half of the addresses being outside the E.C. postcode. In addition, there were public “call rooms” all over London.

The link to Birmingham and northern England was established in 1890 and in 1891 a phone link was established from London to Paris, a distance of some 350 kilometres, about the same as London to Liverpool.¹³¹ However, because of technical difficulties, “transcontinental telephony” only became possible in the early years of the twentieth century and so is beyond the period considered here.¹³²

Changes in Working Practices

In 1880, the Directory suggested:

- Working practices could be made more efficient for “merchants, solicitors and managers”, for whom the telephone meant that “much correspondence, many telegrams and messages become needless.”
- It had proved particularly useful to insurance offices.
- According to “[t]he experience of brokers in the metropolitan produce market...business is done with less friction and in less time” since the opening of the “Telephone Exchanges.”

The 1885 London directory of the United Telephone Company argued that the value of an Exchange connection does not consist simply in being able to converse readily with two thousand or even twenty thousand other Subscribers, but in being able to talk to the twenty or hundred with whom every Subscriber has daily business transactions.¹³³

In other words, its value lies in connecting subscribers better with their business network. It added that there were 30,000 calls a day, which divided

¹³⁰ <http://www.ancestry.co.uk>. (accessed 9 July 2007).

¹³¹ Connected Earth, *First Encounters*. <http://www.connectedearth.com/Galleries/Shaping_our_lives/Living_with_the_telephone/First_encounters/index.htm> (accessed 27 April 2009) and BT, *Events in Telecommunications History*, <<http://www.btplc.com/Thegroup/BTsHistory/Eventsintelecommunicationshistory/Eventsintelecommunicationshistory.htm>> (accessed 27 April 2009).

¹³² Huurdeman, *Worldwide History of Telecommunications*, 228-231.

¹³³ *The United Telephone Co Ltd* (London, 1885), xiv, <http://www.ancestry.co.uk>. (accessed 9 July 2007).

over the 3,495 subscribers, averages 8 each and “there are very few subscribers who do not, on average, use their Telephones four or five times a day.”¹³⁴ It also described a range of uses for the telephone from dealing in stocks and shares, booking theatre seats, arranging urgent supplies for a hotel. All these things might have been done previously by messenger, letter or telegraph. However, it also reports on a new way of working: “the shorthand writers on the staff of the *Times* repeat the speeches from the House verbatim through the telephone direct to the compositors who set up the type at Printing House Square” – the compositors wearing special headgear to leave their hands free.¹³⁵

4. Discussion and Conclusion

Initially I set out two ideas:

- Communication networks grow out of existing social and business networks, which reflect previous communication and transport networks.
- The main immediate effect of a new mode is to increase communication with existing contacts. In the longer run, new practices develop which may change the social and business networks and in particular, increase their size by making it easier to maintain contact.

In 1894 Parkin said, “The land telegraph and submarine cables have changed the whole conditions of national life.”¹³⁶ The interesting question is how this came about. What were the processes involved? In looking at the impact of technology on imperialism, Daniel Headrick argued that it was the interaction between motives and means that resulted in the “European conquest and colonization of the eastern hemisphere in the nineteenth century” and that one of the key technologies was the telegraph.¹³⁷ In the case of the link to India, there was a clear motive of increasing control from London following the Indian Mutiny in 1857. Lord Stanley’s 1859 petition on behalf of the City of London demonstrates the business pressures. The joint committee of industry and Government in 1859-61 illustrates the determination to overcome the great technological challenges: insulation against salty water, high attenuation over long distances, the transporting and laying of cables. All demonstrate the social shaping of this technology. In other words, the new communications network, the electronic telegraph, was developed to provide for pre-existing relationships. The submarine cables were laid to meet the needs of government and trade. Once the link was established, the number of messages sent increased

¹³⁴ Ibid., xiii, xiv.

¹³⁵ Ibid., xiv, xv.

¹³⁶ George Parkin, “The Geographical Unity of the British Empire,” *Scottish Geographical Journal* 10, no. 5 (1894): 225-242.

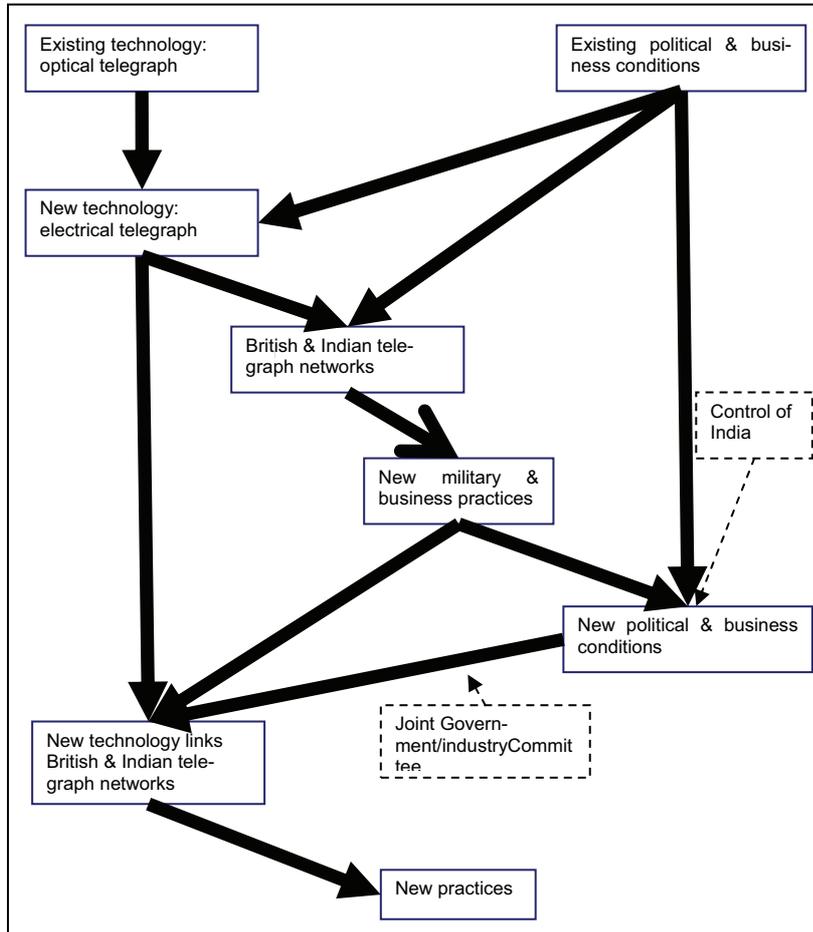
¹³⁷ Headrick, *Tools of Empire*, 9-11.

sharply and in the longer run, new ways of working developed. Figure 4 attempts to illustrate this within the framework set out in figure 1.

Although it was not possible to make intercontinental phone calls before the First World War, the history of initial development of the phone network in Britain suggests that it was growing out of the same political and business network that had generated the telegraph a generation earlier.

To sum up, the story of the telegraph is how communication and transport networks determined the social – or more precisely the political and business networks – networks, which in turn created electronic communications networks, and how in turn the evolution of the communication networks changed both the transport network and the political and business networks. It is, I suggest, a nice example illustrating the importance of the social shaping of technology.

Figure 4: Social Shaping of the Telegraphic Link between Britain and India



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