ISTITUTO DI STUDI STORICI POSTALI

COMMUNICATION AND ITS LINES
Telegraphy in the 19th century among economy, politics and technology

Symposium Proceedings
Prato, 20 September, 2002

Edited by
Andrea Giuntini

QUADERNI DI STORIA POSTALE
N. 28 - OCTOBER 2004

Communication and its lines
Telegraphy in the 19th Century
anf economy, politics and technology

Symposium Proceedings
Palazzo Datini, Archivio di Stato
Prato, 20 September 2002

Layout
Talìa consulenze per i beni e le attività culturali, Venezia

Printed by
Lito-tipografia Bertato, Villa del Conte PD

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ISBN 88-85658-21-0

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INTRODUCTION

The sensational technological progress which, in the last few years, has involved the communication sector is a unique occasion for historians, too. Everywhere in Europe and United States, many a wide project and independent research have started on 19th-20th century roots of telecommunications. These projects have been allowed by the deep changes which have happened in recent times, clearly inspired by the desire of knowing and understanding the historical origins of a phenomenon which has such a great influence nowadays. Many scholars of different origins and training have taken part in such a welcome spread, transforming the story of telecommunications in a crossroads of different and intriguing scientific routes.

All this has widely enriched our heritage, be it made by theoretical and conceptual reflections or by field research. Most contributions we are referring to are cited in the vast amount of notes contained in this volume, therefore we won't quote them here.

Nevertheless, it is worth pointing out the extreme variety of them: from the kind of studies created by Headrick, a mix of technology and political power, to the question of the regulation in the world of telegraphy, from the initiatives dedicated to Marconi, which have spread in the last few years, to the studies about large tecnhical systems and networks, up to the burst of business history in the sector – a range of extremely various subjects is imposing on the historiographic market, helping all those who approach this study with the most various purposes.

Telegraphy, too, is being the object of a new interest, thanks to which new studies have joined the few pioneer studies of the 1980s, have widened the range of the themes and renewed the sector, even from the historiographic point of view. Up to now the results seem to be reassuring and the future looks bright.

The congress held in Prato on September 20, 2002 and organised by Istituto di studi storici postali, the only Italian institute specialised in historical studies on postal and telegraphic subjects, saw the participation of some of the best international specialists: not only were they asked to present a review and a reflection regarding the state of health of the studies on the history of telegraphy, they were also asked to present their lines of research, which most of the times were innovative and stimulating. Let's remember the successful result of that crowded scientific meeting, which was full of lively discussions and of open and fruitful confrontations.

In this volume we have collected the proceedings, a collection which witnesses the significance of this scientific operation. The importance of the contributions and their authors' proved ability to catch the readers' interest confirm the soundness of the subject, without exhausting all its potentialities. The volume is only a first, dense sample of the many themes proposed by this branch of studies. Divided in the three themes of the subtitle, the proceedings spread over geography, over time and, metaforically, over the oceans and the lands where cables and wires ran endlessly, without forgetting wide historiographic territories.

Many a positive signal come from Italy, too: apart from the liveliness of our more than twenty-year old Istituto di studi storici postali, Poste Italiane has started a huge work on the history of the postal service in our Country, helping renewing and reinforcing these studies. Let's also remember the contribution of single scholars, for instance Peppino Ortoleva who, thanks to his versatility, is a real leader in this kind of studies.

In conclusion, the subject is proving to be able to collect a huge amount of works which are enriching this subject and are also changing its scientific features. The path is full of expectations which, we hope, won't be betrayed by this volume.

Andrea GIUNTINI

A METHODOLOGICAL APPROACH

Angel Calvo, *University of Barcelona*

NETWORK INDUSTRIES AND ECONOMIC DEVELOPMENT. AN ECONOMIC-HISTORICAL APPROACH *

Introduction

We happen to be living in a time of galloping globalization, in which the interweaving of computer science and telecommunications and their increasing involvement in productive forces has given rise to a new economy, with effects on the creation, circulation and consumption of knowledge [1]. According to some of the major specialists, the change regarding the economies of the previous periods have passed through the following central issues: acceleration in the creation of knowledge; an intangible capital increase; the conversion of innovation into the primary activity and the revolution in instruments of information [2].

A keen observer of the new reality faces some surprising facts related to the spread of new information and communication technologies. Indeed, taking the most spectacular case of all – the Internet – in the introduction of such technologies some of the more dynamic countries followed a similar model of behavior towards the old 'new technologies' of information and communication of the 19th century [3]. This

* This research was financed by the programs BEC2002-03890 and SGR2000-00009. I would like to thank the Institute for postal historic studies for its invitation and the participants in the Prato Symposium for their accurate remarks and comments. Certain aspects were discussed in the Conference of the Society for the History of Technology held in Toronto in 2002. Needless to say, the remaining errors are my entire responsibility.

[1] A. ECKÉS, T.W. ZEILER, *Globalization and the American Century*, Cambridge, Cambridge University Press, 2003, p. 1; B. VAN ARK, "Measuring the New Economy: An International Comparative Perspective", in *The Review of Income and Wealth*, 2002, 48, pp. 1-14; LAL (2002), p. 2; *The New knowledge economy in Europe. A Strategy for international competitiveness and social cohesion*, ed. by M.J. RODRIGUES, Cheltenham, Elgar, 2002; P. WODALL, "The New Economy; falling through the Net", in *The Economist*, 2000, September, pp. 34-39.

[2] P.A. DAVID, D. FORAY, *Economic fundamentals of the Knowledge Society*, Stanford University working paper, 2002.

[3] K. DONERT, "Virtually Geography: Aspects of the Changing Geography of Information and Communications", in GEOGRAPHY, 2000, 1, pp. 37-45; NRC, *Internet Counts: Measuring the Impact of the Internet*, Office of International Affairs, National Research Council, Washington DC, 1998.

would suggest possible historical recurrences which are typical of distribution procedures but, most of all, this leads us to consider the elements affecting differences in rhythm, chronology and intensity of similar procedures in different countries. On the other hand, the present economic power of the various countries does not necessarily correspond to their rank according to the intensity related to the distribution of new information and communication technologies [4].

In this perspective, this study will deal with the relations between network industries and long range economic development. The importance of the topic is unquestionable, since it affects essential aspects in the evolution of enterprises, such as relationship between technological change and development – in other words, the elements involved in the depth, speed and timing of great economic changes. This perspective is unusual because normally the theme is presented through the measure of the contribution of network industries to the economic growth, while in this case it is the opposite. In the end, it is interesting to know to what extent the circulation of network industries is a reflection of the economic development level achieved in the different countries. From another point of view, the experience is considered in a wide temporal perspective. Therefore, we first go over briefly the terms of the debate, and later we suggest a simple exercise in which we evaluate the levels of economic development attained by a group of countries, measured by means of their gross domestic product, and the degree of circulation of network industries. From a procedural point of view, this application follows Hargittai (2001), Wallsten (2001) and Calvo (1998), who have examined the relationship between the economic development and the expansion of new telecommunication systems in the case of Internet on one hand, and the telephone on the other [5].

Terms of debate

The new systems, i.e. electric telegraph and telephone, were part of a remarkable upsurge in technological change, which starting on the first third of the 19th century radically transformed the traditional telecommunications systems through signs, and accelerated the transmission of information [6] – these new systems were technically

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[4] Thus, in agreement with an investigation carried out by Harvard University, Spain is in the 20th place among countries best equipped with the technologies of information, whereas its economy is among the 10 major ones in the world: Center for International Development, *The Global Information Technology report 2001-2002: Readiness for the Networked World*, University of Harvard, 2002.

[5] E. Hargittai, "Weaving the Western Webb. Explaining Differences in Internet Connectivity Among OECD countries", in *Telecommunications Policy*, 1999, 23, pp. 701-718; A. Calvo, "Telephones in Spain before Telefónica (1877-1924)", in *Revista de Historia Industrial*, 1998, 13, pp. 59-81; A. Calvo, "The origins of telecommunications in Spain", in *Revista de Historia Económica*, 2001, 3, 2001; S. Wallsten, *Ringing in the 20th Century: The Effects of State Monopolies, Private Ownership, and Operating Licenses on Telecommunications in Europe, 1892-1914*, World Bank working paper, 2.690, 2001.

[6] E.J. Hobsbawm, *The age of capital, 1848-1845*, London, Weidenfeld and Nicolson, 1975; A.G.

complementary to printing and railways and reached their highest peak in the second technological revolution [7].

Without a doubt the New Economy should be recognized the merit of granting the circulation and communication of information technology a key role in the developments of recent years [8]. This estimate coincides with the relevant role that has been traditionally assigned to modern telecommunications systems in the transformation of world economy, thanks to the incentive given to the creation of great enterprises, to the mobility of the financial and transportation systems.

There are two opposing forces that have worked to transform the world telecommunications system. One of them, of a technological character, is unifying and integrating. The second is of a social and economic character and works in disintegration and diversification. As network industries, telecommunications went through their most lively period ever since A. G. Bell invented the telephone in 1876. Acceleration in technological innovation and increasing competition led to complete transformation of the types of services offered and of the limits existing among industries, as well as of people's everyday behavior. In fact, telecommunications give reliable information to specific recipients, increase transmission speed which travels at the speed of electricity and allow the creation of national and international networks up to forming a global system [9].

Telecommunications networks played an increasingly central role in the emerging theory of information. In the same way, like the previous network industries did in their respective moments, those telecommunication networks were becoming the basic means of communication of the modern economic system. In its essential quality as merchandise, information was characterized by interdependence, inalienability and outward appearance. However it should be kept in mind that information was an intangible commodity – hardly assessable – not destined to final consumption, and also a public property [10].

KENWOOD, A. LOUGHEED, *Technological diffusion and industrialization before 1914*, London-New York, St. Martin, 1982, p. 147; T. STANDAGE, *The Victorian Internet: the remarkable story of the telegraph and the nineteenth century's on-line pioneers*, New York, Berkeley Books, 1999.

[7] J. MOKYR, "Punctuated Equilibria and Technological Progress", in *The American Economic Review*, 1990, 2, p. 353; A. LUBRANO, *The Telegraph: How Technology Innovation Caused Social Change*, 1997, Garland, New York; L.J. MALONE, "Telegraphs to Incandescent Lamps: a sequential process of Innovation", in *Essays on Economics and Business History*, 1990, XVIII, pp. 123-134.

[8] M. CARPENTER, W. LAZONICK, M.O. SULLIVAN, "The stock market and innovative capability in the New Economy: the optical networking industry", in *Industrial and Corporate Change*, 5, pp. 963-1034.

[9] D.R. HEADRICK, *The Invisible Weapon. Telecommunications and international politics, 1851-1945*, New York-Oxford, Oxford University Press, 1991, p. 4.

[10] *The Economics of Information Networks*, ed. by C. ANTONELLI, Elsevier, Science of Publishers, 1992, pp. 5 ss; R.E. BABE, *Communication and Transformation of Economics*, Ottawa, Westview Press, 1995, pp. 15-16. With 'economics of information' we mean those in which all economic activities associated with the production, distribution and consumption of information grow slowly but steadily: R. CAPELLO, *Spatial Economic Analysis of Telecommunications Network Externalities*, Avebury, Aldershot, 1994, p. 5.

Such powerful action should be considered both in an economic and technical history perspective. The furthest of these perspectives might put into question the succession of the great adjustments towards a new outline in space and organization activities.

Telecommunications have been studied as «large technological systems», according to T.P. Hughes' fitting expression [11], and economic theory concentrated first of all on the characteristic of network industries and their outward aspects.

Marshall had already (1920) defined as outer economies those depending on the general development of industry. The bibliography of economic theory has particularly emphasized the characteristics of network industries [12] and the network outer aspect. The network industries shared three technological characteristics strongly influencing efficiency in the assigning of resources and the dynamics of their development. First of all, they used means of production and distribution that could not be separated in their capacities, which would presume that beyond a certain operating level increasing benefits or lower average prices would develop. Furthermore, the benefits received by the users of these systems depended largely on the pace at which other users were incorporated, implying the existence of the outer aspect from the point of view of demand. Finally, technical and economic performance of the network required the possibility of reciprocally connecting, and thus, in turn, a minimum level of compatibility and possibility of operating in common [13].

The introduction of the network concept was the consequence of three procedures. First, the fast generalized introduction of new technologies of information and communication. Second, the key role of telecommunications networks in giving the necessary inputs for the economic system. Last, the re-discovery of the crucial role of static and dynamic outer aspects in the micro-economic survey of development and change.

The study of the evolution of telecommunications seemed an appropriate context for the development of investigative instruments characterizing the general system of

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[11] E. Bijker, T.P. Hughes, T.J. Pinch, *The Social Construction of Technological Systems: new directions in the sociology and history of technology*, Cambridge, MIT Press, 1987. A. Davies, "Innovation in large technical systems: the case of telecommunications", in *Industrial and Corporate Change*, vol. 5, 4, pp. 1143-1180.

[12] Economists include in network industries Internet, e-mail, telegraph, telephone, computer hardware and software, and also music and video players among others (O. Shy, *The Economics of Network Industries*, Cambridge, Cambridge University Press, 2001).

[13] P.A. David, "Information Network Economics. Externalities, Innovation and Evolution", in *The Economics of Information Networks*, ed. by C. Antonelli, Elsevier, Science of Publishers, 1992, pp. 103-105. Also see N. Economides, "The economics of networks", in *International Journal of Industrial Organization*, 1996, 14, pp. 673-699; M. Katz, C. Shapiro, "Systems competition and network effects", in *Journal of Economic Perspectives*, 1994, 2, pp. 93-115; C. Shapiro, H. Varian, *Information Rules: A Strategic Guide to the Network Economy*, Boston, Harvard Business School, 1999; S. Leibowitz, S. Margolis, "Network externality: an Uncommon Tragedy", in *Journal of Economic Perspectives*, 1994, 2, pp. 133-150.

technological and organizational change. This meant the inclusion of the creation, introduction and distribution of technological and organizational innovations in many fields. These changes emphasized the importance of outer economies or, rather, of all the forms of interdependence among the components of an economic system that did not operate through market mechanisms, or that was not totally determined by prices. The economic analysis of the structure and development of telecommunications networks offered unique opportunities to gain the economic foundations of the increasing cooperative quality of the economic systems in the age of information, an extremely fertile area of investigation [14].

Just as we previously said, in speaking of the practical support provided by this paper, it was an investigation trend on the role of institutions in the creation and development of telecommunications systems, as well as on the frequency of the different market structures [15]. Thus, the object of this report is found among the methodological assumptions that even network industries aim at the need to fade out and establish more complex connections to make room for other elements [16].

Network industries and economic development in a historic perspective

Undeniably one of the major obstacles to implementation a study of the relations between network industries and economic growth lies in the difficulty of measuring the influence of telecommunications in general, and the telegraph in particular, on economic growth. It would not seem particularly hard to measure the impact of the creation of infrastructures on economic growth. However, when measuring in what proportion the services organized around those infrastructures contributed to the whole of the economy, the task was much more complex. As it was these so-called 'general purpose technologies' [17] which affected the economic system as a whole, it

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[14] *The Economics of Information Networks*, ed. by C. ANTONELLI, Elsevier, Science of Publishers, 1992, pp. 5ss.; e R. CAPELLO, *Spatial Economic Analysis of Telecommunications Network Externalities*, Avebury, Aldershot, 1994, p. 5.

[15] H. ESPELI, *From dual structure to state monopoly in Norwegian telephony, 1880-1974*, Norwegian school of management, working paper, 2002; S. WALLSTEN, *Ringing in the 20th century: the effects of state monopolies, private ownership, and operating licenses on Telecommunications in Europe, 1892-1914*, World Bank working paper, 2.690, 2001; R.R. JOHN, *Private enterprise, public good? Communications deregulation, as a National Political Issue, 1839-1851*, University of Illinois, working paper, 2002.

[16] E. HARGITTAI, "Weaving the Western Webb. Explaining Differences in Internet Connectivity Among OECD countries", in *Telecommunications Policy*, 1999, 23, 1011, pp. 701-718; A. CALVO, "Telephones in Spain before Telefónica (1877-1924)", in *Revista de Historia Industrial*, 1998, 13, pp. 59-81; A. CALVO, "The origins of telecommunications in Spain", in *Revista de Historia Económica*, 2001, 3; S. WALLSTEN, *Ringing in the 20th Century: The Effects of State Monopolies, Private Ownership, and Operating Licenses on Telecommunications in Europe, 1892-1914*, World Bank working paper, 2.690, 2001.

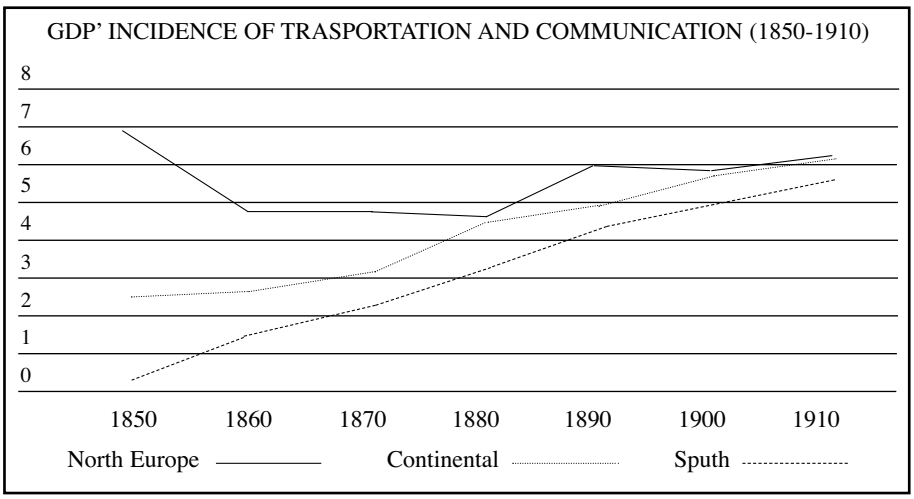
[17] P. A. DAVID, G. WRIGHT, "General Purpose Technologies and surges in productivity: historical reflections on the future of the ICT revolution", in *Discussion Papers in Economic and Social History*, University of Oxford, 31, 1999; P. A. DAVID, G. WRIGHT, "Early twentieth century American productivity

would be necessary to inquire about the impact in each and every one of the many different moments in the production procedure.

Research on the past of telecommunications does not yet correspond to the huge and increasing importance of the so-called 'invisible flows' [18] on the current information enterprise. Economic history has dedicated rather scarce attention to telecommunications. One of the main reasons is undoubtedly the fact that in spite of the expected increase in productivity, the results of empiric studies aimed at measuring the impact on economic growth have been discouraging [19].

One of the main exceptions comes from writers, who assign the historical past a decisive role in the development of telecommunications [20], or of those who feel the «need to describe how the historical procedure propels the development of vertical structures» [21].

This, at least, is what may be assumed from the data in Graph, expressing the share of transportation and communication in the GNP between 1850 and 1910.



growth Dynamics", *Abstracts in Economic History*, 2000; E. HELPMANN (ed.), *General Purpose Technologies and Economic Growth*, MIT Press, Cambridge (MA),1998; O. TAROLA, *Endogenous growth and General Purpose Technologies*, working paper, 2001.

[18] A. GIUNTINI (ed.), *Flussi invisibili. Le telecomunicazioni fra Ottocento e Novecento,* monographic issue of *Memoria e Ricerca*, 2000.

[19] A. CRETI, "Network technologies, communication externalities and total factor productivity", in *Structural Change and Economic Dynamics*, 12, 2001, p. 2.

[20] H.S. DORDICK, "The Origins of Universal Service. History as a Determinant of Telecommunications Policy", in *Telecommunications Policy*, 14, 3, 1990, pp. 223-231.

[21] J. KRAFTT, "Vertical structure of the industry and competition: an analysis of the evolution of the info-communications industry", in *Telecommunications Policy*, 27, 8-9, September-October 2003, pp. 625-649.

During this period percentages in no instances attained 7%. Considering that it is precisely the period of the onslaught of the two great information and communication technologies based on electricity – the telegraph and the telephone – the disappointment is comprehensible.

Also in this way, the telegraph, which was traditionally considered the innovative turning point in communications [22], attracted the attention of qualified international analysts [23], in good measure for their contribution to the rise of advanced industrial society [24] and the advent of increasingly more articulate markets reducing operating costs, increasing the circulation of goods and encouraging specialization [25]. The survey has centered preferably on the investigation of national situations, with little or no concern for the comparative analyses in worldwide contexts.

The new age of 'deregulation' of national telecommunication systems helped the search for the roots of the occurrence, particularly in the telephone sector. In the survey on national cases, for instance, the co-existence of local networks and public sector [26] was emphasized, or the effects of property and concession regulations [27]. Under

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[22] The revisionist stance, denying the telegraph a revolutionary change was recently upheld by Y. KAUKIAINEN, "Shrinking the world: Improvements in the speed of information transmission, c. 1820-1870", in *European Review of Economic History*, 5, 2001, pp. 1-28.

[23] R. B. DU BOFF, "The Telegraph and the Structure of Markets in the United States, 1845-1890", in *Research in Economic History*, 8, 1983, pp. 253-277; P. Israel, *From Machine Shop to Industrial Laboratory: Telegraphy and the Changing Context of American Invention, 1830-1920*, Johns Hopkins U. P., Baltimore-London, 1992; M. Davids, "The Relationship between the State Enterprise for Postal, Telegraph and Telephone Services and the State in the Netherlands in Historical Perspective", in *Business and Economic History*, 24, 1, spring 1995, 1995, pp. 194-205; P. B. ISRAEL, K. NEIR, "The Transfer of Telegraph Technologies in the Nineteenth Century", in D.J. JEREMY (ed.), *International Technology Transfer, Europe, Japan, and USA, 1700-1914*, E. Elgar, Eldershot, 1991.

[24] M. ESTABROOKS, *Electronic technology, corporate strategy, and world transformation*, Westport & London, Quorum, 1995.

[25] J. Kieve, *The electric Telegraph. A social and economic history*, Newton Abbot, London, 1973; A. D. CHANDLER, J.W. CORTADA (eds), *A Nation Transformed by Information: How Information Has Shaped the United States from Colonial Times to the Present*, O.U.P., Oxford, 2000; I. MORUS, "The nervous system' of Britain: space, time and the electric telegraph in the Victorian age", in *British Journal of History of Science*, 33, 2000, pp. 455-475; N. LAMOREAUX, K.L. SOKOLOFF, "Inventive activity and the market for technology in the United States, 1840-1920", in *NBER Working Papers Series, maggio 1999*. For a number of recent discussions, see also J. FOREMAN PECK, "Competition, Cooperation and Nationalization in the Nineteenth Century telegraph System", in *Business History*, 3, 31, pp. 81-102; C.M. CARLSSON, *New Information Technologies. The Telegraph in Sweden 1853-1883*, Summer School of the European Historical Economics Society in Lund, Sweden, unpublished document, 1999; A. FIELD, "The Telegraphic Transmission of Financial Asset Prices", in *The Journal of Economic History*, 59, 2, June 1999, p. 496; A. FIELD (1992), "The Magnetic Telegraph, Price and Quantity Data, and the New management of Capital", in *The Journal of Economic History*, 52, 1992, p. 52.

[26] H. ESPELI, *From dual structure to state monopoly in Norwegian telephony, 1880-1974*, Norwegian School of Management, working paper, 2002.

[27] S. WALLSTEN, *Ringing in the 20th Century: The Effects of State Monopolies, Private Ownership, and Operating Licenses on Telecommunications in Europe, 1892-1914*, World Bank wp, 2.690, October 2001.

particular scrutiny, with regard to the telegraph, was the extensive debate generated in the US and giving rise to the combination of regulation in postal services and 'deregulation' in telegraph services [28]. Two important lines of development in the research were the contribution to growth of services in general [29], and of transportation and communication network infrastructures [30].

The spread of the telegraph and economic development

Even though a code telegraph existed previously, the actual cause of the revolution in telecommunications was the electric telegraph. A complex, incoherent combination of observations, research and testing was necessary before the final achievements of W.F. Cooke and Ch. Wheatstone (1837) and of S.F.B. Morse made possible the development of commercial telegraphy. The technological basis of the electric telegraph was for a long time in the 1837 Morse system, which had the quality of combining a simple printing device with a code. Subsequent developments made it possible to increase synchronism and automatism, according to requirements of greater accuracy and speed in conveying a message.

In a direct way, the electric telegraph was the solution to the need to convey information rapidly to help the functioning of a new technical network, as was the railroad [31]. It was also welcomed as a powerful instrument to reinforce the security of nations, make news circulation smoother, and reduce operating costs, which are features that essentially explain their huge impact.

Since 1845 the electric telegraph spread throughout the European continent at very different rates of speed from one country to another [32]. By 1850, large territorial entities such as Great Britain, the German Empire, France, the Austro-Hungarian Empire, and also small, advanced countries such as Switzerland, had extremely widespread systems [33].

If we take the density of the lines and the number of telegrams per inhabitant as indicators, we will see that the differences in taxing equipment and utilization were

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[28] R.R. JOHN, *Private Enterprise, Public Good? Communications deregulation, as a National Political Issue, 1839-1851*, University of Illinois, working paper, 2002.

[29] O. KRANTZ, "The Transport and Telecommunication Sector in Economic Development: Views from the Historical National Accounts", in *Scandinavian Economic History*, 48, 2000, pp. 5-29.

[30] L.H. ROLLER, L. WAVERMAN, "Telecommunications infrastructure and Economic Development: A Simultaneous Approach", in *The American Economic Review*, 91, 4, settembre 2001, pp. 909-923; A. HERRANZ, *The regional distribution of Spanish transport infrastructure (1860-1930)*, forthcoming, p. 22.

[31] The main source of income of the Electric Telegraph Co., holder since 1846 of the Cooke and Wheatstone patents, were the contracts with the railroad companies.

[32] With reference to the entire sector relating to the European expansion of the telegraph, see A. CALVO, "Los inicios de las telecomunicaciones en España: el telégrafo", in *Revista de Historia Económica*, 3, XIX, 2001, pp. 613-635.

[33] *Bureau International des Administrations Télégraphiques*.

also considerable. The figures in Table 1 show that in 1873 Great Britain and Belgium were the standard, since they had the most crowded lines. From the data it can be deduced that both countries had the highest efficiency in Europe, measured according to the number of telegrams sent per person employed. These were significant countries both for their world leadership and for their advantaged positions as the center between Great Britain and Germany. The passing of time seemed to play in favor of the two more highly developed powers. Eight years before the end of the century, England and France ranked highest in use of the telegraph, according to number of telegrams per inhabitant. An already unified and resourceful Germany was overcoming its initial displacement, while Nordic countries where the telegraph had grown very rapidly were being left behind [34].

Table 1
ESTABLISHMENT OF THE TELEGRAPH IN EUROPE (1873-1892)

	density (km/sqkm) 1873	*tlgr/inhab (number)*	*density (km/sqkm) 1879*	*ca/tlgr (number)*	*tlgr/inhab 1892*
Belgium	0,68	0,471	0,812	46	0,436
Great Britain*	0,54	0,704	0,563	46	1,632
Switzerland	0,34	0,753	0,390	30	0,655
Austria	0,26	0,173	0,303	57	-
France	0,25	0,387	0,341	34	0,818
Germany	0,23	0,280	0,441	49	0,437
Itay	0,21	0,173	0,284	32	0,224
Denmark	0,17	0,282	0,217	42	0,287
Hungary	0,14	0,146	0,164	34	-
Portugal	0,07	-	-	-	-
Sweden	0,05	0,166	0,065	44	0,240
Romania	0,05	0,105	0,052	19	-
Norway	0,03	0,307	0,049	17	0,531
Spain	0,02 **	0,089	0,078	57	-
Russia	0,005	0,060	0,303	21	-
Greece	-	0,196	0,090	-	-

* In 1879 and 1892 Great Britain included also Ireland.
** Spain: 1875.

The first and third column express the relationship between longitude of the telegraph wires and the surface of the country in 1873 and 1879; the second and fifth, the number of telegrams

[34] The French electric telegraph line, the result of the subsequent implementation of the different overall projects, was held back by the imposition of telegram distribution service to the townships. Already in 1873, only 0.4% of the telegrams were due to government communications. Later, in 1896, in Austria, Belgium and the Netherlands between 50 and 55% of the telegrams were due to trade, stock market and industry operations.

per inhabitant in 1879 and 1892; the fourth, the relationship between the number of letters and telegrams.
Source: A. CALVO, "Los inicios de las telecomunicaciones en España: el telégrafo", in *Revista de Historia Económica*, 2001, 3, p. 617.

The differences among countries concerned also the formalities of the utilization of the telegraph service: public in continental Europe for administrative, military and public order reasons; private in Great Britain, where military or security requirements towards foreign countries were less important [35]. If we consider non-European experiences, the British model of private management was different from the American utilization system. The monopoly exercised in the United States by a gigantic company - Western Electric - had little in common with the cooperation among companies of different size, typical of Great Britain [36]. In turn, the American and the European models differed in management effectiveness: there was a combination of low efficiency, high unitary costs and ineffectiveness of subsidies in general in the European instance [37].

Table 1, therefore, shows a clear difference between a bloc of relatively well equipped countries and another of relatively poorly equipped countries, which essentially coincide with developed and underdeveloped countries. Up to this point there is a clear similarity with what had been predicted by the methodological premises on which this report was based.

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[35] The British telegraph remained in the hands of four large companies and several small size ones, before being nationalized in 1870.

[36] C. ADAMS, O.R. BUTLER *Manufacturing the Future. A History of Western Electric*, Cambridge University Press, 1999.

[37] In the U.S. the telegraph acquired a definite urban character after the civil war. *The Electrician*, 9 novembre 1894, p. 57.

Table 2
PER CAPITA GDP IN VARIOUS EUROPEAN COUNTRIES
AND EXPANSION OF THE TELEGRAPH, 1870

	GDP/capita *($ 1990)*	*telegraphic density (linea/ sqkm 1873)*	*ranking GDP/capita*	*ranking tel.dens.*
Great Britain	3,191	0,54	1	2
Belgium	2,697	0,68	2	1
Switzerland	2,202	0,34	3	3
Denmark	2,003	0,17	4	8
France	1,876	0,25	5	5
Austria	1,863	0,26	6	4
Germany	1,821	0,23	7	6
Sweden	1,664	0,05	8	10
Italy	1,499	0,21	9	7
Norway	1,432	0,03	10	11
Spain	1,376	0,02	11	12
Portugal	0,997	0,07	12	9

Source: A. MADDISON, *The World Economy. A Millennial Perspective*, Paris, OECD, 2001, p. 185; A. CALVO, "Los inicios de las telecomunicaciones en España: el telégrafo", in *Revista de Historia Económica*, 2001, 3, p. 617.

The necessary gradation announced among the objectives of this paper is shown in Table 2, which relates to the development level achieved by the different countries, specified by the GDP figures worked out by A. Maddison, with the degree of expansion of the telegraph, expressed by the development of the surface lines. Leaving aside the objections as to the reliability of the figures and representative quality of the selected indicators – per capita GDP on the one hand, and telegraph density on the other – we find some parallelism between columns 3 and 4, that is in the ranking of the different countries according to their per capita GDP, and according to their telegraph density. In this way, for instance, among the seven highest ranking countries in the GDP/capita level there were six with the highest telegraph density; among the four lowest ranking according to GDP/capita level there were three with the highest telegraph density. However, as far as internal rank is concerned, things were not exactly the same, to the point that there were some really surprising examples. For instance, the good ranking of Denmark according to GDP/capita and its poor performance in telegraphic density; or Austria's good position in telegraphic density, hardly comparable to its GDP/capita. All this does not lead one to think that, even if there had been a relationship between level of development and growth of the telegraph, there are other elements that should be kept in mind in an explanation of the aspects of the spread of the new technologies.

Table 3
HUMAN DEVELOPMENT INDEX (HDI) IN DIFFERENT EUROPEAN COUNTRIES AND SPREAD OF THE TELEGRAPH, 1870

	HDI	*telegr. density (TD) (km line/sqkm)*	*ranking HDI*	*ranking TD*	*TD/HDI*
Switzerland	0,515	0,340	1	3	0,66
Denmark	0,512	0,170	2	8	0,33
Great Britain	0,500	0,540	3	2	1,08
Sweden	0,483	0,050	4	10	0,10
Belgium	0,469	0,680	5	1	1,44
France	0,463	0,250	6	5	0,53
Germany	0,463	0,230	7	6	0,49
Norway	0,454	0,030	8	11	0,06
Austria	0,331	0,260	9	4	0,78
Spain	0,301	0,020	10	12	0,06
Italy	0,268	0,210	11	7	0,78

Source: N. CRAFTS, "The Human Development Index, 1870-1999: Some revised estimates", in *European Review of Economic History*, 2002, 6, pp. 395-405; A. CALVO, "Los inicios de las telecomunicaciones en España: el telégrafo", in *Revista de Historia Económica*, 2001, 3, p. 617.

Table 4
ESTABLISHMENT OF THE TELEGRAPH IN EUROPE AND ECONOMIC DEVELOPMENT (1873-1892)

	GDP/capita ($ 1990) 1870	*tlgr/inhab (number) 1873*	*tlgr/inhab (number) 1892*	*ranking GDP/capita 1870*	*ranking tel/inhab 1873*
Great Britain	3,291	0,704	1,632	1	2
Belgium	2,697	0,471	0,436	2	3
Switzerland	2,202	0,753	0,655	3	1
Denmark	2,003	0,282	0,287	4	6
France	1,876	0,387	0,818	5	4
Austria	1,863	0,173	-	6	8
Germany	1,821	0,280	0,437	7	7
Sweden	1,664	0,166	0,240	8	11
Italy	1,499	0,173	0,224	9	9
Norway	1,432	0,307	0,531	10	5
Spain *	1,376	0,089	-	11	13
Hungary	1,269	0,146	-	12	12
Russia	0,943	0,060	-	13	14
Greece	0,913	0,196	-	14	10

* Spain: 1875.

Source: elaboration based on *Bureau International des Administrations Télégraphiques* (1875); *The Electrician*, 12 gennaio 1894, p. 276; for Spain: *Anuario Estadístico de España*.

Greater differences appear if one of the indicators is changed, and relating the HDI, elaborated and examined by N. Crafts, and the spread of the telegraph (Table 3). By adding the simple ratios to the study of the ranking, there are still significant differences between the level of human development and telegraph density. The ratio seems more accurate if you again change one of the alternatives and compare the use of the telegraph, expressed in numbers of telegrams per inhabitant, and in level of development expressed as in the GDP. However, some instances of considerable differences remain, such as those of Norway, Sweden and Greece (Table 4).

Conclusion

In this report we have analyzed the long term relationships between network industries and economic development. After briefly going over the terms of the debate, a simple exercise has made it possible to relate the spread of the telegraph as a technology representing the network industries in a large group of European countries, with the level of economic development. The selected indicators were telegraph density and the indicator of use (telegrams/inhabitant) on one hand, and the GDP or the HDI on the other. In the line established by the authors lending methodological support to this paper, the above mentioned exercise made it possible to examine a clear relationship between level of development and degree of spread of the selected network industry. At the same time it emphasized the existence of instances requiring the use of supplementary elements to account for the spread of network industries.

TELEGRAPH SYSTEMSI IN DIFFERENT EUROPEAN COUNTRIES, 1873

	longitude/sqkm (km)	*telegram/employee (number)*	*product/employee (francs)*
Belgium	0,68	2.205	1.149
Great Britain	0,54	1.903	2.529
Switzerland	0,34	1.861	1.289
Germany	0,23	1.853	2.178
Hungary	0,14	1.835	2.176
Sweden	0,05	1.716	2.856
Frane	0,25	1.660	2.870
Austria	0,26	1.566	2.496
Denmark	0,17	1.484	1.702
Italy	0,21	1.318	1.932
Portugal	0,07	554	615
Rumania	0,05	798	805
Norway	0,03	1.258	2.041
Spain*	0,02	681	1.561
Russia	0,005	556	3.018

* Spain: 1874 and product per employee in pesetas.

Source: elaboration based on *Bureau International des Administrations Télégraphiques* (1875) e sull'*Anuario Oficial de Correos y Telégrafos de España, 1880-81*, 1880, pp. 176-177.

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PRIVATE ENTREPRISE AND STATE CONTROL IN TRANS-ATLANTIC TELEGRAPH (THE EARLY PERIOD)

Introduction

In this paper we propose to examine the evolution of state control in trans-Atlantic telegraphy, with particular regard to its relationship with British free trade ideals. In order to expand on this we must distinguish between operational and strategic control. The former, which equates to the day-to-day running of business by state officials, is exemplified by the Royal Mail and also by telegraph operations on the Continent. The latter, involving strategic government intervention at a more subtle level, represents an important influence on the early telegraph companies in Britain – at least until 1870 when land telegraphs truly came under operational control.

Although cable financing, cable companies and cable-laying technology were totally British during the early phase, French influence on the developing communications network might have been greater were it not for the Franco-Prussian war [38]. So, as international cable telegraphy expanded after 1870, Britain remained the dominant power and the Government could have exercised strategic control had it chosen to do so. Instead, as Cain and Headrick [39] have argued, this coincided with the aftermath of an apparent change of policy, when the Government appeared to move from a position of close involvement to one of no involvement with such enterprises. The reasons for this policy shift are easy to comprehend, although some of the manifestations are less clear and will be discussed here. Private enterprise had dominated the early forms of communications (canals and railways). In the context of state secu-

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[38] In 1865 Napoleon III convened the first meeting of the International Telegraphic Union which was held in Paris. Britain was not invited as it did not have a state controlled telegraph system.

[39] R.J. CAIN, *Telegraph Cables in the British Empire*, PhD thesis, Duke University, 1970; D.R. HEADRICK, *The Invisible Weapon: telecommunications and international politics 1851-1945*, Oxford University Press, 1991.

rity international telegraph communications could be viewed as the first strategically important communications technology to arrive after the Great Year of Revolution (1848). But when the Government become financially involved in the early cable ventures (1857-63), the experience had not been good. Accordingly, during many years the Treasury successfully blocked any attempt at Government subsidy of projects, irrespective of their strategic merits. So, during the period of relative peace between 1863 and 1895 cable telegraphs remained the realm of private enterprise, although there were those (most notably John Pender) who were not beyond taking steps that might serve the strategic interests of Empire and thereby profit his Eastern Group of Companies which became the major component of Cable & Wireless following the Imperial Wireless and Cable Conference of 1928.

It was not until there had been several crises as imperial interests (British, French, Spanish, Dutch, German and Belgian) crashed into each other in the scramble for territory that the British Cabinet appointed a committee in 1898 «to consider the control of communications by submarine telegraph in time of war». This 112 page report [40] set out precisely what should be done. Their ideal was a form of operational control that did not hinder legitimate trade interests. The control of the flow of information, as Headrick has demonstrated, became a very successful weapon of war, something that remained in place right up to the end of the telegraph era.

In spite of the perceptions at the time, the gradual extension of strategic control and the 1898 recommendations for All-Red Routes (cables which touched only British or Portuguese territory) and their total control, we will argue that there existed from the very beginning the legal instruments by which British telegraph companies could be required to pursue «the public interest».

In a future paper we will discuss the broad subject over the entire period for which telegraphy was a dominant means of trans-Atlantic communications. In this paper we will restrict ourselves to the early period and will argue that the potential for strategic control of submarine telegraphs by the British government existed from the very beginning. The key is to be found in the legislative framework that was in place, a framework that was intended to promote the interests of (British) free-trade and yet maintain a high level of behind-the-scenes state control.

The presentation of telecommunications history in terms of its legal background is not new. Kieve [41] discusses the nationalisation of the UK inland telegraph system in terms of the Parliamentary Acts that brought it about. Hall [42] has gone much deeper in his treatment of the development and regulation of all forms of telecommunications in Ireland. However, we believe that this is the first comprehensive analysis

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[40] *Public Record Office*, CAB 18/16/4.

[41] J. KIEVE, *The Electric Telegraph: a social and economic history*, Newton Abbot, David & Charles, 1973.

[42] E.G. HALL, *The Electronic Age: telecommunications in Ireland*, Dublin, Oak Tree Press, 1993.

of UK control of international communications in term of the legal instruments that brought about the private companies that operated the cables.

Communications and the British political landscape in first half of the 19th century

Time-Line 1 presents a brief summary of the early developments of communications systems in Britain. Against this background we must remember that canals had been started during the Napoleonic wars. During this time there were two political factions: the Liberals who were the champions of private enterprise (and the new middle classes) and the Tories, mostly conservative land-owners who favoured protective tariffs.

The aristocratic land-owners were big proponents of canals, but we should not overlook the implications of such a venture. After all, a canal is a 'permanent' intrusion on someone's land. A private Act of Parliament was required to establish an incorporated company even before land could be acquired and these could be prohibitively expensive. Gladwin in his book on canals [43] cites a case where the legal costs of obtaining a private Act absorbed 9% of the capital. Most of the aristocratic land-owners were vigorously opposed to the advent of railways and this is quite understandable. They saw the new technology as both a financial and a social threat. Railways were dirty and they were noisy, but above all they were fast. They threatened to take business away from the canals and thereby damage existing investment. When they could not prevent the establishment of a railway, they 'milked' it and forced costs to escalate. The omission of a single step (e.g. failure to give proper notification to a small farmer along the route) might cause the Parliamentary bill to fail. And finally, when they had done all this, MPs opposed to a railway company Act might still amend a bill by insisting on the addition or removal of clauses.

Telegraphs and the first telegraph Acts

The Admiralty (Signals Stations) Act of 1815 was intended to ensure that there were no obstacles to the establishment of lines of optical telegraphs that might be used to inform the authorities of the start of a large-scale French invasion [44]. Semaphore telegraphs, as they were also called, became less important after the Battle of Waterloo and so, for our next major development in this area, we must turn again to the railways. Kostal [45] provides an excellent account of the many private acts as well as the legislation relating to early railway companies. In this paper we will

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[43] D.D. Gladwin, *The Canals of Britain*, London, B.T. Batsford, 1973, p. 36.

[44] G. Wilson, *The Early Telegraphs*, Chichester, Phillimore & Co. Ltd, 1976.

[45] R.W. Kostal, *Law and English Railway Capitalism 1825-1875*, Oxford, OUP, 1994.

only concern ourselves with the Railway Regulation Act of 1844 [46]. This contains a particularly relevant element in Section 13: «And whereas Electric Telegraphs have been established on certain Railways and may become more extensively established hereafter and it is expedient to provide for their due Regulation: be it enacted That every Railway Company on being required so to do by the Lords of the said Committee with Servants and Workmen, at all reasonable Times to enter upon their Lands and to establish and lay down on such lands adjoining the Line of Such Railway, a Line of Electric Telegraphs for Her Majesties Service and give to him or them every reasonable facility for laying down the same, and for using the same for the Purpose of receiving and sending Messages on Her Majesty's Service, subject to such reasonable Remuneration to the Company as may be agreed».

Section 14 dictates that electric telegraphs whether belonging to the railway company or some other company must be open to the public «all Persons alike, without Favour or Preference». Section 17 describes the actions that may be taken against a railway company for failure to comply with the requirement for the provision of telegraphs. It vests power in the Board of Trade to certify infringements to the Attorney General who would then proceed against the company. So, even at this stage in the history, the instruments for Government control of private enterprise in a form of mass communications are already in place.

The establishment of telegraphs was different in some respects to canals and railways in that they did not use land; they traversed it and therefore the same issues of land acquisition did not arise. However, the early telegraph companies (inland and international) also had to have special Acts of Parliament, although the process was somewhat easier than earlier as a result of the passing of the 1844 Joint-Stock Company Registration and Regulation Act [47]. In Time-line 2 we have identified the arrival of the Electric Telegraph Co (ETC), the pioneering company that grew out of the invention of Cook and Wheatstone. The British Electric Telegraph Co. was promoted in 1849 and although strongly opposed by the Electric Telegraph Co, received its Act of Incorporation in 1850. Of particular interest here is the fact that this Act includes mention of connection to other countries (the Dover-Calais cable was laid in November 1851). In 1855 these two companies merged to become the Electric and International Telegraph Co and Parliamentary approval for this was obtained under the Electric Telegraph Consolidation Act [48]. The Atlantic Telegraph Co Act followed two years later [49]. The content of this Act is worth examining in some detail. The early parts deal with the Company's corporate structure and it is only at section 39 that the actual purpose of the Company is mentioned. Although many of the sections are com-

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[46] 7 & 8 Victoria c. 85.

[47] J. KIEVE, *The Electric Telegraph: a social and economic history*, Newton Abbot, David & Charles, 1973, p. 47.

[48] 18 & 19 Victoria c. 23.

[49] 20 & 21 Victoria c.102.

mon to all Company Acts we would like to highlight the following. Section 25 stipulates that «The principal Office of the Company and its Corporate Domicile shall be in London (sic)». Section 32 permits the appointment of honorary directors who may be from the United States or the British Colonies of North America, but the upper limit for each is defined. The Treasury has power to appoint an *ex-officio* Director (Section 33), (who was given a power of veto to protect Government interests) and to approve the appointment of every new Director (section 38). Once we get to the purpose of the Company, then the extent of the government powers continues to become apparent: «Company to lay down Lines to London in case the Government requires it» (section 41), «Plans to be approved by the Admiralty» (for any work within three miles of the shore of Britain or Ireland) (section 46), «Admiralty may order local Survey at Expense of Company» (section 47), «Electric Telegraphs to be open to the Use of Her Majesty's Government at all reasonable Times» (section 55). Section 57 is of particular interest, as it vests power in the Treasury to make arrangements and enter into agreements on behalf of any Government Department.

Section 62 gives the Government sweeping powers and will be reproduced in full. «At all times from and after the Period of Twenty-five Years from the opening of the said Lines of Telegraphic communications for the Transmission of Messages, whenever One of Her Majesty's Principal Secretaries of State for the Time being shall be of opinion that Circumstances render it expedient to vest in Her Majesty's Government the Control of the Operations of the Company, it shall be lawful for such Secretary of State, by Warrant under his Hand, to cause Possession to be taken of all the Telegraphs and Telegraphic apparatus of the various Stations of the Company, their Licensees or Assigns, for the space of One Week from the Date of such Warrant, for the Purpose of preventing any communication being made or Signals given, save such as shall be directed and authorised by any such Secretary of State, and also by further successive Warrants to cause Possession of the said Telegraphs and Telegraphic Apparatus to be retained from Week to Week so long as any such Secretary of State shall deem such Possession expedient for the Public Service: Provided always, that for every such Week which Possession shall be so retained the Company, their Licensees or Assigns, shall receive from and be paid by the Lords Commissioners of Her Majesty's Treasury the same Amount of Profits as the Company would have made in case they had continued the working of the said Telegraphs, such Profits to be computed upon an Average of the weekly Profits of the Company for Three Months immediately preceding the issuing of the First of the said Warrants».

UK telegraph legislation might be viewed as an incremental accretion of power, the assertion of increasing levels of strategic control no less potent but more subtle than the great nationalisation programmes of the 20th century British Labour governments. Control and regulation was the spirit of the Liberal Government and this is quite clear even in the title of the 1863 Telegraph Act [50] «An Act to regulate the

[50] 26 & 27 Victoria c. 112.

Exercise of Powers under Special Acts for the construction and Maintenance of Telegraphs». It was mainly concerned with land telegraphs and the main thrust of Act was to give generic powers to all telegraph companies so as to save the Parliamentary time and Company expense of seeking individual Private Acts. One of its provisions (section 6) stated «The Company shall not be deemed to acquire any Right other than that of User only in the Soil of any Street or public Road under, in, upon, over, along or across which they place any Work». This was designed to prevent the telegraph companies from acquiring any property right e.g. by limitation of actions (when the land-owner's action for trespass, ejectment etc has run out of time) or by prescription (long user)*. The Act is of particular interest for present purposes because it vests power of control over any telegraph company with the Board of Trade, who may direct a company to lay tines for Government service, if required. The Government retains the right to take over the telegraphs in the case of emergencies and section 52 has some similarities in content to section 62 of the Atlantic Telegraph Act. However, it is even more specific in the manner that control may be exercised: «the Secretary of State, by warrant under his Hand, may direct and cause the Company's Works, or any Part thereof, to be taken possession of in the Name and on behalf of Her Majesty, and to be used for Her Majesty's Service, and, subject thereto, for such ordinary Service as may seem fit; or may direct and authorise such Persons as he thinks fit to assume the Control of the Transmission of Messages by the Company's Telegraphs, either wholly or partly, and in such Manner as he directs».

Certain powers were extended downwards within the Government hierarchy. The Act specifies that if the Board of Trade, a Principal Secretary of State or other Department of Government requires the transmission of any message on Her Majesty's Service, then this shall have priority and that all other traffic must be suspended until transmission of such messages has been completed.

Finally, section 35 covers cable landings: «The Company shall not place any Work under, in, upon, over, along, or across any Estuary, or Branch of the Sea, or the Shore or Bed of any tidal Water, except with the Consent of all Persons and Bodies having any Right of Property, or other Rights, or any Power, Jurisdiction, or Authority in, over, or relating to the same, which may be affected or be liable to be affected by the Exercise of the Powers of the Company (which Consent where Her Majesty in right of her Crown is interested, may be given on behalf of Her Majesty by the Commissioners for the Time being of Her Majesty's Woods, Forests and Land Revenues, or One of them, in Writing signed by them or him)».

Conclusion

A detailed inspection of the Acts that have been cited here lead us to some interesting conclusions. Even at an early stage the Government was aware of the strategic benefits of the new means of transport and communication, both as isolated and as integrated technologies: railways for the rapid transfer of troops, railway lines for the construction of telegraph lines and telegraphs for information exchange. In general,

however, railways and telegraphs were seen as business ventures and the Acts specify the close involvement of the Board of Trade. Thus the association of the Treasury with the Atlantic Telegraph Co seems somewhat out-of-step with the practice at the time. On the other hand, control passing from the Treasury to the Board of Trade would be consistent with a desire to put telegraph companies at a more arms-length distance from Government, i.e. Treasury control might involve funding whereas Board of Trade control involves government regulation of independent and (crucially) financially self-determining enterprise.

The Atlantic Telegraph Act seems to have been relatively generous to the Company in relation to the possible level of Government control. However, the 1863 Act appears to have been much more stringent in its provisions. This is quite understandable. In granting generic powers to everyone the 1863 Act could have led to (i) floodgates risks and (ii) risk of abuse – both potentially watering down vested property interests to an unacceptable level. These risks were much reduced when specific powers were given to the Atlantic Telegraph Company alone.

Many Acts contain 'dead wood' i.e. provisions (sometimes grossly illiberal) which are quietly repealed after 100 years never having been used, but which are inserted 'just in case' they are needed. This is slightly less of an issue in the 19th century than in the 20th and 21st centuries – and UK legislation is much less notorious for this than some other countries. It might be argued that some of the provisions that we have highlighted may be 'dead wood' and that it is dangerous to rely entirely on black letter law to make historical conclusions. Nevertheless, we believe that the points which we have raised suggest that that even three years before trans-Atlantic telegraph communications became a reality, the UK Government had acquired all the powers that it might need to exercise either operational or strategic control over private companies at any time in the future. How this developed during the remainder of the cable telegraph era, particularly when foreign (American) companies became involved will be the subject of a future paper.

EARLY COMMUNICATIONS

date	*medium*	*enactment*	*notes*
1750-1800	canals	special Acts of Parliament (AP)	
1801	semaphore telegraphs	Admiralty Telegraph Act	
1835	start of railways	special AP	
1840	modern postal system		government control
1845	high point of railways	special AP	(followed by slump)
1846	incorporation of ETC	special AP	
1849	incorporation of BETC	special AP	other countries
1851	Dover-Calais link		successful
1855	ETC becomes EITC	special AP	Electric Telegraph Consolidation Act
1856	incorporation of ATC	special AP	
1857/8	1st T-A attempts		failures
1865	last attempt by ATC		failure
1866	formation of AATC	no special Act used	cable laying success
1868	moves to nationalise UK inland telegraphs		

GOVERNMENT CONTROL OF TELEGRAPHS

date	*act*	*control*	*special requirements*
1844	railway regulation act		provision of telegraph for Gov.t and public use
1846	ETC		
1849	BETC		
1855	E.T. consolidation act		
1856	atlantic telegraphic act	treasury secretaries of State	Govt priorities, where offices must be, who can be on Board
1862	companies act		
1863	telegraph act	Board of Trade Secre. of State any Govt Depart.	Govt priorities sale/lease/transfer
1866	(AATC)		
1868	telegraph act	post office	
1870	telegraph act	post office	
1885	submarine cable act	international	rights of belligerants

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PRIVATE ENTREPRISE, PUBLIC GOOD? COMMUNICATIONS DEREGULATION AS A NATIONAL POLITICAL ISSUE, 1839-1851 [51]

In June 1847, Supreme Court justice Levi Woodbury delivered a remarkable paean to the regulatory powers of the federal government. «To dream» Woodbury declared, that the Post Office Department might be supplanted by «individual enterprise» was to «dream as wildly as in the tales of the Arabian Nights». Private enterprise might conceivably meet the needs of a compact territory that was densely settled and bustling with commercial activity: «But what could it do for the county of Coos, or Tioga, or for Iowa, and Florida, and Oregon?» [52]

Woodbury's remarks had been occasioned by one of the many lawsuits in the mid-1840s that pitted the federal government against a parcel delivery company. Beginning around 1840, these companies, known popularly as private expresses, challenged the various legal restrictions on private mail delivery by providing postal patrons with a low-cost alternative to the Post Office Department on many lucrative routes in New England and the Mid-Atlantic states.

Supporters of the private expresses included David Hale and Gerald Hallock, the editors of the influential *New York Journal of Commerce*. Beginning in 1840, Hale and Hallock editorialized in support of the establishment of 'free trade' in mail delivery in the conviction that this would foster a salutary competition [53]. «Private enterprise carries the letters better, as well as cheaper, than the government mails» Hale and Hallock declared, in a typical column in February 1844 [54]. Hale and Hallock went so far as to proclaim the postal monopoly unconstitutional, and to endorse the unsuc-

[51] For suggestions and advice I am grateful to Daniel Feller, David Hochfelder, Daniel Walker Howe, Peter S. Onuf, Jeffrey L. Pasley, Edwin J. Perkins, Kenneth Silverman, and David Waldstreicher.

[52] *Washington Daily Union*, 29 June 1847.

[53] *New York Journal of Commerce*, 16July 1840, 30 July 1840.

[54] *New York Journal of Commerce*, 2 February 1844.

cessful attempt of postal reformer Lysander Spooner to bring the issue before the Supreme Court [55].

Woodbury was well aware of the challenges to the postal monopoly that its critics had raised, and met them head-on. His critique was at once historical and normative. To contend that the postal monopoly lacked a constitutional warrant was to ignore the circumstances that had existed seventy years earlier, when the federal Constitution had been originally drafted. At that time, Woodbury observed, no one could have envisioned that the Post Office Department might one day face private competition. On the contrary, such a situation had become conceivable only in the relatively recent past, with the improvement of the road network, the coming of railroads and steamboats, and the rise of «greater private enterprise and capital» [56].

Normative considerations underlay Woodbury's historical argument. The elimination of the postal monopoly, Woodbury warned, would benefit the few at the expense of the many. Should the courts dismantle the «great central regulations» that the federal government enforced, this would severely disadvantage the two-thirds of the American people who lived in the seven-eighths of the country that lay outside of the major commercial centers. No longer would these Americans be able to enjoy the postal cross-subsidies that the postal monopoly underwrote. While some contended that Congress might choose to fund these cross-subsidies out of the general treasury, Woodbury did not: like most public figures, he considered it axiomatic that the Post Office Department should, at the very least, break even. As a consequence, he considered the postal monopoly an indispensable mechanism for transferring the surpluses generated in the major commercial centers to the thousands of towns and villages in the interior. In its absence, there would be no way to subsidize the circulation of the myriad newspapers, magazines, pamphlets, and government documents that crowded the mails. The subsidized delivery of such an enormous volume of printed matter was, Woodbury argued, one of the «great peculiarities» of the American government. Without it, Americans would be deprived of intelligence of every kind, including «food for the public mind, new views, new helps, new discoveries of inventions, new principles, new reforms – in short, new improvements in everything that strengthen or adorn society».

Woodbury found the rationale for the federal regulation of communications so compelling that he extended it to embrace even the electric telegraph, a means of communication unknown to the framers of the federal Constitution. Woodbury was well aware that, for some time, a small but articulate group of promoters, newspaper editors, and congressmen had been advocating the commercialization of the telegraph as a private enterprise. Here, once again, Woodbury demurred. Under no circumstances, Woodbury warned, should the government permit «private experiments» with the new technology to override the «welfare and wants of the whole community».

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[55] *New York Journal of Commerce*, 29 February 1844, 14 March 1844.

[56] *Washington Daily Union*, 29 June 1847.

Woodbury's remarks provide a vantage point from which to explore the movement that flourished between 1839 and 1851 to limit the involvement of the federal government in mail delivery and telegraphy – at the time, the two principal forms of long-distance communication. This essay is neither a full history of this movement nor a survey of its relationship to the wider currents of American reform. Rather, it highlights certain features of its history in order to document the emergence in American public life of a new, and distinctive, understanding of the advantages and disadvantages of what we today would call communications deregulation, or what contemporaries called private enterprise.

For over fifty years, historical accounts of nineteenth-century public life have downplayed the importance in national politics of issues involving the regulatory powers of the federal government. Beginning in the 1940s, with Thomas C. Cochran's critique of the «presidential synthesis» and accelerating in the 1960s, with the rise of the 'new' social history, it has been customary to dismiss federal regulation – along with most governmental institutions – as irrelevant to the larger drama of social and cultural change [57].

Curiously enough, this neglect of federal public policy has extended even to political historians. Intent on exploring the social dimensions of public life at the grass roots, the so-called 'new' political historians often ignored national political issues altogether. Preoccupied with why voters voted, they only rarely pondered what the government did. And when political historians did turn their attention to federal public policy, they typically reduced it to nothing more than a distributive struggle over discrete and often highly particularistic outcomes, such as a land sale or a political appointment. As a consequence a host of regulatory and redistributive issues were assumed away [58].

This essay points historians of the early republic in a different direction. Building on recent scholarship on social relationships and cultural norms, it shows how the study of national political issues can raise larger questions about American public life. In particular, it reveals that, even in the supposed heyday of laissez faire, private enterprise remained a contested ideal. Not until the 1840s would public figures begin even to acknowledge the possibility that large-scale, nationwide enterprises, such as the postal system or the telegraph network, could be coordinated by institutions other than the federal government. The significance of this perceptual shift is often overlooked. To borrow a phrase from Eric Hobsbawm, private enterprise was an invented tradition, a late-Jacksonian era response to prior developments in American public life.

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[57] For a more extended critique of historical writing on the early American state, see R.R. JOHN, "Governmental Institutions as Agents of Change: Rethinking American Political Development in the Early Republic, 1787-1835", in *Studies in American Political Development*, 1997, 11, pp. 347-380.

[58] *The invention of Tradition*, E.J. HOBSBAWM, T. RANGER eds., New York, 1984.

The novelty of the idea that large-scale ventures could be coordinated by non-governmental institutions is underscored by the infrequency with which the phrase «private enterprise» occurred in the writings of the founders of the American republic [59]. The phrase was rarely used in early congressional debates, and appeared but once in the published edition of the journals of the Continental Congress. In the half century between the adoption of the federal Constitution and the Panic of 1837, the only president to invoke the phrase in a public address was Thomas Jefferson, who used it once in his 1806 message to Congress [60]. Jefferson's use of the phrase was revealing. In his address, Jefferson proposed that the federal government support the establishment of certain scientific institutions that private groups lacked the resources to endow. «Education» Jefferson observed «is here placed among the articles of public care, not that it would be proposed to take its ordinary branches out of the hands of private enterprise, which manages so much better all the concerns to which it is equal» [61].

Though Jefferson acknowledged the superiority of private enterprise in «all the concerns to which it is equal» he implicitly conceded that public support would be imperative in certain realms, such as the funding of scientific institutions. Nowhere did Jefferson imply – as would later government critics – that even complex and costly ventures were best coordinated by organizations other than the federal government. Indeed, it would be a mistake to assume that Jefferson accorded the phrase any special significance. If he had, he could have been expected to have repeated it in a variety of contexts. In fact, in a lengthy address he used it but once, as a felicitous counterpoint to «public care».

The phrase «private enterprise» remained somewhat exotic until the 1830s [62]. A few public figures, like Jefferson, invested it with positive meaning. The Post Office

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[59] For a related discussion, see R. WELTER, *The Mind of America, 1820-1860*, New York, 1975, chap. 6.

[60] These generalizations are based on an on-line search of *A Century of Lawmaking for the New Nation: Congressional Documents and Debates, 1774-1873*, an electronic library that is part of *the Library of Congress's American Memory* project.

[61] *House Journal*, 2 December 1806.

[62] To get some idea of the frequency with which Americans used the phrase 'private enterprise' in the early republic, I conducted an electronic search of the large collection of nineteenth-century machine-readable documents that are included in the *Making of America*, electronic libraries maintained by the University of Michigan and Cornell. Electronic searches must be used in conjunction with other, more traditional methods of historical inquiry, since, among other things, their utility is predicated upon the representativeness of the documents they include. Still, it is suggestive that in neither library is the phrase 'private enterprise' at all common prior to the 1830s, while, in the period between the 1830s and the Civil War, the phrase rarely occurs more than once or twice in a single book or article. Had contemporaries invested the phrase with the thick layers of meaning that it has since come to acquire, one would have expected that it would have been more frequently invoked. In most instances, contemporaries used it merely to distinguish a government project from a project that lacked government support. Only rarely did they hail it as a distinctively American achievement, and almost never did they use it to characterize a business activity (such as, for example, textile manufacturing or blacksmithing) in which the government did not engage. Searches of the Lexus-Nexus and Century of Lawmaking electronic libraries generated similar results.

Department, observed *New York Evening Post* editor William Leggett in 1835, did not own the means of conveyance upon which it relied to transmit the mail. Why, then, might not the legal restrictions on private mail delivery be abolished, and the business «safely trusted» to «private enterprise» [63]? Others considered it something of a put-down. The «grander cosmopolitan project» of a government-funded ship canal across the isthmus of Panama, one essayist warned in 1839, might well be stymied by small-scale ventures that were hostile to the «common interest of the world at large» and that could be consummated «even by private enterprise» [64].

Not until the 1840s would the phrase private enterprise become common, and only gradually would public figures begin to endorse the related idea that non-governmental institutions could coordinate large-scale ventures such as a postal system or a telegraph network.

Historians of the United States often assume that, in the United States, in contrast to Europe, big business preceded big government [65]. From the standpoint of the Progressive era, this generalization is understandable. After all, by the early twentieth century, no public agency could match the administrative capacity of private corporations such as the Pennsylvania Railroad or AT&T.

In the early republic, a different situation prevailed. While most businesses remained small, the government – including, above all, the federal government – was enormous. Within the federal government, no public agency could match the size or geographical reach of the Post Office Department. No institution of any kind employed more people, deployed more complex managerial techniques, or operated on a comparable scale. Few commanded a comparable measure of trust [66].

The large size and expansive mandate of American governmental institutions – at the state as well as the federal level – owed much to their genuine popularity. Ordinary Americans coveted a vast panoply of public works – including canals, roads, and improved mail delivery – and legislators responded [67].

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[63] W. LEGGETT, "Free Trade Post Office", *New York Evening Post*, 23 March 1835, in *A Collection of the Political Writings of William Leggett*, T. Sedgwick ed., New York, 1840, vol. 1, p. 245.

[64] "The Projected Ship Canal to Connect the Atlantic and Pacific Oceans", in *United States Magazine and Democratic Review*, 6 novembre 1839, p. 423.

[65] M. KAMMEN, "The Problem of American Exceptionalism: A Reconsideration", in *American Quarterly*, 1993, 45, pp. 22-24; T.K. MCCRAW, "Business and Government: The Origins of the Adversary Relationship", in *California Management Review*, 1984, 26, pp 42-44.

[66] R.R. JOHN, *Spreading the News: The American Postal System from Franklin to Morse*, Cambridge Mass., 1995.

[67] J. LAURITZ LARSON, *Internal Improvement: National Public Works and the Promise of Popular Government in the Early United States*, Chapel Hill, 2001; R.R. JOHN, C.J. YOUNG, "Rites of Passage: Postal Petitioning as a Tool of Governance in the Age of Federalism", in *The House and Senate in the 1790s: Petitioning, Lobbying, and Institutional Development*, K.R. BOWLING, D. R. KENNON eds., Athens, Ohio, 2002, pp. 100-138.

Prior to 1851, Congress mandated that improvements in mail delivery be funded out of postal revenue, without recourse to the general treasury. While this requirement was occasionally relaxed, it was rarely ignored. To fund popular, though expensive services – such as the low-cost circulation of newspapers and the extension of postal facilities into thinly settled regions – legislators established an ingenious regulatory regime. To keep the Post Office Department self-sustaining, postal administrators used the surplus generated on letter-postage to cover the cost of transmitting newspapers and other kinds of printed matter, and the surplus generated in the major commercial centers to maintain postal facilities in the rest of the country. In no sense were these cross-subsidies merely distributive, in the sense of providing easily divisible benefits to particular claimants. Rather, they had structural biases that reflected – and, indeed, helped to promote – policy goals that were widely shared [68].

Prior to the coming of steam-powered transportation, this regulatory regime worked reasonably well. In large measure, this was because postal administrators retained a great measure of control over the stagecoach proprietors and post riders upon whom they relied to transport the mail. Postal administrators set the schedules that stagecoach proprietors followed, and had little trouble discouraging post riders – who they themselves had appointed – from circulating mailable matter on their own private account.

With the advent of steam-powered transportation – steamboats, railroads, and ocean going steamships – the situation grew more complex. By greatly increasing the facilities for travel, these new means of conveyance enormously expanded the opportunities for travelers to carry small packages – including letters – on their persons, or, as the phrase went, «outside of the mail». No longer was the mail carriers' carrying capacity confined to the stage drivers' baggage rack and the post riders' saddlebags. And no longer did postal administrators set the schedules for the means of conveyance on which the mail carriers relied.

This novel situation created a market niche that was quickly exploited by the enterprising group of young men who founded the parcel delivery industry. The first successful parcel delivery company was established in 1839 by William Harnden, a twenty-five year old former railroad conductor. Harnden set himself up in business by advertising that, for a set fee, he would carry newspapers and small parcels by railroad and steamboat between Boston and New York. For a time, Harnden also carried

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[68] R.R. JOHN, *Spreading the News: The American Postal System from Franklin to Morse*, Cambridge Mass., 1995, chap. 2. The establishment of a regulatory regime in mail delivery provides additional support for Michael F. Holt's recent reminder that the federal regulation of economic life began long before the Interstate Commerce Act in 1887. Holt cited federal legislation enacted in 1851 to regulate steamboat boilers; another, even more elaborate regulatory regime had been established almost sixty years before 1851 with the enactment of the Post Office Act of 1792. M.F. HOLT, "Change and Continuity in the Party Period: The Substance of American Politics, 1835-1885", in *Contesting Democracy: Substance and Structure in American Political History, 1775-2000*, B.E. SHAFER, A. J. BADGER eds., Lawrence, 2002, pp. 100-114.

letters under a special arrangement with the Post Office Department. Harnden's success was assured when, following a tip from the New York newspaper vendor James W. Hale, he coordinated his trips to meet the heightened demand for high-speed communication that followed the establishment by Samuel Cunard of ocean-going steamship service between Liverpool and Boston [69].

Harnden's innovation led to the establishment of similar parcel delivery companies throughout much of New England and the Mid-Atlantic states. Like Harnden, these companies often carried letters, which as a consequence of the existing regulatory regime, they could transmit for substantially lower rates than the federal government. To avoid running afoul of the laws prohibiting competition in the letter-mail business, Harnden took various precautions. «Keep good friends with the Post Office folks» Harnden wrote a business associate in 1841, after his original contract with the Post Office Department had expired: «Gain and keep their confidence. Receive nothing mailable ... You will have no small number of Post Office spies at your heels. They will watch you very closely. See that they have their trouble for their pains» [70].

Harnden's competitors ignored his warnings and quickly became major competitors of the Post Office Department in the lucrative letter-mail business throughout much of the Atlantic seaboard and upstate New York. By 1845, private expresses and ordinary travelers were together diverting from the Post Office Department as much as two-thirds of all the correspondence in the country [71].

The rise of the parcel delivery industry raised basic questions about postal policy. If the private expresses could make large profits by underbidding the Post Office Department, why did the basic letter rate remain so high? Between 1840 and 1845, this question received a great deal of coverage in the press. During this period, individuals from throughout the country flooded Congress with petitions for «cheap postage« – including, as its centerpiece, a major reduction in the basic letter rate. Few of the major political issues of the day boasted a broader base of support. Perhaps the best measure of the popularity of cheap postage was the willingness of so many Americans to patronize the private expresses – mounting what was, in effect, a massive boycott of the federal government.

Many Congressmen opposed the letter-rate reduction that the petitioners sought. They feared, not implausibly, that such a radical change would significantly reduce the revenue that postal administrators relied upon to maintain the existing regulatory regime. Echoing their misgivings were Postmaster General Charles Wickliffe and the *Washington Madisonian*, the official organ of the Tyler administration. Taking to the

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[69] R.R. JOHN, "Private Mail Delivery in the United States during the Nineteenth Century. A Sketch", in *Business and Economic History*, 1986, 15, pp. 131-143.

[70] William Harnden to J. W. Lawrence, 25 March 1841, in A.L. STIMSON, *History of the Express Companies*, New York, 1859, p. 60.

[71] *Congressional Globe, Appendix*, 27 January 1845, p. 266.

offensive, Wickliffe intensified the legal campaign that postal administrators had long waged against their competitors [72]. By 1845, Wickliffe's subordinates had instituted hundreds of lawsuits against individual companies. This prosecutorial crusade was so elaborate that, at its height, James W. Hale, now the proprietor of his own letter-mail company, quipped that he was the 'most arrested' man in the world [73].

This combination of popular defiance and governmental intransigence occasioned a searching reevaluation of the possibilities of private enterprise. Initially, as maverick expressman Lysander Spooner would later reminisce, his critics derided the mail delivery company that he had established as «destitute of all patriotic or moral principles». Gradually, however, they came to dignify it as «private enterprise» [74]. No longer did contemporaries assume – as had, for example, Thomas Jefferson – that private enterprise must necessarily be restricted to commercial ventures that were relatively small in scale. With the rise of the private expresses, it was now plausible to envision – for the first time in American history – that even the mail delivery business might be entrusted to private companies. At the height of the private mail delivery boom, one of Harnden's former agents, Henry Wells, was reputed to have offered to take over the entire mail delivery business and run it himself [75]. Prior to the boom, such a proposal would have been quite literally inconceivable. In a similar spirit, political economist Amasa Walker offered Congress $1 million in 1844 for the rights to the postal monopoly for twenty years on the condition that he maintain the existing level of service while significantly reducing the basic letter rate [76].

Several public figures followed the lead of the *Journal of Commerce* and called for the outright repeal of legislative prohibitions on private competition. Yet such appeals were relatively rare. More characteristic was the response of a special committee of the New York Chamber of Commerce. In August 1844, this committee presented the postmaster general an open letter on postal reform. Unsurprisingly, the committee endorsed a major reduction in the basic letter rate. Yet the committee also supported new legislation to tighten the laws prohibiting private mail delivery, on the grounds that the present conveyance of letters by private expresses – «even if legal» – was not a proper source to be permanently relied on for «so responsible a trust» [77].

Public sentiment, so far as it can be gauged from petitions to Congress, expressed similar misgivings. In the early 1840s, thousands of Americans petitioned Congress

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[72] C. WICKLIFFE, "Report of the Postmaster General", *Senate Document*, 1, 28 Cong., 2nd sess., serial 449, 1844, 667-73; *Washington Madisonian*, 9 December 1843, 6 January 1844, 3 February 1844.

[73] J.W. HALE, "History of Cheap Postage", in *American Odd Fellow*, 1871, 10, p. 183.

[74] L. SPOONER, *Who Caused the Reduction of Postage in 1845?*, Boston, 1849, p. 15.

[75] A.L. STIMSON, *History of the Express Companies*, New York, 1859, p. 150.

[76] *Boston Morning Chronicle*, 12 July 1844.

[77] James De Peyster Ogden to Charles Wickliffe, 22 August 1844, in "Report of the Postmaster General," *Senate Document* 1, p. 685; and *Boston Daily Advertiser*, 26 June 1844.

to lower the basic letter rate. Yet few regarded the private expresses as anything more than a temporary expedient, even though many recognized that, by successfully underbidding the Post Office Department, these companies had provided a major impetus to the rate reductions that the petitioners desired. Should the Post Office Department match its competitors, predicted the Illinois General Assembly in 1843, the whole people might soon secure a level of service that, at present, was confined to a few: «Under a just and reasonable rate of postage, this successful competition with the public mail could never succeed» [78].

Newspaper editors voiced related concerns. Arunah S. Abell of the *Baltimore Sun* prided himself on being the first editor south of the Hudson to champion the cause of postal reform [79]. Yet Abell had little patience with what he derisively termed the «daily increasing activity and efficiency» of the private expresses, and urged Congress to reduce the basic letter rate so that these «evils» might may be averted [80]. The mail delivery business, reflected Horace Greeley in the *New York Daily Tribune*, had for many years exceeded the «powers» of private enterprise. Now the situation had changed and the federal government should respond by lowering the basic letter rate. Greeley deplored the prosecution of the private expresses: «No government is in the discharge of its rightful duty while thus seeking to repress private enterprise and industry» [81]. Yet Greeley regarded private competition as a mere temporary expedient that would hasten the long-hoped-for postal reform: «We believe one mail establishment can serve the people of the whole Union better and cheaper than a thousand warring concerns» [82].

Greeley's straddle was typical of many city editors. Private enterprise, declared an editorialist in the *Buffalo Commercial*, would hasten postal reform. And when it did, the authority to transmit letters and other mailable matter should be «exclusively vested in the government» [83]. What would happen, wondered the editors of the *Washington Daily National Intelligencer*, if the Supreme Court declared the postal monopoly unconstitutional? Without that «great regulator» the Post Office Department, how would the public be guarded from the exorbitant charges that a private combination might levy? And who would guarantee the sanctity of the mails [84]?

Even Hale and Hallock of the *Journal of Commerce* recognized that certain private expresses might endanger the public good. The occasion for this remarkable

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[78] *Senate Document* 215, 27 Cong., 3rd sess., serial 416, 1843, 1.

[79] *Baltimore Sun*, 19 March 1844.

[80] *Baltimore Sun*, 8 January 1845.

[81] *New-York Daily Tribune*, 3 October 1843.

[82] *New-York Daily Tribune*, 24 April 1844.

[83] *Buffalo Commercial*, 29 June 1844, cited in E. Perry, *Pat Paragraphs*, G.T. Turner, T.E. Stanton eds., Takoma Park, 1981, p. 305.

[84] *Washington Daily National Intelligencer*, 14 February 1844.

departure from free trade orthodoxy was the establishment by a consortium of merchants in January 1845 of a private horse express between Covington, Georgia, and Montgomery, Alabama. Such an express, Hale and Hallock warned, might well give a half-dozen men in New Orleans advance knowledge of a sudden rise in the markets in Liverpool – a valuable asset, should the New Orleans market be glutted with cotton, wheat, and other sought-after goods. Hale and Hallock found the merchants' «private enterprise» commendable, yet considered it a «nuisance» to the mercantile interests and urged that it be swiftly «countervailed» with the establishment by the Post Office Department of a competing government express [85].

Private mail delivery fared little better in Congress. Between July 1842 and March 1845, postal reform was the subject of several long and sometimes contentious debates. Though several congressmen questioned the propriety of prosecuting the private expresses, none hailed them as commendable examples of private enterprise or urged the abolition of the postal monopoly – as, for example, one congressman had in 1839[86]. On the contrary, everyone affirmed the indispensability of the existing regulatory regime. The crux of the matter, explained congressman James Buchanan of Pennsylvania, was to protect postal revenue from outside assault. What would happen, Buchanan asked, if the private expresses rendered profitless the very routes postal administrators relied on to keep the institution from running into debt? To pose the question was to answer it. Under no circumstances, Buchanan declared, should Congress permit its «unquestionable constitutional power» to be defeated by the «lawless action of individuals» [87]. Some Congressmen favored stiff new penalties to frustrate private enterprise in mail delivery; others a major reduction in the basic letter rate. Still others favored some combination of the two. On one point, everyone agreed. The private expresses must be stopped [88].

Few Congressman attacked private enterprise in mail delivery with more ingenuity than Maryland Senator William Merrick. It was «indispensably necessary» Merrick declared, to prevent by suitable legislation the «great and alarming frauds» that the private expresses had perpetrated [89]. After all, the proprietors of these companies were nothing but mere «private competing individuals» actuated by the «cupidity of gain»: the public good was far above such «mere» pecuniary considerations. Merrick conceded that an exclusive reliance on restrictive legislation could never solve the problem that the private expresses posed. In addition, he believed, Congress

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[85] *New York Journal of Commerce*, 29 January 1845. The Post Office Department did in fact establish such an express. *Washington Constitution*, 22 February 1845.

[86] *Congressional Globe*, 11 February 1839, 184.

[87] *Congressional Globe*, 22 March 1844, 423.

[88] A. Dana, "Speech of Mr. Dana, of New York, on the Post Office Bill, Washington, 1845, 5", in *Congressional Globe*, 25 February 1845, 348.

[89] *Congressional Globe*, 22 January 1844, 172.

should curry public favor by lowering the basic letter rate. Mollified by the rate reductions, the public would once again sustain the government's legal campaign against the private expresses and perpetuate the regulatory regime [90].

Merrick's compromise became a cornerstone of the Post Office Act of 1845, which simultaneously reduced postal rates while strengthening legal prohibitions on private mail delivery. The popular response to this legislation, however, fell short of Merrick's hopes. Though Congress had substantially reduced the basic letter rate, the new rate remained higher than that charged by many of the private expresses. Predictably, a few decided to risk prosecution and remain in business. «Private expresses» reported one New Hampshire newspaper editor shortly after the new law went into effect «have not been discontinued in this quarter. Far from it. They are now doing as large a business as ever, carrying letters at half the government rates... The new postage act did not abate what is called 'private enterprise', and the act itself, it is thought, will soon be found to be insufficient» [91].

Within Congress, the failure to suppress the private expresses led a growing number of legislators to call for the outright privatization of the Post Office Department. In the near future, speculated the chairman of the House post office committee in June 1848, the public good might well be better served if Congress replaced the postal monopoly with a competitive «system» that encouraged «individual enterprise». Under such an arrangement, Congress could retain the power to designate post routes and set maximum postal rates [92]. The conveyance of the mail, however, would become the prerogative not of salaried dependents but of the same kind of energetic individuals who were running the private expresses and the nascent telegraph industry [93]. It would not be long, declared one Senator a few months later, before the «present post office system» would cease to exist, with its «duties» taken over by private enterprise. It was only a matter of time before legislators took the logic of privatization to its extreme – and proposed, as did Gerrit Smith of New York did 1854 – the outright abolition of the Post Office Department [94].

In the end, however, all proposals to deregulate the Post Office Department failed. In an era that witnessed the defeat of John Quincy Adams's national program of internal improvement and the triumph of Andrew Jackson's war on the Bank of the United States, this failure is worth underscoring. How can it be explained?

The failure of postal deregulation owed something to the role that postal patronage had come by the 1840s to play in campaign finance. For the party workers who

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[90] *Congressional Globe*, 27 January 1845, 196.

[91] New-Hampshire Patriot (c. 1845), cited in Joshua LEAVITT, *Cheap Postage: Remarks and Statistics upon the Subject of Cheap Postage and Postal Reform in Great Britain and the United States*, Boston, 1848.

[92] *House Report* 731, 30th Cong., 1 sess., serial 526, 1848, 3-5.

[93] *Congressional Globe*, 19 January 1849, 301.

[94] G. SMITH, *Abolition of the Postal System*, Washington, 1854.

rallied voters to the polls, postal contracts and jobs were a highly coveted reward. For postal reformers Joshua Leavitt and Barnabas Bates, this simple fact doomed any thoroughgoing reform. The «naked truth» Leavitt editorialized in 1845, was that Congress perpetuated the postal monopoly neither for the benefit of the people, nor by virtue of any constitutional authority, but to provide party leaders with jobs for their supporters [95]. Political exigency, Bates confided to one-time expressman Lysander Spooner in 1851, derailed Bates's attempt to secure from the federal government an exclusive franchise to transmit the mail. Bates had failed – or so Bates assumed – because Congress insisted on maintaining the Post Office Department for «electioneering purposes» [96].

Partisan imperatives furnished postal reformers like Leavitt and Bates with a convenient explanation for their inability to secure the reforms that they sought. Yet they cannot explain the failure of postal deregulation. Far more important was the reluctance of Congress to buck public opinion and dismantle the existing regulatory regime. Though thousands of Americans had patronized the private expresses in the early 1840s, only a few joined Hale and Hallock of the Journal of Commerce in championing private enterprise as a permanent alternative to the Post Office Department. Of the hundreds of petitions on postal topics that found their way to Congress during the 1840s, for example, few praised the private expresses, while none called for the outright abolition of the Post Office Department. What petitioners sought, instead, was the elimination of special privileges for government officials, improvements in the level of service, and, most important of all, a major reduction in the basic letter rate. Popular pressure proved so compelling that, in 1851, Congress lifted a major constraint upon postal expansion. Henceforth postal revenue no longer had to cover postal expenses, making it possible for Congress to cut postal rates – as it did in 1851 – without a countervailing reduction in the level of service [97].

Postal improvements, in short, were popular, while private mail delivery was not. Should Congress permit private competition, explained Missouri congressman Willard P. Hall in 1851, it would be well advised to get out of the mail delivery business altogether. Yet such a radical proposal, Hall added, had the support neither of Congress nor of the «people of the country» [98]. The existing regulatory regime, lawyer Charles M. Ellis declared at about the same time in an unusually forthright statement of a common view, was not a monopoly in its «odious sense». In a «democratic state of society» Ellis posited, a monopoly deprived the people of the ability to control the means of communication through «united and efficient action». In no sense

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[95] *Boston Morning Chronicle*, 12 September 1845.

[96] "Barnabas Bates to Lysander Spooner, 16 marzo 1851", in *Lysander Spooner Papers*, Boston Public Library.

[97] W.E. FULLER, *The American Mail: Enlarger of the Common Life*, Chicago, 1972, p. 65.

[98] *Congressional Globe*, 14 January 1851, pp. 234-235.

was this true of the Post Office Department. For reasons vital to the public welfare, the federal government had an obligation to put everyone on an equal footing in the «transmission of intelligence» by making it «as free, as quick, as sure and as cheap as the light of day». Should a private mail delivery company ever rival the federal government in its «completeness» it would be the «most dangerous power in the State» [99].

The telegraphy

A comparable faith in the regulatory power of the federal government shaped the initial public response to telegraphy. Electric telegraphy was new in the 1840s, and it was by no means obvious to contemporaries how it was going to be commercialized, or even whether it would promote the public good. These anxieties are worth underscoring, since they are often forgotten. From the outset, newspaper editors, merchants, and public figures from almost every corner of the United States hailed the new technology as the greatest invention of the age. Almost no one questioned the desirability of facilitating high-speed – and, at least in theory, instantaneous – communication between far-flung localities [100]. Accompanying this euphoria, however, was a strong undercurrent of concern. The new technology was so powerful, its critics warned, that, were it not properly regulated, it might well prove less of a blessing than a curse.

The appeal of federal control helps explain why the first telegraph line in the United States to be open to the public – a forty-mile line between Washington and Baltimore – was financed out of general revenue and administered during its first two years by the Post Office Department. Among the most tireless champions of federal control was Samuel F. B. Morse, the painter-turned-inventor whose ownership of a majority share in a key telegraph patent gave him a major voice in the early history of the industry. Morse fervently believed that the federal government should own the rights to his patent – which, with a self-confidence bordering on arrogance, he presumed to cover every important feature of the new technology. In pursuit of this goal, Morse secured federal support for experiments that culminated in 1844 with the successful demonstration of the commercial possibilities of electric telegraphy and in 1845 with the opening of the Washington-Baltimore line.

Morse's faith in federal control antedated by almost a decade the commercialization of the new technology. «It would seem most natural» Morse observed in 1837, to «connect a telegraphic system with the Post Office Department; for, although it does not carry a mail, yet it is another mode of accomplishing the principal object for

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[99] C. M. Ellis, "The Postal System Exclusive", in *Massachusetts Quarterly Review*, 10 March 1850, pp. 271-274.

[100] J.W. Carey, *Communication as Culture: Essays on Media and Society*, Boston, 1989, pp. 201-230; D.J. Czitrom, *Media and the American Mind From Morse to McLuhan*, Chapel Hill, 1982, pp. 8-14.

which the mail is established, to wit: the rapid and regular transmission of intelligence» [101].

Morse predicated his postal analogy on the expansive role that the Post Office Department had come since the 1820s to assume in the circulation of time-specific information. Beginning with Postmaster General John McLean, a succession of postal administrators had proclaimed that the federal government had an obligation to transmit information faster than any possible rival. In an age when merchants could make fortunes overnight by running private horse expresses to outpace the mails, this federal guarantee was vital to the thousands of planters and farmers who were dependent on foreign markets for the sale of their crops. Federal control, Morse predicted, would prevent the few from defrauding the many. Should Congress leave telegraphy to speculators to monopolize for themselves, Morse warned, it might easily become the means of enriching a single corporation while causing the «bankruptcy of thousands» [102].

Equally disturbing for Morse was the possibility that the federal government might monopolize the new technology by itself. Such an arrangement, Morse warned, might well work «vast mischief». The optimal form of federal control, instead, was a mixed enterprise in which the federal government retained the exclusive right to the new technology by virtue of its ownership of the key patents – including, of course, Morse's own. Under such a scheme, the federal government could designate a number of lines for its own use. The core of the network, however – the «private telegraphs» as Morse termed them – would be built and maintained by investors upon payment to the federal government of a licensing fee that granted them exclusive rights to specific routes. In this way, the federal government would possess the communication facilities it needed, while encouraging a general competition among investors governed by whatever regulations legislators might think proper. Such «checks and preventives of abuse» Morse predicted, would harness this «otherwise dangerous power» to the public good. Given the enterprising character of Americans, Morse predicted, it was «not visionary» to suppose that before long the whole surface of the country would be «channeled» for those «nerves which are to diffuse, with the speed of thought, a knowledge of all that is occurring throughout the land; making, in fact, one neighborhood of the whole country» [103]. Prior to 1847, every contract that Morse entered into specified that Congress retained the right to purchase his patent for a mutually agreed-upon sum. After 1847, Morse and his business associates struggled doggedly – though, ultimately, with limited success – to exploit the new technology in an orderly fashion by using their ownership of Morse's patent to enforce common procedures for companies wishing to enter the market.

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[101] Samuel F. B. Morse a Levi Woodbury, 27 September 1837, *House Document* 15, 25 Cong., 2nd sess., serial 322, 1837, 31.

[102] Samuel F. B. Morse a Francis O. J. Smith, 15 February 1838, *House Report* 753, 25 Cong., 2nd sess., serial 335, 1838, 8.

[103] Morse to Smith, 15 February 1838, *House Report* 753, pp. 8-9.

Similar, though usually less elaborate, plans for federal control had broad support in the press. Early on, many editors regarded a federal buy-out of Morse's patent as inevitable, if only because, like the private expresses, private telegraph companies threatened to deprive the Post Office Department of a great deal of revenue. Others looked to federal control as a safeguard against speculative fraud and abuse. Private enterprise, declared James Gordon Bennett of the New York Herald in April 1845, was fast erecting telegraph lines in many directions, yet the public interest would be much more securely promoted should the federal government undertake the arrangement [104]. It must be «clear to every one» declared James Watson Webb of the *Morning Courier and New-York Enquirer*, at about the same time, that no private enterprise should be permitted to use the new technology for «private and exclusive purposes». On the contrary, the federal government should control it, and make «such a disposition of its vast powers as should most conduce to the public welfare» [105]. So enormous were the dangers of speculation, editorialized William M. Swain of the *Philadelphia Public Ledger* the following October, that the federal government might even find it advisable to prohibit anyone other than a government official from transmitting a message over the wires [106].

Some contemporaries openly doubted whether telegraphy could be administered as a public-private joint venture, as Morse had hoped. Congress had erred in permitting the new technology to be commercialized by a «private company» warned a New York newspaper correspondent in 1845 who styled himself «Mercator» since no governmental body could devise regulations sufficiently stringent to «shut out the chance, not to say probability, of its abuse». Should the «vast monopoly» fall into the hands of speculators, Mercator warned, an indignant public could be expected to rise up and destroy its property immediately after it learned of the first major speculation to have made use of its «agency» [107].

The merits of federal control were recognized even by stalwart champions of private enterprise. Should telegraphic promoters refuse the 'privilege' of sending and receiving telegraphic dispatches to anyone willing to pay a reasonable fee, Hale and Hallock reflected in the *Journal of Commerce* in January 1845, private control of an «instrumentality so powerful» would be a «public nuisance» that should not to be tolerated [108]. And were speculators to gain control of the new medium, Hale and

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[104] *New York Herald*, 22 April 1845.

[105] *Morning Courier and New-York Enquirer*, 21 April 1845.

[106] *Philadelphia Public Ledger*, 31 October 1845: «Perhaps the best security» Swain speculated «would be in the prohibition of all private correspondence. Some will say that this would render the telegraph nearly useless. We grant that it would to speculators, and we add that for mercantile speculations only will it be much used in private correspondence, excepting during elections».

[107] *Morning Courier and New-York Enquirer*, 22 April 1845.

[108] *New York Journal of Commerce*, 11 January 1845.

[109] *New York Journal of Commerce*, 18 November 1846.

Hallock warned in November of the following year, this would be an «evil of no ordinary magnitude» that would require the prompt intervention of the strong arm of the law. The reluctance with which even such fervent champions of private enterprise endorsed the privatization of telegraphy was perhaps the most telling evidence of the extent to which its future remained contested. Nineteen months after the telegraph had made its commercial debut, the editors of one of the most influential commercial newspapers in the country remained uncertain as to whether the new technology would be a «public blessing» or a «public nuisance» [109].

Editorial support for federal control owed a good deal to the uneasiness with which editors contemplated the disruptive effects of telegraphy on their own news-gathering efforts. Some editors worried that private telegraph companies might discriminate against their newspaper in ways that would benefit their rivals. Others worried that the new technology would raise the cost of news-gathering. Telegraphic dispatches were expensive, and, at least initially, it was far from self-evident that newspapers would receive favorable rates. At present, observed the editor of the *Baltimore Patriot*, newspaper editors enjoyed under federal law the right to exchange with each other an unlimited number of newspapers free of charge. These exchanges, in turn, provided editors with the bulk of the news that they relied on to fill their columns. Should the Post Office Department retain control of the new technology, this policy would presumably be maintained; if it devolved upon private enterprise, however, it might well be abandoned. In either event, the postmaster general should work with the private telegraph companies to ensure the free circulation of all information «important or interesting to the whole people». The cost of this information, in turn, should be borne by those individuals who used the telegraph for «private benefit or speculation» – by analogy with the longstanding presumption that the postage on merchants' letters subsidized the exchanges upon which editors relied for their news: «This will be found, we are sure, to be the true policy of the telegraphs, whether regard be had to their profits or to their use». Should this policy be adopted, editors would continue to receive news broadcasts free of charge «as in the case of the exchange papers in the ordinary mail» [110].

This constellation of concerns helps explain why federal control of telegraphy had the backing of four of the most widely circulated newspapers in the country – the *New York Sun*, the *New York Herald*, the *Baltimore Sun*, and the *Philadelphia Public Ledger* [111]. The editors of the 'penny press', as these newspapers would come to be known, had been quick to fault the Post Office Department for high rates and poor service. Indeed, they were among the leading champions of postal reform. These criticisms notwithstanding, they remained skeptical of all proposals to privatize the new

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[110] *Baltimore Patriot*, 14 November 1845, 21 May 1846.

[111] *New York Sun*, 29 November 1845, 18 December 1845, 13 February 1846, 4 February 1847; *New York Herald*, 22 April 1845; *Baltimore Sun*, 15 November 1844, 23 November 1844, 9 December 1845, 17 December 1846; *Philadelphia Public Ledger*, 7 June 1844, 15 May 1845, 29 and 31 October 1845.

technology. It was not hard to see why. In contrast to their more expensive, better-established rivals – such as the *Morning Courier* and the *Journal of Commerce* – the penny papers were dependent for revenue on daily sales rather than annual subscriptions. As a consequence, their editors were extremely sensitive to anything that might affect their access to a steady stream of cheap and abundant up-to-date news.

Editorial support for federal control persisted even after private companies had begun to extend lines to the major commercial centers. «Public opinion» declared the editor of the Philadelphia-based *Pennsylvania Inquirer* in June 1846, was «decidedly in favor» of a federal takeover of the various telegraph lines that private individuals had established. A federally owned and operated telegraph, the editor predicted, would reduce rates and improve service. The many individuals who had built up the telegraph industry during the past year deserved great credit for their «enterprise and perseverance» yet such a «vast engine of communication» should be in the hands of the federal government under proper regulations [112].

Even critics of federal control acknowledged its popularity. Though he himself favored the commercialization of the telegraph as a private enterprise, Jeremiah Hughes of *Niles's National Register* acknowledged that his views were unique, at least within the press. «All the other public journals that expressed opinions» Hughes observed in September 1846, «appeared to urge the government to make the telegraph a government monopoly». Impatience with private enterprise, Hughes inferred, was a logical counterpart of the universal desire to expand the telegraph network rapidly, since it was taken-for-granted that the federal government could construct new lines faster than even the most enterprising of private companies [113].

Perhaps the most careful student of popular sentiment on the telegraph issue was Morse's business agent, Amos Kendall. Federal control – or so Kendall reported to Morse's business partner, Francis O. J. Smith, in a series of confidential letters in 1845 – was broadly popular, making it imperative that the patentees not foreclose the possibility of a government sale. It was «all important» Kendall lectured Smith shortly after the opening of the Washington-Baltimore line, to keep «public opinion with us» [114]. Most telegraph investors, Kendall explained in 1846 to the chairman of the House committee on the post office and post roads, opposed such the sale of Morse's patent to the government. Nonetheless, Kendall added, the owners of Morse's patent felt themselves called upon by public opinion to «hold this great instrument of wealth and power» at the disposition of the federal government for a «reasonable consideration» [115].

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[112] Cited in *Washington Daily National Intelligencer*, 18 June 1846.

[113] *Niles's National Register*, 26 September 1846.

[114] Kendall to Smith, 12 and 31 August, 1st September, 4 December 1845, *Francis O. J. Smith Papers*, Maine Historical Society. The quotation is from Kendall's letter of 31 August.

[115] Kendall to George W. Hopkins, 17 January 1846, *Petitions, House Committee on the Post Office and Post Roads*, RG 233, National Archives.

Federal control even received the formal endorsement of one group of prominent merchants. It was simply unacceptable – declared the influential Baltimore mercantile house of Alexander Brown & Co. in November 1846, in heading up a petition to Congress signed by many of the city's leading merchants – for the federal government to permit the private expresses to beat out the Post Office Department day after day. Should Congress purchase Morse's patent this evil could be avoided. «The control of the entire commercial and news correspondence of the country, the merchants explained, was a «tremendous power» that ought to be possessed exclusively by the «most responsible public agents». The «obvious fact» that the new technology gave telegraph managers control over the interests of merchants, the press, the government, and indirectly of the whole people, was sufficient to «show the danger» of leaving it in private hands [116].

Federal control also had the support of Whig presidential candidate Henry Clay. Should the new technology remain in private hands, Clay warned in a letter to one of Morse's business partners during the height of the 1844 campaign, speculators would be able to «monopolize intelligence»: «I think such an engine ought to be exclusively under the control of government» [117].

One of the most elaborate appeals for federal control took the form of a report to Congress in March 1845 by Georgia Whig Absalom Chappell. Enamored, like Morse, with the postal-telegraphic analogy, Chappell tried unsuccessfully to persuade legislators to extend Morse's telegraph from Baltimore to New York. Chappell conceded the dangers of most projects to augment federal power, yet regarded the telegraph as an exception. «The great and fundamental principle«upon which the Post Office Department operated, Chappell postulated, was the presumption that the federal government not be» outstripped «in the circulation of correspondence and intelligence». In support of this principle, Chappell observed, Congress had recently awarded lucrative mail contracts to several railroad corporations. It was with «equal certainty» Chappell predicted, that Congress would adopt for postal purposes any other «newly discovered agency or contrivance«that offered a «decided advantage of celerity» [118].

Chappell's logic failed to sway prominent Democrats in Congress, and had little effect on the Democratic president, James K. Polk, who does not seem to have left any record of his views on the subject. The Polk administration's official organ, the Washington Union, took no position on the telegraph issue, though it did run a letter

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[116] *Petition of Baltimore merchants*, 11 January 1847, ibid. See also Henry Rogers to Cave Johnson, 26 October 1846, *Letters Received, Records of the Post Office Department*, RG 28, National Archives.

[117] Henry Clay to Alfred Vail, 10 September, 1844, *Vail Telegraph Collection*, Smithsonian Institution Archives. Clay's letter was published in 1892 and in the following years was often cited by champions of telegraphic reform. F.G. CARPENTER, "Henry Clay on Nationalizing the Telegraph", in *North American Review*, 1892, 154, pp. 380-382.

[118] Absalom CHAPPELL, *Report of the Committee on Ways and Means*, 3 marzo 1845, House Report 187, 28th Cong., 2nd sess., serial 468, 1845, 3, 5, 6.

from a supporter of federal control as late as December 1846 [119]. Given the traditional Democratic hostility toward governmental activism, this was perhaps not surprising. More intriguing was the fact that federal control did win the approval of several Democratic-leaning newspapers, including the *New York Evening Post*, the *Philadelphia Pennsylvanian*, and the *Washington Constitution*. Federal control also had the support, at various times, of a small number of nationally prominent Democrats. These included Polk's postmaster general, Cave Johnson; two former Democratic cabinet members – Levi Woodbury and Amos Kendall; Morse himself; and former Democratic congressman Francis O. J. Smith. None but Woodbury were disinterested: Johnson stood to gain in power and prestige should the telegraph remain under his control; Smith owned a percentage of Morse's patent; and Kendall was Morse's business agent.

Smith made the case for federal control in an essay on postal reform that he published in the February 1845 issue of the *Merchants' Magazine*. Federal funding for the rapid extension of telegraphy, Smith contended, was far preferable to the «odious system» of harassing the private expresses in the courts. Smith doubted that the Post Office Department could ever underbid the private expresses, given the constraints that the regulatory regime imposed. Were the federal government to establish its own telegraph network, however, the challenge posed by the private expresses would disappear. «Can any one believe» Smith asked rhetorically, that, if Congress lowered the basic letter rate and the Post Office Department established a low-cost telegraph on the Washington-New York route, the private letter-mail companies would persist, even if no penal law should be interposed to deter them? Should the Post Office Department string wires throughout the country, Smith predicted, it would attain the «highest approach to omniscience, within the limits of the Union, that human wants or human agency need aspire to» [120].

Kendall's position on federal control was complex. As a good Democrat, Kendall retained strong misgivings about governmental activism. The true object of government, Kendall postulated in 1843, was not to promote the happiness of the people, but to enable the people to promote their own happiness [121]. Instead of enacting new penal laws to stymie the private expresses, why not encourage the federal government to retrench its own establishments as fast as private enterprise advanced, and «content itself» with doing only that which the citizen «cannot effect for himself?» [122] Indeed,

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[119] *New York Evening Post*, 10 June 1844; *Philadelphia Pennsylvanian*, 13 giugno 1844; *Washington Constitution*, 21 April 1845; *Washington Union*, 24 December 1846.

[120] F.O.J. Smith, "The Post-Office Department, Considered with Reference to its Condition, Policy, Prospects, and Remedie"s, in *Merchants' Magazine and Commercial Review*, 12 February 1845, pp. 144, 147, 148, 149.

[121] *Kendall's Expositor*, 3, 25 July 1843, p. 242.

[122] *Kendall's Expositor*, 3, 25 November 1843, p. 386.

at one point, Kendall went so far as to propose that the Post Office Department abandon the railroad altogether as a means of conveyance, and rely exclusively on post riders to carry the mail [123].

Yet Kendall also recognized that certain public projects fell within the legitimate domain of the federal government. As postmaster general in the 1830s, Kendall had endorsed various innovations in high-speed communication, including an elaborate Washington-New Orleans horse express. By far the most ambitious innovation to win Kendall's assent was an optical telegraph – modeled loosely on the French prototype of Claude Chappe – that Kendall hoped might one day connect the country's leading ports [124]. «That great public benefits will arise from the establishment of a line of [optical] telegraphs along our coasts, if not into the interior, there can be no doubt» Kendall declared in a public letter in February 1837. «The rapid diffusion of intelligence is of great importance in our busy country, and a portion of our abundant public funds cannot, in my opinion, be more usefully employed than in the attainment of that object» [125].

The awkwardness of Kendall's position was evident in a letter that he wrote in August 1845 to Morse's partner, Francis O. J. Smith. «One consideration» that favored a buy-out, Kendall explained to Smith, was the 'certainty' of a quick and substantial financial return. «If you and I and my principals can realize at once all of [the] wealth that the human heart ought to desire, it is better for us to take it, than to fight our way for years through difficulties and perplexities, however brilliant in imagination may be the prospective» [126].

By far the most determined Democratic champion of federal control was Polk's Postmaster General Cave Johnson, the administrator under whose direction the first commercial telegraph had been established in 1845. Johnson's support for federal control is often misunderstood. Well-known as a fiscal conservative, Johnson conceded in his annual report for 1845 that, based on the revenue generated thus far by the Washington-Baltimore line, he did not believe the federal government could ever run the telegraph at a profit [127]. Johnson's gloomy fiscal assessment outraged Amos Kendall, who accused him of deliberately using his public office to depress the value of Morse's patent [128]. In the years after the Civil War, Johnson's prediction would be routinely cited as proof that federal administrators had stumbled badly in their first attempt to run the industry, and should not be given a second chance.

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[123] *Kendall's Expositor*, 3, 17 October 1843, p. 343.

[124] Samuel Reid to Martin Van Buren, 6 January 1837, *Records of the Office of the Electro-Magnetic Telegrap*h, RG 28, National Archives.

[125] Kendall to John M. Robinson, 8 February 1837, in *Washington Globe*, 15 February 1837.

[126] Kendall to Smith, 12 August 1845, *Smith Papers*, Maine Historical Society.

[127] Cave Johnson, "Report of the Postmaster General," 1 December 1845, *Senate Document 2*, 29th Cong., 1st sess., serial 470, 1845, 861.

[128] Kendall to Hopkins, 17 January 1846, RG 233, National Archives.

However wrongheaded Johnson's prediction may appear in hindsight, it is important to remember that it was the only caveat that he raised in what was, in fact, a broad-gauged appeal for federal control. «In the hands of individuals or associations» Johnson declared in the same report, the telegraph might become the «most potent instrument» the world ever knew to effect «sudden and large speculations – to rob the many of their just advantages, and concentrate them upon the few». To forestall such a catastrophe, Johnson regarded some kind of regulatory apparatus as imperative: «The use of an instrument so powerful for good or evil cannot with safety to the people be left in the hands of private individuals uncontrolled by law» [129].

Military exigency reinforced Johnson's commitment to federal control. Shortly after the start of the Mexican War, Johnson reported to Congress that a private consortium of New York editors headed up by Moses Y. Beach of the *New York Sun* had established a horse express in Alabama to transmit from Mexico newspaper clippings with military reports in advance of the mail. The proprietors of this express, Johnson conceded, violated no federal law, since the recently enacted post office law had specifically exempted newspapers from the postal monopoly. Still, Johnson hoped to supplant the horse express with a telegraph for the duration of the war, and took the trouble to secure from Kendall the patent rights for such a venture on the «most liberal terms» [130].

Johnson failed to secure congressional support for his wartime telegraph and, in 1847, the Washington-Baltimore line passed out of federal control. With the exception of a brief moment during the First World War, postal administrators would never again be able to plausibly contend that they could outpace private enterprise in the circulation of time-specific information on commerce and public affairs.

Popular support for federal control never disappeared altogether. With the expansion of the telegraph network, however, several once-potent criticisms of the new technology came to seem overblown. Once the new technology became a mundane reality, rather than a visionary dream, editors discovered it to be less threatening to ordinary commercial transactions than they had feared, and more useful in their daily operations than they had anticipated [131]. It was, for example, by no means incidental that the most searching critiques in the New York press of private enterprise in telegraphy antedated the extension of the first telegraph line to New York City.

Particularly important in legitimating private control of the new technology were the steady stream of public statements that Amos Kendall issued between 1845 and

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[129] Cave JOHNSON, "Report of the Postmaster General," 1 December 1845, *Senate Document 2*, 29th Cong., 1st sess., serial 470, 1845, 861.

[130] Cave Johnson to Dixon H. Lewis, 4 June 1846, *Senate Document 373*, 29th Cong. 1st sess., serial 476, 1846, 2. For a related discussion, see M. BLONDHEIM, *News Over the Wires: The Telegraph and the Flow of Public Information in America, 1844-1897*, Cambridge, Cambridge University Press, 1994, pp. 48-50.

[131] M. BLONDHEIM, *News Over the Wires: The Telegraph and the Flow of Public Information in America, 1844-1897*, Cambridge, Cambridge University Press, 1994, chap. 3.

1847. In these statements, Kendall enunciated the rules and regulations of Morse's Magnetic Telegraph Company and defended the patentees' right to a monopoly of Morse's patent. «Of one kind of monopoly I am in favor» Kendall declared in the *Washington Union* in September 1847, «a monopoly of a man's own property... Patent rights are as much private property as printing presses» [132].

To mollify the press, Kendall promised editors special rates for the circulation of news – a promise that Kendall's own long tenure as a newspaper editor rendered especially credible [133]. And to win over merchants, Kendall stressed that his company would guarantee equal access for anyone who could afford the regular fees, and dismiss any employee who manipulated its wires to promote a purely private speculation. To fault the new technology for encouraging insider trading, Kendall believed, was particularly unfair. Prior to the advent of the electric telegraph, Kendall reminded his critics, merchants had long maintained an optical telegraph between New York and Philadelphia for the benefit of «speculators exclusively» – and no one had complained. It would be impossible, Kendall added, to devise a set of administrative procedures that would preclude the possibility of speculative abuse. Still, the rules his company had devised would «place all men on equality, in the use of the telegraph» – even though, of course, they could not «make them equal in the sagacity, industry, and enterprise, which enables them to use it profitably to themselves» [134].

Beginning in the summer of 1846, criticisms of federal control began to find their way into the press. Led by *Niles's National Register* and the *Albany Evening Journal*, a small but influential number of journals raised questions about the effectiveness of public administration of the new technology and warned against the political dangers that might accompany federal control. [135] Private enterprise, they agreed, had thus far worked remarkably well. Just as competition had brought about major reforms in mail delivery, editorialized Jeremiah Hughes of Niles, so, too, it would spur technical innovation in telegraphy [136]. The commercialization of the new technology by the federal government was likely to prove very costly, warned the *Evening Journal*, and was in any event too complicated for public administrators to coordinate. Furthermore, unless Congress enacted laws as arbitrary as the laws prohibiting private competition in mail delivery, Morse's patent would in all likelihood be quickly superseded, and «individual enterprise» would drive the government into bankruptcy [137].

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[132] *Washington Daily Union*, 22 September 1847; See also *Washington Daily Union*, 30 gennaio 1846, 2, 5, 17, 25 and 31 August 1847, 3 September 1847.

[133] *Baltimore Patriot*, 20 June, 19 November 1845; *Boston Daily Advertiser*, 14 November 1845; *Utica Daily Gazette*, 29 November 1845. See also *Morning Courier and New-York Enquirer*, 25 November 1845.

[134] *New York Morning Express*, 10 March 1846.

[135] *Niles's National Register*, 4 July 1846, 26 September 1846, 19 December 1846; *Albany Evening Journal*, 14 December 1846; *New York Journal of Commerce*, 16 December 1846.

[136] *Niles's National Register*, 19 December 1846.

[137] *Albany Evening Journal*, 14 December 1846.

If any business could be safely left in the hands of the people, predicted the editor of the *New York Evening Mirror* – in articulating the emerging consensus – it was telegraphy: «It is free to all who choose to pay for the use of it, and thus far has been managed with admirable skill and discretion» [138].

The case for federal control received a further blow when, shortly thereafter, several state legislatures, led by New York, passed laws to curb the most serious forms of potential abuse [139].

Following the Civil War, champions and critics of telegraph reform would endlessly debate the significance of this early experiment in federal control. While industry insiders typically dismissed federal control as a bizarre and short-lived aberration, a few old-timers were candid enough to recall that, at the time, they had held a different view. Proposals for the regulation of the telegraph industry by the federal government, declared veteran telegrapher George Prescott in 1866, were «unwise, injudicious, and unnecessary». Yet Prescott added, this had not always been his position. «During the first half of my twenty years' service as a telegraph operator» Prescott explained, «I was strongly of the opinion that it would have been good policy for the government to own and control the telegraph lines, and that the public would have been greatly benefited thereby. The companies were then small and poor, the lines were badly constructed and worse supported; and all progress was prevented by the constant and unremitting competition of rival lines. There was no question but that one company could do the telegraphic business over any given territory much cheaper and better than two or more. There is a striking analogy in this respect between the telegraph and the mail service, and no one will deny that one company can manage this service better than two or more». Given the unlimited resources of the federal government, Prescott explained, he had taken it for granted that it was the only institution with the requisite means to promote the public good [140].

By 1866, Prescott had changed his mind. Now that Prescott's employer, Western Union, had established a dominant position in the American telegraph industry, Prescott no longer doubted that a private enterprise could coordinate a nationwide network. At approximately the same time Morse himself reached a similar conclusion. Western Union, Morse wrote Kendall in March 1866, was «becoming, doubtless, a monopoly, but no more so than the post office system, and its unity is in reality a public advantage if properly and uprightly managed» [141].

During the 1840s, large numbers of Americans participated in a broad-ranging discussion of national communications policy, the first such discussion in American

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[138] *New York Evening Mirror*, 15 December 1846.

[139] T. NONNENMACHER, "State Promotion and Regulation of the Telegraph Industry, 1845-1860", in *Journal of Economic History*, 2001, 61, pp. 19-36.

[140] *Telegrapher*, 1 August 1866, vol. 2, p. 169.

[141] Morse to Kendall, 19 March 1866, *Morse Papers*, Library of Congress. I am grateful to Kenneth Silverman for this reference.

history. Political engagement was high and the command of the issues impressive. Though the privatization of the postal system had influential champions, in the end, Congress buttressed the existing regulatory regime. Indeed, in 1851 Congress went so far as to authorize improvements in the level of mail delivery that were independent of their possible impact on postal finance. In an age in which historians have often dismissed governmental institutions as agents of change, here was one policy decision that dramatically broadened the mandate of the federal government.

In telegraphy, in contrast, deregulation prevailed [142]. Notwithstanding the explicit preference of Morse and the misgivings of a leading segment of the press, legislators declined to establish a regulatory regime that was in any way comparable to the regulatory regime that had long existed in mail delivery. Even in telegraphy, however, deregulation had its limits. The industry remained constrained not only by a congeries of state regulations but also by federal court rulings on patent rights, contracts, and eminent domain. Following the Civil War, reformers would once again agitate for federal control, catalyzing a popular movement for «postal telegraphy» that, in the early twentieth century would shape the regulatory regime at AT&T [143].

The enactment of legislation to promote the public welfare is central to what the founders of the American republic meant by political republicanism, and is among the most important of the legacies of the American Revolution. Not until the 1840s would a younger generation move beyond the founders and decisively challenge this shared consensus. For various reasons, these reformers rejected political republicanism and embraced the noninterventionist economic credo that has come to be known as economic liberalism. In transportation, banking, and telegraphy, federal regulation was almost ritualistically disparaged. For the first time in American history, it became common to characterize as private even those enterprises that were the most heavily dependant on the public largesse – such as, for example, the land-grant railroads in the trans-Mississippi West. In the process, the now-familiar idealization of private enterprise emerged. It was a genuinely new idea, an invented tradition popularized by critics of governmental expansion as a reaction to, and critique of, the prior expansion of the early American state. In mail delivery, in contrast, a regulatory regime that dated back to the 1790s retained enough popular support to endure. Postal deregulation was not without its defenders; yet, in the end, this was one market revolution that failed.

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[142] R.R. JOHN, "Recasting the Information Infrastructure for the Industrial Age", in *A Nation Transformed by Information: How Information Has Shaped the United States from Colonial Times to the Present*, ed. by A.D. CHANDLER, Jr. and J.W. CORTADA, New York, 2000, pp. 55-105.

[143] R.R. JOHN, "The Politics of Innovation", in *Daedalus*, 1998, 127, pp. 187-214.

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THE POWER OF CABLES. SUBMARINE COMMUNICATION IN MEDITERRANEAN

A great innovation: submarine telegraphy

In terms of invested capital, financial risk, technological challenge, and public opinion involvement, submarine telegraphy is an extremely important page in the history of the mid 19th century [144]. Taken from the point of view of the economic historian, it appears as one of the events most typically belonging to the second industrial revolution: as a winning combination of science and technology on the one hand, and of entrepreneurial initiative on the other [145], it fully reflects the leadership of the western world at the time of imperialism, constituting a sort of «extension of the diplomatic and military power of the homelands outside their borders» [146].

The first really international telecommunications network was created thanks to the cables laid in the depths of the sea: submarine cables are fully included as a privileged component in the debate over the original globalization and establishment of a first global economy at the end of the 19th century [147]. The development of submari-

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[144] For an overview on the history of submarine cables, W. SMITH, *The rise and extension of submarine telegraphy*, London, J.S. Virtue, 1891; S.A. GARNHAM, R.L. HADFIELD, *The submarine cable*, London, Sampson, Low, Marston and Co., 1934; B.S. FINN, *Submarine Telegraphy. The Grand Victorian Technology*, London, Science Museum, 1973; C. BRIGHT, *Submarine telegraphs: their history, construction and working*, New York, Arno, 1974 (anastatic reprint of the 1898 London edition); J. AHVENAINEN, *The Far Eastern Telegraphs: The History of Telegraphic Communications between the Far East, Europe and America before the First World War*, Helsinki: Soumalainen Tiedakatemia, 1981; R.M. BLACK, *The history of electric wires and cables*, London, Peter Peregrinus, 1983; e T. STANDAGE, *The Victorian Internet*, Walker & Co., New York ,1998.

[145] M. ADAS, *Machines as the measure of men. Science, technology and ideologies of Western dominance*, Ithaca and London, Cornell University Press, 1989.

[146] D.R. HEADRICK, P. GRISET, "Submarine telegraph cables: business and politics, 1838-1939", in *Business history review*, 2001, 3, p. 544.

[147] P. GRISET, "L'évolution des télécommunications intercontinentales au XXeme siècle", in *History and technology*, 1992, 8, pp. 231-245.

ne cables was explosive: the 1,100 miles in operation in 1864 became more than 20,000 in 1870, 86,000 in 1880, and well over 200,000 at the turn of the century [148].

There are few more intriguing adventures than the construction of the world submarine telegraphy system: as has been appropriately remarked, the one that most closely approaches it is the laborious conquest of space a century later [149]. The idea of connecting all the continents, making possible within a few hours a contact that a few years previously would have required weeks if not months, seemed incredible even in the eyes of those most sensitive to the progress of technology [150]. It was proof that nature could be subdued by man with intents and purposes that promised to benefit the whole of humanity.

The impact of cables event on the European population most alert to innovation in technical and economic fields was amazing. Submarine telegraphy, in the eyes of public opinion of the mid 19th century, was a decidedly different matter from land telegraphy which could somehow be understood in its functioning. Viceversa, how it could be possible to have a telegraph cable function immersed in the depths of the sea, was incomprehensible except by projecting the mind into a future filled with unpredictable novelties: «They intend to send a wire to the moon, and they'll set the Thames on fire very soon», the poet W.S. Gilbert recited, expressing the feelings of a large part of London society in those days.

As a few years previously the middle classes of the continent had been attracted somewhat anxiously to the extraordinary novelty of railroads, so were the great submarine achievements met with as much wonder, since they were even more amazing in terms of technological success. Different sources of information at the time and many forms of art did not fail to give prominence to an adventure of a magnitude that was absolutely out of the ordinary. Concern with regard to the success of a number of attempts made in the fifties and sixties was widespread among observers, and caught the attention of newspapers and periodicals, both the scientific and the more popular ones, attentively reporting the news concerning the long, laborious efforts for the laying of the cables. The persons involved were treated practically like heroes of progress, and the story was decked in triumph. Public opinion fluctuated between almost childish wonder and the depths of discouragement.

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[148] D.R. Headrick, *The Invisible Weapon. Telecommunications and international politics, 1851-1945*, New York-Oxford, Oxford University Press, 1991, p. 29.

[149] C. Bertho, "I sistemi per comunicare. Una scienza della comunicazione invisibile e senza fili", in *Storia delle scienze. Conoscenze scientifiche e trasferimento tecnologico*, Torino, Einaudi, 1995, p. 339.

[150] J. Ahvenainen, "The Role of Telegraphs in the 19th Century Revolution of Communications", in *Kommunikationsrevolutionen. Die neuen Medien des 16. und 19. Jahrhunderts*, ed. by M. North, Koeln, 1995, pp. 73-80.

Rule Britannia

The question of submarine cables bears the permanent mark of the British [151]. The only country to have the required raw materials and first rate engineers readily available was Great Britain, the undisputed ruler of the seas and of mail transportation [152]. Projects and capital came from Britain, and it was the British who stood to gain more than any other nation in this sector, obtaining enormous benefits in all fields from economic to military. The great British Empire was dependent also, to a large extent, on the cable network: in 1900, 72% of the cables laid throughout the world were English property.

The control exercised by Queen Victoria's subjects was total. All messages exchanged even among other countries with their colonies overseas had invariably to go through Great Britain or through British telegraph stations spread around the world. Examples such as the Fashoda conflict or the Boer war prove how the ability to intercept and censor messages on the part of the English was capable of changing the destiny of international politics.

All this was not merely a predominant condition to be exploited in case of war emergencies, but it was also an advantage for British firms with regard to international competition. Neither before nor after this period had a single country exercised such excessive power over the circulation of business and strategic information on a worldwide scale.

The cable across the English Channel

The first attempts to lay a submarine cable date from the same period as the circulation of overland telegraphy. In 1841 Charles Wheatstone [153], one of the recognized fathers of electric telegraphy submitted a plan to the English House of Commons for crossing the English Channel. Also the best known founder of the telegraph system at the time, Samuel Morse, as early as 1845 attempted to lay a cable at the bottom of the port of New York.

Success was achieved in 1851 by the Brett brothers, engineers from Bristol, Jacob (1808-1897) and John Watkins (1805-1863). The first of the two who died long after his brother in inbelievable poverty, had visualized a cable across the English Channel as early as 1845. 1851 was the second try; the previous year it had been thwarted by the accidental interference of a fisherman who had inadvertantly cut the cable so that

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[151] R. Boyce, "Submarine Cables as a Factor in Britain's Ascendancy as a World Power, 1850-1914", in *Kommunikationsrevolutionen. Die neuen Medien des 16. und 19. Jahrhunderts*, ed. by M. North, Koeln, 1995, pp. 81-90.

[152] F. Harcourt, "British oceanic mail contracts in the age steam, 1838-1914", in *The journal of transport history*, 1988, 1, pp. 1-18.

[153] B. Bowers, *Sir Charles Wheatstone FRS 1802-1875*, London, Institution of electrical engineers, 2001.

it lasted virtually only about two hours. The very same year of the great rendezvous of the Crystal Palace, the Bretts, at the head of a group of industrialists, succeeded in an accomplishment that seemed beyond the range of technology at the time; this cable, unlike the preceding one, worked for 37 years. It was laid with rudimentary instruments and procedures, by a simple tug boat, the Goliath; it was only later, in the mid seventies, that special cable laying ships were developed for this task [154].

The following year a second cable, again from Dover to Calais, was laid by the first submarine cable company, the Submarine Telegraphy Company, founded by Thomas Crampton, and in 1853 Belgium was also connected with Great Britain via cable from Middelkerke.

The satisfactory crossing of the Channel convinced the leaders in this sector to envisage a cable across the ocean aimed at the American continent. Enthusiasm was such that the difficulties of the undertaking were greatly underestimated. The following years were an enthusiastic groundwork for Anglo-America submarine communication, to which the Brett brothers themselves were totally committed. In the end a strong feeling of disappointment prevailed, but what should not be disregarded is the development of a final maturity in the techniques which had been developed thanks to the joint effort of a considerable number of engineers and scientists who were called to a challenge of huge importance.

Hopes were also encouraged by the success in 1855 of the laying of a submarine cable, 356 miles long, from Varna to Balaklava on the occasion of the Crimean war. In that case it was the Newall company, one of the leading cable manufacturers, to follow the operation which yielded 7,500 pounds. Communications had an entirely military purpose: thanks to it London and Paris were able to keep in constant contact with their armies on the battle fields.

Technology and economy of the cables

Installation of the cables required long, hard work. Design and construction were not the only complex stages of a submarine connection, it was in fact also necessary to transport the cables, weighing several tons, and lay them – after adequate testing – on a possibly flat, deep sea floor, submerging them with utmost care by means of pulleys.

The operation required the use of large ships, expressly built for that purpose, and the participation of expert technicians, mainly research chemists, geologists and engineers. The queen of the cable laying ships was the Great Eastern, the largest and most famous of all, originally used for the transportation of immigrants to Australia.

Transmission of electric impulses, subsequently converted into signals, through a cable submerged in deep water was a challenge of a technical and scientific nature

[154] In 1904 the British had 28 cable laying ships, twice as many as all the other countries put together; Italy had only one, the *Città di Milano*, owned by the Pirelli company.

highly different from that of overland telegraphy. While the wire of the aerial lines was metal, the conductor of submarine cables had to be encased in special waterproof material, gutta-percha, that would prevent the dispersion of electric power. In order to prevent the cables from suffering damage or, worse still, rupture, they were enclosed in a sheaf of wires, usually up to seven, 1 millimeter in diameter each, in order to make them resistant to blows and tension, but also to shellfish, the anchors of ships, and fishermen who were unintentionally responsible for many failures of submarine telegraphy.

The invention of an effective insulating material was one of the turning points in the history of submarine telegraphy. Where tar and rubber had failed, gutta-percha was successful; it was a plastic material known in Great Britain since 1843, extracted from a tree growing in Singapore, Borneo and Malaya, with the faculty of restraining the electric impulse and then releasing it, insulating the copper wires. Werner von Siemens, the inventor in 1847 of a machine for the application of gutta-percha, provided the necessary turning point; it was the firm created by him that produced the first underground line insulated with gutta-percha, in Berlin in 1848.

Such a financial undertaking, as in the case of the railroads with which it was possible to establish a parallel in many repects [155], could not be sustained by a single entrepreneur; only large companies were in a position to guarantee a rich availability of capital collected mainly on the British market. The submarine telegraphy sector, potentially more profitable than the overland one, was managed largely by private companies, initially often organized by resourceful engineers, who ordered the construction of cables by the leading firms specializing in the sector: Siemens and Halske, Henley, Newall, Glass and Elliot were the most important in the early period.

The relationship that was developing between the State and private companies came within the sphere of public law, since it was a service [156]. This does not mean that the role played by the public sector is insignificant; on the contrary, the guidelines indicated by the different governments were always crucial also in terms of support to the different initiatives. Great Britain generously subsidized its cable manufacturers, while it was always rather unenthusiastic regarding as intense an involvement in the field of overland telegraphy. Moreover, the unique political, diplomatic and strategic value of submarine cables did not escape anyone, and led in the end to heavy subsidies, which were necessary due to the high cost of the cables themselves and due to the insufficient profitability of the business.

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[155] Massive investments in both overland and submarine telegraphy flowed from the railways sector in Great Britain. Lord Brassey was one of the major investors and Daniel Gooch went as far as purchasing the Great Eastern (D. Gooch, *Sir Daniel Gooch. Memoirs and diary*, Newton Abbot, David & Charles, 1972).

[156] P. Bata, "Les sociétés concessionnaires de liaisons de télégraphie sous-marine au XIXe siècle", in *L'État et les télécommunications en France et à l'étranger 1837-1987*, sous la direction de C. Bertho-Lavenir, Genève, Libraire Droz, 1991, pp. 115-146.

The importance of the international submarine network reflected also on other sectors. From the shipping business which was deeply affected, to an increased awareness of the influence of market conditions on business practices, and the beginning of a modern information system, the innovations brought about by cables laid under water were significant.

Basically there were four main clients of the new submarine telegraph communications : press agencies, the major ones being Reuters, Wolff and Havas [157]; trading and shipping companies; governments and armed forces; the public in general which was a less important client due to the fact that, for a long time, sending a telegram was very expensive. In short, this new type of telegraphy launched the issue of submarine cables into the big business of the time.

The first Italian line

Parallel to the development of expectations regarding the Atlantic cable, telegraphy interests also flowed towards the Mediterranean, where France and Great Britain rivaled one another for the main strategic routes.

Though unable to compete with the other two European powers from both a technological and entrepreneurial standpoint [158], Italy played a relevant role in the sphere of submarine telegraphy in the years following the laying of the first submarine cable between Dover and Calais in the late seventies. This was possible on account of its geographical position, actually an authentic income situation: being at the center of the Mediterranean, the country happened to be a natural crossroads for telegraph communication which at the time was expanding most successfully. The Italian peninsula with its elongated shape and central position was an ideal landing place for the submarine cables connecting Great Britain and other European countries with the African and Asian colonies. Basically there were two strategic points for which Italy was at the center of a busy chain of initiatives: it was the means of access to northern Africa and at the same time to the East.

The Italian peninsula was a sort of bridge between Europe and Asia, and as such was particularly useful to British strategies of communication with its Indian possessions. In the course of a few years, beginning even before its unification, Italy was able to accumulate a considerable supply of submarine cables, in spite of its unquestionable overall weakness, actually playing a top level strategic role. All this took place also owing to the forethought of its governments which tried to exploit this

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[157] Y. KAUKIAINEN, "Shrinking the world: improvements in the speed of information transmission, c. 1820-1870", in *European Review of Economic History*, 2001, 5, pp. 1-28; A. NALBACH, "Poisoned at the Source? Telegraphic News Services and Big Business in the Nineteenth Century", in *Business history review*, 2003, 4, pp. 577-610.

[158] S. FARI, "La telegrafia in Italia dal 1861 al 1866. Origini della rete telegrafica nazionale", in *Archivio per la storia postale*, 2003, 14-15, pp. 81-126.

most inviting opportunity stipulating a number of agreements with the foreign companies in charge of submarine telegraphy.

The original initiative goes back to 1853, when the Paris government, which had made its own laws on the monopoly of overland telegraphy since 1837, decided to support the project for submarine communication with Algeria. The itinerary included crossing Corsica and Sardinia, thus developing a mixed overland and submarine route. The place of arrival was located in the city of Bona.

The leading figure of the episode was again John Watkins Brett, who had expressly founded the *Compagnie du télégraphe électrique sous-marin de la Méditerranée pour la correspondance avec l'Algerie et les Indes*. The company's board of directors contained some outstanding names of the European railroad and telegraphy field, especially English and French: Count de Morny, Jean Hastermann, Samuel Laing, William Chaplin, James Carmichael, all happened to held shares in the two major communications organizations of the time.

The company drew up two separate agreements with the French and the Piedmonte administrations. The text of the contract with the French concerned the construction within two years, laying and subsequent maintenance of the cables, besides operation of the service on the entire line from France to the Algerian colony. The plan envisaged by Brett, however, provided also for extension towards Tunis, Malta and from there towards the East through Egypt; the idea soon fell through for fear that the line might reveal itself unproductive and difficult to build and operate.

With the Turin government, however, the company agreed to carry out also the plan for a cable between the locations of Santa Croce, near the river Magra on the border between Tuscany and Piedmont, and Cap Corse, which was laid in July of 1854. The administration of the Piedmontese House of Savoy, in turn, agreed to connect Genoa with Santa Croce by means of a telegraph line. In exchange for this commitment the Piedmonte government undertook to pay the company 150,000 Lire a year for fifty years, which amounted to a 5% security on capital. Also, against payment of a compensation of 16,000 Lire, the telegraph administration of the House of Savoy took over the control, but not the maintenance, of the Sardinian overland lines which were also completed in 1854 along with the connection of Bonifacio with the Sardinian coast [159]. The fact that the French had granted 4% security on a much lower figure, 4,500,000 Lire, is revealing of the importance given to the issue by the Piedmonte government.

The first Italian cable, finished rapidly considering Italian conditions at the time, was the same as the one connecting Dover to Calais. It consisted no fewer than six conductor wires wrapped in several layers of gutta percha and enclosed in a sheath of tarred hemp, the whole protected by an outer framework of wires arranged in a spiral «so as to resemble a kind of case», wrote Carlo Matteucci, creator of the first Italian

[159] In the chronicles of the *Annales Telegraphiques* from 1855 to 1859 there are detailed descriptions of the construction of the line. A second cable between Livorno and Corsica was laid in 1866.

telegraph line [160]. Every time it broke down, which happened often, it had to be repaired in Great Britain, which took an enormous amount of time. It had been manufactured by Glass & Elliott, the largest supplier of Mediterranean cables in the second half of the fifties.

The cable presenting the greatest difficulties was the one between Sardinia and Algeria, laid in a very deep stretch of the sea plagued by currents, and probably also too long for the equipment of the time: «Proof had however been obtained – recites a report of English origin – that it was possible to submerge a heavy cable, successfully, to a depth of 1.640 fathoms. It was all important, in enterprises of this kind, to ascertain, with accuracy, the relative speed of the ship and of the paying-out of the cable» [161]. The depths of the Mediterranean – the cable between Siracusa and Bengasi went through areas where the sea floor was as deep as 4,200 meters – were an important element in the whole of the submarine telegraph adventure.

At the end of a complicated cycle of negotiations, due also to the delay that had by then been accumulated by the agent, the firm Newall was assigned the job, and in 1857 it completed its task; however, communications never actually worked satisfactorily, and the 256 miles of cable, whose loss cost 70,000 pounds, were finally abandoned at the bottom of the sea.

The failure was probably not caused only by technological problems. During the general meeting of the company in June of 1857, there were a number of attacks on the part of some of the stockholders against the management: doubtful bookkeeping, to say the least, lack of bookkeeping records, misappropriation and fraud seemed to have been normal practice in Brett's company, which explains the disappointing outcome of the second part of the initiative [162]. The deficit against which measures were attempted by issuing new bonds, had been as crucial as the technical difficulties in causing the collapse of the enterprise.

The Piedmonte stockholders in vain consulted their Ministry of Trade, in an attempt to own their investments. Brett was under heavy charges: from «the harm produced by negligence or incapacity of a management that in no way justified the trust that had been placed in it» to «the waste perpetrated up to now» and also to «blameworthy omissions», the analysis was ruthless, but ineffective to practical intents and purposes [163].

The bitter fate of the Sardinia cable weighed heavily on the strategic claims of the Piedmontese government, which was definitely the most enlightened among the pre-

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[160] C. MATTEUCCI, *Manuale di telegrafia elettrica*, Torino, Utet, 1861, p. 385.

[161] Archives of Institution of civil engineers di Londra, miscellaneous papers.

[162] *Compagnie du télégraphe électrique de la Mèditerranée. Procès-verbal de l'Assemblée générale du 15 juin 1857*, Paris, Typographie Charles de Mourgues Frères, 1857.

[163] Archivio Centrale dello Stato (Central State Records, hereinafter ACS), *Fondo industrie banche e società*, b. 137, f. 1084.

unification Italian governments. The defeat, though caused by natural reasons, risked cancelling the advantage of an early start.

The failure brought on a distinct deterioration in relations between the two administrations involved, and the agent Brett, who in 1859 was forced surrender, yielding the leadership of the telegraph company to Claude Ernest Lami de Nozan [164]. Applying the dictates of the agreement, the French government declared the end of the agreement with the company that had been unable to keep to its promise. The Italians instead could not assert the same rights as the French against the company, so they kept up the relationship with it since it was not in default as far as the Italian tract was concerned. Renunciation to the agreement was requested later, in 1864, following the interruption of submarine contact between Liguria and Corsica, which was replaced two years later by a new one; at that point the wording of the contract provided for the Italian government to take possession of the line. A tough court dispute then broke out between the Italian Ministry of Agriculture Industry and Trade and what remained of Brett's company which could not seem to obtain anything except the evident termination of the license [165].

The French did not give up. Unable to reach Algeria from Sardinia, they were forced to find an alternative course, but it was equally ill-fated. Environmental conditions evidently were not the favorable to laying a submarine cable. Only in 1870 were they able to complete the connection with their North African colony from Port Vendras via Minorca, and from there on the Spanish coast, between Cartagena and Orano in Algeria. The cable was an important acquisition also for Spain, which had laid the first cables in the Mediterranean to reach the Balearic Islands. The Spanish produced their greatest effort in the Atlantic [166], while they paid much less attention to Mediterranean connections [167].

Below the ocean

During those same years the most sought after objective was connection between the two shores of the Atlantic Ocean. The reunion of the two Anglo-Saxon families, proving their superiority, had its primary expression in the laying of the cable, and at the same time was proof of the very close blood ties between the two people.

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[164] *Procès-verbal de l'assemblée générale des actionnaires de la société J. W. Brett et cie, dite Compagnie du Télégraphe électrique sous-marin de la Méditerranée*, Paris, 1859.

[165] ACS, *Fondo industrie banche e società*, b. 137, f. 1084.

[166] M. ARCARONS, "La Spagna e i collegamenti telegrafici transatlantici (1858-1898)", in A. GIUNTINI (ed.), *Flussi invisibili. Le telecomunicazioni fra Ottocento e Novecento,* monographic issue of *Memoria e Ricerca*, 2000.

[167] A. CALVO, "Los inicios de las telecomunicaciones en España: el telégrafo", in *Revista de historia económica*, 2001, 3, pp. 613-635; ID., "Los cables submarinos: una rama emergente de la ingeniería civil en el siglo XIX", in *Quaderns d'historia de l'enginyeria*, 2002-2003, V, pp. 255-270.

So research got under way for preparation of the colossal operation of laying a cable of inconceivable size; and in the meantime investors from both countries started moving. In 1854 a group of U.S. capitalists led by the paper dealer C.W. Field (1819-1892) founded the New York, Newfoundland and London Telegraph Company, with the specific purpose of connecting the two worlds at their closest point, between Ireland and Newfoundland which in 1856 had been linked to the American continental network. The role played by Field in both endeavors was crucial, to the point that Bright defined him «a man of destiny» [168].

Vital encouragement to attempt the Atlantic undertaking came to Field from Matthew Maury's report to the U.S.navy in which the bottom of the ocean was described «as a plateau, which seems to have been placed there especially for the purpose of holding the wires of the submarine telegraph, and keeping them out of harm's way» [169]. Of equal importance was his meeting in England with John Pender (1816-1896) [170], known as the «cable king», the greatest entrepreneur in the field of submarine telegraphy. The next step was the creation in London, in October of the same year, of the Atlantic Telegraph Company, of which Pender became manager, and whose 350 shares at 1,000 pounds each, were underwritten, with considerable reluctance, almost entirely by British capitalists, who were in any case much more inclined to get involved than their American colleagues. Thanks to the good results of the underwriting, production of 4,600 km of cables was completed as early as June 1857. The ships in charge of carrying out the submersion of the wire were supplied by the British and U.S. governments. Both guaranteed financial support for twentyfive years for transmission of their official correspondence.

Cable laying was started from the small Irish island of Valentia, August 7, 1857, but five days later, having laid 500 km., the cable, created in only four months, half by Glass and Elliott and half by Newall, broke and disappeared at a depth of 3,600 meters, where it was impossible to retrieve [171].

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[168] S. CARTER, *Cyrus Field: man of two worlds*, New Yotk, G.P. Putnam's Sons, 1968, p. 121. On Field, cf. also I. JUDSON FIELD, *Cyrus W. Field. His life and work*, New York, 1896.

[169] D.R. HEADRICK, P. GRISET, "Submarine telegraph cables: business and politics, 1838-1939", in *Business history review*, 2001, 3, p. 548.

[170] A typical advocate of a monopolistic approach, Pender accumulated an astonishing fortune, as many as 50,000 nautical miles of cables spread all over the world. It was Pender to provide the Empire with the "red line" of communication, a system of cables that incorporated the entire globe but only touched the territories of the Crown. Concerning his work, cf. K.C. BAGLEHOLE, *A century of service. A brief history of Cable and Wireless Ltd. 1868-1968*, London, Cable and Wireless Ltd., 1979; H. BARTY-KING, *Girdle round the Earth*, London, Heineman, 1979, pp. 3-7; ID., "John Pender (1816-1896)", in *Dictionary of Business Biography*, ed. by D.J. JEREMY, vol. 4, London, Butterworths, 1985, pp. 609-614; J.A. BRITTON, J. AHVENAINEN, "Showdown in South America: James Scrymser, John Pender and United States - British cable competition", in *Business history review*, 2004, 1, pp. 1-27.

[171] B. DIBNER, *The Atlantic cable*, Norwalk, Burndy, 1959.

The project was put off to the following summer: on June 1858 a second attempt was made, which was equally unsuccessful, as were other subsequent attempts. It was then decided to revise the cable and the machinery for submarine laying. One month later the third attempt was more successful. On July 29th the same ships again started laying the cable, and on August 5th the cable connected Ireland to Newfoundland [172]. Five days later the first messages were dispatched; on the 16th the cable transmitted a message of good wishes from Queen Victoria to President Buchanan, whose reply, sent on the 19th and received 16 hours later, stirred up great enthusiasm, and lyrical paeans rose to the sky: «The seven wonders of the world have passed into oblivion with this miracle of modern science», wrote a periodical of the time, which enumerated the marvels of the latest scientific achievements [173]. On the U.S. coast the organization of «parades, dinners and speeches» [174] immediately got under way, only to be sorrowfully cancelled.

In September the cable broke in several places, preventing operation; on October 20th, before even opening to the public, the cable became totally silent. At the moment of the final breakdown of the cable, Field «wept like a child» [175].

In spite of the disaster , the *Punch* proved its full optimism, stating: «It is wrong to imagine that the spark of life is extinct. The most eminent physicians in electricity declare it is only a state of suspended animation that for the moment has taken away the faculty of speech» [176].

The one to pay for the loss was the person responsible for the electric sector of the company, Edward Orange Wildman Whitehouse (1817-1890), a gifted scientist and, as he was defined, «testimony to the technological enthusiasm of the mid-Victorian era» [177]. He was accused of sufficiently testing the resistance of the cable, and fired by the Atlantic Telegraph Company. He was not spared heavy charges of being a lunatic

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[172] The ships used, both capable of carrying thousands of miles of cables, were the *Agamemnon*, a 3,200 ton ship built in 1852 by the Royal Navy, which had fought at Sebastopol, and the *Niagara*, 4,600 tons, built by the U.S. Navy in 1855. The two ships were supposed to meet in the middle of the ocean, the *Agamemnon* ran into a terrible hurricane that almost sank it. The firm Gutta Percha was appointed to insulate the two copper cables, while Glass Elliott and Newall to cover them with an iron framework and to lay them.

[173] C.A. Hempstead, "Representations of transatlantic telegraphy", in *Engineering science and educational journal*, 1995, 1, p. 518.

[174] B.S. Finn, *Submarine Telegraphy. The Grand Victorian Technology*, London, Science M., 1973, p. 21.

[175] L. Coe, *The telegraph. A history of Morse's invention and its predecessors in the United States*, Jefferson, Mc Farland, 1911, p. 98.

[176] C.A. Hempstead, "Representations of transatlantic telegraphy", in *Engineering science and educational journal*, 1995, 1, p. 523.

[177] D. de Cogan, "Dr. E.O.W. Whitehouse and the 1858 trans-Atlantic Telegraph Cable", in *History of Technology*, 1985, 10, pp. 1-15; e B.J. Hunt, "Scientists, engineers and Wildman Whitehouse: measurement and credibility in early cable telegraphy", in *The British Journal for the History of Science*, 1996, 29, pp. 155-169.

and a swindler, but most of all – and in greater likelihood – he was accused of having exaggerated with the voltage, which had actually been kept high in an attempt to recuperate the insulation that undue exposure to the air had destroyed. Actually, when the cable was found again many years later, and tests were made on the remains, it was seen that it was probably fated to be damaged anyway, and that Whitehouse's responsibilities were negligible.

Nor did the other persons in charge of the company receive better treatment: violent criticism was made against President Brett, and Vice President Field, and almost as intense were the charges against the Secretary George Saward [178]. Charles Tilston Bright (1832-1888), chief engineer [179], had to suffer the disgrace, on the part of the *Scientific American*, of seeing his undertaking defined «a lottery», rather than an «important scientific, engineering and nautical operation». Pender, finally, «risked unpopularity by supporting Field in his insistence that the company should try again» [180].

A total of 732 messages had been sent [181], and this was sufficient proof that it was possible to communicate at a distance of over 3,000 km without any intermediary station [182].

An alternative by way of land was investigated to connect the American continent to the European; the itinerary, designed by Perry Collins and explored in 1858 by the initiative of Hiram Sibley of Western Union, wound from San Francisco up through Alaska and Siberia, aiming at the heart of Europe, but was abandoned before its completing.

Towards the East

At the end of the fifties the technology available in the field of submarine telegraphy did not consent construction of long, demanding lines. The equally unfortunate end of the initiative for crossing the Red Sea, which from a financial point of view with a loss of 800,000 pounds and no messages sent was the biggest fiasco, fully confirms this. The resulting frustration scared capitalists away from this field of business and drove the British government to drastically re-evaluate its involvement.

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[178] G. Saward, *Deep sea telegraphs: their past history and future progress*, London, 1861; e id., *The Trans-Atlantic submarine telegraph*, London, 1878.

[179] C. Bright, *The life story of Sir Charles Tilston Bright civil engineer*, London, Archibald Constable, 1908.

[180] H. Barty-King, "John Pender (1816-1896)", in *Dictionary of Business Biography*, ed. by D.J. Jeremy, vol. 4, London, Butterworths, 1985, p. 610.

[181] D. de Cogan, "Innovazione tecnologica e stagnazione finanziaria (lo sviluppo della telegrafia internazionale tra il 1866 e il 1900: una prospettiva britannica)", in A. Giuntini (ed.), *Flussi invisibili. Le telecomunicazioni fra Ottocento e Novecento,* monographic issue of *Memoria e Ricerca*, 2000.

[182] J.W. Brett, *On the origin and progress of the Oceanic electric telegraph*, London, 1858.

The Indian revolt in 1857 encouraged the English to plan for a cable between Suez and the Red Sea with a view to extending it all the way to Karachi. Conscious of the political and military importance of such communication, the Queen's government pledged a yearly 4.5% guarantee for five years on the capital of 800,000 pounds, even in the event that the cable would not work, which is what actually happened.

The first concession for a line from Egypt to India through the Red Sea, with an extension to Constantinople was granted in 1858 to the Red Sea and India Company of the brothers Lionel and Francis Gisborne, by the Ottoman and Egyptian governments. Francis (1824-1892) had been planning this line for years, after acquiring experience with the early Canadian lines and having worked on the first submarine cable in North America. In the meantime the Brett brothers entered the competition founding the European and Indian Junction Telegraph Company, with the objective of connecting the Mediterranean with the Persian Gulf through the valley of the Euphrates, a project that was soon discouraged by the denial opposed by the Ottoman Empire, which decided to complete the telegraph line to the Persian Gulf on its own [183].

The Gisbornes assigned the job of laying the Red Sea cable to the Newall company, which carried out the operation between May 1859 and February 1860. The line did not work, and the reason was hastily identified to be the high temperature of the waters crossed; the cable was also much lighter than the earlier ones, and rust and worms soon had the better of it. It was a huge disaster for the English, to be blamed also on political and organizational reasons – an «extraordinarily lovely case of bureaucratic ineptitude» [184] – as well as of technological incompetence.

The Mediterranean challenge

The Red Sea scheme implied the crossing of the Mediterranean which in the late fifties had not yet been achieved. The English counted entirely on Malta as the foundation of the Mediterranean strategy and the basic means of access to reach Suez more conveniently. Connecting with the small Mediterranean island which was the British outpost towards the East, meant not depending on any country and therefore establishing a connection entirely under its own control.

For this reason as of 1859 the English had supported the creation of a cable between Sicily and Malta, followed by others in subsequent years; according to their reckoning it was better, at least in that period, to cut through the Italian peninsula lengthwise and get as close as possible to Malta, rather than pointing on Gibraltar, as was done later, and having then to deal with a long, difficult marine crossing. Also the alternative of an overland line through Turkish territories caused doubts due to the

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[183] J.W. Cell, *British colonial administration in the mid-nineteenth century: the policy-making process*, New Haven and London, Yale University Press, 1970, pp. 228-229.

[184] *Ivi*, p. 233.

low reliability inspired by the Ottoman Empire. From Malta it was then necessary to reach Egypt: the Malta and Alexandria Telegraph company in 1861 finally succeeded in achieving this crucial connection, which from Alexandria then branched off in one direction towards Suez and in another towards Algeria and Tunisia.

Therefore Italy came to find itself as the main crossroads of the flow of British correspondence to and from the Asian and African colonies, and until the time when the English reached Malta independently from the west, it had the somewhat arrogant dream of becoming the hub of telegraph communications for Britain with the East. The Telegraph Construction and Maintenance company (Telcon), the product of the merger decided by Pender in 1864 between Glass & Elliott and Gutta Percha [185], did not hesitate in preferring the construction and operation of a long overland line from Modica to Susa, laying as many as four cables in the Strait between 1867 and 1868, when it was replaced by the Anglo-Mediterranean company. The agreement drawn up with the Italian government was highly favorable to it, and it was also free from any commitment regarding maintenance of the line. The idea essentially retraced the one for the railroads known as the Indian Mail, changing the point of arrival from Brindisi to Modica. The Italian government was to get the income from the fares traveling on the line, receiving a significant economic benefit, and the English could count on the safety of the connection.

However, it was necessary to cross the Straits. The first cable to Sicily had been laid January 25, 1858, and had not held out more than nine months. Altogether nineteen cables broke down in those years due to the strong currents in the Straits, requiring special reinforcement of the cable armor. The question was solved when finally in 1863 the general supervisor of the Italian telegraph administration, Salvatori, had a cable laid which in fact offered more than twenty years' resistance on a slightly longer but less wearing course from Bagnara in Calabria to Torre di Faro in Sicily. The cables then multiplied: more were laid between Pozzallo and Torre di Faro in 1884, 1886 and 1889. In that same period communications were also started with the Eolie islands via the Milazzo-Lipari cable in 1881, and the Lipari-Salina in 1882.

Connection between the two major islands was not less of a problem. In 1863 the first cable between Sicily and Sardinia was laid, prompted by Glass & Elliott, but the stretch of sea was as rough as the Straits and communication was extremely difficult. The cable broke down immediately, and the company, due to the unfortunate agreement made by the Italian administration, was exempted from repairing it. The difficulties were overwhelming to such a point that Sardinia remained telegraphically isolated for almost two years, and in 1868 the plan for connecting the two islands was finally abandoned. Then the Italian government was compelled to make do with a new connection with Corsica and between it and Sardinia. It was only in 1875 that a direct connection was achieved between Sardinia and Orbetello without going through Corsica, and it was the longest: 118 nautical miles.

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[185] G.L. Lawford, L.R. Nicholson, *The Telcon Story 1850-1950*, London, The Telegraph,1950.

Italy, ultimately, was the leading player in a further initiative which confirmed its relative vitality, in consideration of its overall backwardness. In 1859 the administration of the Kingdom of the Due Sicilie completed a stretch of submarine telegraph which from the beginning revealed itself of major economic and strategic importance, between Otranto in Puglia and Valona in Turkish Albania. Two years later, after the Italian unification, a second cable constructed by the Henley company connected Otranto to Corfu [186].

Seemingly the agreement made with the Ottomans was a drawback for the Neapolitan state. The latter actually undertook the transportation, submersion, laying and opening up of the cable, remaining the only responsible party in case of a breakdown or inadequate performance. The Neapolitan government would therefore have to deal with the maintenance and possible repairs to the submarine cable. The Turkish administration was thus free from any responsibility except that of continuing the overland telegraph line from Valona in three directions, toward the territories of the Austro-Hungarian empire, towards Constantinople and from there towards Persia, and to the telegraph network of the Russian territories. In this way, by means of the Adriatic cable, the Kingdom of the Due Sicilie could connect with distant capitals such as Vienna and St. Petersburgh, avoiding transit through the Papal States [187].

Actually the Bourbons, and later the Italian government, benefited widely from this agreement, thanks also to the fact that the cable, laid along a flat and relatively calm sea bed, worked without too many problems, and even earned large profits. Through that line, in fact, passed the main dispatches directed towards the East, whether towards Russia or towards Persia and the British Indies. Even though part of the route was made by post, generally speaking this cable made possible the first telegraph connection between Europe and the East. For this reason in 1864 the Italian telegraph administration made a new agreement forcing the Sublime Porta to complete connections between Constantinople and the Persian Gulf, where the telegraph line would be connected to Bassora by the submarine cable which reached Karachi, and from there to Bombay. The advantages were obvious and continued until the line to Malta went into effect. Up to that time the Italians were able to forward dispatches originating from Northern Europe and directed to the East on the Adriatic line, taking advantage also of the fact that international agreements on the subject indicated the requirement of using the least expensive means for each telegram, and going through Otranto was actually the cheapest alternative [188].

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[186] *Annales télégraphiques*, sept.-oct. 1860, p. 593.

[187] *Annales télégraphiques*, janv.-fevr. 1860, p. 106, mai-juin 1860, p. 348.

[188] There is a considerable number of reminders to respect rules on the part of the Italian government relating to these years, in the records of the International Telegraph Union (Archives de la Union Internationale des Télécommunications, *Notifications*, 1869, n. 14).

The Atlantic cable of 1866

The two failures suffered in 1858 in the Atlantic and Red Sea was an inevitable setback for the entrepreneurs involved in the sector. In spite of the disappointment, the Atlantic Telegraph Company prepared to lay another cable, providing for a capital increase which was underwritten in spite of the huge risks that the undertaking obviously entailed. In fact the English government guaranteed 8% interest on the new issue for twentyfive years from installation; 4% interest was guaranteed to the first-time issued securities. It was also necessary, however, to support the viability of the project; so the British government nominated a committee – The Joint Committee of Privy Council for Trade – jointly with the Atlantic Telegraph Company, made up of renowned scientists, who worked from December 1859 to September 1860 on the project, and expressed a favorable opinion. In April 1861 the committee made its results public in a particularly substantial publication, *The Blue Book*; these results were on the whole reassuring in relation to the estimated profitability of the investment, and the technical feasibility of the Atlantic project [189].

Government aid did not end here: a British Navy Ship, the Porcupine, again sounded the ocean between Ireland and Newfoundland in order to supply more exact data. The most visible result of these forms of support, besides creating technical progress, was to arouse confidence in the investors. In spite of the disastrous financial precedents, early in 1864 the necessary capital had been collected and the price of the shares shot up. It was calculated that, once communications had been established, one year of operation would be sufficient to recuperate the invested capital.

The period following the 1858 disaster was characterized by an intense phase of research and preparations, particularly in the sector of electrical studies, which led to the final maturing of submarine telegraphy. In actual fact this level remained as the standard until the 1920s. A number of leading figures contributed to the technological progress needed to win the Atlantic challenge. From Fleeming Jenkin (1833-1885) teaching in Edimburgh [190], to Willoughby Smith (1828-1891), to William Thompson, lord Kelvin (1824-1907), a professor of natural philosophy at the University of Glasgow when he was only twenty one, who developed in a significant way the theory of the transmission of signs [191], the role of scientists in this situation was absolutely crucial. As confirmation of the enormous progress made, it should be kept in mind that out of 56 cables laid until 1860, 46% had failed, while 17 of the 18 cables laid between 1861 and 1866 performed brilliantly.

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[189] B.J. Hunt, "Doing science in a global empire: cable telegraphy and electrical physics in Victorian Britain", in *Victorian science in context*, ed. by B. Lightman, Chicago-London, The University of Chicago Press, 1997, pp. 312-333.

[190] G. Cookson, C.A. Hempstead, *A Victorian Scientist and Engineer: Fleeming Jenkin and the birth of electrical engineering*, London, Ashgate, 2000.

[191] A. Russell, *Lord Kelvin, his life and work*, London, 1912; and P. Turnbridge, *Lord Kelvin: his influence on electrical measurements and units*, London, Institution of electrical engineers, 1992.

The 1866 expedition, finally made possible also by the end of the American Civil War, was prepared with the utmost care [192]. The Times sent, on the Great Eastern – the 22,500 ton ship selected for the undertaking, as the largest cable layer in existence at the time and the only one with the capacity to carry 4,500 tons of cable – a journalist, W.H. Russell, former correspondent from Crimea at the time of the war, whose articles thrilled readers [193]. It was a complete success; two cables, immediately opened to business with a transmission capacity of 5-6 words per minute [194], connected Hearts Content, Newfoundland with Valentia Island, Ireland [195], both territories belonging to Great Britain. In 1869 a new cable was added to the existing ones [196].

Following the 1866 success telegraphy seemed to disclose real horizons of glory, and Jenkins stated that the cable business was «no longer gambling ventures, but legitimate speculations» [197].

Submarine telegraphy in international expos

For the public at large telegraphy represented a science capable of storring vast enthusiasm, at the same time cloaked in mystery. For this reason the 19th century expos represented an extremely useful means for visitors to understand how a telegraph system was made or what a submarine cable was like. At the time of the second industrial revolution there was a lot of talk about telegraphy, but few were directly acquainted with it.

The rendezvous of the Crystal Palace coincided with the first cable in the English Channel, while the great Paris expo of 1867 took place immediately after the laying of the first transatlantic cable. Cyrus Field was being awarded prizes and acclaimed, and specimens of the cables which were the leading figures of the event could not fail to be exhibited in such a way as to make clear to visitors their technological evolution: «Une exposition rétrospective faite sur de larges bases n'aurait donc pas été seulement un objet de curiosité» (a retrospective exposition on a broad basis should not

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[192] V.T. Coates, B. Finn, *A retrospective technology assessment: submarine telegraphy. The transatlantic cables of 1866*, San Francisco, San Francisco Press, 1979.

[193] The account of the trip is in W.H. Russell, *The Atlantic telegraph*, London, 1865.

[194] The tariff system already in use in overland telegraphy was adopted, the standard structure of telegrams was 20 words, on which the charge was worked out. A message was calculated on the basis of 20 words of 5 letters. The charge was reduced to 10 pounds on Novembre 1st, 1866, to 5 guineas (5.25 pounds) in December 1867, and to 3 pounds 7 shillings and sixpence (3.37 pounds) in September 1868. In order to encourage traffic, the standard length of the message was reduced to 10 words.

[195] D.R. Tarrant, *Atlantic sentinel. Newfoundland's role in transatlantic cable communication*, St. John's, Flanker Press, 1999.

[196] G. Cookson, "The French Atlantic cable of 1869: settled technology and unsettled relationships", in *Engineering Science and Education Journal*, 1999, 8, pp. 135-141.

[197] G. Cookson, "Ruinous competition: the French atlantic telegraph of 1869", in *Entreprises et histoire*, 1999, 23, p. 94.

have been merely the object of curiosity), warned Gavarret, one of the top telegraphy experts in France, in introducing the topics relating to electric telegraphy at that expo; and, as a matter of fact, he complained because the submarine cables had not been put in chronological order to make clear the progression of their employment. Displaying them according to the line for which they were being used, was not considered to be the best choice [198].

It is of considerable interest how the need to emphasize the change was felt; the progress made, as far back as the expos of the early sixties, caused the mechanisms of the previous generation – twenty, or at the most thirty years earlier – to be almost objects of industrial archeology when compared to the present. On the whole the accounts concerning the telegraphy sector abounded in details and explanations: it was clear to the organizers and the exhibitors that the subject was intricate, and it seemed necessary to insist in order to make possible the highest level of understanding on the part of the public.

In India

As they were unable to cross the Red Sea, the English had to be satisfied with conveying their messages to India by land. In 1865 the Suez telegraph line was finally linked to the Turkish network and reached Bassora and Karachi, thus completing the connection from London to their major colony. There was long diplomatic, as well as technical, groundwork, requiring practically the entire first half of the sixties. Particularly laborious were the long negotiations with the different governments, many of them politically unstable, whose land the line went through. This made the government in London uneasy, since it would have preferred a submarine line totally under its control, and it did not appreciate having to measure itself with the demand of using local personnel, many of whom often did not even speak English.

The first submarine connection between London and Bombay, uninterrupted except for the Suez-Alexandria stretch which was still overland, was inaugurated in 1870 by the Falmouth, Gibraltar and Malta Telegraph Company [199]. The long cable, from Great Britain to Gibraltar, Malta to Suez and from there to Bombay, represented, after the Atlantic cable, the second greatest telegraph system in the world. It was the «first link in an intended 'all red' system, that is a cable network which linked all the parts of the Empire without ever touching foreign soil» [200], a matter of major

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[198] J. GAVARRET, "Télégraphie électrique", in *Journal des télégraphes*, 15 juin 1867, pp. 2 e 5. Gavarret was an expert telegraphy conoisseur. In those very years he had published a famous treatise which was immediately translated also into Italian: J. GAVARRET, *Télégraphie électrique*, Paris, 1861 (*Telegrafia elettrica*, Milano, 1862).

[199] The entire event is reported by C.P. HARRIS, "The Persian Gulf submarine telegraph of 1864", in *The geographical journal*, 1969, 135, pp. 169-190.

[200] P.M. KENNEDY, "Imperial cable communications and strategy, 1870-1914", in *English historical review*, 1971, 86, p. 731.

importance to the London government. That same year another long overland line connected Great Britain to Teheran through Germany and Southern Russia.

In the following years other cables were added to the first one, and others still were made to continue on their way from Bombay to the Far East, Australia, South Africa and Latin America [201].

The International Telegraph Union

Agreements among various European States, in order to facilitate telegraph communications, were drawn up beginning in 1849. At first these agreements were bilateral, like the one between Prussia and Austria in 1849, which led up to the founding the following year of the Austro-Germanic Telegraph Union, to which other countries of Austro-German influence gradually adhered. Between 1851 and 1854 the States of Western Europe also started stipulating agreements of this sort among each other until June 1855 when Belgium, France, the Kingdom of Sardinia, Spain and Switzerland founded the Telegraph Union of Western Europe; the Papal State and the Kingdom of the Due Sicilie also joined it later. In 1865 the two Unions made alliances and agreements of different kinds, ratified by a succession of international conferences.

At first agreements among the different States to regulate telegraph communication originated from purely technical requirements, mainly in terms of different telegraph mechanisms and codes, and these were met by means of the generalized adoption of the Morse system. As international telegraphy expanded, the agreements tended to shift their attention from technical to accounting and tariff issues. It was necessary to establish exact the price at which international telegrams were to be offered to the public, and in what way the profits were subsequently to be shared out among the States involved in the telegraph interchange. In the beginning a system prevailed based on the charge increasing according to greater distance between office of origin and destination.

Intense international cooperation, developing also along with the progress of the submarine telegraph network, led to the creation on the part of twenty States – with the exception of Great Britain [202] and the United States – of the International Telegraph Union, founded at the time of the Paris conference in 1865 [203]. The Union, with headquarters in Berne, was the first international large scale organization among various countries, and pre-eminently the setting in which to form a procedure and a

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[201] D.R. HEADRICK, *The Invisible Weapon. Telecommunications and international politics, 1851-1945*, New York-Oxford, Oxford University Press, 1991, p. 21.

[202] Great Britain became part of the International Telegraph Union after the Rome Conference in 1871, following nationalization of the overland telegraph network in 1869.

[203] G.A. CODDING jr., *The International Telecommunication Union*, Leiden, E.J. Brill, 1952; A. DESCALZI, "Creacion y desarollo de la Union Internacional de telecomunicaciones", in *Las Comunicaciones entre Europa y America, 1550-1993. I Congreso internacional de comunicaciones*, Madrid, 1993, pp. 287-298.

background in common about this subject matter, adapting interests and avoiding useless conflicts that would have obstructed its remarkable progress.

On the occasion of the conference following the Paris one, which took place in Vienna in 1868, the submarine telegraph companies were allowed to participate in the discussions of the international conferences, without the right to vote. The submarine cables were the central issue of the second great international conference on telegraphy, held in Rome in 1871, in which there was an attempt to work out specific regulations. The fact that the cables were laid in international waters and therefore, actually, could not be subject to surveillance, raised a series of new problems of a legal nature. Submarine telegraphy was at the same time the occasion for international cooperation but also for keen rivalry among nations. Commonly accepted was the neutrality of the cables in times of war, with the pledge on the part of the signer countries not to cut them, a decision that however the English did not accept, in spite of pressure on the part of the Italians [204], thus for the most part thwarting its purpose [205]. It was a well known fact that in the event of war the risk of cut cables was high; for this reason also the stations of origin were provided with actual military defense. In 1884 the international telegraph agreement for the protection of submarine telegraph cables signed in Paris, established rules for the protection of the cables in times of peace.

Also at St. Petersburgh conference in 1875, whose decisions were granted permanent character, the principle was confirmed. This meeting was the last international telegraph conference in which political issues were debated; after that, meetings of this type were characterized almost entirely by debate over tariff coordination.

The turning point

Once the first cable to the United States had been successfully laid, Great Britain transferred all its attention towards the Mediterranean in order to take possession of the essential strategic route towards India. Nationalization of overland telegraphy in 1868 released a considerable amount of capital which was for the most part diverted towards submarine telegraphy [206].

At that point the English drive was such as to subdue the fragile central quality Italy had established up to then. The Italian golden moment therefore failed, more or

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[204] Archives de la Union Internationale des Télécommunications, *Notifications*, 1870, n. 75.

[205] Almost as harmful as sabotage was the deliberate circulation of rumors on non-existent cable interruptions, which caused the abandonment of a particular itinerary with the resulting economic loss for the country controlling it. Such an incident, concerning the cable connecting Otranto to Constantinople, is evidenced in a harsh letter of protest sent by the general management of the Italian telegraph in August 1877 to the International Union (Archives de la Union Internationale des Télécommunications, *Notifications*, 1877, n. 77).

[206] J.L. KIEVE, *The electric telegraph, London*, David & Charles, 1973.

less, from that time; the Mediterranean became the center of economic and political interests that a country as young and powerless as Italy was not in a position to hold up with its own strength. When at the end of the sixties the United Kingdom, relying on an unquestionable supremacy in this field, connected Malta to Gibraltar and the latter to England, the Italian peninsula, and with it all of continental Europe, was left out from the flow of English correspondence to and from the colonies.

When the Falmouth, Gibraltar and Malta telegraph company, founded in 1869, laid a cable from Porthcurno, in Southern England, to Lisbon, Gibraltar, Malta and finally Egypt, for a total of 2,281 miles, everything was all set for Great Britain. In this way it avoided potentially risky crossings, such as the Italy, preferring a securely loyal country such as Portugal, a good friend of the English, and also interested in an international connection. In 1873 another cable reached Carcavelos in Portugal from Porthcurno; then in the eighties other cables were laid to Malta and Egypt.

The French were also moving with increasing vigor in the Mediterranean area. The cable laid by the Marseilles, Algiers and Malta Telegraph Company of England in 1870 from Marseilles to Algiers was obviously not satisfactory, so they prepared to lay new ones in 1871, 1879 and 1880, and also others to Tangier in 1887, to Orano in 1892 and Tunis in 1893.

The situation changed further in 1872, when Pender merged four large cable companies – the Anglo-Mediterranean, the Falmouth, the Marseilles, Algiers and Malta, and the British Indian – founding the Eastern Telegraph, which thus became the leading business enterprise in the Mediterranean. The creation of Eastern Telegraph confirmed the ultimate change in attitude of the English regarding the Southern European area. In the course of twenty years Eastern Telegraph, with a capital of 3.8 million pounds, and whose dividends in the period from 1873 to 1901 never fell below 6.75% [207], acquired 45.5% of the world's submarine cables [208].

In the Mediterranean sphere power relations had been restored, and Italy had to put away the hopes it had nurtured in the early years of its existence. The short-lived period of glory, however, contributed to a growth of the sector that was most significant in the course of events [209].

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[207] P.M. KENNEDY, "Imperial cable communications and strategy, 1870-1914", in *English historical review*, 1971, 86, p. 739.

[208] In those same years Pender created another big company in the Far East, the Eastern Extension Austalasia and China Telegraph Company, with a capital of 3 million pounds. Not only, but he was also active in South America and South Africa; in other words in the space of a few years he was able to establish a world network covering all the continents.

[209] In 1886 a major company, Pirelli, made its first appearance in the field of submarine telecommunication, immediately obtaining the monopoly of state cable laying, including one between Naples and Palermo, a new one from Otranto to Valona, and the ones from Massaua to Assab and from Assab to Perim, in the area of eastern Africa, where Italy had established the original center of its colonial conquests.

The Adriatic

Since the time of the first cable between Puglia and Turkish Albania, the activity of submarine cable laying had been ceaseless also on the eastern side. Between 1870 and 1898 fewer than 80 cables were laid in the eastern Mediterranean.

The main route, in its shortest stretch which was later continued as far as Egypt, was followed by other itineraries creating a vast network of cables linking the Adriatic shores of Italy to those of Greece and its islands.

Alexandria could be reached also from Candia in 1873 and from Larnaca in 1878. Most of the Greek and Turkish cables were in the hands of the Eastern Telegraph Company: «I have the pleasure to inform you that various greek and turkish cables in the Mediterranean are now marked by this Company» [210], is the official announcement of 1872, with which a penetration that soon became decidedly aggressive got under way. The British company by no means scorned protecting itself from possible interruptions of the line to the East, by taking over also Brindisi as a possible landing place of a line to Egypt.

The Austrian government in 1882 also gave its consent for a submarine cable between Trieste, Ragusa and Corfu to Malta; the concession was the privilege of the Erlanger firm in Paris, which later gave it up to Eastern Telegraph [211].

A planet of cables

Beginning in the seventies, an actual competition for cables got under way, involving the whole world. The final consolidation of technology and financial strengthening of the sector made it possible for the submarine network to include all the continents; on the eve of World War I telegraphy was an operating structure, a teeming system of communications criss crossing the oceans, which had changed the way of doing politics, business and information transfers.

Thanks to Pender's unrestrained activism, creating the Eastern Extension Australasian and China Telegraph Company, the cables reached the Far East and Australia: in 1870 Singapore was connected, three years later Hong Kong, the first message from Port Darwin arrived in London on November 16, 1871, and from Adelaide June 23, 1872, in October 1872 the line for the Australian continent was officially opened. In 1879 the Eastern and South African Telegraph Company laid a cable at the Cape of Good Hope; in the same period it also laid cables in Latin America, where Pender merged the Brazilian Submarine Company with the Western and Brazilian and the Pacific and European Telegraph Company. Altogether Pender owned one third of all the world's cables. In 1902 the cable connecting Vancouver to Auckland and Brisbane

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[210] Archives de la Union Internationale des Télécommunications, *Notifications*, 23 settembre 1872.

[211] Archives de la Union Internationale des Télécommunications, *Notifications*, 1877, n. 77.

closed the circle of Pan-British submarine cables around the world, which really was an imperial operation.

The English were increasingly the masters of the submarine cable system, but the other countries were doing their best to keep up with British power from a point of view of growing colonial rivalry. Soon after the accomplishment of the 1866 cable, the French were planning an independent connection with the U.S. [212]. It is a fact that in spite of French and German progress, in 1914 the English maintained a clear superiority in this field, as in that of shipping; and even compared to the dawning American power, the gap continued to be evident: at the end of the century English cables exceeded American cables four times in terms of nautical miles [213].

There was also a clear preference for private operation: out of a total of 516,000 km. of submarine cables, 94,000 were state owned and of these one third were in the hands of the British Empire. Out of 422,000 km. of submarine cables belonging to private companies, 250,000 were the property of companies registered in London.

As it had been at the beginning, the field of cables was not a perfect example of free competition. The cables used mainly for business purposes usually did not benefit from subsidies, while those of some political and strategic importance were financially supported, whether they belonged to the State or to private companies. In this latter instance the companies were expected to give precedence to official messages announced by the «clear the line» signal. The fact that the strategic cables guaranteed subsidies to the companies or even a monopoly situation, was highly criticized by the companies that did not enjoy any benefits, and by anyone advocating an open market and competition in telegraph communication. The company that was most protected by the government was the Eastern Telegraph Company, due to the fact that the majority of the strategic lines belonged to it. At the end of the century it was even expected that its ships would be placed under the command of the English Admiralty.

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[212] P. GRISET, *Entreprise, technologie et souveraineté: les télécommunications transatlantiques de la France (XIXe-XXe siècles)*, Paris, Editions rive droite, 1996.

[213] L. SCHOLL, "L'impatto delle telecomunicazioni sui traffici marittimi mondiali prima del 1914", A. GIUNTINI (ed.), *Flussi invisibili. Le telecomunicazioni fra Ottocento e Novecento,* monographic issue of *Memoria e Ricerca*, 2000.

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TELEGRAFY AND NEW FINANCIAL PROCEDURES

History and economics are complementary, and they do have something to say to one another, despite the quote from Henry David Thoreau concerning the telegraph: «They tell us Maine can communicate with Texas. But does Maine have anything to say to Texas?»

K. J. Arrow

Problem

Introduction

The period between 1890 and 1915 was a crucial one in the history of the stock markets of industrialized or industrially developing countries. The shared amplification of the levels and range of activities that can be found in most of the stock exchanges contributed in these years to asserting the importance of the markets within the different European financial systems. The launching of new regional and national stock exchanges (Berlin, Milan, Genoa, Vienna) that were previously secondary with respect to the major reference markets (above all London and Paris), promoted the establishment of a multipolar system that worked intensely under the great monetary umbrella of the gold standard. A number of signs indicated a period in which stock exchange institutions appeared to be able to respond systematically to the financial requirements of the international economy which was galvanized by the promise of the second Industrial Revolution.

In another article [214] we had already shown that the role of the stock markets with respect to industrial systems, both on the primary market (issues) and on the secondary market (speculation) had expanded in those years, along with two other extremely important indicators: the national and international integration off financial markets,

[214] S. Baia Curioni, *Modernizzazione e mercato. La Borsa di Milano nella "nuova economia" dell'età giolittiana (1888-1914)*, Egea, Milano 2000.

and the increase of measures to control stock exchanges within different national circumstances. These were two mutually related courses: market integration on a national (internal markets) and international scale, in fact implied on one hand greater available liquid assets, but on the other caused greater sharing in the area of the effects of the instability implicit in speculative activity. Integration of the stock exchanges thus worked as a propelling element for their role within the financial system, and at the same time, by increasing the complexity of the system, it stimulated the creation of rules that would effectively extend their effects over the entire national economy.

A number of features contributed over time to increase stock market integration. Among them technological development, in particular that of information technology (telegraph and telephone), seems to have played a major role. The possibility of sharing information rapidly at low cost was the condition for market integration, in other words for the reduction of lack of symmetry in information, and for the subsequent improvement of efficiency in their operation.

Abstractly speaking it is possible to visualize a logical-chronological order through which technological development would promote market integration, which in turn would stimulate the creation of better trade procedures, the development of new roles for brokers (arbitrage) and consequent controlling and institutional structures that would regulate their performance for the common good.

This progression seemed in particular to correspond to the key points of the Italian state of affairs, where telegraph integration among markets came about in 1894, market development between 1898 and 1906, with the first significant national measures of supervision in 1913.

However, the evidence now available on the subject makes it necessary to view this progression with greater caution.

First of all, the ability of international markets to develop forms of significant integration accompanied by efficient arbitrage competence on the part of brokers, surely preceded the circulation of telegraph and telephone technologies. This is true, to quote a typical example, for the markets of Amsterdam and London studied by Larry Neal [215]. According to this study, innovation in information technology mainly added support to a system which had already developed spontaneously and was fueled by other institutional, political, organizational, economic concerns at the base of the itineraries of collaboration-competition between 'opposites' in a capitalist system.

Secondly, the progression of significant measures of control that occurred on a European and world scale between the mid 1890s and World War I does not seem to have been inspired by the needs of modernization required by technological innovation so much as by the need to safeguard political and institutional balances in the different national financial systems which were prevailingly oriented by a need for sta-

[215] L. NEAL, *The Rise of Financial Capitalism: International Capital Markets in the Age of Reason*, Cambridge University Press, Cambridge 1990.

bility and, in the case of Italy, by the need for concerted control of the allocation of resources with respect to the industrial system [216]. According to this particular interdependence between control requirements and practical needs, the relationship between innovation in communication systems and innovation in exchange procedures did not seem to find, in most instances, adequate repercussion in the sedimentation of regulations and in the institutional structure of markets.

Thirdly, the result of the process of integration among markets, provided it takes place, is not necessarily the definition of complementary roles, such as those identified by Michie in the case of the London and Glasgow stock exchanges; it is also possible to see the definition of progressive polarization procedures and therefore of progressive predominance of one market over another [217]. The relationship between development of the communications sector and development of markets therefore does not display univocal traits, but produces different solutions according to institutional and cultural conditions which are typical of the different markets.

The spread of the telegraph and the physical presence of the telegraph in stock markets, on the other hand actually did determine a considerable and steady drop in price disparities (on the same business days) among stock exchanges both in the U.S.[218] and Italy at least as far as public bonds are concerned [219], and the progressive reduction of the differences in the evaluation of the same securities through time is the main sign of the integrated function of the markets. It is therefore possible to trace empirical signs of the consequences or the interaction between the 19th – 20th century development of information technology and the evolution of the overall operating effectiveness of the markets themselves.

The input provided here is intended to produce and comment further empirical evidence that may consent to further clarify the facts in the Italian case extending to investigation of the relations between Italian markets and the Paris market which was one of the main European references. More specifically this study focused on the 1890-1910 period, during which the major technological innovations for the distribution of information were implemented out.

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[216] R. C. Michie, "The London Stock Exchange and the British Securities Market, 1850-1914", in *The Economic History Review*, NS, 38, 1, February 1985, and S. Baia Curioni, *Regolazione e competizione: storia del mercato azionario in Italia (1808-1936)*, Mulino, Bologna 1995.

[217] C. P. Kindleberger, "The Formation of Financial Centers: A Study in Comparative Economic History", in *Princeton Studies in International Finance*, 36, Princeton University Press, Princeton 1974.

[218] K. D. Garbade, W. L. Silber, "Technology, Communication and the Performance of Financial Markets: 1840-1975", in *The Journal of Finance*, XXXIII, 3, June 1978.

[219] S. Baia Curioni, "Il telegrafo e la formazione di un sistema integrato dei mercati mobiliari in Italia (1888-1905)", in *Innovazione e sviluppo. Tecnologia e organizzazione fra teoria economica e ricerca storica (secoli XVI-XX), Atti del secondo convegno nazione della Società Italiana degli Storici dell'Economia, 4-6 marzo 1993*, Bologna, Monduzzi, 1996.

The Italian stock exchange between 1890 and World War I

The overall performance of the public and private securities market in the period under study (1890-1914) can be described as follows, according to a survey of the Milan stock exchange:

The first seven years (1890-1897) were marked by the repercussions of the serious financial and productive crisis that affected Italy in the stage of greatest cyclical international depression. Bank emergencies reduced the stock exchange list, caught in a routine of extremely rarefied trading concentrated on a very small number of securities, mainly railroads or public stocks. There followed an initial 'brief' cycle, between 1897 and 1902, characterized first by a stage of expansion in financial activity, with considerable increase of speculation and stock market yields, followed by a period of stagnation and uncertainty due to international and domestic political instability.

Then came a distinctly expanding second stage extending from 1903 to 1906. Altogether, between June 1897 and June 1906 there were 78 months (out of a total of 108) of favorable profits in the stock market as compared to the bond market, accompanying the first real take off of the stock exchange in Italy.

In June 1907 there were growing signs of a slump in prices which had started in the preceding months, and the market went into a marked depression, characterized by an enduring reduction in stock profits in favor of those guaranteed by public bonds, which lasted from 1908 to 1914.

These price trends were significantly reflected in the primary market which remained rather stationary (very few new issues) until 1903. Then there was a strong development in the stock exchange list and generally in stock issues, which was drastically interrupted after 1907, followed by resumption of public bond issues.

Similarly, for the secondary market, there was a concentration of ready money in stocks between 1903 an 1907, then a firm recovery in negotiations in the bond market with an equivalent decline in trading on the stock market which showed increasing signs of instability.

The evolution of microstructure and connectivity

In spite of their frequent and common Napoleonic origin, the various city stock exchanges of the period after the unification of Italy moved along highly differentiated evolutionary paths, due to the stratification of very different practices and habits between one market and another, and by a virtual lack of coordination on the part of MAIC. The principle of freedom of brokerage accepted by the national code, from 1865 on, intensified management problems in the main stock exchanges, due to the increasing and uncontrollable presence of unauthorized brokers with a consequent decline in the institutions for local control of activities.

The precarious quality of institutions and control systems increased after the speculative stage of the Seventies as a consequence of the extremely permissive rules adopted by the 1882 code, which in fact contributed to the elimination of the last remnants of local control, without replacing them with a solid system of national coordination.

Virtually left to themselves, the various markets gave rise to forms of self-organization which further differentiated their evolutionary paths; what they possessed in common was the simultaneous presence on the floors of unspecialized agents of different types, security and size, from banks to commission agents, from stock brokers to unauthorized brokers.

After the slump suffered by the large brokerage banks starting in the mid Nineties, the structure of the stock exchange population was enriched by the presence of new, large banking agents operating from several headquarters with branch offices connecting to markets that were substantially different one from another (as far as operations and control were concerned) without a high level of coordination with the main offices.

The trading systems formally provided for the call floor, that is an auction system with daily price fixing simultaneously traded on the different markets; but actually the procedure was coherent with traditional practice providing for 'continuous' trading of various securities made according to individual contacts (a long 'meanwhile') which were recorded by the Syndicate at the end of the day. The call floors were only periodical before World War I, while generally speaking it was not possible to synchronize the opening schedule for the stock exchanges or their individual trading order. There were therefore extensive opportunities for developing arbitrage activities.

Telegraph networks were developed relatively late on Italian stock exchanges as compared to the main European and world markets: 1894 was the opening year for the presence of the telegraph in the stock exchange. Needless to say, stock brokers used the telegraph even before its installation on stock exchange premises. At the end of 1888 the closing prices of three European markets reached the Milan stock exchange daily: «In order to comply with the wishes of the syndicate, the Chamber of Commerce has provided for daily broadcast of the telegram with the closing prices from the Berlin stock exchange, where lately Italian securities have been the object of lively bargaining. At this time the closing prices of three [foreign] markets – Paris, London, Berlin – reach our stock exchange» [220]. Also at the Milan Chamber of Commerce, in 1892, «Aliprandi, Chairman of the Stock Exchange Board, reports the steps taken by his office to ensure the opening in the city's central post office of special accounts in favor of stock brokers for the transmission of telegrams, similar to what has been done for some time in Paris and Berlin» [221]. This provision would lead

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[220] *Atti della Camera di Commercio*, 192, 1888, 05/12/1988, n. 11, 2 b. We wish to thank Angelo Riva for pointing out these documents, as well as for his generous help in the retrieval and interpretation of Stock Exchange lists and, more generally, for the exchange of ideas on various matters, not only about financial history.

[221] «The post office and telegraph ministry was requested authorization to place, in the telegram counter office, a special box in which stockbrokers could introduce their telegrams written on special forms which would be immediately collected and conveyed to the machine room by special employees without wasting time in recording and calculating their respective charge, except for weekly payment of each firm's state-

to the assumption that telegraph communications among the different Italian and European markets were fairly frequent already at the beginning of our period of observation. The results of this investigation, however, indicate that the quality and frequency of communications was not such as to consent actual integration of the markets by means of arbitrage operations. This theory is confirmed by a comparison with 1880 for which we carried out a sample survey as a test, without finding substantial differences in the degree of integration among markets, compared to 1892. A number of signs also contribute to suggesting that not even completion of telegraph connections in 1894 could have ensured immediate and complete integration among markets, compared to 1892: the rotation systems for access to the telegraph and then to the telephone, the ban on private lines, the difficulties in connection that were often reported by stock brokers, are all elements of a technical-organizational type limiting arbitrage possibilities.

The telephone was introduced to the stock exchange in Milan at the time of the inauguration of the new building in 1901, and in subsequent years its progressive circulation in the different banking houses took place. All this suggests – as we intend to show – that technological progress was a continuous variable, gradually unfolding its effects over the twenty-year period in consideration (and which can therefore be considered the time variable), rather than a discrete variable, displaying its effects promptly in correspondence with special innovations.

Test

Technological innovation in the field of telecommunications, such as the telegraph, the telephone and, more recently, the Internet, insofar as they accelerate the transmission of information, from the point of view of economic theory, cause a reduction of those barriers among markets represented by so-called information asymmetries. However there are very few surveys attempting to verify this link experimentally with reference to historical cases. The effects of the new means of communication are often evaluated qualitywise in terms of relocation in the geography of financial markets or, more generally by comparing the consequences of market organization, trading guidelines [222], efficiency and economic growth [223].

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ment according to the count of telegrams sent, the amount of which would be withdrawn from the account opened by each firm. This would eliminate the overcrowding which is the present complaint of the telegraph office, particularly during the hours of official stock exchange transactions; this crowding causes considerable waste of time for all senders, and it would be possible to give a speedier outlet to the conveyance of the telegrams. The post office and telegraph ministry seems favorable to accepting the proposal, provided there is a fair number of subscribers (at least 50). The banks subscribed immediately and the list will be sent to Rome. It ends off by pointing out the advantages that would result for bankers and stockbrokers as well as to the public in general who will no longer have to put up with crowding at the windows due to bankers and brokers» (*Atti della Camera di Commercio*, 192, 1892, 05/07/92, n. 10, VI).

[222] R. C. MICHIE, "The London Stock Exchange and the British Securities Market, 1850-1914", in *The Economic History Review*, NS, 38, 1, February 1985.

In this study, however, we would like to draw attention to the progress of communications, represented by the telegraph and telephone, in relation to the degree of integration of financial markets. A preliminary investigation in this area was made by Garbade and Silber [224] on three American examples: completion of the national telegraph network in the 1840s, inauguration of transatlantic connections between New York and London in 1866, and the introduction of ticker tape for communications between Wall Street and regional stock exchanges in 1875. In the first two instances Garbade and Silber found a significant reduction in the level of separation between markets, measured by price differentials for certain securities. A similar study in Italy showed that at the time of the completion of telegraph connections among the major Italian and foreign stock exchanges, there was actually a convergence of prices for government bonds; while for the stock market there were no significant reductions in price differentials [225].

This survey intends to ascertain the theory of a progressive integration of financial markets over a longer period of time which would also include the introduction of the telephone: the field of inquiry is therefore extended from 1892 to 1910. We then widened the inquiry field to consider the degree of integration of stock exchanges not only in Italy but throughout Europe. In order to obtain a sufficiently wide, standardized data base, we limited our analysis to three markets: Milan, Genoa and Paris. As a final point, evaluated both the stock and the bond market.

Our objective was to verify the following:

1. Whether, as seems apparent from the previous survey [226], price differentials were reduced only for bonds and not for stocks;

2. Whether technological progress in the field of communications can be considered a significant illustrative variable element of the possible convergence;

3. Which are the other aspects that contributed in determining the level of integration among the Italian financial markets in the period under consideration.

In order to reach this result, we created sets of comparable data for the three markets, beginning with the official stock exchange lists, examining the performance of security prices and their respective volatility throughout the twenty-year period under consideration. Starting from homogenous sets, for each security we calculated the price differentials among the markets, in order to evaluate their performance through

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[223] A. J. FIELD, "The Magnetic Telegraph, Price and Quantity Data, and the New Management of Capital", in *The Journal of Economic History*, 52, 2, June 1992.

[224] K. D. GARBADE, W. L. SILBER, "Technology, Communication and the Performance of Financial Markets: 1840-1975", in *The Journal of Finance*, XXXIII, 3, June 1978.

[225] S. BAIA CURIONI, "Il telegrafo e la formazione di un sistema integrato dei mercati mobiliari in Italia (1888-1905)", in *Innovazione e sviluppo. Tecnologia e organizzazione fra teoria economica e ricerca storica (secoli XVI-XX), Atti del secondo convegno nazione della Società Italiana degli Storici dell'Economia, 4-6 marzo 1993*, Bologna, Monduzzi, 1996.

[226] *Ibidem*.

time, with reference to yearly averages and daily prices. Finally we carried out a backward survey to verify how much the level of integration among the markets depended on the progress in communications and how much on the state of volatility of the securities.

Creation of the sets

Our observation period goes from 1892 to 1910. The effective integration of Italian markets was estimated with reference to the Milan and Genoa markets. Comparison between the prices of Milan and Genoa securities was conducted on the basis of five historical series: two bonds (Italian government bonds for cash with cash redemption) and three stocks (Ferrovie Meridionali, Navigazioni Generali Italiane, Banca Commerciale Italiana). Integration with European stock exchanges was measured with reference to the Paris prices of the government bonds and Ferrovie Meridionali.

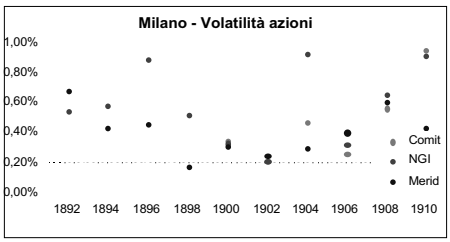
The assessment of data was made on a sample basis, taking as reference the month of March of each even year in the period under observation. In this way we obtained 10 sample months equally distributed over the period under consideration and with different characteristics in terms of amounts, availability and changes in security prices. Banca Commerciale was not quoted until 1898, so our evaluation starts from the year 1900.

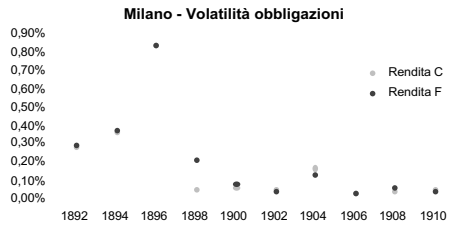
For Italian markets, security prices are drawn from the official stock exchange price lists. The composition of these price lists and the way they are drawn up changed many times over the twenty year period. Generally, stock exchange price lists do not give a single quotation for each security, but differentiate between nominal prices and sale prices and, among these the different terms of payment, cash, end of current month, or end of coming month. Having as our objective the comparison between Milan and Genoa prices, we created two sets as standardized as possible for each security, day by day taking the prices of the same type on each market and determining their average. For the Paris stock exchange the prices are those published by I*l Sole*, according to the Stefani's wire service.

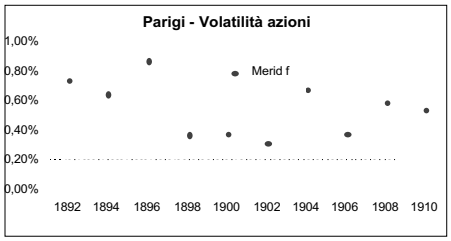
Trend and volatility of securities

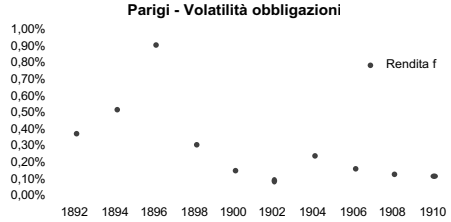
The trend of the sets (indicated in the appendix) was coherent with the more general progress of the stock market, also in relation to the evolution of the bond market, previously described.

Stocks showed decreasing volatility during the first decade, and increasing in the second decade, with a peak, for Banca Commerciale and Navigazione Generale Italiana, as early as 1904, which may have been caused by an increase in speculation. After a decrease in 1906, volatility of stocks increased again after the 1907 decline, this time presumably due to the reduction of available funds. The volatility of the bonds, on the contrary, was much lower to the point of being almost non-existent after 1906. This might have been due to the greater availability of funds that government bonds enjoy as compared to stocks, particularly after the 1907 decline.





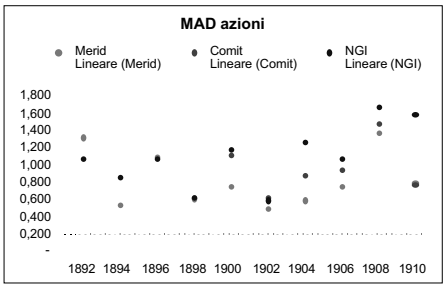


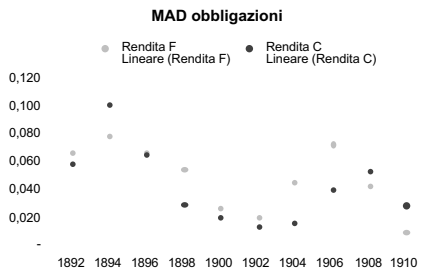


Mean differences

A preliminary test to verify the integration of two markets through time consists of ascertaining whether price differentials are reduced, i.e. the differences in absolute value between the price of a security in the first market and the price of the same security in the second market.

This is the method adopted by Garbade and Silber (1978) and followed by Baia Curioni (1992): the mean absolute difference is taken as the indicator of price differentials between markets. Price differentials, in turn, are a sign of the presence of barriers preventing arbitrage and therefore integration between markets [227].

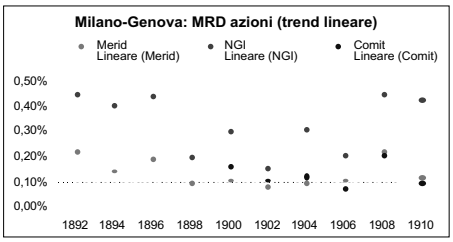


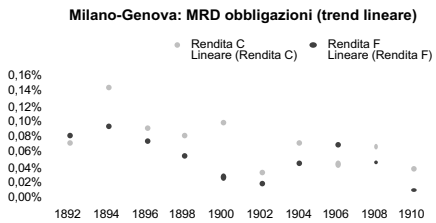


[227] The degree of integration between two markets can be measured, in general, also with reference to the volume exchanged (O. ISSING, "The Globalisation of Financial Markets", in *European Central Bank*, Ottobeuren, 2000). However, in this specific instance this is not possible due to the lack of data on the volume of transactions carried out between different markets.

In consideration, first of all, of the relationship between Milan and Genoa, the graphs evidence a decreasing trend in mean differences for the series relating to the government bonds, while stocks show a less evident trend, generally upwards. This seems to suggest that the introduction of the telegraph, and subsequently the telephone, contributed to the integration of Italian markets only for government debt securities, thus essentially confirming the results of Baia Curioni.

However, this study does not concentrate on the immediate area of technological innovation, but extends over a twenty-year period during which security price variations are by no means negligible. For this reason it is advisable to relate absolute differences to price level [228], obtaining a series of relative or percentage differences which can be used to estimate the mean (mean relative difference). As may be easily expected, since the prices of all securities tend to increase during the period under scrutiny, the relative price differentials between Milan and Genoa show a trend line with a lower slant as compared to absolute price differentials.

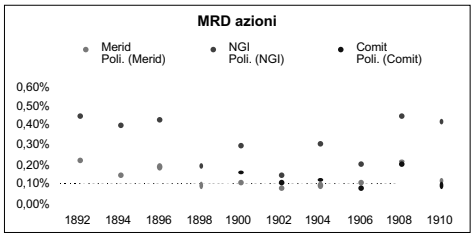


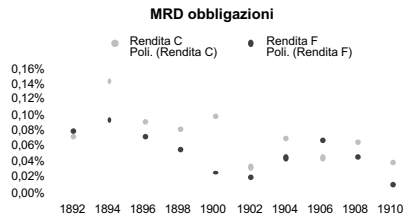


Mean relative differences of the government bonds decrease even more noticeably; but those of the stocks also take on a negative, though slight, downward trend. Therefore there is a progressive integration between the Milan and Genoa stock exchanges, not only for government bonds, but also for stocks, though to a lesser extent. This essential convergence over the twenty-year period may be seen more accurately as the succession of two periods: an initial stage of greater integration up to 1902 approximately, followed by a second stage during which discrepancies become stronger again. (The second degree polynomial trends allow the substantiation of the two stages).

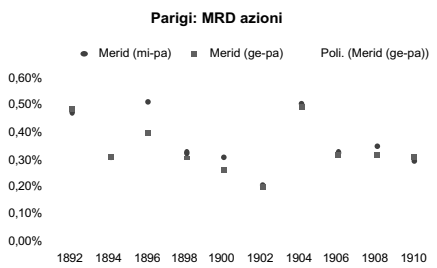
The same separate performance for the stock and bond markets is apparent also in the international assessment. Differentials between Paris and Milan and between Paris and Genoa have virtually a similar performance and appear to be higher, on average, than those between Milan and Genoa. This suggests, in general, the existence of greater integration between the Italian markets. On the other hand, on an international level it is also possible to note a process of progressive integration of the govern-

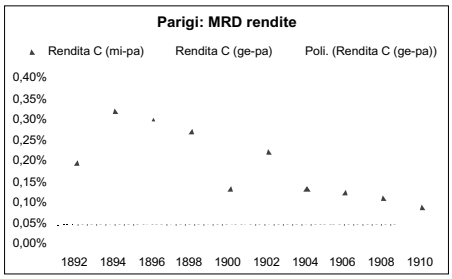
[228] In particular, the average level of prices between the two markets was taken as reference.





ment bond market, while the stock market shows a more uncertain degree of solidity, with a tendency towards integration in the first decade and a subsequent division in the second.

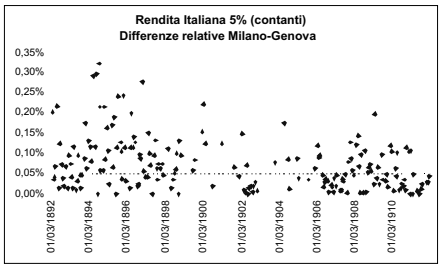


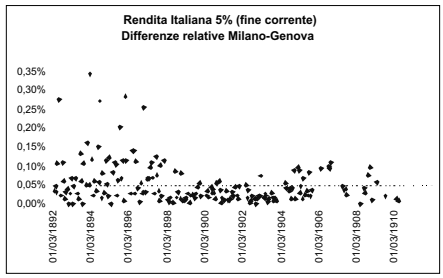


Finally, it should be emphasized that according to the data collected for the year 1880 it seems possible to rule out that a significant integration of the markets had taken place in the decade preceding the period under scrutiny. Indeed, price differentials for the government bonds between Milan and Genoa are 0.11% for government bonds negotiated for cash and 0.20% for the Ferrovie Meridionali stocks. Clearly, these figures are in line with the ones observed in the early 1890s. Up to this period, therefore, telegraph communications did not seem to foster an actual integration among Italian markets. Similar considerations also hold for the relationship with Paris where the differentials with the Italian markets in 1880 were between 0.20 and 0.30%.

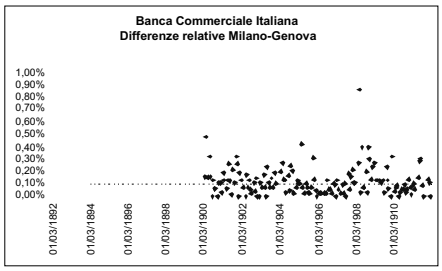
Exact differences in percentage

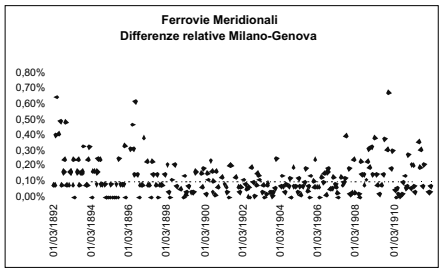
The exact percentage study investigation of relative price differentials confirms the theory of progressive integration of the Government bond market. The charts show day by day the percentage price differences. As far as relationships between Milan and Genoa are concerned, the sets for cash government bonds shows a progressive accumulation of differentials over the entire twenty-year period, while the set of end of current month bonds shows an even more striking convergence as of 1898, with a partial trend inversion beginning from 1904.

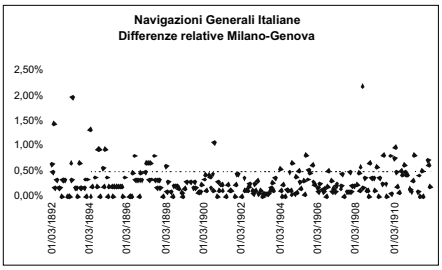




A similar U shaped trend characterizes the stock market even more distinctly. Milan and Genoa prices tend towards convergence until 1898, remain essentially on the same lines until 1906, and then diverge beginning in 1908. For all the sets, with the sole exception of Banca Commerciale, 1902 is the year of greatest integration.



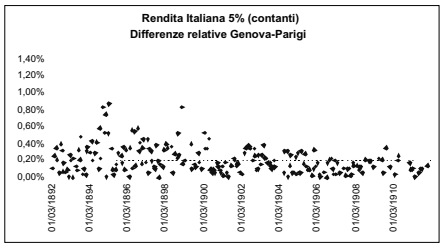


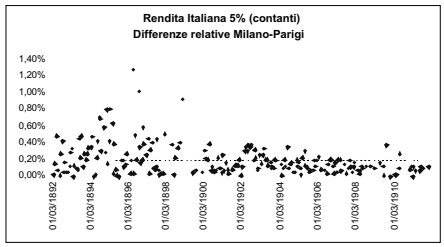


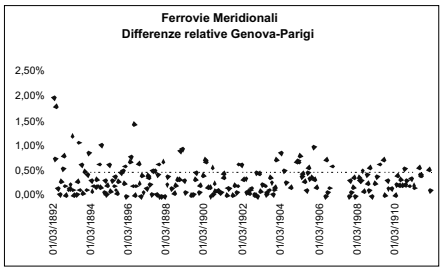
International comparison basically confirms the picture with a maximum price concentration at the end of the period for Government bonds, and at the beginning of the 20th century for stocks.

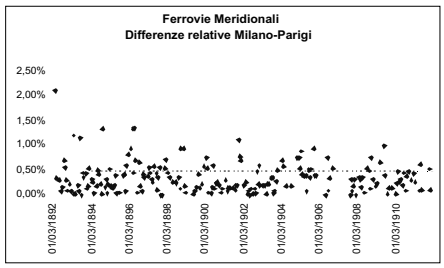
Regression

At this point, our qualitative analysis allows the assumption that the trend of price differentials among markets may depend, for all the securities taken into consideration, on a combination of two elements. On the one hand, time, considered as a pro-









gress indicator in the field of communications; on the other hand, volatility. The first aspect, by accelerating communication between the two markets and progressively reducing information barriers, would work in the direction of a tendency towards price convergence of all securities, both stocks and bonds. On the other hand, increasing volatility in stocks beginning from 1902-1904, seems to have caused an increase in the risk associated with arbitrage operations on these securities, leading prices to diverge again.

In order to verify this explanatory theory in statistical terms we worked backward, considering the price differential as a dependent variable, and time and volatility as independent variables. By means of the stepwise method we then verified, for each individual security, which variables would turn out to be significant. For the Milan-Genoa differentials the results are summed up in the following table:

	time		*volatility*		
	B	*Tsign*	*B*	*Tsign*	*R square*
Government bonds (cash)	**-.007153**	**.0403**		.7231	.42748
Government bonds (end month)	**-.006246**	**.0292**		.4607	.46755
Banca Commerciale Italiana		**.4917**	**.296744**	.0531	.64871
Ferrovie Meridionali		**.1847**	**.304914**	.0003	.82261
Navigazione Generale Italiana		**.4017**	**.288166**	.0426	.42028

Significant variables: bold.

The result of our regression analyses confirms the distinction between stock and bond markets, which we had already observed. Progressive integration of the bond market (cash and end

current month) is justified simply by the time variable element and therefore, in our assumption, by technical progress in the field of communications. Although decreasing parallel to price differentials, volatility is not sufficiently significant, from the statistical point of view, to justify their convergence: the prices for the government bonds in Milan and Genoa are not convergent due to volatility reduction, but rather, presumably just because more rapid communications makes it possible to operate arbitrage even on scanty margins. The possibility of arbitrage is helped by the cash availability of the bond market.

On the other hand, as far as stocks are concerned, the only explanatory variable that is significant is volatility. This would suggest that in spite of the slight integration trend resulting from the graph, the possibility of arbitrage on the stock markets depends basically from the volatility of the securities: when volatility decreases, there is also a decrease in the risks connected with the purchase and the re-sale of securities for arbitrage purposes, earnings can be anticipated with greater certainty even with scanty margins, and price differentials between the two markets tend to decrease; on the contrary, when volatility increases again, arbitrage becomes higher risk and prices may increasingly diverge.

Empirical evidence thus confirms the coexistence in Italy of a bond market that is increasingly integrated, thanks also to more rapid information, and an unbalanced stock market on which, instead, technological innovations in the field of communication do not seem to have significant impact. The explanation of this difference may depend, as we suggested, on the greater cash availability of the bond market, particularly in the final years of the period under scrutiny. This theory is confirmed by the data relating to clearing: the value of the cleared stocks increases sharply until just before the decline, and then falls just as rapidly. The government bonds have a much higher cash availability, increasing as much as twenty times between 1906 and 1907 when the stock market decline diverts a large part of financial capital to the government bond market [229].

	Gov't bonds value (lire)	*Merid value (id)*	*NGI value (id)*	*Comit value (id)*
1900	718.398.559	37.731.388	19.732.293	35.493.463
1902	739.413.039	28.636.375	24.791.833	28.440.332
1904	826.892.238	43.371.243	42.918.949	80.982.862
1906	631.416.275	43.442.467	24.340.349	78.535.178
1907	12.043.906.292	58.533.286	19.707.979	83.148.349
1908	9.203.805.823	19.892.452	12.935.156	66.904.198

Source: Clearing Chamber of Milan.

Also from an international standpoint, regression analysis confirms that the convergence of the bond market is justified by time, and therefore by the progress of communication technology, while the fluctuating trend of differentials in the stock market is justified by volatility.

[229] It is possible, as suggested by Angelo Riva, that the growth of the public bond market in Milan corresponded to a simultaneous reduction elsewhere, as was to happen later in 1913, when from one semester to the next transactions of Rendita passed in substantial measure from Milan to Turin. Indeed the assumption would seem to be confirmed by the fact that the price of Rendita did not experience a sudden upsurge in this period in spite of the unusual growth in volume registered in Milan.

	time		*volatility*		
	B	*Tsign*	*B*	*Tsign*	*R square*
Bonds for cash (Milan-Paris)	-.02201	.006		.186	.633
Bonds for cash (Genoa-Paris)	-.01850	.016		.464	.536
Ferrovie Meridionali (Milano-Paris)		.940	.455	.003	.694
Ferrovie Meridionali (Genova-Paris)		.971	.380	.010	.588

Conclusive considerations

The statistical analysis carried out on the price sets on the different markets makes it possible to see a progressive, significant integration in the Milan, Genoa and Paris stock exchanges between 1890 and 1910. The significance of regression analysis with respect to time for the government bond market allows the assumption that the technological innovation in the field of communications and the spread of its use are among the decisive factors in the context of this process.

Further evidence also indicates that the operating conditions established through time on the different markets, particularly in the sector of stocks (first the highly speculative growth stage and then the months of intense crisis with considerable reduction of activity), gave rise to situations that were not always favorable to actual attainment of integration among the markets. In particular, stages of reduced trading seem to coincide with moments in which the process of convergence is interrupted or reversed.

Moreover, all evidence seems to suggest that the lines of control followed by different governments were much more influenced by the succession of speculation jumps and declines, in other words by the volatility and instability of markets, than by indications of basic convergence which were displayed.

The increasingly felt political need to guarantee a reliable procedure of accumulation, enhanced the sensitivity of regulation to the consequences of speculation, which are harder to restrict locally due to the growing connection among the systems. The 19th and 20th century supervision of stock exchanges thus responded in a characteristic way to the short term requirements, rather than prearranging an institutional network designed for a more international financial system.

Pascal Griset, *Sorbonne University*

FRANCE AND THE ADOPTION OF THE ELECTRIC TELEGRAPH: AN ACHIEVEMENT WITHOUT A REAL FUTURE

The introduction of the telegraph in France happened in two stages. The first, created on an autochthonous technology, provided for the expansion outside of its boundaries of the first modern telecommunications network, in other words the "Chappe" optical telegraph. Subsequently France, the forerunner country, had a hard time in keeping such an arduous commitment in an area presumably too closely connected to the claims of political power. The adoption of the electric telegraph took longer and was more laborious. This imported technology struggled to find its place in political and administrative circles which were strongly conditioned by the adoption of optical telegraphy which had been in use for several decades. In spite of the control and resistance on the part of a political class that was rather skeptical of innovative technology, it showed considerable development during the second Empire, thanks to independent management of the telegraph which was free to apply its technical knowhow.

The Chappe system

In order to ward off the physical restrictions connected with the conveyance of a written message, it was necessary to work out a system of communication that would lack material support. The first 'telecommunication' systems go back to the experience of certain populations which used fire or drums to communicate at short distances. Visual and sound contact made it possible to reduce distance and increase the speed of transmission of simple, pre-established information. The Chappe optical telegraph went far beyond these techniques. Its introduction in a particularly critical period of French history caused the application of legislation and management which established the basis for the development of French telecommunications.

The first modern telecommunications system

In working out the first telecommunications system, Claude Chappe [230] followed the same principles as the primitive procedures. However, he used them within the

scope of a rigorous organization and adopting a code, at once simple and complex, which lent effective value to his invention.

Claude Chappe had devoted many years of study to electricity [231]. In spite of this it was a totally mechanical system of message conveyance that raised him to historical fame. With the assistance of his brothers, Pierre-François and René, he carried out a number of painstaking experiments before realizing his dream of communicating at a distance. The initially planned use of sound signals was soon discarded in favor of black and white panels. In March of 1791 these panels allowed the exchange of information at a distance of 15 kilometers [232]. This basic concept evolved considerably in the course of experiments made in the years 1791 and 1792. Thanks to the collaboration of Abraham Breguet, Chappe was able to solve the mechanical problems related to an increasingly complex system. On July 12, 1793, Chappe officially submitted his device to the three commissioners appointed by the Convention: Arbogast, Daunou and Lakanal. The latter drew up a positive report, and testing on the first telegraph line connecting Paris and Lille began on April 30, 1794.

On August 15, the news of the re-capture of Quesnoy was the first piece of news sent by optical telegraph. The telegraph 'line' was made up of a succession of towers topped by a signaling system made up of three wooden jointed vertical posts. These elements could take many different positions. The main 'receiver' and relais of the network was the human eye, assisted - if necessary - by a telescope. The 'transmitter' was a combination of three jointed arms. The source of energy was human. Actually, and this is where his genius lies, Chappe planned a genuine 'machine idiom' making it possible for the information to proceed swiftly without being in the least altered.

Every position assumed by the three jointed arms corresponded to an indicator which could be interpreted according to different codes [233], the best known being the

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[30] Claude Chappe, born in 1763, was the second born of Ignace Chappe, controller of the King's Customs in Laval, originating from a family of the lesser nobility from Mauriac. After completing his studies in the cities of Rouen and La Flèche, he was conferred two ecclesiastic benefices which obtained him the title of Reverend Chappe even though he held no religious office. Thanks to these incomes he was able to dedicate most of his time to the study of physics in a research laboratory which he opened in the city of le Mans. The nationalization of the clergy's property put him in a rather difficult financial situation which he was able to overcome thanks to his brothers' help. He was thus able to continue his research on electricity. On December 31 1791 he was admitted to the *Philomatique* Society in Paris; in March, 1793, it assigned him and other members with the task of investigating the experiments of Galvani and Valli. About the societé *philomatique*, see M. BERTHELOT, "Notice sur les origines et sur l'histoire de la Société philomatique", in *Mémoires publiés par la Société philomatique à l'occasion du centenaire de sa fondation, 1788-1888*, Paris, 1988. On the context of that time in this setting, see C. GILLIPSIE, *Science and policy in France at the end of the Old Regime*, Princeton, Princeton University Press, 1980.

[231] A. BUTRICA, "Chappe électricien", in *Electricité et electrification dans le monde. Actes du deuxième colloque international d'histoire de l'électricité*, Paris 3-6 juillet 1990, edité par M. TRÉDÉ, Paris, P.U.F., 1991, pp. 43-54.

[232] Between the cities of Parcé and Brulon in the Sarthe department.

[233] The Chappe telegraph made use of 196 different basic signs; it would have been possible to increase this number, but they preferred not to exceed this limit in order not to overly complicate the work of the fixed personnels.

alphabet code. To increase conveyance speed, abbreviations and set formulas made it possible for users to avoid the use of words and full sentences. These codes also made it possible to somehow guarantee the users privacy on the content of the messages conveyed. The first code used by Claude Chappe was arranged by Léon Delaunay, the former French Consul in Lisbon. This code was made up of 9,999 words, each one represented by a number. Subsequently, the Chappe brothers used three codes: one code included 8,464 words, another 8,464 sentences, and a geographical code. These codes were a trade secret for the Chappe brothers: «The Chappe brothers have jealously guarded the secrets of their alphabet and their code in cipher» [234].

The Empire promoted new development opportunities for the Chappe network. In the midst of the Spanish campaign, in a letter addressed to the Minister of the Navy, Napoleon requested an investigation for the network's extension: «so that I may be promptly informed about whatever is happening from Toulon to the straits, to Cape Finisterre to Cape Saint Vincent». The network was extended to Italy, in Brittany and in the North, as far as Venice and Amsterdam. Other European countries set up fairly similar devices: in the middle of the past century, France installed the last line of this type in Algeria.

A French model

In spite of the fact that from a technical standpoint the Chappe system was based on ancient elements, it was designed and constructed only at the end of the 18th century. Social pressure, new administrative structures and evolving thought patterns made this type of telecommunication possible, forestalling in its principles and objectives, if not in its resources, the telegraph networks of the 19th and 20th centuries. Aside from its technical characteristics, it is the structure of the Chappe telegraph which in fact should be highlighted in order to understand the administrative outline of the history of telecommunications in France. Many elements are worthy of note in this pioneering period of the French telegraph network. Their performance directed the development of French telecommunications all the way to the present time.

1. Centralization. The centralizing function of the telegraph appears quite clearly on network documents. The telegraph developed according to the Jacobin concept, a star shaped structure with centralized control.

2. Nationalization. The way in which Chappe was able to develop his innovative discovery sets it in an administrative framework. Besides his technical judgment, Lakanal's report recommended the creation of a national network. The Convention did not recognize Claude Chappe as an entrepreneur. It was as telegraph engineer (sic) with the pay of a lieutenant in the engineering corps that he was appointed to

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[234] The three of them were transformed in a single code in 1830. This new code is probably identical to the one kept in the Postal Museum in Paris (H. GACHOT, *Le Télégraphe optique de Claude Chappe*, Saverne, 1967, p. 30).

carry out his mission. Furthermore, when, after a number of vicissitudes, the Chappe brothers were able to draw benefits from their initiative, they were accused of personal profiteering; communications and private initiative (and therefore benefits) already seemed to be part of two contradictory planets.

3. The weight of the military. The situation at the time caused Chappe to draw nearer to the War Ministry. In 1794 the transfer of protective measures to the Public Works Committee did not again involve such a strict control of the military on the telegraph. In 1797 the telegraph became the province of the Ministry of the Interior.

4. Rivalry between services. Ever since that time considerable rivalry grew between the navy and the army concerning the telegraph. In order not to be inferior as regards the Paris-Lille line, the navy decided to build a Paris-Brest line, and with a view to asserting its prerogatives, chose an entirely different system.

5. Political skepticism. Since it was still an unknown instrument, using codes, the optical telegraph immediately caused skepticism in political circles. At the beginning of the Directoire, Chappe had to defend himself as follows: «On 9th Thermidor, in presenting the telegraph to the troops, Henriot said that the Convention had contacts with the Austrian army. In Prairial I was considered an aristocrat. In Vendémiaire I was a terrorist making armies converge on Paris from all points of the Republic» [235].

Extent of the monopoly

The Restoration did not put the existence of the optical network in question again, so it resumed growing after 1820. In 1846, the year in which the final works in the capital were finished, the network had 534 broadcasting stations distributed over 5000 kilometers. The organization set up to be able to make use of it, laid the foundations of legislation and administrative organization of the French telegraph system.

«In France, the legal structures of the Post Office and Telegraph public service were worked out mainly with reference to mail» [236]. Indeed, the post office monopoly was the basis of reference for the telegraph monopoly. Organized in a prescribed form after Louis XI, the Royal Post Office was opened to private correspondence only during the reign of Henry III [237]. This use became somehow unavoidable under the reign of Louis XIV, since the decree of the year 1681 subjected private correspondence to compulsory use of the Royal Post Office. Thus the latter, managed by Louvois (Minister of Louis XIV), became a source of income for the State. This public monopoly was confirmed during the period of the Revolution and subsequently reaffirmed and defined by the Consulate [238]. Nonetheless the initiative of some entrepreneurs brought this condition back under discussion.

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[235] P. CHARBON, "Le télégraphe aérien français sous la Révolution", in *France Télécom*, 1989, 69.

[236] L. LIBOIS, *Genèse et croissance des télécommunication*, Paris, Masson, 1983, p. 177.

[237] Edict del 1576.

[238] Ordinance of 27 Pratile year IX (16 June 1801).

In the early Thirties A. Ferrier multiplied the projects for private telegraph lines. In June 1830 he asked permission to open a Calais-London line. Foy, manager of the telegraph administration at the time, who was put in charge of the matter by the prime minister, answered firmly: «Mr. Ferrier's question seems totally inadmissible [...], such telegraph communication would undoubtedly harm the privilege that the government enjoys at present, that is to be the first to be informed of all relevant news». Foy countered to this the disparity that would arise from a business point of view among citizens having access to such information and those that would be kept from it. Nonetheless, the episode revealed that actually no law existed allowing the government to refuse such authorization, so Ferrier went ahead: on January 24, 1832 he started the *Entreprise générale des télégraphes publics de jour et de nuit* (general day and night public telegraph enterprise) and suggested creating a Paris-Rouen line, a connection that was not covered by the government network. Since there was no law about the telegraph, the Administration tried to counter it with the post office monopoly, but it was a clumsy step, and Ferrier's attorney had no difficulty stopping it. In spite of real government concerns, Ferrier opened the network in July 1833. In the month of December the enterprise was forced to close due to its most inadequate success. Alarm for the public monopoly had been strong; it revealed in full the inadequacy of the existing regulation contents. Though fairly original, the story about the Blanc brothers who, thanks to a stratagem, had used the network to start an extremely profitable speculation, provided new claims for the advocates of close control of the telegraph [239]. The debate was reopened after discovery of an illegal connection between Paris and Lyon and subsequently by the opening of a line between Paris and Bruxelles in October 1836. As in the instance of the Paris Rouen line, the Administration was legally unprepared. The instructions given to the prefect of the Seine-et-Oise department clearly confirm it: «it is advisable, in the present state of legislation, to refrain from any legal action against the owners and employees of these companies» [240]. On January 6, 1837, the government registered a bill. The text of the Ministry of the Interior took up the usual issues again and concluded: «Due to its very nature, the telegraph is inevitably a monopoly [...] the only way to prevent the telegraph from going private is to assign it to the government» [241]. Far from obstructing this tendency on the part of the Interior Ministry to keep a close control of the telegraph, the members of Parliament fully confirmed the Ministry's verdict. With reference to the Government's considerable responsibility, the committee's report stated: «if there is a new way to communicate ideas at a great distance at an unusual speed,

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[239] P. CHARBON, "Genèse du vote de la loi de 1837, origine du monopole des télécommunications", in *L'État et les Télécommunications en France et à l'étranger, 1837-1987*, sous la direction de C. BERTHO, Genève, 1991, pp. 11-21.

[240] *Ibidem*, p. 18.

[241] O. GASPARIN, "Discorso pronunciato il 6 gennaio 1837 alla Camera dei Deputati", in *Le Moniteur Universel*, 7 January 1837, p. 40.

the Government must by all accounts take possession of it [...] the use of the telegraph can never become worldwide» [242]. Approved by the Chamber of Deputies on March 14 and the House of Lords April 17, the law was promulgated on May 2. Its single article was worded as follows: «Whoever shall, without previous authorization, transmit signals from one place to another, by means of telegraph machinery as well as by any other means, shall be liable to one year of imprisonment, and payment of a fine ranging between one thousand and ten thousand francs [...] The Court will order the destruction of the station, machinery or means of transmittance» [243]. The law indicated specifically: «In the matter of new resources, the human mind is boundless and in this case – with reference to the words 'by any other means' – it is necessary to anticipate something that does not exist yet, is not known yet or has never even been conceived of, something that could be devised to evade the law, if overly restrictive terms were to restrain the judge's conscience. It is necessary to reach all the solutions with which to obtain this result» [244]. So the wording was particularly rigorous. However, it did not leave out the possibility of an authorization, though without establishing the limits and regulations within which this authorization might be enforced.

Furthermore, the principle of non liability of the Government originated during the same period. The monopoly mentioned in all legal texts concerning the telegraph was extended by the law issued in December 1851 to the construction of the network.

The electric telegraph

To begin with Volta's major discovery, the development of the techniques for the production of electricity made it possible to consider utilizing it to transmit messages at a distance as of the second quarter of the 19th century. The plans devised from the second quarter of the 18th century, which remained in historical records – the very first ones were based on the use of static electricity – could not terminate in a business enterprise [245].

The Chappe system acts as an obstacle

In France, the development of the electric telegraph was hindered by the presence of the Chappe network. The administration in office was in no way inclined to lose its prerogatives due to a new technique about which there were as yet no certainties. The mere fact of referring to telegraph lines caused strong concern in France. The

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[242] M. Portalis, "Rapport de la commission présenté devant la Chambre des députés le 28 février 1837", in *Le Moniteur Universel*, 1 March 1837, pp. 416-417.

[243] Law on telegraphic lines, 2 May 1837.

[244] E. Delfieu, *Le Monopole télégraphique et téléphonique*, thesis for the degree in political and economic sciences, Montpellier University, 1918.

[245] J. Fahie, *A History of the Electric Telegraph to the Year 1837*, New York, 1884.

system was not well known, the mere breaking of a single wire was sufficient to halt the network. In the eyes of the military it was an extremely vulnerable system [246]. Nonetheless, in 1842 the first tests were made between Paris, Saint-Cloud and Versailles, with the aid of Wheatstone material. In spite of this, at the same time, the Assembly decided to subsidize Dr. Guyot's project which made it possible for the optical telegraph to work also during the night. Guyot's motives were based on an idea of the use of communication that would win the 'technical' decision of the Assembly. «No – wrote Guyot – the electric telegraph is not a serious invention [...] it's enough to think that one man by himself would be able to work secretly in the middle of the night cutting all the wires to Paris [...]; on the contrary, aerial telegraphy has its towers, its supports, its gates guarded from within by strong men armed with guns [...] Out of 600 insurgents, one half would accept with pleasure the mission of going to cut the wires of the electrical telegraph, while to break down an ordinary solid wood gate there would be no one willing to embark on such an undertaking». And he concluded with these words: «Replacing aerial with electrical telegraphy would quite frankly be a regrettable fact, a truly idiotic act» [247].

A committee responsible for studying the installation of the new technology was founded in 1844 [248]. This committee recognized the success of the electric telegraph abroad and recommended its acceptance [249]. The chief administrator of the telegraph, A. Foy, followed these recommendations his own way, deciding to adopt the electric telegraph… but to retain the Chappe code. Only an unclear, half measure, which revealed the supremacy of the State over innovation through its monopoly, highly representative of the French Government's half measures [250], or «one of the first examples of compatible evolution between two technical systems» [251], the opinions of historians confronted each other on this single example of transition from air to electric telegraphy. The device created by Breguet made it possible to record the symbols of the Chappe code on a small dial, using at the same time a network of electric transmission. This option, essentially a rather unusual one since it did not make it possible to derive the utmost advantage from the use of electricity, might seem like a 'socio-technical half measure', which today's specialists would define as an «adapted technology» [252]. This option, according to us, is explained by the importance of the

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[246] Y. Stourdze, "Le gouvernement de la mécanique", in *Culture Technique*, 1979, 1, pp. 47-54.

[247] Quoted by L. Fournier, *Comment voyagent nos dépêches*, Paris, p. 31. This text is also commented on *IRIS, Communications et sociétés, éléments d'analyse*, 1, Paris-Dauphine, 1978, pp. 38-39.

[248] Arago e Becquerel were members of it.

[249] With reference to this period, see also L. Figuier," La télégraphie aérienne et la télégraphie électrique, en Amérique, en Angleterre et en France", in *La Revue des Deux Mondes*, 15 agosto 1849, pp. 594-622.

[250] Y. Stourdze, *Généalogie des télécommunications*.

[251] M. Atten, "Quand les télégraphistes français font traverser la Manche à Maxwell; 1860-1890", in *France Télécom*, 1988, 67.

[252] P. Flichy, *Une histoire de la communication moderne. Espace public, espace privé*, Paris, La Découverte, 1991, p. 65.

'human capital', represented by the optical line 'sentry'. Their inflexibility, which was acquired with considerable hard work during the first years of activity, seemed like the basic element of the telegraph system. Given that the problems connected with hiring and establishment of qualified labor throughout the 19th century were a recurring problem for the French economy, this priority given to men over technology to our eyes, besides being somewhat outmoded, seems particularly well suited, since it appeared to be temporary, and France subsequently was fairly quick in adopting the Breguet alphabet system and later the Morse apparatus. Technological upgrading was constant and corroborated by the international success of the Baudot system. By designing a five key keyboard making faster operation possible, the French inventor brought average speed to 60 words a minute [253]. This system became a huge success which continued into the Fifties.

Birth of an administration

Up to the last quarter of the 19th century the telegraph administration had developed independently, strongly influenced by the persons directing it. The Chappe family therefore represented the actual core of a telegraph administration prototype [254]. However, in the course of development of the optical telegraph lines the structures had been somewhat adjusted.

In spite of Claude's tragic death in 1805 [255], the family kept direct and indirect control of telegraph administration until 1830. The structure of this administration was rather inconsistent as far as personnel was concerned. The majority was made up of the so-called 'fixed personnel': persons responsible for the mail and the transmission of messages, who were carefully selected by the Chappes. «As much as possible we have tried to select telegraph 'fixed personnel' among simple men with no particular ambition for whom a pay of 25 sous a day would be quite sufficient, and whose habits and personalities were as detached as the machine that made them work», they explained [256]. Without any actual in-between stages, there were the inspectors, hired after taking an examination and responsible for the network's key positions and its supervision. The students of the Polytechnic school, admitted without any examination, did not even apply for this type of job. The Central Administration (so to speak) was in an embryonic stage. The network was the responsibility of the Civil Engineers [257].

The institution of the electric telegraph caused important developments on an organizational level. As early as 1844 a decree established that 4/5 of the inspector

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253 P. MERCY, *Le Système de télégraphie Baudot et ses applications*, Parigi, Dunod, 1924.

254 Claude was director, his brothers Ignace and Pierre-François, deputy directors, Abraham inspector in Lille, and René translator.

255 Struck by serious illness, he committed suicide.

256 L. FOURNIER, *Comment voyagent nos dépêches*, Paris, p.32.

257 E. GERSPACH, "Histoire administrative de la télégraphie aérienne en France", in *Annales télégraphiques*, 1860, 2, v. 3.

jobs were reserved to the students of the Polytechnic school. In 1854 the government decided to turn the telegraph administration into a general management, and Viscount H. de Vougy became the head of it. Except for a brief period, he remained in charge until 1870. With his rather complex personality, he marked the development of the Administration and succeeded in maintaining its independence. Thus he rejected an initial plan for the merger between the post office and the telegraph. In 1862 he gave an actual structure to his administration by supplying it with greater organization, establishing its personnel qualifications [258]. The higher positions went from 120 in 1840 to 240 in 1862, for a total of 3000 fixed personnel. However, the rather personal concept the Viscount had about power, and his strong inclination towards favoritism in hiring, did not make it possible for the telegraph administration to change entirely. In spite of this there was considerable development. At the end of the Franco-Prussian war the number of jobs was 5574. A core of managers had gradually formed, two thirds of which was made up of people from the Polytechnic school. The telegraph administration was an independent structure which was able to operate according to its own logic of development.

Electricity and opening to the public

One might rightfully talk about synergy between the development of the electric network and the opening of the public telegraph office. Owing to the rather limited capacities of its lines, the optic telegraph would have proved itself too expensive for private users. Thanks to its definitely higher capacity offer, the electric telegraph made it necessary to open to the public, since the investments made for the opening of new lines could be paid off only by means of widespread utilization. Nonetheless the decision promoted a major debate. In putting forward a new law, the Minister of the Interior went as far as emphasizing «it seems impossible that the French government should refuse to have our country's trade and industry participate in the extraordinary advantage connected to communication that saves time, an element of primary importance in business» [259]. A negative position was being expressed which presented this reform as a threat to the stability of the State. «private people will be informed along with the government of events that might take place locally» – explained a member of parliament who feared hat the use of the telegraph would be given to groups who might make use of it to «plot with greater skill and promptness their despicable schemes» [260]. At any rate, the law on private telegraph correspondence was

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[258] Ordinance of 20 January 1862. De Vougy had not held back on the budget since the organization chart was made up of: 1 general manager, 10 general inspectors, 92 department inspectors, 40 assistant inspectors and 92 directors of transmissions (L. Libois, *Genèse et croissance des télécommunications*, Paris, Masson, 1983, p. 190).

[259] F. Barrot, "Discours à la Chambre des députés, 1er mars 1850", in *Le Moniteur Universel*.

[260] M. Le Verrier, "Rapport présenté à la Chambre des députés le 18 juin 1850", in *Le Moniteur Universel*.

voted on November 29, 1850. It opened telegraph lines to private persons. The text repeated the principles which already regulated the management of the post office, applying them to the telegraph: article one specified the following «Every person whose identity [261] has been confirmed has the right to correspond via the National electric telegraph, through the employees of the telegraph administration». As was the right of the Government to interrupt this service at any time and refuse to send out telegrams «in the interest of public order and decency». The principle of the State's non-liability was applied to the telegraph similarly to the one on the secrecy of private correspondence [262]. The beginning of the second Empire can therefore be considered to all effects as «the beginning of the telecommunications public service in France» [263].

In this institutional and technological context, the development of the electric telegraph prospered significantly under the second Empire. While in 1850 the vote to allow an initial credit of 900,000 francs gave way to a rather hesitant start [264], in 1852 five million francs were granted to expand the development. During that year the network sent out 48,000 telegrams. The following year traffic tripled. In 1855 all prefectures were connected with Paris, and the capital could count on an inner network as of 1854. In time similar systems were adopted by the major French cities. As of 1857 connections with prefectures and sub-prefectures were achieved, and in 1862 it was the turn of national and departmental networks. These networks developed over approximately 30,000 kms with traffic amounting to 1.5 million telegrams sent [265]. Since this network developed extremely fast and therefore in a somewhat disorganized way, the decree of January 20, 1862 laid the foundations for its restructuring. The offices of the warehouses opened at the prefectures which classified the materials, establishing an accurate nomenclature of the wires used according to traffic.

Development of cantonal networks started in 1864. The townships that wanted to be connected had to supply the buildings that would house the telegraph office, and guarantee the Administration a minimum income. This new stage of development based on a more detailed subdivision of the national territory made it possible for the great majority of the population to have access to the service [266]. At the time of the first telegraph connection between Europe and the United States, the national telegraph network was permanently established.

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[261] The requirement to declare one's identity established serious application problems. The procedures, which had initially been drastic, were however abated in 1854.

[262] Law of 29 November 1850, enforceable from 1 Marc 1851. In consideration of the fact that a telegram was not a 'sealed' means of dispatch, the crime of 'opening' mail could not be attributed to the agents. It therefore seems implicit that it was an actual principle of professional secrecy.

[263] L. Libois, *Genèse et croissance des télécommunications*, Paris, Masson, 1983, p. 183.

[264] At the end of the year 1851, the network was just over 2,000 kilometers

[265] J.-L. Narjoux, "Le télégraphe électrique public en France, 1851-1861", in *Colloque international d'histoire de la poste et des télécommunications*, Montpellier, FNARH, 1989, t. III.

[266] When between 1864 and 1877 the extent of the network was doubled going from 2,800 to 5,000 kilometers, the post offices increased from 610 to as much as 4,587.

In spite of initial resistance, France, in the context of the «political economy of December 2» [267], had thus organized the service in a perfectly satisfactory way and, at the beginning of the Third Republic, could avail itself of a widespread and functional telegraph network. This achievement had been made possible thanks to the skill demonstrated by the telegraph administration which in just a few decades had been able to create a solid organization basing itself on an extremely strong technical culture. «One could almost say that the administration of the telegraph lines at the time worked as an actual and relatively independent public system. This is almost certainly what gave it its strength» [268].

The creation of the Post Office and Telegraph Ministry did allow this vitality to consolidate through time. While Cochery's farsightedness made it possible for more than a decade to safeguard the independence of telegraphists, the superiority in numbers of the mail carriers ended up prevailing at the end of the 1880s. The technical culture which had allowed the success of the electric telegraph was overpowered and then substituted by a bureaucreatic culture, which was more favorable to preserving rather than creating, supporting rigidity in the organization and the decline of technicians. Thus France missed its rendezvous with the telephone, and 'telecommunicators' had to wait almost a century to recover the independence that would allow them to give France back a telecommunications network worth of the name.

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[267] F. CARON, *La France des patriotes*, Paris, Fayard, 1985, p. 39. Railroads and transportation in general and town planning are cited; the telegraph, which is not mentioned, can definitely be included.

[268] L. LIBOIS, "Du télégraphe électrique à la télévision, Actes du colloque Réseaux de télécommunications et réseaux électriques (1840-1940"), in *Recherche sur l'histoire des télécommunications*, 1986, p. 16.

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THE TELEGRAPH SERVICE IN ITALY AFTER ITS UNIFICATION. INSTITUTIONAL ASPECTS

The telegraph in the Italian States before unification

Before the unification, in Italy – as in the rest of Europe and the United States – the development of the electric telegraph was closely connected with that of the railroad network: «All over Europe and the United States – Peppino Ortoleva remarks – the development of the railroad network from the 1840s would probably have been much slower without the parallel development of the telegraph network, which allowed the coordination of stations and switch points ahead of time compared to the means of transportation running on tracks» [269]. The other powerful incentive for the adoption and development of the electric telegraph on the part of the different States was of a strategic nature: «in the 'industrial' wars fought since the time of the American Civil War, the instruments of telecommunication appeared everywhere to be a strategic instrument in the control of territory and of relocation» [270].

The first State of the Italian peninsula [271] to be equipped with electric telegraph was the Grand Duchy of Tuscany [272]: the planning and construction of the Pisa-

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[269] P. ORTOLEVA, "Telecomunicazioni", in *Dizionario storico dell'Italia unita*, N. TRANFAGLIA, B. BONGIOVANNI (eds), Roma-Bari, Laterza, 1996, pp. 905-921, p. 906.

[270] *Ibidem*.

[271] The bibliography on the vicissitudes of the telegraph in Italy is not very extensive: in this regard, thought should be given to the ideas of A. GIUNTINI, "Con filo o senza filo. Per una storia delle telecomunicazioni", in *Memoria e Ricerca*, 5, 2000, pp. 5-12. Still now an essential reference point is A. ANTINORI, *Le telecomunicazioni italiane 1861-1961*, Roma, Istituto Superiore PT, 1962 (reprinting from Edizioni dell'Ateneo, 1963); on the organization of the telegraph in the pre-unification States and the Kingdom of Italy, cf. the work of E. MELILLO, *Ordinamenti postali e telegrafici degli antichi Stati italiani e del Regno d'Italia*, Prato, Istituto di studi storici postali, tomi VII, 1984-2001, v. I, II e III, passim; also specifically dedicated to the telegraph service are the eighth and last volume of the work, being edited by S. FARI; S. BAIA CURIONI, "Il telegrafo e la formazione di un sistema integrato di mercati mobiliari in Italia (1888-1905)", in *Innovazione e sviluppo. Tecnologia e organizzazione fra teoria economica e ricerca storica (secoli XVI-XX). Atti del secondo convegno nazionale della Società italiana degli storici dell'economia*, Bologna, Monduzzi, 1996, pp. 377-386; for a general interpretation of the "Italian model" in the telecommunications sector, the works of P. ORTOLEVA, "Telecomunicazioni", and "Telecomunicazioni: un modello italiano?", in *Memoria e Ricerca*, 5, gennaio-giugno 200, pp. 107-118.

Leghorn line (the first in Italy) were entrusted in 1847 to the physicist Carlo Matteucci, one of the foremost researchers of that time in the field of electric phenomena, who completed the line in 1848; the Florence-Pisa line was also opened to the public in that year, and in 1849 the Lucca railroad and the city of Lucca were provided with the telegraph. Also in 1849, a telegraph office was opened at the Town Hall in Leghorn, directly connected with Pisa, Florence, Empoli and Pontedera. The Tuscan telegraph network was a reality: in 1852 the High Office of Management of the Telegraph was established in order to supervise the service, and Matteucci was appointed general manager. The rate was calculated according to distance and number of words, and was considered rather expensive: in December 1859, therefore, the distance norm was abolished by the provisional government and the rates reduced. At the time of its admission to the new Kingdom, March 22, 1860, Tuscany had 873 kilometers of lines and 30 telegraph offices [273].

At the beginning of 1850 the electric telegraph was also installed in the Lombardo-Veneto [274], under the management of Carlo Zelli; the development of the new communication instrument was immediately quite substantial: in Lombardy, in the decade previous to the unification, 570 kilometers of lines were established and 11 telegraph offices opened. In September 1850, by provision of the imperial Trade Ministry, the regulations and rates provided for by the agreement signed in Dresden on July 25, 1850, by Austria, Bavaria, Prussia and Saxony, were adopted: the agreement established the Austro-German Telegraph Union, extended to the Lombardo-Veneto region, and to which also the Duchies of Modena and Parma adhered in 1851; the rate, as in Tuscany, was based on the distance and the number of words. Between 1851 and 1855 the Telegraph Union was able to bring into its sphere of service all the states of the Italian peninsula: in 1852 the Granduchy of Tuscany entered it, signing an agreement with the Duchy of Modena; similar agreements with the House of Este brought into the Union the Papal State (1853) and the Kingdom of Sardinia (1855); in 1854 it was the turn of the Papal State, which drew up an agreement with the Kingdom of the Two Sicilies providing for interstate exchange of telegrams, thus connecting also this zone to the Italian peninsula's telegraph system, though in a very limited manner, as we will see. In June 1858 the Telegraph Union drew up an agreement with Belgium and France, and the following September another agreement was made in Berne between Belgium, France, Holland and Switzerland; the Kingdom of Sardinia also entered this second agreement in February 1859. The original core of the telegraph network that would serve the entire national territory after 1859 was developed in this setting of organization and rates.

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[272] ANTINORI, pp. 8-9, and attached table; MELILLO, II, p. 14.

[273] With regard to the number of telegraph offices the figure given by A. Antinori is followed, differing from Melillos (38 offices).

[274] ANTINORI, pp. 8-9, and attached table; MELILLO, I, pp. 75-76.

After Tuscany and the Lombardo-Veneto, the electric telegraph was introduced to the Duchy of Modena [275]: in the agreement of June 4, 1851 with Austria, the House of Este administration, besides joining the Telegraph Union promoted by the Hapsburg empire, undertook the construction of an internal line connecting Modena to the Parma boundary; the Austrians, on their part, undertook to set up simultaneously the Mantova-Borgoforte-Guastalla line, and to connect Modena with Lombardy. The telegraph service started on January 1, 1852, under the direction of Carlo Roncaglia, and on February 3, the link up with the Lombardo-Veneto went into operation. The agreement with Modena was closely connected to the one with the Parma Duchy, formally established on September 15, 1851, with an agreement pledging the parties to link up between the Parma, Este and Austrian lines: in March 1852 the management of the telegraph was set up in Parma, run by Giuseppe Cattani, and the following June the first telegraph office was opened in the State capital; in May 1853 the Piacenza office was opened. The internal rate between the two cities was established according to number of words, while for other destinations the system of estimating according to distance and words provided for by the Telegraph Union was adopted. At the time of annexation the Duchies had 516 kilometers of lines and 13 offices [276].

In April 1852 the telegraph service in the Kingdom of Sardinia also started, with the opening of the Turin-Genoa line [277]; subsequently an underwater cable was laid from the coast south of Genoa to Corsica, a line was created to connect Corsica and Sardinia, and a further cable connected Sardinia with Algeria: they were manufactured by the firm Brett, which also was in charge of their maintenance, while the State was in charge of their operation. In 1853, in fact, the Kingdom of Sardinia had introduced the State exclusive privilege for the telegraph, too, and its management was put under the supervision of the Ministry of the Interior [278]; however, in 1858 it was deemed preferable to transfer the telegraph service to the Ministry of Public Works, setting it within the General Management of Railroads, under Bartolomeo Bona. Before the establishment of the Kingdom of Italy, Piedmont and Sardinia had 1,400 km of lines and 60 telegraph offices [279].

Telegraph services in the southern part of the mainland were also started in 1852, with the establishment of a General Management of the Neapolitan telegraph, under the direction of Gennaro Attanasio [280]. The Kingdom of Two Sicilies was then linked up in 1854 with the lines of the Papal State through the telegraph office of Terracina,

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[275] ANTINORI, pp. 8-9, and attached table; MELILLO, I, pp. 105-106.

[276] Modena had 8 offices and 316 km of lines, Parma 5 offices and 200 km.

[277] ANTINORI, pp. 8-9, and attached table; MELILLO, I, pp. 56-57.

[278] Law of June 23 1853 n. 1563; the State could draw up special agreements with companies holders of railroad concessions: actually, the telegraph would come partly under the authority of the Ministry of the Interior, partly under that of Public Works.

[279] Piedmont had 1,000 km of lines, Sardinia 400; neither Melillo nor Antinori specify the distribution of telegraph offices in the two regions.

[280] ANTINORI, pp. 8-9, and attached table; MELILLO, II, p. 64.

the only station qualified for the inter-state exchange of messages; the particularly restrictive measures regulating the service between the two States were an indication of the climate of political segregation that characterized the two areas during this period: the use of coding was allowed only in official telegrams, and it was the only instance in the entire peninsula in which the conveyance of messages was dependent on ascertainment of the sender's identity.

In the Papal State the first telegraphs were activated in 1853 on a stretch of the Rome-Bologna line; adherence to the Austro-German Telegraph Union was given the same year, and the link-up of the Lines with the Este Duchy through the Bologna-Modena connection. The offices and personnel of the Papal telegraph were put under the higher Management of the Rome Telegraph, directed by Fedele Salvatori, which depended from the Ministry of Trade and Public Works. In 1855 the telegraph service (up to that time reserved to State service and granted to private persons only for special reasons) became public: the rate adopted was based on distance and on number of words, and was later reduced in 1858, basing it only on word count. Finally, following an agreement with Austria drawn up in August 1856, the Papal State lines were linked up directly with those of the Lombardo Veneto region, through Ferrara; in 1860 the Papal provinces annexed to Italy had 20 telegraph offices and 900 km of lines.

In 1857 the telegraph was finally extended to Sicily, which was assigned its own Management directed by an extremely skilled specialist, Ernesto D'Amico, who a few years later became general manager of the Kingdom of Italy telegraph service; the administration of the telegraph in the Two Sicilies thus came to have two central managements, one in Naples and the other in Palermo. At first telegrams for Sicily crossed the Straits of Messina by boat, to be re-transmitted on the other side; then an underwater cable was laid between Reggio and Messina, but it soon stopped working and the service via sea was resumed. Only after the Unification was the connection via cable finally activated. A similar experience was that of the other underwater cable required by the Bourbon government, laid between Otranto and Valona, soon becoming unserviceable, and returned to service under the Kingdom of Italy. At the time of the unification the Kingdom of Two Sicilies had 3,974 km of lines and 114 telegraph offices [281].

The main reason for the adoption of the electric telegraph in the pre-unification States was not the service of private message conveyance: as said before, it was rather the need for development of the railroad network and considerations of a military nature which initially induced governments to equip themselves with this latest communication technology. Furthermore, it met the requirement for fast communication, independent from the physical dislocation of messages, deeply rooted in the contemporary world, and tied on the one hand to the need for a communication system "in

[281] The southern mainland had 2,874 km of lines and 86 offices, Sicily had 1,100 km. of lines and 26 offices.

real time" that could rationalize distribution mechanisms and meet the requirements of the growth of industry and the large technological networks (of which the railroads is only a first example), on the other hand to the widespread circulation of information and the beginning of that characteristic feature of contemporary times which is mass communication. All these characteristics can be verified in the origins and development of the Italian telegraph system: first and foremost, the demands of industrialization and the creation of infrastructures were very much present in the Lombardo-Veneto region and in its satellite States, in the Granduchy of Tuscany and in the objectives evidenced in Cavour's economic policy in the Sardinian kingdom. Moreover, the increase in circulation of daily newspapers, which was supported by the attainment of high-speed printing techniques and particularly favorable postal costs, was also sustained by the creation of great agencies (connected with the introduction of the telegraph), such as the United States' Associated Press, France's Havas, England's Reuter, and Stefani in the Kingdom of Sardinia, founded in 1853 with the encouragement of Cavour himself among others. The telegraph service for the public was another inevitable development: it was rather a policy of high rates tending at first to select its use to the advantage of private individuals in a network which had been created with different functions, favoring industrial, trade, and professional users and limiting the use for personal communication to situations of special need and importance. In certain States, such as the Papal State or the Kingdom of the Two Sicilies, the service for the public only appeared later, surrounded by special precautionary measures. On the contrary, certain kinds of application kept their privileged status. For instance in the Kingdom of Sardinia the public administration enjoyed exemption from telegraph costs, the railroad companies benefited from a system of franchise in spite of patent rights, and the Stefani Agency operated according to special agreements with the government, communicating via telegraph, to State authorities and to other subscribers, political and trade information of public interest, the gathering and circulation of which was the motive for its establishment. Moreover, in the 1850s the rates experienced a trend towards reduction and simplification: for the domestic service in the Granduchy of Tuscany, the Kingdom of Two Sicilies and the Papal State, the single rate was used (according to number of words regardless of distance), even though the international service continued to follow the other rule due to agreements with the Austro-German Telegraph Union.

Creation and development of the national telegraph network

The Austro-German Telegraph Union undoubtedly facilitated the connection among the telegraph networks in pre-unification States; achievement of a continental relationship situation, first through the agreement between the Union, Belgium and France, and later with the Berne agreement of September 1, 1858, entered also by the Kingdom of Sardinia, had then included central and northern Italy in the vast flow of continental telecommunications. The south of Italy was left out, unable to link the continental network with the island network, and with its only interstate point of

exchange being the one with the Papal State in Terracina. The first limitation was due to a technical fault (failure to lay a reliably working underwater cable between Reggio and Messina), the second stemmed from a choice of political preference reflected in the limitations imposed on the service. The particular characteristics of the pre-unification circumstance undoubtedly helped the complex work of bringing together the national telegraph network after the unification. A further favorable element was also the strong patriotic motivation of the most influential public figures of the pre-unification telegraph management.

During the initial post-unification stage, the Piedmontese Bartolomeo Bona headed the Italian telegraph companies, though a foremost role was immediately undertaken by the Tuscan Matteucci, first as inspector general and then as scientific consultant to the management; Ernesto D'Amico had a particularly important role, as general manager of the Italian telegraph from 1865 until 1886; in addition, in 1859 Fedele Salvatori, exiled from the Papal State, having become part of the Italian telegraph management, undertook the laying of the new underwater cable between Otranto and Valona and succeeded D'Amico as general manager from 1886 to 1889. Also significant were those telegraph officers such as Tommaso Picco, inventor of a multiple automatic lightning rod which was awarded a prize at the Moscow exhibition in 1872, and of the electro-astronomic service of the Genoa observatory of the Navy, and Michele Francisci, a hero of the Milan five-day conflict and member of the Mediterranean Underwater Telegraph Company, or Clemente Viale, the future inspector general and member of the board of directors of the Post Office Ministry. Associated with the different armies during the 1859-1861 campaigns, they had provided the planning and hte construction of the lines from the Tuscan border to Sicily, and later had been stationed as department managers to see to the merger and reorganization of the service and personnel in the annexed provinces [282].

The first step in the creation of a unified telegraph service was the merger of the previous managements under a single set of rules. With this intent in February 1861 a decree was passed endorsing the first regulations for the Italian State telegraph, which was then extended to the Neapolitan and Sicilian provinces the following April[283]. The territory of the Kingdom was divided into department managements, five at first, then increased to ten in the course of a decade due to the annexation of the South, and later the Veneto and Rome [284]. Along with the telegraph systems, the new management also inherited the Piedmontese legislation, which had established since 1853 the principle of state monopoly on the telegraph with the above mentioned

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[282] M. GIANNETTO, "Il Ministero delle poste e telegrafi: l'organizzazione", in *Le riforme crispine*, vol. I, *L'amministrazione statale*, Milano, Giuffrè, 1990, pp. 519-581, p. 529.

[283] The regulations were approved by Royal Decree of February 7, 1861, N. 4674, and extended to the southern provinces by Royal Decree of April 11, 1861, N. 4758.

[284] There were nine departments in 1865: Turin, Milan, Bologna, Florence, Naples, Bari, Reggio Calabria, Cagliari, Palermo; in 1867 Venice was added, and in 1871 it was the turn of the special Rome delegation. Rome then became a department, absorbing Florence.

decree. Thus the setting up and operation of telegraph lines were left to the government, except for the special agreements drawn up with the railway agency companies. It should moreover be said that the State monopoly in this field was already a fact in all Italian States, and the extension of Piedmontese legislation did no more than regulate by law a situation which was already consolidated. Also concerning service regulations and rates, the Piedmontese legislation was the basis for the Kingdom of Italy legislation issued in 1862 [285].

The first layout of the telegraph network goes back to the years 1861-1864, under the direction of Bartolomeo Bona, with the creation of a number of important works and financing of a great many others [286], to incorporate and rationalize the legacy of lines and offices inherited from the pre-unification States. The objectives to be followed were the standardization of lines and apparatus, and the expansion of the network; from one State to another the characteristics of the lines varied in the use of components (such as poles, wires and insulators) with different technical features, and also the characteristics of apparatus [287]. As far as the latter is concerned, the Morse code was adopted on a national scale [288], with the gradual replacement of the other types, and the type of batteries to be used was uniformed. As far as the lines are concerned, they were gradually standardized by specifying the materials to be used for the different components and tackling the serious problem of maintenance, which had been neglected by the more backward of the pre-unification administrations, and was therefore inadequate on much of the national territory. The national network was gradually developed along two main arteries, Tyrrhenian and Adriatic, connected by seven transversal lines: upper Po, lower Po, Porrettana, Col Fiorito, Abruzzese, Pugliese, Lucana. Similar principles affected the Sardinian and Sicilian networks, connected to the mainland network by means of underwater cables. Once the first layout of the network had been completed, in 1885 it was decided that the lines located along ordinary roads would be moved wherever possible along railroads, due to the latter more regular layout, as well as to make maintenance easier, and for security

[285] The regulations and the rate «for the correspondence by telegraph of private parties in the Kingdom» were issued by the Kingdom of Sardinia by Royal Decree of April 7, 1859 N. 3357, which renewed the regulations keeping in mind the Berne agreement of September 1858, which the subalpine monarchy had accepted in February 1859; the subsequent Italian national regulations were issued by Royal Decree of May 28, 1862 N. 1659.

[286] Appropriations needed for the construction of the various telegraph lines that were meant to act as carrier axis for the national network were approved in the years 1862-1865, before the separation of the telegraph management from the railroads management (Law of March 30, 1862 N. 523, Law of December 24, 1864, N. 2075; Law of May 11, 11865, N. 2301).

[287] ANTINORI, pp. 8-9, and attached table, and G. ARCURI, "Il Ministero delle poste e telegrafi: l'istituzione", in *Le riforme crispine, vol. I, L'amministrazione statale*, Milano, Giuffrè, 1990, p. 502.

[288] The Morse code was in use in all pre-unification States, supported by other types of apparatus: Bréguet, with dials, in Tuscany, Wheatstone, with magnetic needles, in Sardinia and the Papal State, Henley, by induction, in the Two Sicilies.

reasons. The conveyance of messages was carried out through "direct" circuits, linking the points of greater traffic and provided with swift devices, "semidirect" circuits, requiring re-transmission of the message, and "omnibus" circuits which included a series of different offices, served by Morse code devices, and needed a number of re-transmissions.

Another aspect of the growth and rationalization of the network concerned the location of the offices: while on the one hand it was indeed necessary to make circulation over the territory more widespread, on the other hand there was a need for regulations that would make it possible to eliminate of the ones located in unimportant places, and the opening of new ones where they were considered useful. At first, as the townships in which the law granted special advantages requested installation of the telegraph, the new offices were fitted into the "omnibus" circuits of the network without a plan established beforehand. Not until 1885 was a plan devised to rationalize the offices, allocating the necessary financing. It was then decided that the outermost offices of a line should coincide with the capital of a province, or at any rate with towns with greater importance in trade and industry. The main limitations in the efficiency of the telegraph service depended on the number of re-transmissions averagely needed to convey each dispatch to its destination, and on the insufficient transmission speed of the Morse systems (700 words per hour). With regard to the first point, as late as 1881 every dispatch required an average of more than three re-transmissions to reach its destination [289], and on this problem, deriving from the layout of the telegraph network, the administration was unable to act; as a matter of fact, the proportion became worse to over four re-transmissions on average in 1911, reaching almost five re-transmissions at the end of World War I. On the second point instead, the administration took effective steps, supplying the higher traffic circuits with Hughes systems, which had twice the speed of transmission, and subsequently using also the Caselli pan-telegraph, the Meyer printer telegraph, double Hughes systems, the new Wheatstone, and the double Baudot systems [290].

Important adjustments were made also in the field of underwater cables [291]. Sardinia had already been connected, as we have seen, in the Fifties. Sicily was connected by laying a new cable between Reggio and Messina, ordered in April 1861. In 1864 a new cable was also laid between Otranto and Valona, directly connecting the Italian network with those in the Balkans. The connection with Sicily, moreover,

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[289] The figure is obtained from the ratio between domestic and international telegrams and work in the offices (ANTINORI, table on p. 30), and is 3.35 in 1881, 4.24 in 1911 and 4.95 in 1918. It was therefore not uniformly spread over the entire traffic, since the dispatches transmitted on direct lines between the main centers did not undergo any re-transmission, and those on semi-direct lines only one: thus the problem concerned mainly the efficiency of the omnibus circuits, and therefore penalized traffic on the secondary lines serving the minor locations.

[290] ANTINORI, p. 13, and ARCURI, pp. 503-504.

[291] ANTINORI, pp. 10-11, 12, and ARCURI, pp. 503-504.

posed serious problems, since the violence of the currents in the Straits of Messina constantly interrupted the cables: a great number of attempts were made, investigating special expedients to reinforce the armor of the cables themselves, but still in 1862 and 1863 there were negative results, and frequent interruptions in the line. In 1867, finally, the management decided to make an agreement with the British firm Telegraph Construction and Maintenance [292], which that same year was able to lay three cables, thus guaranteeing continuity in the connection, and in 1868, with a fourth cable, it completed the long-distance circuit Torino-Modica-Malta. Also in 1868 the plan to directly connect Sicily and Sardinia was irrevocably abandoned, as the cables laid were constantly breaking down. In the meantime also the line connecting the mainland and Sardinia through the La Spezia-Corsica circuit started showing signs of aging, through a number of problems; it was therefore decided in 1868 to lay a new cable between Leghorn and Corsica, and another between Corsica and Sardinia; an agreement to this effect was reached with the French management. Instead in 1875 the option was made for a direct connection between Sardinia and the Italian peninsula without going through the French island: in this case construction, laying and subsequent maintenance of a cable between Orbetello and Terranova were ordered from the German firm Erlanger, and was installed that same year. Finally, in 1886-1887 the management signed two agreements with Pirelli for the laying and maintenance of several underwater cables including one between Naples and Palermo, for the maintenance of the Otranto-Valona cable, and for the laying and maintenance of cables between Massaua and Assab and between Assab and Perim.

At the time of the unification, for its domestic service the Kingdom of Italy adopted the rate based on number of words and distance. As early as 1863 D'Amico, however, advocated a single rate for the telegraph [293], a suggestion that was enacted by law only in 1870. Exemption for government dispatches was a serious additional increase: in 1862 they represented one third of the telegrams sent and one half of the ones received; «if those dispatches had not been exempt they would have been charged approximately 5 million lire, in other words twice the total income of the telegraph» [294]. In 1862 the exemption was limited to the royal family and the ministries: «Hopefully – D'Amico wrote – the ministries will be thriftier in sending dispatches, and the implementation of the decree relating to the officers will be so organized that they will not take the liberty of issuing circulars to all the authorities of the Kingdom for every trifle» [295]. The agreement with the Stefani Agency was maintained, however, and in 1872 a daily collaboration was started with the Central Bureau of Meteo-

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[292] At the time this firm was «leader in the sector of production and laying of cables» (D. De Cogan, T. Baldwin, "Innovazione tecnologica e stagnazione finanziaria. Lo sviluppo della telegrafia internazionale tra il 1866 e il 1900", in *Memoria e Ricerca*, 5, 2000, pp. 25-43, p. 26.

[293] E. D'Amico, *Sulla telegrafia italiana*, Torino, Tip. Letteraria, 1863, p. 49.

[294] *Relazione statistica sui telegrafi del Regno d'Italia dell'anno 1870*, Firenze, 1871, p. 34.

[295] *Ibidem*.

rology of the Ministry of Agriculture, Industry and Trade for the daily collection and transmission via the telegraph of the data related to weather situation; the data were transmitted by semaphore to the telegraph service from weather stations equipped with special instruments for observation.

In the late 1870s, the telephone made its appearance: the Telegraph General Management had been following its technical development since the beginning; as a matter of fact, the first telephone connection on telegraph wire and with plain Bell telephones without a microphone, was carried out in Rome in 1878, just a year after the experimental connection of February 12, 1877 between Essex and Boston. As early as 1877 the manufacture of telephones with a Bell patent had been started in Milan by F.lli Gerosa, an early embryo stage of the future Face-Standard company [296]. In 1879 a permanent telephone connection was established between the telegraph offices of the Capital: these early connections were not meant for public service, but in support of the existing Morse code telegraph communication. This new form of communication was also subjected to State monopoly, without any objections being raised; however, the development of the telephone service really started only after the Baccarini law of 1880 authorized its exercise by concession on the part of private industry. The first concession was granted to the Bell Company on April 1, 1881. The management of the new service, both direct and on concession, was immediately assigned to the competence of the General Telegraph Management; in 1882 there were already 1,900 telephone subscribers [297] and their number was increasing fast. But the real importance of this change was the sudden rise in quality which it demanded of the administration's technical culture. While in the first two decades of national unification telecommunications had virtually been identified with the telegraph, in the following three decades new prospects were opening for more widespread development due to rapid progress in the wire telephone, as well as the introduction of radiotelegraphy at the end of the century, and finally the development of "electronic" technology following the introduction of radio tubes in the first decade of the 20th century. The telegraph administration had to deal directly with these new developments even after the establishment of the Post office Ministry, until the Schanzer reform of 1907.

The Telegraph General Management: structure and development

After the appointment of Bartolomeo Bona as general manager of the Southern Railways in November 1864, a period of regency began on the part of the general Post Office manager Barbavara, lasting until August 1865; during this period the decision was made to create a Telegraph General Management, separated from that

[296] ANTINORI, pp. 15-17, and ARCURI, p. 504.

[297] ARCURI, p. 504. The figure is not far from the rest of Europe: Germania 2,000, Francia 2,700, Inghilterra 2,900, Austria 400, Svizzera 800.

of the Railroads, within the Ministry of Public Works, as a more effective instrument to meet the «requirement of bringing together materials, equipment and service regulations and giving the telegraph rapid circulation as required by the growing needs of the State and the public» [298]. The General Management was created in September 1865 [299], and the role of manager was assigned to Ernesto D'Amico, who was assigned the final nomination as General manager August 1, 1866. The General Management was made up of two divisions, one for personnel and telegram service, the other for materials, offices and line service; there were also accounting and bookkeeping departments, and an office controlling the scientific and technical laboratory, central workshop and central warehouse. The director was assisted by a technical-administrative Board with its own secretariat, chaired by the director himself and made up of the head supervisors and the two division heads. The Board was called on to express its opinion on a number of issues and it could invite the collaboration of two physics professors when required to rule on technical and scientific matters, or the chief accountant when dealing with administrative or accounting problems, or even one of the department directors for specific business. While the accounting and bookkeeping departments had administrative functions which won't be described here, it is interesting to look at the combination of central technical functions which were delegated to the office in charge of the technical-scientific laboratory, of the workshop and of the warehouse: the central workshop, set up in 1867, was in charge of repairs to the telegraph systems in the general warehouse with specialized personnel, but it also manufactured models to be used for study or as samples. The technical laboratory was in charge of experiments and testing and kept its records on file at the disposal of the General Management or the chief supervisors. The latter had entirely technical capacities and they devoted themselves to the construction and maintenance of the lines, office installations and supervision of general services. This structure, however, could only partially meet the requirements of materials control and the preparation of technical regulations: it was therefore expanded and improved making it into the original core of the Telegraph Technical Office, established in 1869, which in turn was the beginning of what would become the Post Office and Telecommunications Higher Institute. At the same time the position of scientific consultant was abolished, an appointment held by Carlo Matteucci until his sudden death on June 25, 1868, and then briefly by Giovanni Minotto, an engineer and inventor of a model of hydro-electric battery, who in turn died on February 10, 1869.

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[298] ANTINORI, p. 11; also ARCURI, p. 504.

[299] Royal Decree of September 18, 1865, N. 2504, and rules for realization issued by Royal Decree of March 4, 1866 N. 2820. On the organization and activity of the telegraph administration before establishment of the Post Office Ministry, ANTINORI, pp. 10-17; ARCURI, pp. 501-505; MELILLO, III, pp. 29-39; M. GIANNETTO, "Ministero delle poste e telegrafi (1889-1924)", in *L'amministrazione centrale dall'Unità alla Repubblica*, ed. by G. MELIS, vol. IV, *Il Ministero della Cultura Popolare. Il Ministero delle Poste e Telegrafi*, ed. by P. FERRARA and M. GIANNETTO, Bologna, Il Mulino, 1992, pp. 161-162.

The secondary organization was divided into several departments and divisions. The divisions were in charge of the lines: each one was responsible for a stretch of 500 to 1,000 km. of lines, had a management, was run by a technical officer with the qualification of inspector, and was equipped with a materials warehouse and a lineman school. In each department several divisions were established, and from them depended all the subordinate personnel in charge of the lines, which consisted of foremen and lineman agents, the latter responsible for seeing to a stretch of the line. The most important lines (the ones containing more wires or "direct" wires) were taken care of and monitored by the administration personnel, while the maintenance and monitoring of the other lines was divided into sections that were let out on contract. But the load bearing axis of the distribution of services over the territory was made up of the departments which repeated on a smaller scale the organization of the General Management. The department manager, to whom important decision on making and operating duties were delegated on a local scale, directed and supervised the state of both administrative and technical services; the members of his team were an accountant who ran a department office corresponding to the accounting department of the General Management, and two secretaries, one for the bookkeeping part, the other for the technical part, with responsibilities on a departmental level similar to those of the two central divisions. Besides the management offices, each department had a workshop, a warehouse and a school: the workshop was run by a "mechanic" and was in charge of repairs to the telegraph systems; the department school had the task of training newly hired personnel and updating those already in service on the use of the telegraph systems and batteries, on the administration services and the tasks of the offices. The meticulous job of receipt and transmission of telegrams was carried out in the telegraph offices which were divided into three categories according to telegram traffic and/or the importance of the office [300]: each one of them was not to represent for the administration a cost exceeding the income earned. At the main offices there were schools for the full instruction of telegraph messengers.

In 1870, similarly to what had recently taken place in the Post Office, D'Amico was able to obtain also for the Telegraph the establishment of an independent administration, a General Management separated from the rest of the Ministry from which also the suburban structure depended; this arrangement was then further improved by the regulations passed in 1875 [301]. The organization of the central and suburban administration confirmed what had been established so far: unlike what had happened for the Post Office, D'Amico was in fact able to convince political authorities of the inappropriateness of an arrangement based on provinces, arguing that undue fractioning of a system of telegraph lines would have caused considerable hindrance to regular

[300] First class offices were those sending out more than 10,000 telegrams a year and having special technical importance; second class offices were those sending out more than 2,500; offices with less work were considered third class. E. MELILLO, III, p. 36.

[301] Royal Decree of October 27, 1870, N. 5987 and Royal Decree of April 11, 1875, N. 2442.

performance of the service [302]. In the arrangement of the telegraph administration there continued therefore to be greater emphasis than in that of the postal one on the need to meet the technical requirements of the service with a "special organization"; this caused strong resistance to the introduction of changes based on principles of administration uniformity. The experience developed in the unification years, when the administration had given proof of its excellence by appropriately timing telegraph connections from one end of the peninsula to the other, also proved that in the telegraph sphere the basic approach taken on from the time of the Sardinian Kingdom was oriented towards objectives of technique and efficiency. The Sardinian arrangements, extended to the whole Italian peninsula and modified in 1870 to adjust them to the requirements of a service which in the meantimehad greatly expanded, had brought about the establishment of offices and professionalism that had remained practically unchanged until the establishment of the Post Office Ministry in 1889, with characteristics of marked technical specialization destined to form a hardly removable tradition and a standard that was still present in Giolitti's time. From 1861 to 1888, on the eve of the establishment of the Ministry, the development of the telegraph service had achieved considerable results [303]: the offices open to the public had gone from 248 in 1861 to 3,565; the ground lines from 7,833 in 1861 to 33,848, and underwater lines had attained 1,900 km with 176 cables laid; from 700 Morse code systems in 1861 there were 3,651 in 1888, added to which were the over 150 Hughes, Wheatstone and Baudot type high-speed systems set up at the main junctions of the network. Only the net income of the service had remained virtually unchanged due to the considerable investments required by the development of the service: while revenues had more than doubled from 7,004,347 lire in 1861 to 15,542,456 lire in 1888, costs had equally increased, and the income had gone from about 2,650,000 lire in 1861 to about 3,000,000 in 1888.

Establishment of the Post Office Ministry

The first politician to visualize the establishment of a special ministry for postal and telegraph services was Alfredo Baccarini, minister of Public Works from 1878 to 1883; Baccarini's suggestion was taken up by the prime minister, Depretis, and the president of the Budget Committee of the House of Representatives, Luigi La Porta; Crispi, however, though declaring himself favorable to the establishment of the new ministry, brought up two matters: one of a constitutional nature, the other political-administrative. The first question, for years debated in the House, concerned the authority to determine the number, the powers and the organization of the ministries, in other words whether this authority belonged to Parliament and therefore their esta-

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[302] E. D'Amico, *Cenni sull'amministrazione dei telegrafi in Italia dalle origini all'anno 1885*, Roma, 1886, p. 22.

[303] The data are derived from Arcuri, p. 505.

blishment, modification or abolition should be approved by law, or if instead it belonged to the executive branch, therefore to be approved by royal decree. The second concerned the relationship between political power and bureaucracy: on this point there were also two opposite opinions, one which considered that the supremacy of political authority could not be renounced, and claimed the abolition of all forms of organizational and managing independence (of which the two General Managements of Post Office and Telegraph were a particularly conspicuous example), and the other which held the opinion that for special services of an industrial and technical quality supplied by public administrations, independence should be upheld and even commended, though within the sphere of a ministry of its own. On the first point Crispi was favorable to the idea which might be defined pro-executive, and in 1888 as Prime Minister he made an effort to have it adopted by Parliament; on the second point he claimed the expediency of abolishing the two General Managements which he considered «anomalous, non-responsible administrations» since it was up to them to exercise any decisional and operative power, «leaving the ministers to put their signature and sometimes only the sand on the ink», but answering politically in Parliament for administrations over which they had no actual power [304]. Baccarini was of the opposite point of view on both questions raised by Crispi, particularly on the one of the two General Managements: he recommended the establishment of a Post Office Ministry certainly not as a way to «replace and destroy» two administrations that worked so well that it would have been «a real administrative crime to disrupt them»; and he added that «if there were no General Managements they should be created in order to provide for the regular running of public services» where the ministers are assigned the part of tasks including some responsibility, not the handling of secondary business which is the job of the head clerks [305]. Crispi replied that he did not intend to disrupt anything, but merely wished to imitate the English system, where post office and telegraph linked up to a single individual – the Postmaster General – and the central administration was organized in simple divisions. The matter remained undecided since the House adopted the agenda proposed by La Porta approving the government plan without entering upon the issues raised in the discussion.

Although it had not reached any actual result, the 1883 discussion had put in evidence the main subjects of debate: the constitutional issue, the one of interference from political power in the administration, as well as that of the organization of services with special technical-industrial characteristics. It was the constitutional issue that actually stopped all development in the matter in subsequent years; however, also the issue of the general managements held the scene: the June 1887 discussion on a reorganization plan presented by the Depretis government was especially thorough. In November 1887 Crispi, who had in the meantime succeed Depretis as Prime

[304] *Ibidem*, p. 494.
[305] *Ibidem*.

Minister, presented a new bill on the 'Reorganization of the Central Administration of the State': it was the new elaboration of the former Depretis text, as amended previously by the Budget Committee, and once again provided for the establishment of the Post Office and Telegraph Ministry; but this attempt at conciliation did not please the House, and lead to a fairly animated parliamentary debate. The opinions opposing the Ministry to be established were addressed against the risk of future political interference in the administration: «If there is in Italy an administration that is proceeding favorably in comparison with all the others – the Piedmontese representative Luigi Tegas cautioned – that is, in everybody's opinion, the post office and telegraph administration. The proof is that no complaints have been expressed against it, such as those deafening us against the other public or private administrations […] I am afraid that the new Post Office Minister, whoever he may be, for no particular reason might venture to spoil this fine arrangement» [306]. After a number of events Crispi replaced the initial text of the bill with another of a much firmer content, which was approved on December 9, 1887 and shortly after became Law 5195 of February 12, 1888; the provision did not enter upon the matter of how the central administration was run, but gave the government the power of determining by royal decree the number and functions of the ministries (art.1), established the position of undersecretary of State (art. 2), and gave the Cabinet the possibility of increasing or decreasing by royal decree the number of General Managements and to provide for the re-arrangement of the different administration services (art. 3). Thus the constitutional issue was clearly solved in favor of the executive, and the road had been smoothed for Crispi's administrative reform. However, it was another year before the actual establishment of the Post Office Ministry could take place in March 1889 [307], and the nomination of the minister (the Potenza representative Pietro Lacava) and the undersecretary (the Piedmontese representative Carlo Compans di Brichanteau.

Internal arrangement of the Ministry and reorganization of the services

The March 10, 1889 decree established the Ministry of Post Offices and Telegraph, and simultaneously abolished the 'separate' General Managements heading the two services, at the same time it replaced the two positions of general manager on the roll with the ones of minister and undersecretary, without differences in cost which further parliamentary movements might cause. In the report accompanying the decree to the king's signature Crispi confirmed the reasons for this choice: «it was recognized [by Parliament] that the post office and telegraph services, due to the development they have acquired, now represent powerful means of civilization, and

[306] *Ibidem*, p. 497.

[307] Royal Decree of March 10, 1889, N. 5873; the decrees for the nomination of the minister and undersecretary are dated March 11 and 17.

that the General Managements, subsisting of their own livelihood and with an almost self-sufficient and independent existence for the administrative part, do not correspond to an entirely accurate concept of free institutions, in as much as the political responsibility of the administrations of the State is exclusively up to the Ministers, nor can the by-laws recognize administrations that are not responsible». Shortly before, in the same text, he had confirmed the reasons – mainly political – which had led to the establishment of the Ministry, and were closely connected to the abolition of the two Managements: «When an administration is too vast it is impossible for the person in charge to keep an eye on all its parts, so that his responsibility is nominal; the internal correspondence which is the consequence of this situation, is detrimental to the swiftness of the service. It follows that certain offices with fewer affinities towards others, escape the direct dependence from the minister and work themselves into a situation of self-determination which is first of all an insult to the political principle of ministerial responsibility». The need to substantiate and motivate this choice originated from a basic misunderstanding: in the vast majority favorable to the establishment of the Ministry, two schools of thought countered each other, «one which in the post office and telegraph administration visualized public services, prevailingly industrial, managed by the State, to be organized and directed with criteria of special administration, and the other seeing it as a political government body, exactly like the one of the other administrations with the role of carrying out public power» [308]; Bertani and Baccarini, for instance, belonged to the first, Crispi and Depretis to the second. The option to abolish the Managements and the nomination of a political summit which had already shown its preference for Crispi's line of thought, thus served to form an accurate political course in the internal organization of the new ministry.

The following March 20, minister Lacava issued his first circular letter, addressed to the managers and inspectors on the different levels of the administration, in which he defined his work program [309]: after a general reference to the wish to further extend postal and telegraph services to give «taxpayers» from smaller towns the same opportunity of «enjoying their benefits», Lacava widely emphasized the need to pursue a financial policy that would make it possible to obtain the scheduled improvements adapting them to the country's economic conditions, «which do not consent expenses other than necessary», and pointing out that it would be «his constant and foremost care to be most sparing in expenses»; the circular ended with the promise that the minister would be an «active supporter of his staff, at the same time firmly demanding of the fulfilment of their individual duties». The importance given to the need to reduce costs is the actual key to interpretation of the definition given to the

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[308] M. GIANNETTO, "Ministero delle poste e telegrafi (1889-1924)", in *L'amministrazione centrale dall' Unità alla Repubblica*, ed. by G. MELIS, vol. IV, *Il Ministero della Cultura Popolare. Il Ministero delle Poste e Telegrafi*, ed. by P. FERRARA and M. GIANNETTO, Bologna, Il Mulino, 1992, pp. 163-164.

[309] An ample summary of the circular may be found in ARCURI, pp. 506-507.

reorganization of the Ministry. Indeed, it is a well known fact that Crispi's reforms were in a context of a particularly difficult financial situation: the widespread tendency to increase the functions and participation of the State in the economy, the policy of public works started with high appropriations, and the growing costs of the African undertaking, were countered by an economic crisis in full progress with the resulting standstill in the growth of income. Even those administrations (such as Post office and Telegraph) which brought a profit to the Treasury had to squeeze expenditures to increase this profit, to the detriment of the investments needed for the improvement of the service. The option of eliminating the positions of the general managers, aside from Crispi's overall persuasions on the relationship between politics and bureaucracy, was probably dictated by his very wish to weaken what he termed «the coalition of bureaucratic requirements and that natural esprit de corps that prevents any major reform», without which it would have been hard to bring about the plan for reorganization that Crispi and Lacava had in mind [310].

This was based on the idea of merging the postal and telegraph services, resulting in considerable savings gained from sharing office space and personnel for the two services in many towns. Those who were doubtful were confronted as an example, as Crispi had already done in 1883, with the British model, supported where necessary with the instances of other European countries. The suggestion to merge the two services was not of itself a novelty: it had in the past already been advocated mainly by post office staff members, citing the similarity in the aims of the two services, but was generally opposed by telegraph personnel who felt particularly bound by the specific technical features of their activity. The merger policy was firmly pursued in the period from 1889 to 1896 by the ministers Lacava, Camillo Finocchiaro-Aprile and Maggiorino Ferraris, with a standstill during the di Rudinì government between February 1891 and May 1892. At that time the Post Office Ministry was assigned temporarily to the minister of Public Works Ascanio Branca, who was positive that «the post office and telegraph services were two absolutely separate services» and that «the scientific part is predominant in the telegraph service, while the administrative part is predominant in the post office service» [311]. He therefore drafted a bill, which was withdrawn by his successor Finocchiaro-Aprile, based on the re-establishment of the General Managements (though no longer independent) and on the distribution of the personnel into two main sectors – post office and telegraph – since he was convinced that only separation of the jobs could produce lower costs and improvements. Finocchiaro-Aprile instead introduced his own reform project, in which the merger trend was enhanced, but it had no follow-up due to resistance on the part of the telegraph personnel, which in 1893 also lead to the first successful strike of the sector, and also due to the cabinet crisis following denouncement of the

[310] This possibility is supported by the fact that the enactment of the reforms authorized by the law of 1888 led to the abolition of general managements only in the instance of the Post Office and Telegraph.
[311] Quoted from ARCURI, p. 511.

Uccialli treaty and the bank scandals. The merger trend was therefore resumed by Maggiorino Ferraris with greater caution, and, ultimately, with greater success [312].

Strong points in the enactment of the merger strategy were the following: founding of a single Board of Directors for both services, presided by the undersecretary; establishment of a single central purchasing department for the two administrations; replacement of the two post office and telegraph accounting departments with a single central accounting department of the Ministry; separation of the central administration into ten Divisions (in turn subdivided into a total of 36 sections), plus a central inspection bureau and four special bureaus; concentration into organs of general competence of business of common interest to the two services (such as personnel, registry and records offices, central cashier's office); merger of the central administration staff roles. A similar operation was undertaken on a suburban level: the second Lacava circular [313] in fact made public his intention to «combine in the locations, where there are 1st class post offices, including the branch offices in the main cities of the Kingdom, and 2nd class telegraph offices, the post office and telegraph service, in such a way that one and the other are carried out in the same premises», and this would be in order to save as well as for «greater advantage for the public, finding both services combined in a single office»; subsequently the supervisory roles were combined by organizing them into districts where supervisors were in charge of post offices as well as telegraph offices with the only limitation being in the latter case not to be involved in technical matters; furthermore, in 1895 in every province capital a single management of the post office and telegraph was established and assigned to an executive who might come from either career, according to level and seniority [314]; telegraph departmental managements and their respective divisions instead continued to exist, though with the exclusive task of seeing to the construction and maintenance of the lines and systems. Lacava's objectives were taken up again by Ferraris, and at the end of 1895 the situation of the suburban administration appeared to be modified as follows [315]: 29 districts for postal inspection some of which responsible for several provinces; 10 telegraph department managements, with authority over 27 divisions each one comprising several provinces; 27 first and second category provincial managements and 42 third and fourth category; 116 first category post and telegraph offices, and 1755 second category ones were combined; 56 first category post offices and 146 first category telegraph offices were not yet combined

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[312] *Ibidem*, pp. 511-516.

[313] *Ibidem*, p. 508.

[314] The provincial managements were divided into four categories: the first and second category ones had the same administrative duties formerly assigned to the primary post office managements and to the telegraph departmental managements, and in their district they could have some third and fourth category managements; all of these differences fell through in 1896.

[315] Owing to Royal Decrees of August 1, 1895, N. 531, and of October 27 1895, N. 665; the data exhibited are in MELILLO, III, pp. 69-72.

as well as 2813 second category post offices and 1079 second category telegraph offices. While integration of services on a local supply and communications level proceeded gradually but successfully, the same cannot be said as far as the idea of joint use of suburban personnel assigned to the services: the merger policy in this area in fact required a training effort to have the post office personnel gain knowledge of the telegraph service and viceversa; but this training did not give good results and was discontinued at the end of the Lacava tenure [316].

Telecommunications services in the Post Office Ministry

In the twenty-five year period from the establishment of the Post Office Ministry to the outbreak of World War I, fairly broad prospects opened up for telecommunications [317]: there was indeed significant innovation in the telegraph field, and especially in the telephone field. The invention of radio telegraphy took place in this period, after the success of Guglielmo Marconi's first experiences in 1895 at Villa Griffone, near Bologna, and after he moved to England in 1896 to be guaranteed the patent and industrial development of his findings. The actual acceptance of radiotelegraphy started in Italy only from 1902, thanks to the Navy, and the first civilian installation, authorized in 1903, was completed in 1911 at Coltano, near Pisa, and was part of the international network of Marconi stations for communications with South America. Actually, before the war, the main use for radiotelegraphy concerned naval security, and the 1904 agreement between the Italian government and Società Marconi was committed to mainland to aboard-ship communications.

Since 1881, the telephone service had been licenced to private companies for a three year term, with the installations being transferred to the State free of charge at the end of this period. This regulation remained in force until 1903, when the duration of the licences was increased to 25 years; however, on the whole, the indecision of government trends did not help the development of the telephone service, nor in coordinating with the telegraph service, although they would have found mutual motives of advantage in the network. Only in 1903 the necessary sum was allocated to create a state network linking the 69 provincial capitals, but it was not possible to establish consistency in management and coordination of standards between state and agent held installations. In 1907, thanks to minister Schanzer, it was decided to proceed with the redemption of the agencies that were expiring, and gradual passage of the entire service to government management. Up to that time the telegraph and the telephone services had been entrusted to the same technical structure: in 1907 they came together in a single General Management, which then split in 1908: for the telephone service, nine Departments were established operated by a General Management with a separate budget, its own accounting department and technical-admini-

[316] On the subject of the failure in the training of "joint" personnel ARCURI, p. 509, and MELILLO, III, p. 44.
[317] ANTINORI, pp. 18-43.

strative board. However, the administration was faced with hopeless difficulties deriving from obsolete equipment and the impossibility of financing its replacement, as well as by the lack of adequate administrative independence. In 1910 the Casana Committee, created to examine the development problems of the service, suggested financing the installations resorting to Treasury loans, to increase the independence of the telephone administration, and to retain the mixed system of Government and agency-holders, though with a separation of tasks which gave the government operation of the long-distance network, and agents that of urban services. These suggestions went unheeded, but in 1913 funds for the development of the long-distance network were granted: in 1915 it connected not only the province capitals, but all the capitals of the district; furthermore, 362 urban lines had been created, and the service by then had 99,593 subscribers.

As far as the telegraph is concerned this period was characterized mainly by the impressive development of the network of underwater cables; on the other hand, attempts to rationalize the network met with an essential failure, which left unsolved, or rather made worse, the problem of the many re-transmissions necessary for the "omnibus" networks. The first protests for the conditions of the post office and telegraph service started coming up in Parliament in June 1896, becoming a chorus in the subsequent period, and led to second thoughts on the policy followed up to that time in the organization of the Ministry; this was also promoted by the crisis following the defeat at Adua, which on March 1, 1896 caused Crispi's final fall [318]. From then until June 1898 cabinet crises followed one another, and in two years as many as four different persons alternated at the head of the Ministry. Political instability thus was added to the commotion caused by the merger policy, with negative consequences on the efficiency of the services which were already under stress due to economic problems. After Pietro Carmine's brief tenure, Emilio Sineo was at the head of the Ministry from July 1896 to February 1898, and he introduced a number of organiztion innovations on a central as well as on a suburban level: in particular, starting November 1, 1896 he abolished the departmental managements of the telegraph and extended the same powers to all provincial managements of the post office and telegraph of any category [319]. This provision simplified the continuation of post office and telegraph office mergers locally, all the way to virtual disappearance of independent telegraph offices in all towns, except for a few in which particular historical or local patriotic reasons advised against it. As far as the central government was concerned, Sineo decided to reinstate a number of in-between positions between political leaders (minister and undersecretary) and division heads, in order to be able to concentrate his activity on the complex political problems presented by the obviously critical

[318] On the reforms of the post office administration in Giolitti's time, M. GIANNETTO, "Ministero delle poste e telegrafi (1889-1924)", pp. 172-180, and M. GIANNETTO, "Il Ministero delle Poste e Telegrafi: l'organizzazione", pp. 561-568.

[319] Owing to Royal Decrees of September 24, 1896, N. 437 and N. 438, and of October 30, 1896, N. 489.

situation of the services, as well as to compensate the negative effects of government instability with a role that would lend continuity to the administration. Unable, or unwilling to revert to General Managements, he established three "departments" assigned to general supervisors who were experts, one of personnel and general business, another of postal services, and the third of telegraph and telephone services. Upon Sineo's death in February 1898, the interim period of the Minister of the Treasury, Luigi Luzzatti, followed, then the very brief term in office of Secondo Frola. The ministry was then taken over by Nunzio Nasi; he was convinced of the need for a radical maneuver in the central administration and organization of personnel, which he enacted in spite of the short duration (only 11 months) of his tenure.

Nasi's idea was that the crisis that the post office and telegraph administration was experiencing was caused by the failure to complete the merger of the services, and by the persistent instability produced by the elimination of the General Managements. Thus the three "departments" created by Sineo were abolished and replaced by a General Secretariat, in charge of the Minister's cabinet, the bookkeeping office and the personnel division, and a single General Management composed of seven divisions and a general supervisory office in charge of all the postal, telegraph, telephone and cash services; Antonio Miglioranzi, the former head of the "department" for postal services, was the person in charge. The personnel of the central and suburban administration was merged in a single roll, subdivided into four categories: responsibility and management (from deputy secretary to general manager), administrative-bookkeeping (from official to head clerk), junior (the former category of assistants, in which temporary employees were to be enrolled), and finally the lower level category in which helpers, telegraph messengers, mail carriers and postal brigadiers were enrolled. The order given to the administration by Nasi was left unchanged by his successor, Antonino di San Giuliano, and completed by Alessandro Pascolato who enacted the regulations of the Nasi staff organization in October 1900: «there was to be a single administration, both central and suburban, a single professional culture, a single career, a single management [...] the arrangement of the administration attained the peak of the merger both in the services as in the staff» [320].

The timeliness of new solutions, therefore, though perceived by the different ministers, was conditioned by the need to move along the lines of the Lacava reform; this was clearly evident also in the measures introduced by Pascolato's successor, Tancredi Galimberti, who again modified the organization of the central administration, eliminating the General Management in January 1902 and restoring the three "departments", responsible respectively for personnel, money orders and savings, and the third of mail, parcel, telegraph and telephone services; this new organization was completed by the minister's cabinet, the bookkeeping office, and the Maritime Services Supervisory office. The latest proposal of unifying postal and telegraph offi-

[320] M. GIANNETTO, "Ministero delle poste e telegrafi (1889-1924)", p. 174.

ces was submitted by Galimberti as «the logical and necessary consequence of the entire attitude conferred to the administration for more than a decade» [321], but this lack of consideration for the specific technical quality of the services was at this point evidenced as one of the main weak points of that attitude. It was precisely in discussing Galimberti's terms that Filippo Turati announced his diagnosis of the general causes of the crisis of the administration: «The first cause is to have turned the post office establishment into a political establishment, for totally parliamentary reasons, putting politicians in charge of an essentially technical ministry. [...] Nor was the merger of the two services – post office and telegraph – into a colossal establishment, a minor contribution to this disorder. A disastrous merger from a technical point of view, contradicting the rule of the distribution of labor and leading inevitably to the triumph of incompetence» [322].

While the Lacava reform had been characterized by intense economic depression and the resulting determination to assign to the management of postal and telegraph services a role supportive of the state's budget, the new course was also favored by the country's improved political and economic prospects. Indeed, along with the development of that period, a new reformist trend permeated by rising industrialist standards had been building up on all levels. The Federation of postal and telegraph workers led by Turati, through criticism of the guidelines expressed by former ministry administrations, had succeeded in establishing a program that could be summed up in the following key points: improvement in the services by means of reinvestment of profits; division of the different branches of the service to adjust the administration to the requirements of the nation which was on the way towards a stage of intense industrialization; a personnel strategy based on better pay, gradual elimination of temporary jobs, speeding up careers, and staff adjustment [323]. A preliminary reply in this sense came from the reform carried out by Galimberti's successor, Enrico Stelluti-Scala: aware of the need of requalifying the members of the administration also from a cultural standpoint, the minister appointed to the position of division heads two physicists (Giuseppe Vanni and Quirino Majorana) and a jurist (Torquato Carlo Giannini) to the Central Telegraph Institute and to the Money Order Division respectively. Subsequently Majorana was the one to promote the Postal and Telegraph Higher Institute, and Giannini the Comparative Statistics and Legislation Office. On the other hand, the Stelluti reform was unable to adequately reorganize the personnel which continued to be unified in role, training and in their joint use in suburban offices; in spite of the reform therefore, the ministry remained far from the model recommended by Turati. After Stelluti-Scala three ministers followed one another in a single year: Gismondo Morelli-Gualtierotti, Ignazio Marsengo-Bastia and

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321 *Ibidem*.

322 *Atti Parlamentari, Camera, Discussioni*, session of June 17, 1902.

323 M. GIANNETTO, "Ministero delle poste e telegrafi (1889-1924)", p. 176.

Alfredo Baccelli.

In this context, a new minister, Carlo Schanzer announced his reform plan: the new structure was enacted between 1907 and 1908, with the establishment of five General Managements (for the secretariat, for postal services, for savings and money orders, for telegraph services and for telephone services); in 1907 the Postal and Telegraph Higher Institute was created, and its management assigned to Quirino Majorana. The ministerial structure attained with the Schanzer reform remained virtually unchanged, with only some partial adjustments made in 1914 by the minister Vincenzo Riccio, until the end of World War I. It agreed, on the whole, also with the general policy lines emerging during the 2nd Convention of the Postal and Telegraph Federation, and confirmed by Turati in the House of Representatives in June 1910, when he asserted the need «to industrialize especially the economic type services, Postal, Telegraph, Railway [...] to avoid the economic failure of State undertakings that we seem to be headed for according to so many admissions and indications» [324]. Turati requested the appointment of a committee in charge of studying the overall reorganization of postal and telegraph services: the request was accepted by the Minister, at that time Augusto Ciuffelli.

The royal committee for the reorganization of postal and telegraph services was headed by senator Matteo Mazziotti, of Naples, a specialist of postal law and who had been an opposer of Crispi. In its Relazione a S.E. il Ministro delle Poste published in 1912, when Ciuffelli had been succeeded by Teobaldo Calissano, the Committee pointed out the historical reason for the «disturbance in the postal and telegraph service and its employees» in the neglect «of the initial arrangement which was perfectible in its further advance; and in the subsequent ceaseless conversion of the administrative arrangement, without uniformity of standards and action, but with an inconstant trend generated by the intrusion of political inclination. Which was possible due to the fact that the general managers responsible for the services breached the discipline and tradition in their assignments» [325]. The negative consequences of this option had been made worse by the economic situation: «also the postal and telegraph services felt the consequences of the general conditions of national life, and instead of being stimulated and favored, so that with the development of communications the Country's economy [...] would also develop and advance, consequently reacting beneficially on the State's budget, found themselves being dealt with the same as the other public administrations and, with reduced or no means, could only perform their tasks in an inadequate manner, causing at first a standstill and later a decline in the development of the service» [326]; this caused the strategy of merging the services and a management whose primary objective was to increase the income to be passed on

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[324] *Ibidem*, p. 178; Turati's address took place June 22, 1910.

[325] *Commissione reale per il riordinamento dei servizi postali e telegrafici, Relazione a S.E. il Ministro delle Poste*, Roma, 1912, vol. I, p. 190.

[326] *Ibidem*, p. 141.

to the Treasury. After this accusation of Crispi's policies, the Committee advocated the return to an arrangement distributed among the main traditional branches of postal and electric services, but most of all it recommended the radical conversion of the administrative structure with the return to independence [327]. This idea had future developments, but the Committee encountered difficulties in accomplishing it at the time.

[327] *Ibidem*, p. 188.

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TECHNOLOGY ON WIRE. TECHNOLOGICAL CHANGES IN THE FIRST THIRTY YEARS OF THE ITALIAN TELEGRAPH EXPERIENCE: ACHIEVEMENTS AND DIFFICULTIES

A country behind the times

As for many 19th century inventions, the telegraph cannot be attributed to the idea or genius of a single person. From the earliest studies on dynamic electricity that led to the invention of the first battery by Volta, or the enunciation of the fundamental principles of electromagnetism by Oersted and Arago, many scientists understood that it would be possible to use the transmission of electrical impulses for some form of long distance communication. For this reason a number of scientists in the 1830s and 1840s built more or less complex machines by means of which the transmission of long distance messages was possible, at least experimentally. In the succeeding decade patents began to be sold and later used by the first telegraph companies and private firms [328].

In the early stages of its development, as in the case of the railways, different machines and materials were used in telegraph lines [329]. In Great Britain and the U.S., where telegraphy was originally created by private companies, this feature was reinforced by the fact that they were often built to exploit some inventor's telegraphic patent. However, in other European countries, where public companies took charge of the first telegraph communications, different materials and equipment were often used. For this reason in early years in each telegraph company a natural process of standardization in materials and telegraph communication techniques occurred, in favor of the most efficient and less costly ones.

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[328] For further investigation of the origins of telegraphy: T. STANDAGE, *The Victorian Internet*, New York, Walker and Company, 1998.

[329] J.R. BENIGER, *Le origini della società dell'informazione. La rivoluzione del controllo*, Torino, Utet, 1995.

In Italy, this standardization was even more evident and emphatic due to the political events that this country experienced. The first telegraph communications were in fact opened to the public in the first half of the 1850's, in other words before national unification. Throughout that entire decade, therefore, eight separate telegraph networks were developed, each one using different materials for the lines and different mechanisms for the transmission of messages.

The first ten years of the Kingdom of Italy were thus characterized by a rush to unify the materials of the telegraph network. The recently created Italian Telegraph Administration followed the objective of establishing a single national telegraph network, developed with identical criteria and materials. A procedure of "forced" standardization added to that which normally involves any technological macro-system in the course of its evolution [330].

The forced technological selection of materials by the Italian administration was actually also driven by the backward economic conditions of the new Kingdom of Italy. The telegraph was the ideal instrument, guaranteeing swift connections and exchange of information over long distances, at very low fixed costs. Building telegraph lines and opening new offices was in fact much less expensive than building new railroads. So, particularly in the first decade, the government tended to give great drive to overland telegraphy, in order to stimulate the exchange of information between the center and the suburbs. In this way the telegraph would be exploited as a means of political control in the areas affected by the problem of bandit assaults, as well as a means available to the increasing number of trading enterprises located mainly in the north.

Thanks to relatively low management costs, overland telegraphy could remain on a level with the latest technological innovations: in Italy there was a modern telegraph service in a backward country.

During the sixties and seventies, in spite of the limited resources available, the Italian telegraph service was able to keep up with the technological development shown by other countries. On the whole, considering the main indicators of international statistics concerning the development of telegraph services, such as for instance number of messages received and sent, number of offices opened, income earned, kilometers of lines laid, Italy was still behind the more industrially advanced countries such as Great Britain, France and Germany [331]. In spite of an evident initial inferiority, thanks to its considerable efforts Italy was able to introduce the most significant technological innovations from abroad. The keystone to understanding what happened lies in the good organization of the telegraph company, an independent structure within the Ministry of Public Works, led by a manager and made up of highly

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[330] A. GRAS, *Nella rete tecnologica. La società dei macrosistemi*, Torino, Utet, 1997.

[331] For these figures reference should be made to the series of *Statistique Générale de la Télégraphie*, publishe between 1869 and 1885 by the Bureau International des Administrations télégraphiques located in Berne.

selected and adequately trained personnel. Free from the slow pace of bureaucracy the telegraph company was able to concentrate on the technical aspects of the service, on assuring the highest level of quality [332].

In general we can state that the first years of development of the telegraph networks witnessed a progressive improvement in the materials used in the network, as well as of the equipment used for transmission, while later the application on the lines of the so called swift devices prevailed, making it possible to send and receive a greater number of messages with the same lines. Swift devices were introduced in Italy in the second half of the seventies, with a fairly reduced delay with respect to the more advanced European countries.

As the networks improved, alternative uses for telegraph communication increased. The telegraph was in fact used for the earliest weather observation and seismological warning, to establish longitude, and also for various branches of the army and the fire department. Since at the time it was the most advanced form of telecommunication, it was made available to all civilian, military and scientific applications requiring fast and efficient communication even over long distances.

Standardizing of components and mechanisms of the telegraph network (1861-1870)

To understand the evolution of the mechanisms and components of the lines used for transmission, it is necessary to know how the telegraph network was originally set up. Like all networks the telegraph consisted of junctions and lines [333]. The junctions were the offices in which the telegraph machines required for transmission and receipt of messages were located, with the batteries supplying the electric power needed to activate the mechanisms. The offices were in communication through telegraph lines consisting simply of metal wires standing on poles. The wires rested on insulators which in turn were inserted on iron supports. The purpose of the insulators, as suggested by their very name, was to avoid dispersion of electric power from the wires during communication. The wire could not rest directly on the iron supports since it is well known that metals are excellent conductors.

As shown in the chart, there were five main components to be considered in describing the telegraph networks: the message transmitter and receiver mechanisms, the wires through which the power is conveyed, the poles supporting them, the insulators and the batteries. Before political unification of Italy occurred, in the different States these five essential elements used with different procedures and materials.

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[332] P. Ferrara, M. Giannetto, "Il Ministero della Cultura Popolare. Il Ministero delle Poste e dei Telegrafi", in *L'amministrazione centrale dall'Unità alla Repubblica. Le strutture e i dirigenti*, ed. by G. Melis, Il Mulino, Bologna, 1992, pp. 153-193.

[333] P. Pucci, *I nodi infrastrutturali: luoghi e non luoghi metropolitani*, Milano, Franco Angeli, 1996.

Table 1
MATERIAL COMPONENTS OF TELEGRAPH NETWORKS
PRIOR TO ITALIAN UNIFICATION

State	*mechanisms*	*wires*	*poles*	*insulators*	*batteries*
Sardinia	Wheatstone Morse	galvanized iron	oak, larch	grès	Daniell
Lombardy	Morse	copper (3 mm.)	non-jniected pine	glass	Daniell
Modena	Morse	ferro (4 mm.)	pine, larch, chestnut, poplar	glass	Daniell
Parma	Morse	not galv.d iron, copper (3 mm.)	non-jniected pine	glass	Daniell
Papal States	Morse	galvanized iron	chestnut, larch, oak	porcelain	small Daniell
Tuscany	Breguet dial system	galvanized iron, or not	chestnut	porcelain	Bunsen
Naples	Morse (Adriatic side) Henley (Thyrrenian side)	galvanized iron	chestnut	porcelain	Daniell
Sicily	Morse	galvanized iron	chestnut	porcelain	Daniell

Source: E. D'Amico, *Cenni sull'amministrazione telegrafica*, Torino, 1863.

Battery run systems for message transmission and reception

In all the States before the unification of Italy, the Morse system was in use, because international conventions provided for communication among the different States to take place by means of this system [334]. However, the reason for which the Morse system had originally been adopted in almost all of the States was its simple and efficient operation.

The Morse system was based on a physical principle discovered by Arago, according to which, if electric power is passed through a metal wire twisted around a piece of soft iron, this became magnetized. More simply one might say that when electric power was applied in the Morse apparatus the previously magnetized piece of iron attracted another in the shape of a pointed hammer. A paper ribbon unwound between the two metal pieces by means of a clockwork mechanism, leaving a mark imprinted

[334] June 30, 1858, ratified Jamuary 3, 1859, Telegraph Agreement made in Brussels between Belgium, France and the Austro-German League, Article 3.

on it. According to the length of the electric impulse, this mark could be a dot or a dash. The length of the impulse was established by the transmitting telegraph operator by pressing a lever which guaranteed the opening of the electric circuit, and therefore the release of power to another apparatus.

The messages were therefore sent and received in a dot-dash code, known as Morse code, which remained imprinted in relief on the paper. There was a modified version of the Morse telegraph which made it possible to print the signs in ink, thus making reading easier for the telegraph operators.

In actual fact the machine only had to ensure that when electric power was applied, the hammer would imprint the mark, which according to the length of the electric impulse, could be a dash or a dot. This made it an extremely simple mechanism and a fairly easy one to repair even by the telegraph operators [335].

The so called "needle" telegraphs, like the one patented by Wheatstone and Cooke in 1837, were based instead on another fundamental principle of electricity, discovered by Oersted, according to which if electric power is applied through the needle of a compass, the latter temporarily changes its magnetic pole. Therefore, more simply, according to whether positive or negative electric power was applied, the needle on the dial of the Wheatstone telegraph moved to the right or to the left. Also in this case the messages were sent and received in a conventional code, according to the oscillation of the needle on the right or left side of the dial. In Europe and Italy often two dials were used, in order to combine the oscillation of the two needles [336]. This code was obviously more complex than the Morse, and for this reason the Morse soon came into use also on needle telegraphs, considering by rule the right and left hand oscillation respectively as a dot and as a dash. Even with the introduction of the Morse code, the Wheatstone telegraph still had a significant drawback: the messages could not remain imprinted on paper, instead they were interpreted and translated simultaneously by the employee, thus increasing the possibilities of error in reception. This made reception of short, frequent messages much faster compared to Morse, and therefore the railway offices used the Wheatstone telegraph for a number of years after the unification of Italy [337]. In this connection it should be remembered that the model of this telegraph was first applied on British railroads in 1837 along the section between Liverpool and Manchester [338]; it is not surprising therefore that through the years specialization in this sense was acquired.

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[335] For further details on the function of the Morse telegraph: C. MATTEUCCI, *Manuale di telegrafia elettrica*, Torino, 1861, pp. 108-121; for almost a decade this manual was reference not just for telegraph employees, but also for all those who wished to approach telegraphy from a scientific point of view. Matteucci was in fact a researcher and physics professor, and until his death he held the post of scientific consultant with the Italian Telegraph Company.

[336] For the function of needle telegraphs: MATTEUCCI, pp. 96-101.

[337] The railway companies used their own telegraph network, on which in exceptional cases also private and government messages could be circulated. For this reason in the telegraph offices it was possible to use a different system from the one prescribed by the Telegraph Company.

[338] A.S. SAAVEDRA, *Tratado de Telegrafia, I, Historia Universal de la Telegrafia*, Barcellona, 1880, p. 357.

There were also highly more complex telegraph systems, generally known as "dial" systems, including the telegraph invented by Breguet [339]. These telegraph systems also made use of the fundamental principles of electricity discovered by Arago and Oersted. In this type of mechanism the sender device was separate from the receiver, which already made it more complex than the Morse telegraph or the needle ones. Messages were sent with a "Morse key" which displayed all the letters of the alphabet around a circle. To send messages the operator turned a knob on to the position of the required letter. According to the position of the letter on the key, the operator's gesture produced a given number of electric impulses which reached the receiver telegraph operator, making the needle on the dial move to the same letter [340]. Due to the many inner gears, the Breguet telegraph was particularly complex and therefore hard to repair. In general, however, dial telegraphs had the great advantage of making it possible to send and receive messages without having recourse to conventional codes. Nonetheless this advantage, which reduced errors occurring in translation from one code to another, was countered, as in needle telegraphs, by the impossibility to print the messages directly and therefore subject them to subsequent testing.

The advantages, also in economic terms, offered by the Morse system as compared to the others are therefore evident. Its simplicity made repairs easy, and they were often carried out directly by the employees without the need to apply to the manufacturers of the machinery. This meant repair and maintenance costs that were vastly lower than those of the more complicated telegraphs such as the dial ones. On the other hand, immediate printing of the messages on paper reduced the possibilities of error, and therefore stimulated greater utilization of the service, consequently increasing proceeds [341].

When the Italian Telegraph Administration was created the main telegraph system in the offices was chosen to be Morse, which gradually substituted the others originally in use in the different regions [342]. In Italy this choice was determined, aside from technical reasons, also by administrative reasons: it was simply not possible to use different machinery within the same national network, since this would have meant higher costs in terms of personnel training, as well as repair and maintenance of the machinery.

In most of the other countries, which were not involved in a political unification procedure like Italy, the gradual preference for the Morse apparatus occurred in relation to its greater versatility and ease in handling and maintenance. In Great Britain, for instance, due also to the private management of the service, originally there were

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339 J.C. MONTAGNÉ, *Histoire des moyens de Télécommunication de l'Antiquité à la seconde guerre mondiale: du sifflet préhistorique à la télévision. Les hommes, les idées*, Bagneux, 1995, pp. 131-32.

340 For the operation of the dial telegraphs: MATTEUCCI, pp. 101-108.

341 To compare the mechanisms in use at the time: MATTEUCCI, pp. 127-130.

342 E. D'AMICO, *Sulla telegrafia italiana*, Torino 1863, p. 26.

different systems all over, the prevailing one being the Cook and Wheatstone in both the "one needle" and "two needle" versions. In France, in order to avoid different training for the personnel assigned to the optical telegraph, the creation of a telegraph that would reproduce the movement of the arms had been entrusted to Foy and Breguet. However, the incompatibility of such machinery with international communications, as well as its complexity, encouraged the French administration to soon replace it with the "dial" variety created by Breguet himself and also adopted in the Granduchy of Tuscany [343].

Even in the United States, Morse's country of origin, his telegraph was not the only one adopted by the different private companies. Nevertheless, the Morse telegraph, in its "ordinary" version which left marks in relief on the paper, as well as in the "printed" version which left marks printed in ink, asserted itself over all the other models almost everywhere. This explains why the early international agreements made starting in the mid 1850's provided for the use on international lines of the Morse code and system [344].

As far as the machinery was concerned, batteries were an essential element in telegraphic communication, since they made possible the production of the electric power necessary to send telegraph messages. Before the unification, in Italy all the States except the Granduchy of Tuscany used Daniell model batteries – without diaphragm in the southern regions, with diaphragm in the northern ones [345]. The fact that the Bunsen batteries, used in Tuscany, were toxic, forced the Italian Telegraph Administration to choose as regulation batteries in the offices, the Daniell batteries, with or without diaphragm [346]. In this case the selection was made before unification and was a "technological selection", with no political and administrative basis, but only according to evaluation of the quality of the available material.

Wire

From the above chart we can see also that there was a fair amount of variety in the solutions adopted by Italy before unification with regard to the choice of the metal wire for the telegraph lines. Copper or iron were normally used: two metals with extremely different characteristics. Copper is a better electric wire than iron, but it is much less resistant than the iron to twisting and strain. Since in outdoor telegraph lines, metal wire was often subject to the effect of atmospheric agents including wind and snow, which could twist or strain it, and s besides, when it was fastened to the poles the wire had to be pulled from one supporting pole to the other without damage, it is easy to understand why many pre-unification States had already adopted iron

[343] Z. FERRANTI, *Telegrafia*, Torino, 1895, p. 9.
[344] G. A. CODDING jr., *The International Telecommunication Union*, Leiden, E. J. Brill, 1952.
[345] The diaphragms were membranes separating the chemical reagents of the battery from each other.
[346] E. D'AMICO, *Sulla telegrafia italiana*, Torino 1863, pp.25-26.

wire along their telegraph lines, for reasons of climate as well as to avoid damage in the construction stage. This wire could be galvanized or not. Galvaniziation was a process which protected the iron from rust, which, besides deteriorating the wire itself, also reduced its electric conductivity. In areas where rain was fairly frequent throughout the year, as almost all Italian regions, galvanized iron became absolutely essential [347]. The data supplied in the chart confirm these observations before unification; in fact, only Lombardy, the Este States and the Duchy of Parma did not use galvanized iron wire, while the Granduchy of Tuscany already used it alternating it with non- galvanized iron wire.

Following unification, the construction of new lines was undertaken with galvanized iron wire which gradually substituted the old lines [348]. As with the telegraph machines, the wire in the lines underwent a procedure of standardization, concluded after unification, though it had started earlier and undoubtedly for reasons of technology and economics. Indeed, since galvanized iron wire had greater resistance, it had to be substituted due to breakdown or wear and tear much less frequently compared to the other kinds, and on the long run this was a considerable savings. Due to its advantages over other types of wire, galvanized iron wire soon took over also abroad [349].

Up to now we have always spoken of outside lines, consisting of metal wires suspended on poles. At the time, however, some attempts were also being made to build underground telegraph lines which would have the advantage of not being exposed to atmospheric agents, and, more important, the sabotage by whoever might wish to damage them. However, the disadvantages of underground lines compared to outside ones, were such that no country had adopted them to create its network, except to a negligible extent. Underground lines for one thing had to be buried, and this lead to two serious problems: that of damage repairs and that of perfect insulation of the wire. In fact, four lines laid underground, for every breakdown there would have been huge problems in the exact identification of the place to be repaired and in all events it would have been necessary to dig up a long stretch of wire. Moreover, it is a well known fact that the soil is an excellent conductor, so that if the metal wire had been laid "bare" in the ground [350], the electricity for communication would be dispersed. It was therefore essential to cover the metal wire with good quality insulation like gutta-percha, in other words following a procedure similar to that of the manufacture of underwater cables. Such a procedure, however, was too high-priced

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[347] On the subject ofconductor wires: MATTEUCCI, pp. 134-137.

[348] DIREZIONE GENERALE DEI TELEGRAFI, *Guida degli impiegati telegrafici, I, parte tecnica, costruzione e manutenzione delle linee telegrafiche*, Roma, 1884, § 32-33-34.

[349] R.S. CULLEY, *Manuale di telegrafia pratica*, Roma, 1873.

[350] Actually, in P. LAURENCIN, *La télégraphie terrestre, sous marin, pneumatique*, Paris 1877, there is mention of the underground laying of an unsheathed copper wire during a military operation in a British colony. In that occasion the dryness of the ground made it possible for the wire to conduct electricity with no dispersion incidents.

compared to the one used for outside lines, and this explains why gutta-percha cables were laid only inside railway tunnels [351].

Poles

The supporting poles of the aerial lines were an essential component for the correct working of the telegraph service in the long run; for obvious reasons they were always made of wood. Wood is, first of all a very bad conductor, thus guaranteeing negligible dispersion of electricity, but also the least expensive material. The type of wood used, nonetheless could have strong repercussions on the costs for maintenance of the lines. Except for the Kingdom of Savoy where the poles were made of bay oak or larch, in all the other States pine or chestnut were used. Pine was the most widespread wood in Italy and therefore the least expensive, but it tended to rot very quickly due to its biological characteristics. Though inexpensive, therefore, a pine pole had to be replaced every three years, more or less. To prevent pine wood from rotting so quickly, a special technique had been invented consisting in injecting it with substances similar to tar which gave greater durability to the telegraph poles. However, injected pine wood poles, due to the treatment necessary to make them weather proof, were much more costly and did not last more than five to seven years [352].

Chestnut was more expensive than pine because it was less widespread, but if left to season properly, it needed no further treatment. Chestnut poles, indeed, could do their job without deteriorating even for more than nine years [353]. Their higher cost was therefore easily repaid thanks to their triple life span as compared to untreated pine poles. For this reason Italian telegraph lines at the time unification were generally made with chestnut poles. Also in this case, after unification, the Italian Telegraph System standardized the type of poles, providing for the use of chestnut poles for the construction of new lines and progressive replacement of the old ones with these, or at best with red larch poles [354]. Also abroad, telegraph poles were all made of wood, and clearly the different countries used the wood most readily available that guaranteed the longest life. In France, for instance, where the procedure for injection of insulating substances into the wood was more advanced, and therefore less expensive, other types of wood similar to pine were also used.

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[351] A. Di Canosio, *Il Telegrafista. Guida pratica al maneggio delle macchine telegrafiche usate in Italia, Torino*, 1861, pp. 29-34.

[352] Boursel, "Osservazioni sulle cause generali della distruzione dei pali di legno del sig. Bourseul sotto-ispettore dei telegrafi francesi", in *Bullettino Telegrafico*, 1869, pp. 134-37 e 165-73.

[353] C. Viale, *Istruzioni sulla conservazione dei pali telegrafici, Appendice della Guida degli impiegati telegrafici, I , Parte Tecnica, Costruzione e manutenzione delle linee telegrafiche*, Roma, 1884.

[354] Direzione generale dei telegrafi, *Guida degli impiegati telegrafici, I, parte tecnica, costruzione e manutenzione delle linee telegrafiche*, Roma, 1884, § 1.

Insulators

Insulators were another technological component that was essential to the development of telegraph lines. Having ineffective insulators on the lines actually meant providing poor quality communications and being unable to guarantee them over long distances. The purpose of the insulators was to avoid power dispersion during telegraph communication, by keeping the wire insulated from the iron support on which it rested on the pole. Insulators made of glass, ceramic or porcelan had all sorts of shapes: bell shaped, inverted mushroom, etc. As far as the materials are concerned, the least effiencient from the point of view of telegraphic transmission was definitely glass, which was more likely to trap moisture and therefore to disperse more electricity. The best insulator, on the contrary, was definitely porcelain, which in fact did not hold moisture and was therefore more reliable in very damp locations [355].

The chart may be deceptive by showing an apparent uniformity which did not actually exist. In other words, if in the territories under Austrian control and influence insulators were manufactured of the same materials and in the same way, in all the other States the use of the same material did not imply correspondence in forms and structures.

Just because of these profound differences in the structure and, at times, the materials of the insulators, the new Italian Telegraph Administration had to replace the whole lot with more modern and efficient models [356]. The so called "Roman type with stem" was chosen, representing a combination of insulators for supporting poles and those for voltage poles. Originally in almost all telegraph networks there were two different types of poles: "support" poles which served simply as support for the metal wires, and "voltage" poles which enabled the wires to maintain a given voltage [357]. Aside from the different size of the poles, the difference between the two was mainly in the insulators and the mechanisms connected to them. Support poles carried out the same function, though in various forms: that of leading the wire through. Among the more commonly used, there was the so called "bell" form: the bell, attached to the iron arm of the pole at its upper end, at the lower end had a metal device through which the wire was passed. On the "voltage" poles, instead, there was often a gear wheel which kept the wire taut, while the insulator consisted simply of a ceramic washer. "Stem" insulators, required in the construction of the new lines and gradually replacing previous models, eliminated the distinction between voltage and support poles: made of ceramic, they had the shape of an inverted mushroom, were connected to the iron arm in its lower part, with a groove in the stem through which the wire

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[355] MATTEUCCI, pp. 144-152.

[356] A. ZENONI, R. PIQUÉ, "Isolatori italiani", translators' note in E.E. BLAVIER, *Nuovo trattato di telegrafia elettrica*, Livorno 1874, pp. 39-40.

[357] On the difference between support poles and voltage poles: A. DI CANOSIO, *Il Telegrafista. Guida pratica al maneggio delle macchine telegrafiche usate in Italia, Torino*, 1861, pp. 34-38.

passed, its voltage directly controlled by means of a screw. These ceramic insulators were manufactured by two firms destined to play a major role in the Italian economy: Richard and Ginori.

In short, among the different components of the telegraph network, insulators were the only ones for which the procedure of national standardization began only after the unification of Italy, due to an administrative measure [358]. Indeed, for the mechanisms, batteries, wires and poles, as seen above, the Administration prescribed a model, but the selection had actually taken place before unification according to technological criteria: the choice of the Administration in those instances was therefore in a sense predetermined. In the case of the insulators, instead, the Administration had to choose and practically "invent" the best solution among the many existing on the national territory. This also explains why insulators, though all made of ceramic or at the most of ebonite, came in different shapes depending on the origin [359]. The efficiency of an insulator in fact depended primarily on the good quality of the material; the outer shape could, or rather had to, differ according to the environmental conditions in which the line was located, and the way in which it was constructed.

Construction of the lines

After the political unification of Italy, the materials used to construct the lines were standarding to uniform directions for their installation were applied. In particular, the measures, weights and lengths to be used by the workers in charge of the construction were specified precisely, such as for instance the distance between poles, the length of pole to be set under ground, the maximum curve of the wire stretched between poles. These instructions were later confirmed by publication in the Guides for employees [360].

Even more important, though, was the tendency, following the example of the more technologically advanced foreign countries, to build new lines along the railroads, or, where possible, to move lines built along the carriage roads to the railroads, in spite of the fact that in the first five years of the Kingdom of Italy the railway

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[358] 22 maggio 1863, n. 105, MINISTERO DEI LAVORI PUBBLICI, DIREZIONE GENERALE DEI TELEGRAFI, DIVISIONE CONTABILITÀ, *Istruzioni per la parte tecnica del servizio telegrafico*.

[359] As suggested by Culley *supra*, pp. 149-150, ebanite insulators were better conductions than porcelain, though they were more resistant and less conspicuous, which avoided attracting the attention of vandals. Often indeed insulators and the lines in general were the target of stone throwing and other acts of vandalism, probably bred by widespread hostility towards telegraphy and insufficient awareness of its importance. They were used mostly in the British colonies where hostility towards new technologies was combined with that towards the Empire.

[360] DIREZIONE GENERALE DEI TELEGRAFI, *Guida degli impiegati telegrafici, I, parte tecnica, costruzione e manutenzione delle linee telegrafiche*, Roma, 1877; DIREZIONE GENERALE DEI TELEGRAFI, *Guida degli impiegati telegrafici II, parte tecnica. Impianto, manutenzione ed esercizio degli uffici*, Roma, 1879.

system was still not highly developed, although there had been some expansion after the unification. In 1867, in fact, telegraph lines laid along the railroads were only a third of the whole [361], while about one third of the remaining lines were along non-practicable roads [362]. In laying telegraph lines the railroad tracks were followed essentially for reasons of greater convenience and efficiency. Being on call and making repairs on the line if it were located along a railroad would cut down on time, and therefore costs, compared to repairs on a line located along a carriage road. If on the one hand the Telegraph Company required a relationship in close cooperation with the railway companies in order to build telegraph lines along the railroads, the railway companies needed their own telegraph network to control traffic and avoid accidents. For these reasons the Telegraph Company and the Railroads stipulated agreements by which the former undertook to build telegraph lines that would carry the wires of the private railroad networks, providing for their maintenance, while the latter, besides paying construction and maintenance costs, also guaranteed travel free of charge on its trains to maintenance personnel.

In this section we have illustrated in some detail how the Italian telegraph service was involved in an intense process of standardization of the materials it was made up of. We have also seen how this procedure fulfilled more or less three parallel needs: to have a single national network, select the most efficient materials, and follow the example of the more advanced countries. By the early seventies the first goal was attained. It therefore became crucial to concentrate on utilization of the technological innovations available at home as well as abroad.

Technological innovation in telegraphy in the 1870s-1880s

In the seventies and eighties, both in Italy and abroad no particular technological innovations were made as regards components of telegraph lines. Insulators, batteries, types of wire and supporting poles remained largely the same as those that had been used for technical or administrative reasons during the first ten years. As far as these components of the lines are concerned, therefore, the same considerations hold as stated above. The great novelty lay in the fact that some of these components started to be manufactured, no longer abroad, but by Italian industry, and this trend gained further strength in subsequent decades. For instance there was a continued increase in the production of insulators by the Ginori and Richard plants, the production of wire was started in the Bormida industries, and in the eighties the Rosati machine shop in Milan started the production of Morse and Hughes telegraphs [363].

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[361] DIREZIONE GENERALE DEI TELEGRAFI, *Relazione statistica dei telegrafi del Regno d'Italia 1867*, Firenze, 1868, p. 39.

[362] Non practicable roads were those that did not consent transit to work vehicles or carriages, such as for instance mule tracks and country paths.

[363] E. D'AMICO, *Cenni sull'amministrazione dei telegrafi in Italia dalle origini all'anno 1885*, Roma, 1886.

"Accelerated systems"

Beginning from the seventies there was a strong tendency towards the introduction of more efficient and innovative telegraph systems. As a matter of fact, although the Morse telegraph continued for decades to be the machinery most widely used in Italian offices, on Italian as well as foreign lines, also systems making it possible to send a greater number of telegrams in the same length of time began to be used. These were the so called "accelerated systems", which, as their name suggests, were capable of sending and receiving messages at a considerably higher speed in comparison to the Morse telegraph.

The first accelerated telegraph system, the Hughes, was introduced in Italy in 1862; it was able to send and receive messages directly in alphabetical language. The Hughes telegraph was, for the times, an important technological innovation in the field of telegraphy. It was the first telegraph able to print in the letters of the alphabet. This mechanism had the enormous advantage of making it possible to print messages immediately without using conventional codes such as the Morse code. Needless to say, the speed and accuracy of the messages sent and received could be drastically increased by the introduction of the Hughes system; however, it had a significant flaw: it was extremely delicate, since the principle on which its performance was based was synchronism [364]. The different mechanisms connected with each other had to be perfectly synchronized so that the letters sent would be the same as the ones received. This system therefore, while guaranteeing enormous advantages, had the same faults as dial telegraphs. It was, however, the advantages that in August 1862 caused ratification by Parliament of the agreement between the Telegraph administration and the inventor of the system, for installation of five Hughes machines in the stations of Turin, Florence, Genoa and Naples [365]. Italy was one of the first administrations to introduce the Hughes system on its lines, which shows its capacity of assimilation and readjustment of the technological innovations developed abroad. To do this the Italian administration must have significantly improved its level of technological development, adjusting it to that of the more advanced countries. In subsequent years the number of Hughes telegraphs increased, but remained in the tens; these telegraphs were used particularly on the lines with greater traffic, such as the Tyrrhenian line, while in most of the offices the Morse telegraph continued to be preferred, due to its simple operation, and very low costs of maintenance and repairs.

The machines introduced in Italy beginning in the second half of the seventies had a considerable advantage over the ones used until then (Morse and Hughes): they

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[364] A.S. Saavedra, *Tratado de Telegrafia, I, Historia Universal de la Telegrafia*, Barcellona, 1880, pp. 413-415.

[365] *Atti parlamentari, Camera dei deputati*, VIII legislatura, first session, introduced in the August 5, 1862, P"rogetto di legge presentato dal Ministro delle Finanze (Sella) sul telegrafo a stampa del professore Hughes. Spesa straordinaria sul bilancio 1861 del Ministero dei Lavori Pubblici", pp. 3377-3379.

made multiple transmission possible. Telegraph systems were defined as "multiple" when they were able to send more than one message simultaneously, in other words using the same conductor wire. Multiple transmission could occur in two ways. The first consisted of sending more than two messages simultaneously from the same office: in this case, through synchronized mechanisms, it was possible to use the very brief pauses that were physically necessary to the operator between transmission of one word and that of the following word. The second type of multiple transmission, instead, made it possible to send and receive messages simultaneously between two offices. In other words, using the same wire and taking advantage of a physical property of electric transmission, it was possible to send a message at the very same time as another was being received. These systems were sometimes termed "simultaneous" [366], to differentiate them from the first, which were instead considered in a strict sense as "multiple" telegraphs.

However, aside from the different definitions, multiple telegraphy on the whole was an essential technological innovation for the transmission of messages: it actually made it possible to significantly increase telegraph traffic without the need to add new wires. This technology on more than one occasion proved to be essential for Italy whose network also consisted of submarine cables. For instance, in spite of the great number of cable breakdowns in the Strait of Messina, the use of multiple systems made it possible to send the same number of messages, even when the number of conductors functioning was reduced.

Multiple telegraphy in reality had been made technically possible from the early sixties, thanks to the contribution of a number of inventors such as Wheatstone, Siemens, Stearns, Meyer. Nonetheless, its practical application in Italy was possible only in the second half of the seventies, with a relatively short delay compared to the other European contries that were more advanced from a technological point of view. The multiple systems used in Italy in the period under consideration were the Stearns system, making possible simultaneous transmission of messages in two opposite directions, and the Meyer system consenting simultaneous transmission of four or six messages from the same office.

The Stearns system was tested during 1873 and 1874 on the Italian lines with excellent results. In 1875 the Italian Telegraph Administration drew up a contract with the English inventor providing for the exploitation of his patent on the Italian lines, That same year the Administration stipulated an agreement with the Frenchman, Meyer, for the purchase of two of his multiple systems, in order to introduce them as an experiment on some of the major Italian lines. In this way in 1875 Meyer transmission started between Naples and Messina and between Rome and Florence [367].

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[366] A.S. Saavedra, *Tratado de Telegrafia, I, Historia Universal de la Telegrafia*, Barcellona, 1880, p. 474.

[367] Direzione generale dei telegrafi, *Relazione Statistica dei Telegrafi del Regno d'Italia 1875*, Roma, 1876, pp. LII-LVI.

Actually, Stearns had not designed a device, but rather a system, defined as "differential", which could be applied to telegraph mechanisms already in use in Italy, such as the Morse and the Hughes. This system was based on a phenomenon of physics known to telegraph operators since the origins of telegraphy. Indeed everyone knew «perfectly well that when two offices contended the use of a circuit, the signals of each one were affected by the other's». Stearns merely understood, as had other scientists, that it was sufficient to find the means to «separate the effect on the needle of the power being transmitted from that of the power being received», in order to decipher messages being sent simultaneously in two opposite directions. The U.S. scientist conceived as this means a special disposition of the circuit between the two sending and receiving mechanisms, and introduced an instrument known as "condenser". Thanks to this system it was possible to separate incoming and outgoing electric signals, thus obtaining simultaneous transmission of the telegrams [368]. The cost of this system, moreover, was not high, since it could be applied to the Morse and Hughes systems which the Italian Telegraph Administration had been using for years.

Meyer instead created a new mechanism which, depending on the model, was able to send four or six messages simultaneously, but in the same direction. As stated by the inventor himself, «the purpose of the system was to allow several employees to exchange a number of telegrams simultaneously on the same wire, and [the mechanism was] based on the distribution of time and work» [369]. Meyer's multiple telegraph consisted in four or six receivers paired with four or six keyboards, placed on a counter so that four or six employees could simultaneously sit and work at them. Each employee therefore had his own keyboard from which to send the messages and a receiver from which to receive them. Compared to transmission on the Morse telegraph, for the operator the only difference was in the keyboard consisting of eight keys, four white and four black: the white keys were for the dashes of the Morse code, the black keys for the dots. This keyboard made transmission even faster, since one pressed at the same time all the dots or dashes making up the letter to be sent. For instance, to send a letter made up of three points and one dash three black keys and one white were pressed simultaneously. Since transmission was made in the usual Morse code, obviously for the employee also receiving on paper was entirely similar to an ordinary Morse telegraph.

What made the Meyer such an unusual telegraph system, however, was a device called the "distributor". It consisted in a disc divided into four or six equal parts to which the eight wires departing from each key of each keyboard were connected. Turning on this disc was a device known a "carriage" and consisting in an arm with

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[368] R.S. CULLEY, *Manuale di telegrafia pratica*, Roma, 1873, pp. 511, 500, 501 e 511-521.

[369] B. MEYER, "Apparato a trasmissione multipla", attached to R.S. CULLEY, *Manuale di telegrafia pratica*, Roma, 1873, p. 559.

a point, called "brush", which, following a synchronized mechanism, made it possible at every turn to connection of each of the transmitting systems with the corresponding receiving system. The device was also provided with a correcting mechanism making self-correction possible in case the receivers and transmitters were not perfectly synchronized: the Meyer system was therefore a very advanced system from a technical point of view.

Using both of these systems did not require particularly long training on the part of the telegraph operators. As we have just seen, in fact, the transmission procedure of the Stearns system was similar to that of the Hughes or the Morse, while the one of the Meyer was a simplified version of Morse code. This probably contributed to the prompt acceptance of these mechanisms by our Administration.

In 1876 the Telegraph Administration experimentally used another type of accelerated telegraph, the Wheatstone automatic system. Automatic telegraph systems made faster transmission possible because, thanks to special devices, the messages were sent by a mechanism, not by the hand of the telegraph operators. In the case of the Wheatstone system, punched cards were prepared on special paper or on metal sheets, and once introduced into the transmitter they were then received by another system [370]. In this case, however, preparation of the cards and the fact that they were transcribed in a conventional code required expert telegraph operators, and their training was long and complex. Furthermore, Wheatstone's automatic telegraph did not provide significant advantages, except when sending out circular messages, that it, messages to be sent simultaneously to several offices. That is the reason why this system was adopted by our Administration only in the early eighties precisely to send out the long parliament reports [371]. In this specific case, Italy introduced an automatic system with a delay of almost ten years compared to the British experience. This was the exception confirming the rule, since this system had been tested in Italy six years prior to its introduction. Nonetheless, since there was no need to distribute circular messages, our administration postponed its adoption. In other words, while adoption of the Meyers and Stearns systems evidences our Administration's interest in technical innovation developed abroad, failure to introduce the Wheatstone apparatus was due to backwardness in our information industry. The flow of information to newspapers by way of the telegraph in Italy was indeed enormously lower than in the United Kingdom, as pointed out in a controversial tone by Maggiorino Ferraris in an article in *Nuova Antologia* [372].

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[370] For a detailed description of the operation of the automatic Wheatstone system: Z. FERRANTI, *Telegrafia*, Torino, 1895, pp. 26-28.

[371] *Bullettino Telegrafico* 1883, pp. 132-38.

[372] M. FERRARIS, "Il telegrafo ed il giornalismo in Inghilterra ed in Italia. A proposito di due disegni di legge", in *Nuova antologia*, 15 January 1882.

Telegraph lines along the railroad

Improvement of the lines in those days did not mean just introducing new systems or replacing obsolete material that was unsuitable for long distance transmission with better material. To make the operation and maintenance of the lines more efficient, it was at this point necessary to install them along the railroads. As mentioned before, in 1867 only a third of the telegraph lines ran along the railways, while the remaining two thirds were ran along along ordinary roads, or in some instances even through the woods. In spite of the Telegraph Administration's efforts, the ratio of the lines along the railways to the total Italian telegraph lines remained constant until 1879. This, however, does not mean that the Administration provided for moving lines, particularly direct ones, from normal roads to railroads. In the 1870-1879 period there was a rapid increase in the mileage of lines, so that railway construction and relocation of the lines along them progressed at the same pace, though it was not possible to reduce the percentage of lines present along ordinary roads.

In 1879, besides having more kilometers of lines on railways, the Administration was also able to considerably increase the numbers of wires along the railways. By that date, the wires on railroads were almost double those on ordinary roads [373]. However, since the percentage of lines on railways remained constant, obviously the latter were much more "burdened" with wires compared to those along carriage roads, a condition which is understandable in consideration of the greater speed and safety in making repairs on wires along railroads than along ordinary roads.

Training and updating personnel in relation to technological innovation

As mentioned before, from the seventies technological innovation took on considerable importance: for this reason the Administration began to give greater attention to the training of its employees.

Contrary to the practice with the majority of State employees at the time, employees of the Telegraph Administration were required to have knowledge of both technical and scientific aspects to their carry out their task in the best possible way [374]. Such a store of information was not necessary only to the personnel in charge of the telegraph machines, but also to those responsible for the maintenance and control of the lines. The linemen, for instance, who were assigned a simple task of unskilled labor, in any event had to be acquainted with a number of basic concepts about telegraph lines and electricity, such as the importance of insulation for the correct trans-

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[373] DIREZIONE GENERALE DEI TELEGRAFI, *Relazione Statistica dei Telegrafi del Regno d'Italia 1879*, Roma, 1880, p. XXVI.

[374] M. GIANNETTO, "I tecnici delle comunicazioni fra età liberale e fascismo", in *Burocrazie non burocratiche. Il lavoro dei tecnici nelle amministrazioni tra Otto e Novecento*, ed. by A. VARNI e G. MELIS, Torino, Rosenberg & Sellier, 1999, pp. 15-55.

mission of electricity along the metal wires, the right way of placing the poles in the ground, and the time to replace them. For this reason, even for linemen, the minimum requirement for entering service was knowing how to read, write and do arithmetic, which is the basic knowledge allegedly provided by primary schooling [375].

For the correct operation of the telegraph service, the Administration therefore had to hire adequately trained personnel able to keep constantly updated. For this reason almost all professional hiring took place by competition or at least by taking a qualification exam. This was the rule both for career personnel as well as subordinate, all the way down to the very linemen. Telegraph messagers, instead, were not hired through a competition, but they were in all events required to know how to read and write [376].

However, a barrier based on minimum cultural and technical requisites was not sufficient for the Telegraph Administration. Telegraphy was a sector in constant evolution; every year a scientific discovery made possible transmission at a distance that had previously been considered inconceivable, new systems were invented, new insulating materials for submarine cables were elaborated, and also new techniques of multiple transmission on wires. It was therefore unthinkable that a telegraph operator belonging to career personnel was not constantly updated. So the Telegraph Administration always provided professional training for its employees with the utmost care, not just through the competitions which guaranteed their knowledge and skills from the first, but also with incentives for their constant updating.

While most jobs with the Telegraph Administration were assigned by competition, among the requisites for the admission to the competitions or qualification exams, the possession of an educational certificate was hardly ever specified. For instance, as mentioned above, linemen were required to know how to read, write and do arithmetic, but the need for a primary school certificate was hardly ever specified. Likewise, "alunni" [377] candidates were not required to hold a technical school diploma, but knowledge of subjects such as Italian, French, geography, arithmetic, physics, chemistry and penmanship was a prerequisite [378].

In other words, the Administration did not trust educational qualifications awarded by the Italian public school system. This depended largely on its very poor condition at the time. Primary school, organized in two two-year courses, rarely supplied sufficient instruments to acquire and maintain through time the skills of reading and writing. The teachers themselves were often at a level of semi-illiteracy [379]. It could

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375 "Guardafili allievi", in *Bullettino Telegrafico* 1870, pp. 45-46.

376 "Fattorini telegrafici. Relazione fatta a S. M. da S. E. il Ministro dei Lavori Pubblici in udienza del 17 marzo 1872", in *Bullettino Telegrafico* 1872 pp. 81-83.

377 The "trainee" position was the compulsory route for those young people who wanted to become telegraph officers, that is telegraph operators to all effects; it consisted in a period of two years' apprenticeship.

378 "Avviso di concorso per 30 posti di alunni telegrafici", in *Bullettino Telegrafico*, 1870, pp. 318-324.

379 G. Bini, "Romanzi e realtà di maestri e maestre", in *Annali di Storia d'Italia, IV, Intellettuali e potere*, ed. by C. Vivanti, Torino, Einaudi, pp. 1197-1224.

therefore hardly be taken for granted that those who had been to primary school could read and write, which instead were essential skills to perform the normal tasks of telegraph messenger or lineman. Messengers had to be able to read in order to deliver the messages to the required address, and know how to write in order to fill out their delivery register [380]. For linemen knowing how to read and write essentially meant being able to keep up to date on the new techniques of line construction or on new materials to be used [381].

There was a similar problem at higher levels, such as trainee or officer, both of whom were assigned to the telegraph machines. Also in this case the trainee candidate was not required to have a technical diploma, but was implicitly expected to be familiar with all the data which theoretically a technical diploma should have provided. Italian technical schools were totally inadequate for the work situation at the time; they provided abstract scientific concepts and did not meet the requirements of industry [382]. Even less so were they able to meet the requirements of the Telegraph Administration. Only as late as 1864 did the Manna decree found 27 new sets of courses for technical schools inspired by the needs of industry and the community [383]. Among these courses one was telegraphy, but only very few students signed up for it and consequently it was eliminated the following year.

Aside from the knowledge required for admission, the Telegraph Administration also had to instruct new employees about their respective tasks, due to the lack of public schools with specific technical courses. At first this condition was met by means of apprenticeships: this explains the introduction of professional ranks such as apprentice lineman or telegraph trainee.

Nonetheless, while for prevalently manual work such as that of linemen and telegraph messengers, apprenticeship was more than enough, for more complicated tasks, such as the ones performed by telegraph officers, before being hired as officers, "trainees" had to carry out a two-year period without pay in a first class office ("trainee"). In the early seventies, when telegraph traffic started to increase as a consequence of the tariff reform and also of the period of comparative economic development, the two years of training necessary to learn to use the machines became essential. Also, the Administration needed to put capable persons in charge of the systems, not clumsy apprentices; therefore, in time, "trainees" were replaced with supporting personnel paid by the day [384]. However, this caused the problem of how to adequately train those who were about to use telegraph systems, since with the elimination of the trainee role, the possibility of apprenticeship also ceased to exist: «it was necessary

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380 "Doveri dei fattorini", in *Bullettino Telegrafico* 1873, pp. 361-366.

381 "Guardafili allievi" in *Bullettino Telegrafico* 1874, pp. 112-115.

382 L. BESANA, "Il concetto e l'ufficio della scienza nella scuola", in *Annali di Storia d'Italia, III, Scienza e tecnica nella cultura e nella società dal Rinascimento ad oggi*, Torino, Einaudi, pp. 1200-1258.

383 *Ibidem*, p. 1218.

384 Royal Decree of March 17, 1872 on "Ausiliari telegrafici", in *Bullettino Telegrafico* 1872, pp.77-78.

to create telegraphy schools» [385]. In 1873 the Administration decided itself to solve the problem of training, by establishing special telegraphy schools to teach operation of the Morse and the Hughes systems. These two types of schools were set up in all Department offices and in other offices of some importance. The courses to teach the use of Morse machines lasted three months, the others six. These schools were meant to serve for training «of supporting personnel, "trainees", and candidates for employee jobs», but in general they were intended for all those who wished to «seek a position as assistant or day-worker» [386]. In other words, in the course of a few years telegraphy schools became a compulsory route for anyone wanting to start a carer in the Telegraph Administration. Moreover, the schools held the courses in the evening , making attendance possible for "alunni" or assistants who worked during the day. Besides, since the instructors were telegraph officers, evening courses made it possible not to excuse them from work during the day, with a considerable economic advantage for the Administration.

The year in which the schools were established on the premises of the main telegraph offices was the same as the one of the introduction of women among the employees of the Telegraph Administration. However, the telegraphy schools were not opened to women. Admitting women to the schools meant having separate rooms available and, given the small number of women employees in the initial stage, it was decided to save on this aspect. In order to solve the problem of training for women candidates to assistant positions, the General Manager, also by means of donations of telegraph systems, encouraged the teaching of telegraphy in schools for women [387]. The purpose was to train women capable of being immediately given access to third category offices. Likewise, women who took telegraphy courses at schools for women could forgo the course on the Morse machine, held instead for the women candidates to assistant positions.

Only for the competition for the position of Inspector, first called in 1870, the Telegraph Administration required a specific education certificate [388]. To gain access to that competition an engineering licence, issued by a School of Technical Application or a Higher Technical Institute, was necessary. This was due to the fact that the Administration needed a well educated and trained person who could immediately take a management position without having to go through the entire chain of command. Therefore the education certificate could not be disregarded, at least as a preliminary reference point. It was not coincidence that this competition was repeated three times, and that until 1875 it was impossible to find a large enough number of suitable candidates.

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[385] DIREZIONE GENERALE DEI TELEGRAFI, *Relazione Statistica dei Telegrafi del Regno d'Italia 1873*, Roma, 1874, p. 22.

[386] "Scuole telegrafiche", in *Bullettino Telegrafico* 1873, pp. 5-7.

[387] "Istituti femminili per l'insegnamento della telegrafia", in *Bullettino Telegrafico* 1873, p. 473.

[388] "Posti di ispettore telegrafico da conferirsi per pubblico concorso ad ingegneri", in *Bullettino Telegrafico* 1870, pp. 357-362.

Only in the course of the eighties, thanks to an overall improvement in training, education certificates began to be required for positions of all levels from linemen to inspectors. However, the fact that the practice of hiring by examinations and competitions continued is proof that in all events the Administration wished to make sure that future employees possessed certain specific skills.

Furthermore, as mentioned above, the Telegraph Administration was not only concerned with the basic training of its future employees, but also with their constant updating. For instance, officers and linemen were encouraged to attend regular lectures held by sector Inspectors in a number of offices throughout the Kingdom [389]. Also, points of merit could be assigned to those who stood out for «a special job showing intelligence and serious training on the part of the person responsible, without overlooking ordinary performance of their duties» [390].

The measure that more than any other encouraged employees towards constant updating was the introduction in 1873 of a special register [391]. It worked as a kind of "report card" of the telegraph operator, on which were carefully noted the skills of each employee. In particular it indicated whether the telegraph operator was qualified for use of Hughes machines or only of Morse machines, whether he was able to transmit only on "omnibus" circuits or also on direct ones, and so on. According to their skills, telegraph operators were then divided into five categories, and for each one the motive for inclusion in one or the other category was recorded. If an employee was assigned to a lower category due to negligence or because he had refused to participate in the telegraphy school courses, he lost all possibilities of earning points of merit, promotions or financial bonuses. It is therefore clear that the telegraphy career was bound to the determination of keeping in constant training; those who did not do so not only could not be promoted, but also risked being assigned to lesser offices.

Training and professional updating thus had considerably greater importance in the Italian Telegraph Administration than was normally given by the community at the time. It is clear that the telegraph administration, due to constant innovation , was compelled to reason in a more modern, rational way. In order to function correctly and keep up with the foreign telegraph service, the Italians had to constantly train employees. Only in this way was it possible to make the most of the latest scientific discoveries and technological innovations, by guaranteeing Italian telegraphy a high level of technological development in spite of the evident delay in the industrial take off. At times even the Administration employees themselves were the ones to introduce significant innovations, such as in the case of L. Vianisi who invented a new method of multiple transmission [392].

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389 "Conferenze telegrafiche negli uffici di prima categoria", in *Bullettino Telegrafico* 1872, pp. 485-486.

390 Art. 2, b of Royal Decree of May 13, 1869, on "punti di merito e di demerito", in *Bullettino Telegrafico* 1869, pp. 150-156.

391 30 giugno 7122/1220, in *Bullettino Telegrafico* 1873, pp. 212-214.

392 L. Vianisi, *Descrizione di alcuni metodi per ottenere trasmissioni simultanee in direzione opposta ed identica lungo un medesimo filo telegrafico*, Messina, 1887.

Applications of telegraphy in the field of science

So far we have seen the contribution of science to the development of telegraphy, in terms of direct and indirect technological application, as well as of vital information for the personnel. However, the relationship between science and telegraphy was mutual, not just one way. Indeed, telegraphy, which could link distant locations, consented the development of scientific disciplines such as meteorology, geology, seismology, and even astronomy.

Telegraph communication, for instance, gave a fundamental contribution to the exact estimate of differences in longitude between various points of the globe. It is a known fact that longitude can easily be determined by comparing time differences between one place and another after taking an exact astronomic datum point (position of the sun or the stars). Telegraphic transmission, being practically simultaneous, made it possible to evaluate the time difference between two places and therefore also their respective longitudinal position. Accordingly, in 1875, on request by the "Commissione del Grado Europeo", the Italian Administration granted use of its lines to establish the difference in longitude between the cities of Milan, Padua, Munich and Vienna [393]. However, experiments of this kind had been carried out in Italy as well as abroad for a number of years, especially by initiative of astronomical observers. Exact longitude estimate, toward the end of the 19th century made possible the introduction of the so called universal time, based on the system of time zones which is still in force. This system had in turn become essential, due to the progressively declining time required by communication connecting the different continents: in order to carry out international financial transactions or even the simplest business operations by telegraph, it was no minor issue to know exactly the time at the receiver's and the sender's offices. Previous to the introduction of the time zone system, every country generally used as reference the time in its capital city; however this could cause considerable drawbacks, particularly in very large countries. The great convenience of the telegraph in this area is therefore understandable.

The speed of telegraph communication also greatly stimulated the development of metereology. For instance in France, as early as the second half of the fifties, weather stations had started exchanging their respective atmospheric data. A few years later, thanks to this survey system, it was possible to begin making weather forecasts .

In Italy a Central Meteorology Bureau was set up only in 1876: in its Board of Directors there was also a General Supervisor of Telegraph Offices [394]. The Telegraph Administration had in fact made its signal offices available to the Central Meteorology Bureau. These had been equipped in such a way that the employees could

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[393] DIREZIONE GENERALE DEI TELEGRAFI, *Relazione Statistica dei Telegrafi del Regno d'Italia 1875*, Roma, 1876, p. XXXVIII.

[394] "Servizio meteorologico" in *Bullettino Telegrafico* 1876, pp. 364-367.

make the simplest atmospheric observations, and of send them to the Central Bureau by means of the electric telegraph. In 1880, in order to centralize and thus enhance the weather service, the Central Meteorology Bureau of the Navy, located in Florence since 1865, was eliminated, and the one in Rome remained the only bureau where all the weather information from the 42 Italian stations, the signals offices and some foreign observers merged. It was thanks to this constant flow of data guaranteed by the telegraph service, that the Bureau could draft daily reports which were sent to the Ministries of the Navy and of Agriculture, and to all signal posts so that they could advise ships on forthcoming weather conditions [395].

The telegraph service also found application in "public defense", and was used, for instance, to save the Italian population from violent river floods. As with the weather service, information on the flood conditions from different locations along the river, was coordinated, thanks to use of the telegraph with to this surveillance, using special estimates it was possible to anticipate any prospective flooding. The importance of this service was announced by the Administration in 1875 [396]: When all the offices located along the Po river were incorporated under the same Departmental Management, regardless which bank they were on. Previously offices on the two banks belonged to separate departments: the change in the department boundaries actually aimed at better coordination of the preventive action of the offices in the event of river floods.

There were uses of the telegraph requiring, as in other cases, coordination between several observers to express forecasts, also in the fields of seismology and volcanology. For instance, in 1882 seven telegraph offices were organized so as to provide the Catania Vulcanology Physics Laboratory with the necessary information to control the activity of Mt. Etna [397].

As a final point, in some instances telegraph offices became also unintentional observers, due to the interference that certain natural occurrences caused to transmission. For instance, both aurora borealis and earthquakes, when they occurred, caused minor electric discharges which interfered with the intensity of the impulse. Therefore, thanks to the observation of telegraph employees during their occurrence, scientists were able to make considerable progress in research on these atmospheric and seismic phenomena.

Even when adopting these alternative applications of telegraphy, the Italian Administration revealed its determination to follow the example of the more advanced countries. Telegraphy was used to aid meteorology, astronomy and seismology later than in Great Britain, France and Germany. The delay was, however, justified by

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[395] "Servizio meteorologico in Italia", in *Bullettino Telegrafico* 1880, pp. 398-399.

[396] DIREZIONE GENERALE DEI TELEGRAFI, *Relazione Statistica dei Telegrafi del Regno d'Italia 1875*, Roma, 1876, p. XI.

[397] DIREZIONE GENERALE DEI TELEGRAFI, *Relazione Statistica dei Telegrafi del Regno d'Italia 1882*, Roma, 1883, p. LVIII.

Italy's backwardness in most science and technology sectors. Nonetheless, the capillary distribution of alternative uses of telegraphy from the second half of the seventies, reveals once again the effectiveness of our Administration in assimilating and then developing technological innovations introduced in other countries according to its needs.