The Telegraphic Life

Maintenance of the System 1850-1914

John Trelawny Brooks Moyle

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The candidate confirms that the work submitted is his own and appropriate credit is given where reference has been made to the work of others.

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Abstract

Hitherto, historians have assumed that after a submarine telegraph cable had been laid, it provided 50 to 70 years of reliable service. As one who has practical experience of engineering in a professional capacity, I found this order of reliability difficult to accept. I therefore set out to try to determine how reliable or otherwise this new technology was and how it was maintained. These questions had not been asked before and proved more difficult to answer than anyone predicted because much of the information was concealed, deliberately or otherwise, by the cable operating companies. However there were key clues such as the number of cable repair ships afloat and multiple textbooks on cable maintenance. Having unearthed useful data from archives of the Eastern Telegraph Company and of the Telegraph Construction and Maintenance Company, I conclude that the submarine telegraph cables during the period from the first experimental attempts in 1850 up until the Great War were not as reliable as assumed. On average a voyage to repair these cables was required once per annum per 500 nautical miles of cable and this remained constant from 1873, when the company was formed, up until 1914, then end of my period of research. During this period the *system* which was composed of a submarine cable connecting two telegraph stations *appeared* increasingly reliable and efficient because of improvements in the technology at the cable stations and the duplication of many cables which allowed rerouting of communications when malfunctions occurred. I also conclude that data *was* concealed by the operating companies for commercial reasons. If this concealment had been less, then the genesis of the discipline of reliability engineering in the 1940s may have been developed 50 years earlier.

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Abbreviations

BAAS	British Association of the Advancement of Science
BJHS	British Journal of the History of Science
ETC	Eastern Telegraph Company
ICE	Institution of Civil Engineers
IEE	Institution of Electrical Engineers
IEEE	Institution of Electrical & Electronic Engineers
ITM	Imperial Tropical Medicine
JIEE	Journal of the Institution of Electrical Engineers
JSTE	Journal of the Society of Telegraph Engineers
LTS	Large Technological Systems
MRCS	Member of the Royal College of Surgeons
nm	nautical miles
PK	Porthcurno Cable Station (PK was the abbreviated telegraph code)
STE	Society of Telegraph Engineers
TCM	Telegraph Construction and Maintenance Company

1. Introduction

1.1 The conundrum

Much has been written by historians concerning the history of submarine cable telegraphy with respect to finance, politics, diplomacy and commerce. They characteristically assume that once a submarine cable had been successfully laid it worked reliably for many years.[1] No historian of telegraphy up until now has asked probing questions about whether telegraph cables were in fact as reliable as has apparently been supposed, let alone sought to explain why, if the cables were so reliable, cable companies owned such large fleets of specialized maintenance ships. In this thesis I have gone where other historians have previously ignored, directing attention to this hitherto unstudied topic drawing inspiration from the work of Coates and Finn who insightfully analyzed the mean length of usable life of submarine telegraph cables (Figure 1.1). [2]

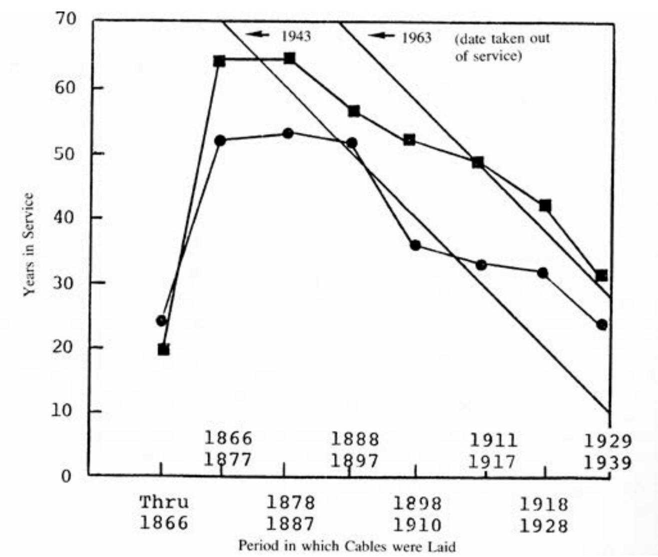

Figure 1-1 Longevity of stranded-copper gutta percha cables, based on average years of service, by period in which the cables were laid. (● cables 5-500miles long, ▪ >500 miles long) from V. T. Coates and B. A. Finn. *A Retrospective Technology Assessment: Submarine Telegraphy*., San Francisco: San Francisco Press, 1979, p. 158.

This chart shows the *operational* life of submarine cables which appears to have increased from approximately 20 years for those laid in the mid-1860s to 50-65 years by the mid-1870s.[3] However, I will show that although they may have been usable for considerable periods, they

[1] The many historians of the first transatlantic cables (see Appendix A of Chapter 3) describe in detail the trials and tribulations during the laying of cables and the technical teething troubles but nothing of the reliability, maintenance and repair thereafter.

[2] V. T. Coates and B. A. Finn. *A Retrospective Technology Assessment: Submarine Telegraphy*., San Francisco: San Francisco Press, 1979, p. 158.. Interestingly, the graph also shows how cable longevity had decreased by World War II and the introduction of satellite communications.

[3]The chart also shows that this life-time was affected by external events: "1943" – events surrounding the Second World War and "1963" – the mass swing from "copper communications" to satellite technology.

were a patchwork of sometimes considerable lengths of replacement cable and many more splices (joints) where the cable had been cut to test the location of faults and interruptions, and re-spliced.

The earliest transmission speeds on the transatlantic cable route (1857-1858) were of the order of three to seven words per minute (wpm), an order of magnitude slower than land line speeds, the reasons for which will be described in Chapter 3. There was a continuing requirement for more speed in transmission and reception and improvements in the technology led to speeds of up to 80 wpm by the time of the First World War.[4] Although this could have been acquired by manufacturing and laying replacement cables with thicker copper conductors and thicker gutta percha insulation, this was prohibitively expensive. It was much more economical to develop more sensitive terminal instrumentation. This will be discussed in Chapters 3 and 5. Submarine cables were exceedingly expensive to manufacture and lay when compared with land-lines (see Table 1.1).

	Land Line Telegraphy	**Submarine Cable Telegraphy**
Distances between exchanges/stations	Commonly <50 miles between exchanges	Commonly >> 50 miles between stations

[4] Coates and Finn, *A Retrospective Technology Assessment*, , p. 157.

Surveying	Man on horse-back	By surveying ship with frequent bathymetric recordings.
Conductor	Iron wire	Copper wire
Insulation	Air with frequent porcelain insulators for support	Gutta percha
Protection	None	Brass tape to protect core from attack by boring organisms. Hemp + tar. Iron/steel wire armouring
Storage	Drums	Storage tanks containing brine
Laying	Horse, cart and ladders. Labour to erect poles etc	Special ships with crew of <50 including specialist engineers and electricians and, on larger ships, a doctor.
Stations/Exchanges	Exchanges with comparatively simple technology	Cable stations with complex and highly sensitive equipment.
Operating Staff	Telegraphers and technicians	Operators of First World skill plus highly qualified electricians
Maintenance and Repair	Simple test equipment. Technicians on horse-back. Repairs usually a few days at the most	Very skilled electricians operating very sensitive and complex instruments to locate faults. Special cable repair ships. Repair voyages 1 week to several months

Table 1.1 Comparison of between land-line and submarine cable telegraphy

Further, as new and significantly better materials for their manufacture were not available until the 1930s, there was no commercial interest in replacing cables if they could still be used. Coates and Finn have suggested that there was also a reluctance to innovate which could be explained by several factors…

> …the risk of losing a large investment by altering proven design; lack of competition from an alternative communications technology; the incremental advantage of repairing long cables rather than replacing them and possibly the excessive cost of building new manufacturing, laying and maintenance equipment to serve the modified cable design.[5]

[5] Coates and Finn, *Retrospective Technology Assessment*, p 156.

Finn has also suggested that the longevity of cables led to a long period of technical stagnation.[6]

There seems to be a lack of interpretive interest in *reliability, maintenance* and *repair* in the historiography of what was a highly complex new technology, which was the first commercially useful wide-scale function of current electricity.[7] I will show that is there a large amount of primary information and archive material about these matters which was concealed from the general public for commercial reasons. A considerable amount of this material requires interpretation by a historian with an engineering background or a labour historian committed to the study of technicians, as training in the concepts of *reliability, maintenance* and *repair* seem to be specific to engineers and technicians. I also demonstrate how important maintenance of the technology *and* also the health of the operators and engineers were to the function of the submarine cable telegraph system as a whole. The system could quite correctly be called *a Large Technological System* (LTS), defined by Hughes as a technical system or network of enormous proportions or complexity (see Figure 1.2).[8] However Hughes did not include individual people as actual parts of the LTS.[9] It is also interesting to note that Hughes' work which was based on electricity supply, has also been applied to railways, gas supply network and to commodity supplies on land but not to networks for international information flow.

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[6] B. Finn . "Submarine telegraphy: a study in technical stagnation." In *Communication under the seas – the evolving cable network and its implications*, edited by B. Finn and Y. Daqing. The MIT Press, Cambridge, Massachusetts, 2009. Pp. 9-24

[7] There are a few remarks about reliability in Anderson's *Statistics of Telegraphy* published in 1872.

[8] T. P. Hughes, *Networks of Power – Electrification in Western Society 1880-1930.* The Johns Hopkins University Press, Baltimore,1983.

[9]G. J. N. Gooday, *Domesticating Electricity,* Pickering & Chatto, London, 2008, pp 16-17

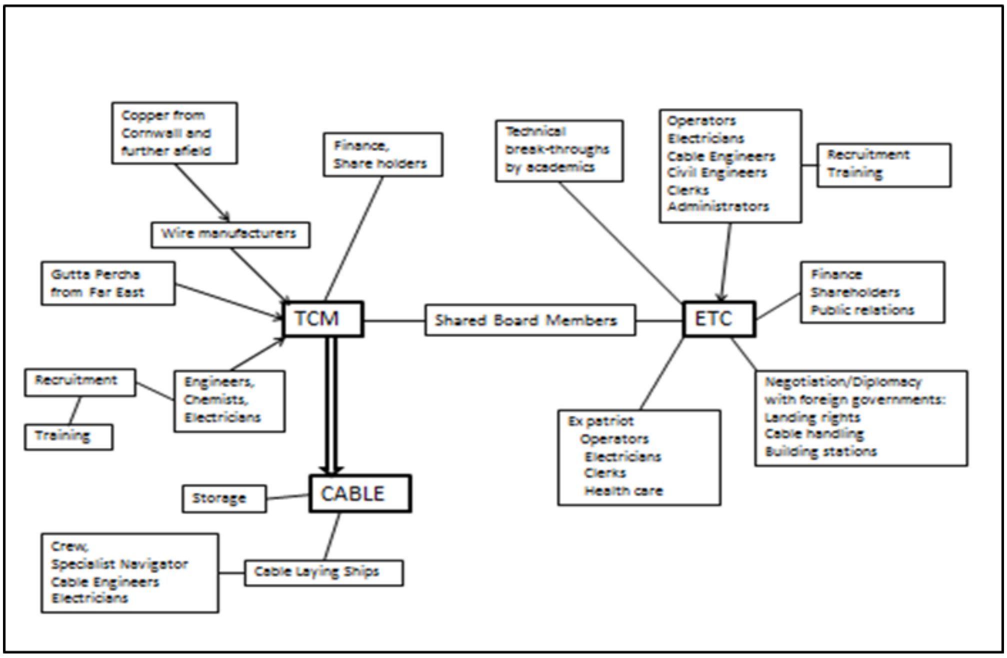

Figure 1.2 My interpretation of the Eastern Telegraph Company and the Telegraph Construction and Maintenance Company as a “Large Technological System from the mid-1870s forward.

I have chosen the period 1850–1914 for this thesis, as it covers important episodes in the early history of the submarine cable system from the first experimental attempts to submerge telegraph cables in sea water until the First World War when submarine telegraph cables played a major role in the conflict. Many changes occurred during this period; in 1850 the total length of international submarine telegraph cable which was working successfully was 25 nautical miles (nm).[10] By 1914 over 300,000nm were in use. The technical complexity had also increased over the same period although not at the same rate as the period after the First World War. In this chapter I will illustrate the phenomenon of cable malfunction and repair that my thesis aims to explain. As I will show, the operating companies strove to convince government, diplomatic and commercial personnel, and share-holders, that submarine cable telegraphy was a worthwhile and reliable system. This required that they hide the costs of maintenance and repair from all but the most probing eyes for fear of loss of investment and customers. This became even more important during the early days of wireless telegraphy (W/T) which was seen at the time a major competitor which had much lower maintenance costs as will be shown in Chapter 5. Another consideration in comparing W/T with cable telegraphy is the longevity of the communication medium.

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[10] “nm” was used as the abbreviation for “nautical miles” during the 19th century unlike its more modern use as the abbreviation for nanometres.

It is not clear from archival material found so far, *why* cables tended to last 50-70 years. One possibility is that they just stopped working after that period for reasons that are not obvious from available archival material. Another possibility is that repeated damage leading to "patching up" may have become so frequent that replacement was a more financially viable option. Some cables may have fallen into disuse as better routes of communication became available.

The assumption of high reliability of submarine telegraph cables by historians may be due to lack of interest in maintenance and, possibly, an undue faith in the sufficiency of physics alone to make the technology work. Also there is a scarcity of archival information relating to reliability and maintenance; this could be due to deliberate destruction of records at the time and may have been part of an overall web of secrecy so that any unreliability would not affect the commercial interests of the cable operating companies. It was a difficult balancing act as the cable repair ships of the larger operators were obvious and scattered around the globe so as to minimize any cable down-time. Another possible reason that this subject has not been investigated by historians is that reliability, maintenance and repair are the province of the *engineer* but one might ask the question: why have historians of engineering and technology overlooked this topic until now?

General histories of telecommunication such as Laszlo Solymar's *Getting the Message - A History of Communications* (1999),[11] Ken Beauchamp's *History of Telegraphy* (2001),[12] Anton Huurdman's *The Worldwide History of Telecommunications* (2003)[13] and Russell Burns' *Communications: An International History of the Formative Years* (2004),[14] all written by specialists in engineering history should surely should have included such important issues as reliability and maintenance. Baglehole's A *Century of Service - A Brief History of Cable & Wireless Ltd 1868 – 1968* (1969)[15] and Barty-King's *Girdle Round the Earth - The History of Cable & Wireless* (1979)[16] do not purport to be technical treatises and the fact that they were both sponsored by the Cable & Wireless Company (successor to the Eastern Telegraph Company group and the Telegraph Construction and Maintenance Company) makes it

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[11] L. Solymar, *Getting the Message – A history of Communications,* OUP, Oxford, 1999. This book is technically quite 'light-weight'.

[12] K. Beauchamp, *History of Telegraphy*, IEE, London, 2001. 6

[13] A. A. Huurdeman, *The Worldwide History of Telecommunications,* IEEE & Wiley Interscience, Hoboken, New Jersey, USA, 2003.

[14] R. W. Burns, *Communications – An international history of the formative years,* IEE, London, 2004.

[15] K. C. Baglehole, *A Century of Service – A brief history of Cable and Wireless 1868-1968*, Cable & Wireless, London, 1969.

[16] H. Barty-King, *Girdle Round the Earth – the story of Cable & Wireless*, Heinemann, London, 1979.

unsurprising that they contain little that is negative about the organization. Even Bernard Finn's books: *A Retrospective Technology Assessment: Submarine Telegraphy* (written with Coates, 1979)[17] and *Communications under the Seas - The Evolving Cable Network and its Implications* (written with Yang, 2009)[18] only mention the overall longevity of submarine telegraph cables. Other histories of submarine cable telegraphy (see Table 1.2) are written by non-technical historians whose texts, although very important to the historiography of submarine cable communication, contain no information concerning reliability, repair and maintenance.

F. J. Goldsmid[19]	*Travel and Telegraph*	1874
D. R. Headrick[20]	*The Tools of Empire - Technology and European Imperialism in the 19th Century*	1981
D. R. Headrick[21]	*The invisible Weapon - Telecommunications & International Politics, 1851-1945*	1991
G. J. Holzmann & B. Pehrson[22]	*The Early History of Data Networks*	1995
P. J. Hugill[23]	*Global Communications since 1844 - Geopolitics & Technology*	1999
J. Ahvenainen[24]	*The European Cable Companies in South America before the First World War*	2003
D. P. Nickles[25]	*Under the Wire - How the telegraph changed diplomacy*	2003
T. Standage[26]	*The Victorian Internet - The remarkable Story of the telegraph & the 19th century's on-line pioneers*	2003
D. R. Winseck & R. M. Pike[27]	*Communications & Empire - Media, markets & Globalization, 1860-1930*	2007

[17] V. T. Coates, B. Finn, *A Retrospective Technology Assessment: Submarine Telegraphy – The Transatlantic Cable of 1866,* The San Francisco Press, USA, 1979.
[18]B. Finn, D. Yang, *Communications under the Seas – The evolving Cable network and its implications,* Massachusetts Institute of Technology, 2009.
[19] F. J. Goldsmid, *Travel and Telegraph,* Macmillan, London, 1874.
[20] D. R. Headrick,, *The Tools of Empire – Technology and European Imperialism in the Nineteenth Century.* Oxford University Press, 1981.
[21] D. R. Headrick, *The Invisible Weapon - Telecommunications and international Politics 1851-1945,* OUP, Oxford, 1991.
[22] G. J. Holzmann, B. Pehrson, *The Early History of Data Networks*. IEEE Computer Society Press, California, USA, 1995.
[23] P. J. Hugill, *Global Communications since 1844*. Johns Hopkins University Press, Baltimore, , 1999
[24] J. Anvenainen, *The European Cable Companies in South America before the First World War* Finnish Academy of Science and Letters, Helsinki, 2004,
[25] D. P. Nickles, *Under the Wires- How the telegraph changed diplomacy*, Harvard University Press, USA, 2003
[26] T. Standage, *The Victorian Internet,* Phoenix, London , 1998.

J. Ahvenainen[28]	*The History of Near-Eastern Telegraphs before the First World war*	2011
R. Wenzlhuemer[29]	*Connecting the 19th century World - The Telegraph & Globalization*	2013
N. Starosielski[30]	*The Undersea Network*	2015

Table 1.2 Other histories of submarine cable telegraphy

This table does not include the many histories of the laying of the first transatlantic cables which are listed in Appendix A of Chapter 3.

Previously, historians have overlooked Haigh's hard-back tome entitled *Cableships and Submarine Cables* which listed all cable ships that have ever been afloat, and ran to two editions: 1968 and 1978.[31] There is currently a discrepancy between the number of cable ships described by Haigh and the apparent reliability of the Victorian submarine cable system. During the period 1850 to 1978, Haigh details 491 cable ships laying 597 major cables. What else were those cable ships doing but carrying out repair and maintenance? Cable historians have also overlooked the evidence of the large number of published textbooks on the location and repair of submarine cables most of which ran to multiple editions during the Victorian period. This will be discussed in depth in Chapter 7. With the huge expansion in land line and especially submarine cable telegraphy there was of necessity a large expansion in the requirement for professional engineers.

1.2 Parallel Changes in the Engineering Profession in the UK

The middle of the 19th century was a period of huge expansion of the engineering disciplines, not least those involved in telegraphy. There were, in parallel, large changes in the profession of engineering in the UK which were to an extent driven by the rapid expansion of submarine cable telegraphy.

The Institution of Civil Engineers (ICE) was the first engineering learned body in the UK. Prior to the formation of the ICE most professional engineers were *military* engineers. It was John

[27] D. R. Winseck, Pike RM, *Communication and Empire – Media, markets and Globalization 1860-1930,* Duke University Press, USA, , 2007.
[28] J. Anvenainen, *The History of the Near Eastern Telegraphs before the First World War,* Finnish Academy of Science and Letters, Helsinki, 2011.
[29] R. Wenzlhuemer, *Connecting the 19th century World – The Telegraph and Globalization*. Cambridge University Press , 2013.
[30] N. Starosielski, *The Undersea Network*, Duke University Press, USA. , 2015.
[31] K. R. Haigh, *Cableships and Submarine Cables*, Standard Telephones and Cables Ltd, Greenwich, London. , 1968, 1978.

Smeaton who first used the term “civil engineer” referring to himself.[32] The word “civil” was a shortening of the word “civilization”; thus the first civil engineers were engineers of/for civilization rather than military, not just the builders of canals, dams, roads and railways but ships and other forms of mechanical engineering. John Smeaton and some engineering colleagues came together as the informal *Smeaton Society of Civil Engineers* in 1771. The engineering profession was expanding rapidly and in 1818 the Society formally became the Institution of Civil Engineers. The ICE was the professional body for all non-military engineers of all engineering disciplines but the majority were those involved in roads, canals, bridges and damns. In 1820 Thomas Telford became president and his fame rapidly increased the standing of the “Civils”. As sub-specialties of engineering such as mechanical and electrical engineering increased in size and importance they were split from the ICE, leaving it to specialize in canals, roads, dams, bridges and such like.

In 1837, Charles Wheatstone and William Fothergill Cooke formed a partnership to develop the electric telegraph for daily use. Before the electric telegraph, electricity had been a scientific wonder and a charlatan’s delight but suddenly telegraphy became the first major practical use of this new medium. This led to an expansion in the number of electrical engineers in the Institution of Civil Engineers. The ICE tried to dominate all forms of engineering including this new telegraphy with its essentially younger exponents. William Preece (see below), in the discussion following a paper by Mance, made a telling statement in 1884, implying that the grandees of the ICE were almost supressing this exciting new field:

> …but would express the very First World regret that in those early days that Mr Latimer Clark has referred to there was no Society of Telegraph Engineers to enable the young men of those days to record the results of their very hard work. It must be remembered that the period of which Mr Latimer Clark spoke was that between 1853 and 1863 (a period when many now present were not born), and when there were no two more earnest, more ardent, and more determined workers in this field than Mr. Latimer Clark and myself. Unfortunately for us there was then no Society of Telegraph Engineers, there was not even a Journal, and there was no encouragement of any sort or kind to spur us on to record our results, and therefore they simply remain dormant in our memories.[33]

In fact 13 years earlier, the telegraph engineers split away from the ICE and formed the Society of Telegraph Engineers (STE) in 1871. The STE evolved into the Society of Telegraph Engineers and Electricians in 1880 and eventually became the Institution of Electrical Engineers (IEE) in

[32] Watson G, *The Civils – The story of the Institution of Civil Engineers*. 1988, The Institution of Civil Engineers, London., p 6.

[33] H. C. Mance.,“Method of measuring the Resistance of a Conductor or of a Battery, or of a Telegraph-Line influenced by unknown Earth currents, from a single deflection of a galvanometer of unknown resistance.” *Journal of the Society of Telegraph Engineers,* May 1884, p. 352.

1887.[34] One of the most important reasons for this split was that the STE could then publish its own scientific journal because the editors of the *Journal of the ICE* limited publication of papers related to telegraphy to produce balanced contents of all branches of engineering. However even the Journal of the STE was limited more to new ideas and techniques rather than the statistics of reliability and maintenance.

1.3 Researching Reliability & Maintenance

The first step in researching the reliability and maintenance of the submarine telegraph cable system was to search out what evidence there was in the archives and this is described in Chapter 2 with the major labour being the construction of a timeline of problems and their repair. This time-line forms an appendix to Chapter 2.[35]

The Table 1.3 lists key events in the history of Submarine Cable Telegraphy and denotes where they are dealt with in this thesis.

Year	**Timetable of Key Events and Technological Innovations**	**Working cable (nm)**[36]	**Chapter(s)**
1851	First practical working submarine cable between England and France	25	3
1857	"Speaking" Mirror Galvanometer	2074	2 & 3
1857-1858	Failed Atlantic cables	3094	4
1859-1860	The first Red Sea cable to India. Short-lived a very unreliable	5574	4
1860	Joint Committee Appointed by the Lords of the Committee of the Privy Council for Trade and the Atlantic Telegraph Company to Inquire into the Construction of Submarine Telegraph Cables	5574	4
1866	First successful Atlantic cable	30000	
1867	Siphon Recorder	34000	2 & 5
1870	First successful UK – Gibraltar – Malta – Suez – Aden – Bombay cable	36000	
1870	Condensers	36000	5
1872	First submarine cable connection from the UK to Australia	37795	
1873	Formation of The Eastern Telegraph Company	40000	2
1878	Brown-Allen Relay*	65000	5
1879	Duplex (2-way) communication	70000	5
1885	Submarine Telegraph Act, 1885	72000	5
1890	Automatic transmission	130000	5
1894	Increased diameter cables (leading to increased speed in	157992	5

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[34] The IEE changed its name yet again to the *Institution of Engineering and Technology* in 2006.
[35] This Time-line is attached to the thesis as a CD-ROM and a USB memory stick.
[36] Nautical miles. Approximate total (not just ETC) working cable estimated from ITU International Telegraph Union reports.

	words/minute)		
1898	Gulstadt Relay*	170000	5
1899	Brown Drum Relay*	192000	5
1902	First Trans Pacific Cable operating	200000	
1910	Heurtley Magnifier*	290698	5
1911	Muirhead Gold Wire Relay*	300000	5
1911	Orling Jet Magnifier*	300000	5
1914-1918	The First World War	320000	2 & 9

Table 1.3 Timetable of Key Events and Technological Innovations
*These devices were the earliest attempts at automating cable relay stations

In Chapter 3, I relate the history of submarine cable telegraphy during what I describe as its *experimental period* (1850-1860) which came to a climax of near commercial failure. The British government, which had already lost large sums of money in this new technology, brought all involved parties together as the *Joint Committee Appointed by the Lords of the Committee of the Privy Council for Trade and the Atlantic Telegraph Company to inquire into the Construction of Submarine Telegraph Cables* (Chapter 4). This reported favourably in 1860 though with many recommendations. Discussions concerning failure and maintenance of cables were also held which lead to a far greater understanding of the *causes* of failure during the ensuing years after the Committee's report. In Chapter 5, I relate these aspects and the resulting technological advances.

By the 1880s techniques for fault and break location and the raising and repair of damaged cables from great depth had become routine. In Chapter 6, I compare and contrast two cable repair voyages from this period; one repair carried out on behalf of a small cable operating company by the huge Telegraph Construction and Maintenance Company and the other the repair of a break by a large operating company using one of its own repair ships. The development of the techniques used by the electricians to locate cable faults and breaks is illustrated in Chapter 7. These developments were driven by the need for ever more rapid and accurate location to improve the reputation of the system. In Chapter 8, I discuss the recruitment and training of these highly skilled electricians and cable engineers and also the conditions under which they lived and worked. In Chapter 9 I draw my conclusions together and suggest that the principles of Thomas Hughes understanding of Large Technological Systems could not be applied to the submarine cable telegraph system.[37] Further, I suggest that the historiography I have assembled may be the true foundations of "reliability

[37] T. P. Hughes, *Networks of Power – Electrification in Western Society, 1880-1930.* Johns Hopkins University Press , 1983.

engineering" as a new discipline. I also outline further possible research themes that emerge from this thesis. My Epilogue, Chapter 10, relates the events of the beginning of the First World War as far as submarine telegraph cable telegraphy was concerned.

2. Reliability and Maintenance

2.1 Introduction

The aim of this chapter is to demonstrate the reliability (or otherwise) of the international submarine telegraph cable system and how this reliability changed over the period of this thesis, 1850-1914. It is mainly based upon the available archives of the Eastern Telegraph Group of Companies, held at the Telegraph Museum, Porthcurno, Cornwall and those of the Telegraph Construction & Maintenance Company, held at the National Maritime Museum, Greenwich. During the period under study the reliability of individual cables remained unchanged, with a rate of approximately one malfunction/repair per 500 nautical miles of cable per year. However, I will show that despite this, the overall reliability of communication *apparent to the customer* did, in fact, improve over the period 1850-1914 and will demonstrate why this should be so. In order to determine the reliability of international cables, I have analysed data from the two largest companies involved (see above)- data that was in general concealed from the public gaze and which has not previously been collected or analysed by historians. This chapter will prepare the reader to understand my analysis of the data in the latter sections by presenting sufficient technical and other detail on submarine cable reliability to render the explanation of my findings clear.

In general, throughout the period of this thesis, the companies that manufactured and laid submarine telegraph cables were separate entities from those that operated the cables; one key case however, was different: The Telegraph Construction and Maintenance Company (TCM) shared many board members with the Eastern Telegraph Company (ETC), the largest operating company at the time. The larger operating companies used their own ships for cable maintenance and repair rather than sub-contracting, as will be seen in Chapter 6. This not only reduced costs but also avoided the need for legal negotiations with sub-contracting companies and reduced the risk of unwanted publicity for service interruptions by keeping the matter “in house”.

The first steps in the entirely new and experimental technology of laying cables under sea water were taken in 1850-1851 with the laying of the cables from Kent to France. The 1850 cable was unsuccessful as will be described in Chapter 3 but there was encouragement to lay ever longer cables after the success of the 1851 cable. A table giving details of submarine cables laid in, 1850-1860 and their fates is attached as Appendix A.[38] It can be seen from this table that shallow-water cables were a greater success technically than those laid in deep water. For this reason the government of the day set up the *Joint Committee Appointed by the Lords of the Committee of the Privy Council for Trade and the Atlantic Telegraph Company to Inquire into the Construction of Submarine Telegraph Cables,* which reported in 1861 (Chapter 4).

This present chapter is based upon the evidence which I have recorded in the spreadsheet *Timeline of Faults, Breaks, Interruptions & Repairs* (Appendix B). This spreadsheet lists all faults, breaks and malfunctions mentioned in company archives, professional journals and *The Times* newspaper in order to assess the reliability of the cable system from the 1850s until just before the Great War. This work has not been attempted by historians in the past. It is important because it shows how much unreliability there was; further it is my view that much of this unreliability was concealed, deliberately or otherwise. A good reputation for reliability was commercially necessary for an operating company for a number of reasons including the maintenance of its share price, the confidence of its shareholders and of its commercial and diplomatic customers.

The succeeding chapters of the thesis deal with the stages in the history of submarine cable telegraphy and its maintenance. However, it is necessary for the reader to understand the basic principles of submarine cable telegraphy before progressing further.

2.2 From land-line to submarine cable telegraphy

There were a number of differences between land line telegraphy and international submarine cable telegraphy. Land line technology was comparatively crude with simple circuits: a source of electricity, usually a battery, which was switched by a straight-forward Morse key activating an electromagnetic sounder. The Morse code used consisted of short or long pulses with a time ratio of 1:3. The sounder did not "buzz" nor "beep" but "clicked": a dot would sound as "click-click" and the dash as "click---click". For reasons that will be described in Chapter 3, the equipment for submarine cable telegraphy was much more delicate and sensitive and instead of a single electrical polarity being used, signals in cable telegraph were of both polarities. At the transmitting station, a pulse of electric current was keyed into the insulated single core copper cable, positive for a "dot" and negative for a "dash" *and both dots and dashes were of*

[38] Modified from the *Joint Committee Appointed by the Lords of the Committee of the Privy Council for Trade and the Atlantic Telegraph Company to Inquire into the Construction of Submarine Telegraph Cables*, 1860

the same duration. This adaptation of Morse code was known as “Cable Code”. A special form of Morse key (see Figure 2.1) was used with one half generating “dots” whilst the other half was used for generating “dashes” using the index and middle fingers of one hand respectively.

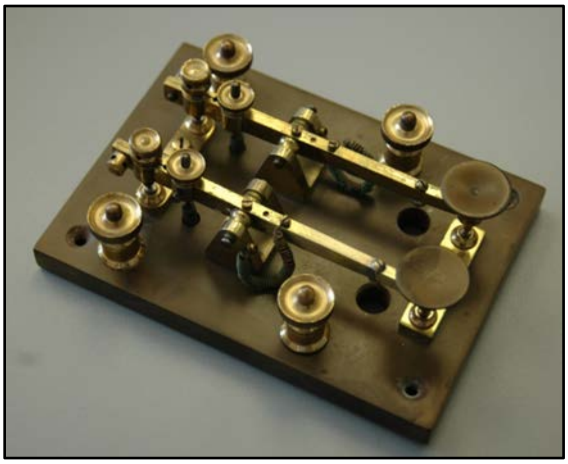

Figure 2.1 Cable key at Telegraph Museum, Porthcurno. (photograph by the author)

At the receiving end of a submarine cable the operator used a galvanometer to observe the fluctuations in electrical current which formed the signal code. The circuit was completed by using the earth and sea water as what was known as the “earth return”. Simple galvanometers of the time were able to transduce signals from very short submarine cables. But as ever longer cables were laid the sensitivity of the simple galvanometer was insufficient because the signals became weaker as cable length increased. Professor William Thomson was the first academic scientist to take a practical approach to this new technology. Senior telegraph electricians, who were immensely practical, realized that they were unlikely to improve the submarine telegraph system without a deeper understanding of the underlying theory. Josiah Latimer Clark (1822–1898), a former electrical engineer to the Electric Telegraph Company (a land line company) was, by 1855, more interested in the problems of submarine cable telegraphy and approached Thomson, by then professor of natural philosophy at the University of Glasgow and known for his ability to turn theory into practice.[39] Having researched the theory of electrical signal transmission through submerged cables, Thomson realized the need for a galvanometer with greater sensitivity to the very weak electrical current of long submarine cables and developed his “speaking” mirror galvanometer in 1858 (see Figure 2.2).

[39]Thomson hated the term “physicist”. See C. Smith and M. N. Wise. *Energy & Empire: A Biographical Study of Lord Kelvin.* Cambridge: Cambridge University Press, 1989.

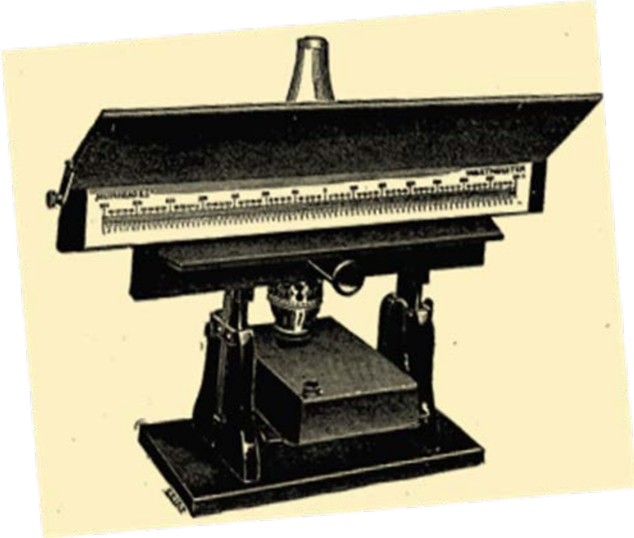

Figure 2.2 Thomson "Speaking" Mirror Galvanometer. A focused beam of light from the oil lamp shown on the left was projected onto a mirror in the galvanometer on the right. The beam was reflected back on to the scale mounted above the oil lamp. (both figures courtesy of Telegraph Museum, Porthcurno)

Thomson conceived of many ingenious instruments but was not very practical and hence his ideas and designs, including the mirror galvanometer, were converted to usable items by his long-term friend, Glasgow based optical instrument maker, James White (1824–1884). The Thomson mirror galvanometer was a modification of Poggendorf's galvanometer.[40] It was very sensitive and was admirably suited to long submarine telegraph cables. It was also fairly tolerant of small to medium sized cable "faults" due to its high sensitivity and long display scale of approximately 80cm, less than a third of which was used to observe the current variations that communicated a message.[41] However the maximum speed of reception was limited to 3-5 words per minute and it required intense mental concentration by two highly skilled operators.[42] One operator observed the fluctuations of the spot of light projected onto the scale, translated its movement and converted the movements from Morse to letters which he dictated to the second operator who wrote down the message on prepared forms.

Figure 2.3 shows the basic Thomson mirror galvanometer in use on the *Great Eastern* in 1866. This uses great artistic license because the simple version shown, whilst suitable for use on land was, in fact, useless on board ships at sea due to the instability caused by the rolling of the ship and also because of the resulting variation in the effects of the earth's magnetic field. Thomson therefore developed a marine version which was both mechanically more robust and

[40] Gooday, *Morals of Measurement,* p. 137.
[41] A "fault" was defined as intact conductor but damaged insulation – See this chapter, Section 2.3
[42] D. Cleaver. *History of Porthcurno*, edited by J. E. Packer. Porthcurno: Telegraph Museum, 1988, p. 6.

contained in an iron casing to reduce the effects of the earth's magnetic field and that of the iron of the ship.[43]

Figure 2.3 Thomson mirror galvanometer in use on *the Great Eastern* in 1866 from *The Illustrated London News*, Oct 13, 1866.

From 1867 the Speaking Mirror Galvanometer was replaced by the siphon recorder for transcribing cable code directly onto a paper strip, referred to as "slip". The siphon recorder's sensitivity was satisfactory for routine use, even on the longest cables, although it was still far less than that of the mirror galvanometer. Hence the Speaking Mirror Galvanometer was retained for use in emergency and for fault finding and malfunction location when it formed the basis of all the tests used being used in various circuits to measure electrical resistance. The speaking mirror galvanometer is described in detail in Chapter 3 and the siphon recorder in Chapter 5.The development of the electrical tests is described in Chapter 7. These tests of resistance were key to the location of cable malfunction in all the instances listed in the time-line.

[43] Gooday, *Morals of Measurement*, p. 137.

2.3 Sources of data

	A	B	C	D	E	F	G	H
1		Cable	Event	ETC Board Minute Books	Engineer's Reports (and other sources)	Ship	The Electrician	The Times
183	09/05/1878	Malta - Alga Grande (Medit Ext Teleg Co)	Interrupted	Interrupted. ETC asked to repair about 40 miles from Malta. CS John Pender sent and found cable in very poor condition. Repair deferred		CS John Pender		
184	09/05/1878	Oranto - Vellona	"in a bad condition"	"in a bad condition"				
185	23/06/1878	Old Aden - Suez	Broken 102 miles from Aden	Broken 102 miles from Aden as already reported. CS Chiltern sent to repair.		CS Chiltern		
186	06/06/1878	Aden - Suez	Repaired 29 May	Repaired 29 May		CS Chiltern		
187	20/06/1878	Aden - Suez	Faulty	CS Chiltern testing at Aden		CS Chiltern		
188	11/07/1878	Red Sea Cables	Repaired fault that occurred 5th July	Repaired fault that occurred 5th July. CS Chiltern now on her way to Suez		CS Chiltern		
189	13/07/1878	Atlantic (1866)	Interrupted				Interrupted	
190	13/07/1878	Amoy-Shanghai	Reported as repaired				Reported as repaired	
191	18/07/1878	Suez - Aden	Aden end faulty	Repairs in progress		CS Chiltern		
192	23/07/1878	Atlantic (1866)	Repairs		NMM TCM/8/12 - 13 CABLE ENGEERS LOGBOOKS. Atlantic (1866), SEINE, 25 May - 23 July 1878; TCM/8/14 CABLE ENGINEERS' LOGBOOKS. Atlantic (1866), CALABRIA, 2 June - 23 July 1878	CS Seine; CS Calabria		
193	01/08/1878	Suez - Aden	Repaired 26 July	Repaired 26 July fault 303 miles from Suez		CS Chiltern		
194	03/08/1878	Havana-Key West (Cuba Sub Co)	Repaired			CS Prof Morse	Reported as repaired by CS Prof Morse	
195	29/08/1878	Suez - Aden	Repaired fault 97 miles from Aden	Repaired fault 97 miles from Aden		CS Chiltern		
196	29/08/1878	Lisbon Direct	Broken	Broken of Cape Finisterre. CS John Pender to repair but damaged in a collision with an Italian caique and a leaking boiler		CS John Pender		

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Figure 2.4 A typical page from the Spreadsheet **Faults, Breaks, Interruptions & Repairs.**

The spreadsheet in Appendix B (on CD-ROM attached) contains a chronologically ordered record of faults, break and interruptions in cable service from January 1857 to 1914. The date in column A refers to the date of the Board minute or the date of publication of the archival source. **Column B** relates the **cable** in which a problem or event had occurred. **Column C** summarizes the **event or its resolution**. The rest of each row indicates the source of the evidence.

The **ETC board minute books** (**Column D**) from August 1875 contained a section headed "Repairing Ships" at each board meeting. Under this heading the tasks being undertaken by each of the company's repairing ships were noted in detail. These minute books remained confidential. The minutes of the annual general meetings are also included in the minute books but there is no mention of reliability or repair at the AGMs. Although the terms "fault" and "interruption" had very specific meanings in engineering terms, it has been suggested that ETC may have used the term fault as it does not sound so serious as break or interruption.[44] I use the term "malfunction". This is because, to the cable engineers and electricians, "fault"and "break"/"interruption" each had specific technical meaning. *Break* and *interruption* referred to discontinuity of the core copper conductor which led to complete failure of signal transmission. *Fault* referred to failure of the insulation to keep the sea water from making electrical contact with the intact copper wire core. In this case communication was still possible, dependent upon how large the fault was. Total failure occurred when the discontinuity in the insulation was very large. However, with very small faults such as those caused by the *Terado navalis* "worm", it was often still possible to communicate though a higher input current was required and it produced a much smaller signal. The rate of communication was also reduced. The first cable engineers and electricians had not foreseen such problems and had predicted malfunctions due only to damage or disturbance from anchors and underwater volcano eruptions. I discuss the many other causes in detail in Chapter 4. Decrease in speed of a faulty cable meant fewer words per minute could be communicated and, as tariffs were based upon words/minute, income was reduced. Interruption also reduced communication speed because of re-routing. An example of this is demonstrated in Chapter 6 of this thesis: a submarine volcano eruption interrupted the Lisbon – Pernambuco cable in 1883 necessitating the routing of communications to and from South America via the USA, the UK and the cables from Porthcurno to Portugal.

The most important information source for cables owned by the Eastern Telegraph Company (ETC) is the minute books of Board meetings. The ETC was formed in 1872 by the merger of four other companies:

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[44]Richard Noakes - Personal communication.

The Anglo-Mediterranean Telegraph Co Ltd in 1868; The Falmouth, Gibraltar & Malta Telegraph Co Ltd in 1869; The British Indian Submarine Telegraph Co Ltd in 1869; The Marseiles, Algers & Malta Telegraph Co Ltd in 1870; and The Anglo-Mediterranean Telegraph Co Ltd in 1870.

The *Eastern Telegraph Company* was a separate company from the *Eastern Extension, Australia & China Telegraph Co Ltd* or the *Western Telegraph Co Ltd*.[45] These three organizations shared many board members and eventually merged to form *The Eastern & Associated Companies*. However, only the ETC board minute books contain detailed information about the serviceability and maintenance and repair of its cables; the ETC owned and maintained more of the working cables than any other single organization and theirs are the only minute books that contain such detail of repairs. This reporting on the repair ships at the monthly ETC board meetings ceased abruptly in 1910 and thereafter the information was recorded in the "Repair Ships Diary" which was one of the books "on the table" at the board meetings. Unfortunately, these diaries have not survived. As this was the major and most accurate source of information I have had to extrapolate the data up to the Great War on the good evidence of the number of cable repair ships that the ETC had in service from then on. Another consideration is that the ETC minute books are incomplete as a source of world-wide data on cable malfunction as only the maintenance and repair data of the company's own cables is recorded.

Column E lists the **Engineer's Reports**, written after each repair expedition by the cable engineer and the cable electrician, and countersigned by the repair ship's captain. Their reports recorded all the technical details of the fault or break and its repair. The main bulk of these reports for cable *repairs* in the spread sheet are those of The Telegraph Construction & Maintenance Company, now held at the National Maritime Museum's archive. The TCM engineer's reports were much more formal than any report written by an operating company such as ETC. The reason for this formality was that they were part of the repair contract between TCM and an operating company, which did not have its own repairing ships, and therefore had to obey contract law.

The **Column F** of the spreadsheet has the name of the **ship** or **ships** involved in a repair. This will allow future researchers to search the spreadsheet by that parameter if desired.[46]

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[45] See Appendix A of Chapter 6 for a "Family Tree".

[46] It is my intention that this spreadsheet will be made available in conjunction with a cable database. This future work is discussed the Chapter 9.

The **Column G** lists entries in the weekly professional periodical, ***The Electrician***. *The Electrician* has been selected here as it is the most comprehensive source available. Regular reporting of cable malfunction and repair began in *The Electrician* immediately with its re-introduction in 1864.[47] Sir James Anderson, the proprietor, was by that time on the Board of ETC having been a captain of the *Great Eastern*. There were almost no reports of malfunction in cable owned by ETC up to c.1890. However, by the mid-1890s an increasing number of ETC cable malfunctions were also reported. This corresponds with Sir James Anderson's death in 1893. Another reason for so few ETC malfunctions being reported in the *Electrician* was cable duplication; duplicate cables allowed messages to be re-routed which on many occasions concealed faults and interruptions.

A rival journal had a less comprehensive listing of cable malfunction; *The Telegraphic Journal & Monthly Illustrated Review of Electrical Science* started publication in 1872. Its proprietor was John (later Sir John) Pender who was the chairman of the Eastern Telegraph Company at the time. *The Telegraphic Journal* was therefore even less likely to report anything detrimental about the reliability of its own submarine telegraph cables within its first few years. While this was generally the case, detailed reading does, however show a small number of such reports, though always in the small print and with no headings or sub-headings.[48]

It can be seen from Figure 2.5 that the only other professional journal in the 1870s was the *Journal of the Society of Telegraph Engineers.* This was reckoned by its editors to be a *learned* publication, not involved with commerce and public relations and it never merely *listed* routinely cable "malfunctions"; however they were used to illustrate articles about earth currents and testing techniques.

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[47]The first series of *The Electrician* began weekly publication in 1861 but was discontinued three years later in 1864. Publication of a new series of *The Electrician*, re-starting at Volume 1 began in 1878 under the proprietorship of Sir James Anderson, the former captain of the *Great Eastern*. *The Electrician* continued as a weekly periodical well into the twentieth century. See Strange P. Two Electrical Periodicals: The Electrician and The Electrical Review 1880-1890. *IEEE Proc*, 1985, vol 132, Pt A, No 8, 574-581.

[48] In 1881 *The Telegraphic Journal* became a weekly publication and simply *The Electrical Review* in 1891.

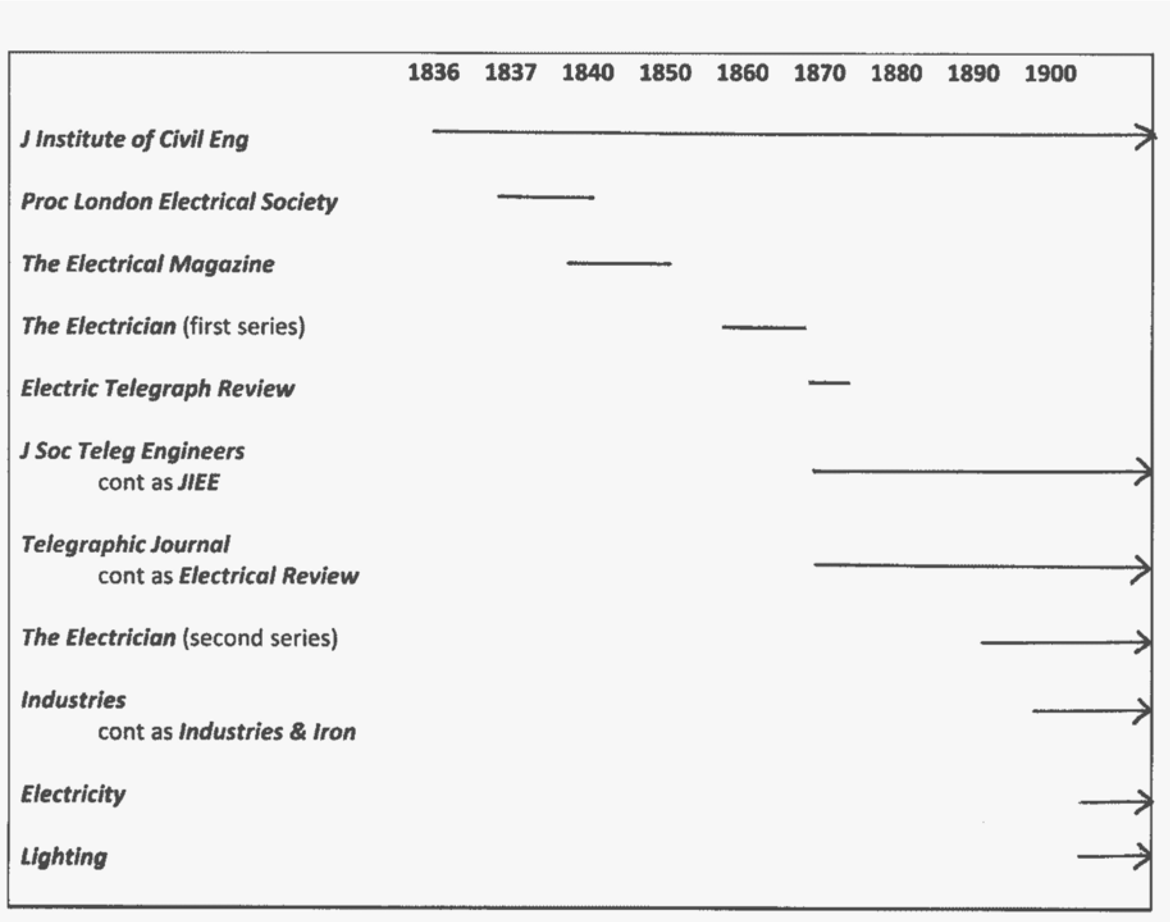

Figure 2.5 Select list of 19th century electrical journals (modified from Strange P. Two electrical periodicals: The Electrician and The Electrical Review 1880-1890, *IEEE Proc.* 1985, vol 132, Pt A, No 8, p575)

The final **column H** of the spreadsheet is entitled ***The Times***. Entries in this column are strictly those referring to malfunction of submarine cables and their repair. I have used such information published in *The Times* as an indication that it had reached the general public (as opposed to professional) domain.

For each row of the spreadsheet the date, cable and problem or event are noted. On many occasions the only evidence found came from a single source, (i.e. ETC minute books OR engineers' reports OR *The Electrician* OR *The Times*) and hence only one other column is completed. As can be seen, details of very few interruptions ever reached the *public* domain. This was because if an ETC cable was interrupted communication was still possible via other cable routes. Also the busier cable routes were often duplicated with sufficient redundancy that any re-routing of telegrams was effected by parallel cables also belonging to ETC.[49] Thus

[49] The engineering sense of the word "redundancy" refers to extra cables or capacity above what would have been normally needed.

the public very rarely noticed an interruption as will be shown, especially over the route between the UK and Gibraltar. This route was especially important as it was the first section of cables through the Mediterranean and on to India, and later, the Far East and Australasia.

2.4 Analysis

Any conclusions drawn from the spreadsheet must be seen in the light of the ever-increasing number of working submarine telegraph cables (Figure 2.6) and the improvements in the technology during the period of this study, 1850-1914.

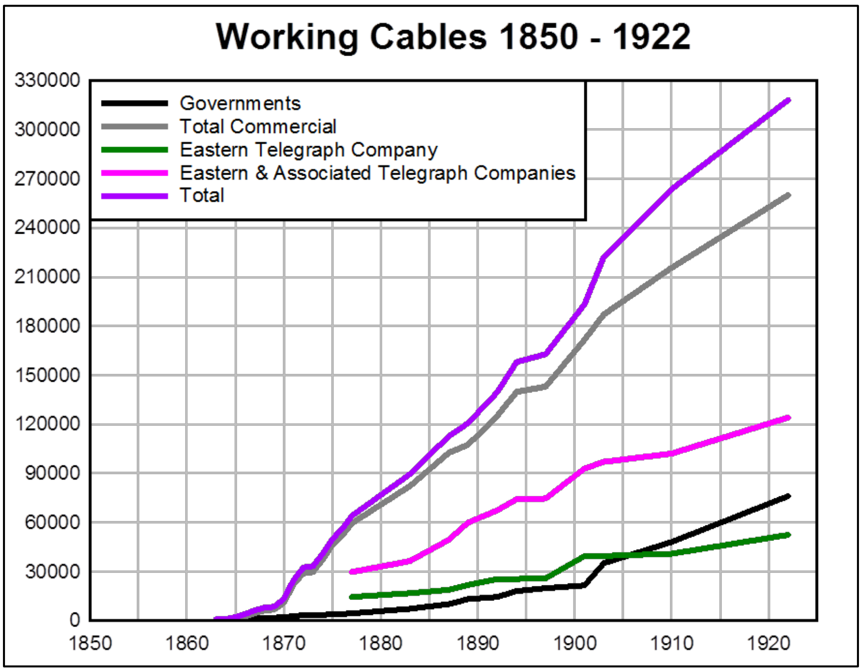

Figure 2.6 Length of working cables in existence at the beginning of each year 1852-1922. Modified from De Margerie M, Le reseau anglais de cables sous-marins. Paris 1909. p21 and ITU Reports

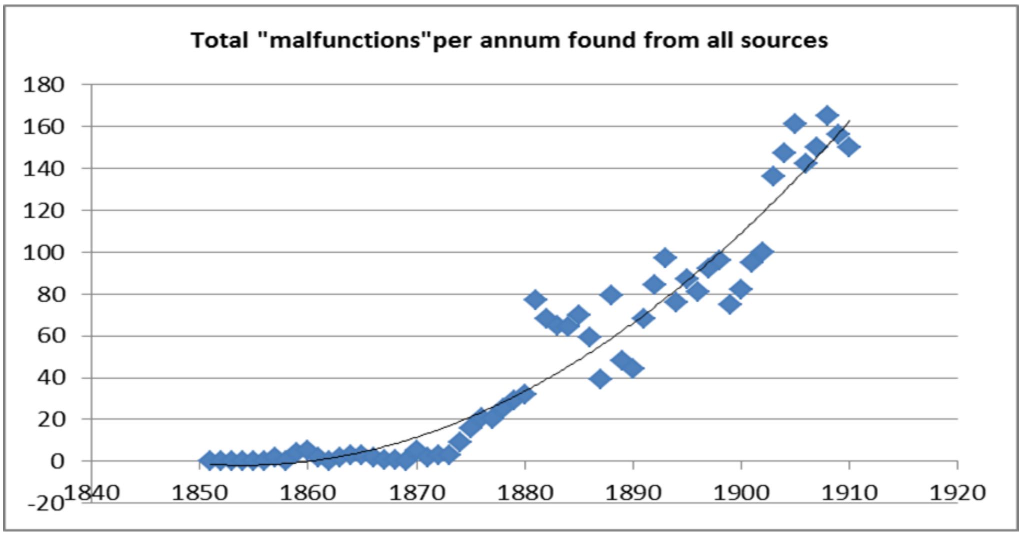

Figure 2.7 Total malfunctions/annum from all sources and trend line.

The Figure 2.8 compares the ETC's total working cable length with their rate of malfunctions/annum. It would be wrong to superimpose any plots of cable malfunction either from ETC's records or the TCM Logbooks on the same graph as the total world working submarine telegraph cables as they do not form the whole picture of worldwide cable malfunction. However it can be seen that the gradients of the curves are similar.

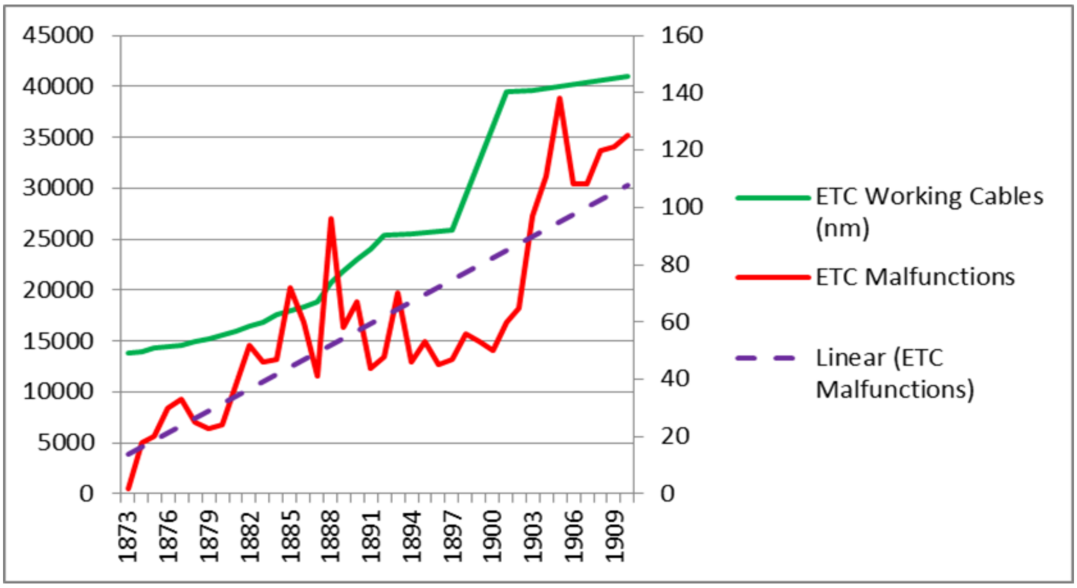

Figure 2.8 ETC Working Cables (nautical miles) and Malfunctions or Repairs (actual and linear trend line)

The peaks and nadirs of the "ETC malfunctions" (Figure 2.8) during the last two decades of the 19th century are not easy to account for. It is possible that they may relate to various wars that the UK was involved in; however, the chart in Figure 2.9 shows that the UK was involved in belligerency almost continuously. However as the sample sizes are not large, some variation is not surprising.

The Crimean War (1853-1856) was a the first major conflict between the Russian Empire and an alliance of the French Empire, the British Empire, the Ottoman Empire, and the Kingdom of Sardinia. The British government paid for R. S. Newall & Co. to lay a temporary submarine cable between Varna (Bulgaria) and Balaclava; this was the first cable to have a significant effect on the management of war. As it was only temporary and was required very quickly, it consisted of a copper core insulated with gutta percha. Of its 365nm length only 35nm were armoured so it was quite surprising that it worked faultlessly until the end of hostilities though it failed soon after and was abandoned.[50]

Only two wars are mentioned in the “Repairing Ships” paragraphs in the ETC board meeting minutes, the “Egyptian Crisis” and the “Suakin Crisis”. The Anglo-Egyptian War (1882-1885) necessitated the closure of the Cable Station at Alexandria because of damage to the station and the risk to the expatriates who staffed it. A temporary fully operational cable station was set-up off shore in one of the cable repair ships, CS *Chiltern*. The Mahdist War in the late 1880s was mentioned in the ETC minutes (26 October 1888) when Suakin was “under siege” with CS *John Pender* standing by off-shore in case the cable station required evacuation. This siege culminated in the Battle of Suakin on the 21st November 1888. Although these events were mentioned in the minutes there were no remarks about cable damage due to belligerency. Neither was there any mention of reliability and maintenance in Hedrick’s *The Invisible Weapon*, a masterly volume about cables in wartime.[51] An International Convention for the Protection of Submarine Cables in April 1884, at which many nations were represented “refused to interfere with the rights of belligerents”.[52] The convention noted that “cable cutting for war purposes had not figured greatly in modern conflicts” - this flew against the evidence of the Peru–Chilean conflict or the Anglo-Egyptian War where many of the coastal cables were cut.

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[50] [R.S. Newall & Co.] *Proposal and terms for laying down an Electric Telegraph between Varna & Balaclava,* (UK) National Maritime Museum, Spratt papers, SPR/5/1, p. 1.
[51] D. R. Headrick, *The Invisible Weapon – Telecommunications and International Politics 18651-1945*, Oxford University Press, 1991
[52] G. E. Walsh. “Cable Cutting in War. ”*The North American Review Vol* 167, no. 503 1898: pp. 498-502.

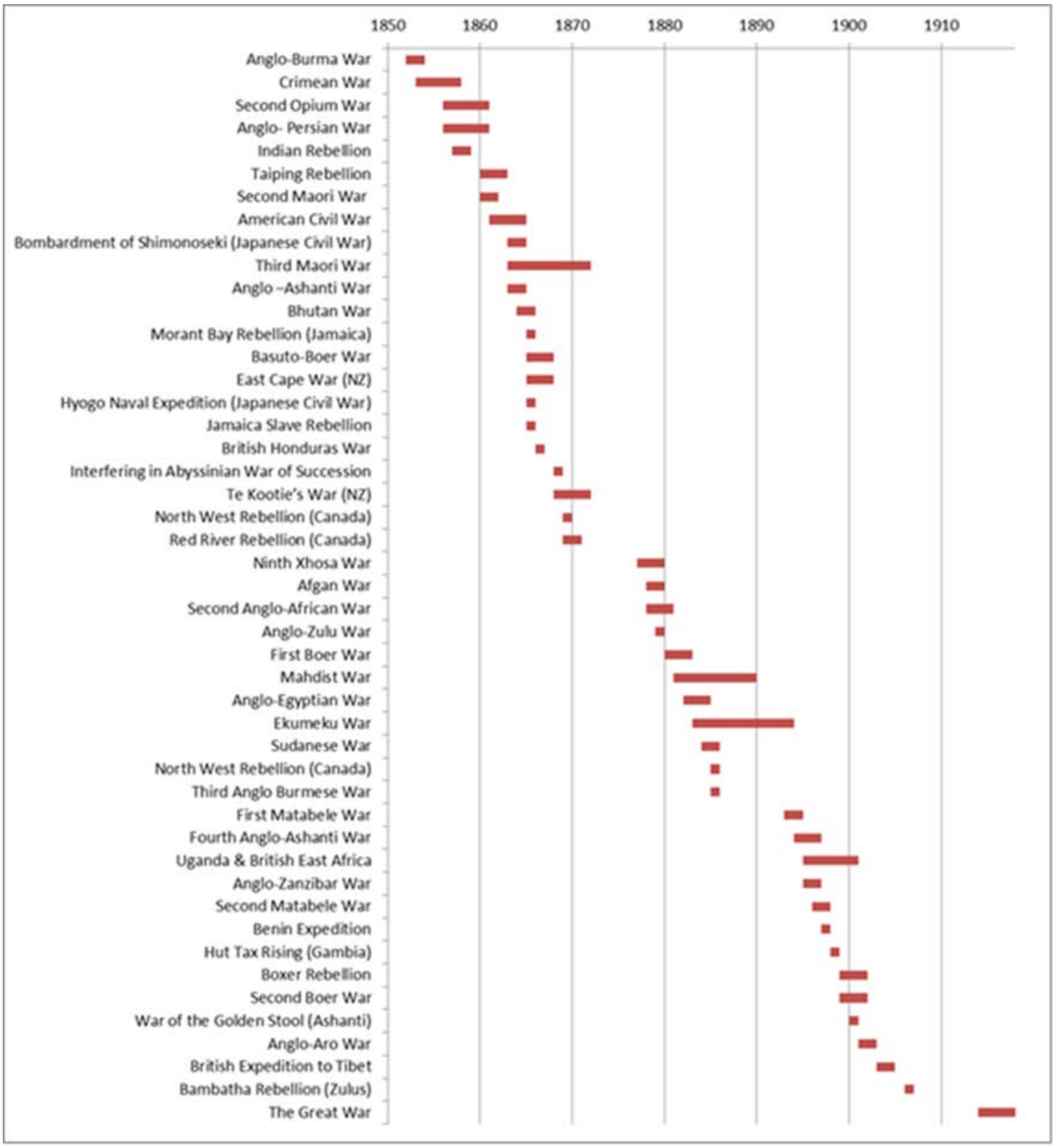


Figure 2.9 Wars and other belligerency involving Great Britain (including the American Civil War which had effects on international cables).

All of the conflicts listed in Figure 2.9 would have involved the use of submarine cable telegraphy in one way or another as, at last, it was a method by which governments could communicate with their forces virtually instantaneously compared with communication by courier. This led to complaints by senior officers in the front line of too much interference from London, not the reaction that the government expected from their "helpful" telegrams.[53]

[53] Nickles DP, *Under the Wire, How the telegraph changed diplomacy.* 2003,Havard University Press. Pp33-35.

Despite the UK's continuous pugnacious history, there is no correlation with the peaks and nadirs of cable malfunction. Other possible causes of the irregular rate of ETC malfunctions include variation due to changes in the economic situation, random failure due to aging of the cable, and submarine earthquakes which were more frequent than those on dry land. I have tried to find specific correlation but have been unsuccessful.[54] There is very clear evidence of deliberate damage to cables at the commencement of the Great War in 1914 which is discussed in Chapter 9. However data from this period is not to be found in the ETC minute books, *The Electrician* or *The Times*.

The chart below (Figure 2.10) summarizes the cable malfunctions recorded in the *Electrician* as examples of the professional press and the *Times* which demonstrated the *public* notification of cable malfunction.

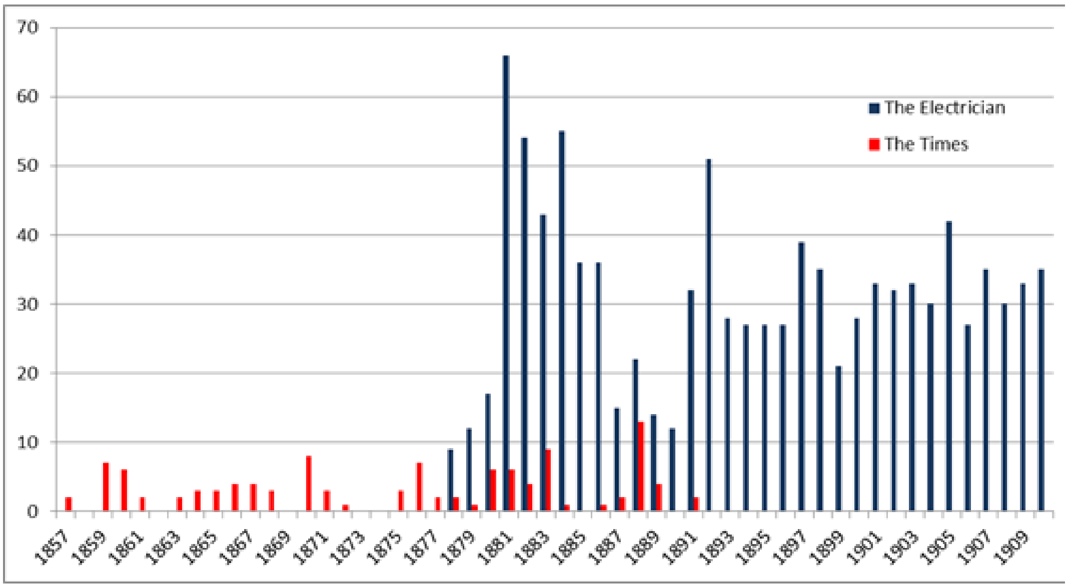


Figure 2.10 Malfunctions of cables in *The Times* and *The Electrician* 1857-1910

Analysis of the spreadsheet shows that that less than 2% of malfunctions listed in the *Electrician* referred to cables operated by the Eastern Telegraph Company which implied that the *Electrician* was possibly under some sort of constraint from its proprietor. The method of annotation of cable malfunction in the *Electrician* varied from year to year especially during the late 1880s. In the first decade of its publication each cable problem was noted as a separately headed short paragraph. But from 1891 with increasing interruptions due to the

[54] I will continue to look for correlation, especially with earthquakes, in research to follow this thesis when constructing a database of every known submarine cable – See Chapter 9.

increasing amount of working cable, the interruptions were summarized in a small table each week (see Figure 2.11).

Cable Interruptions and Repairs :—

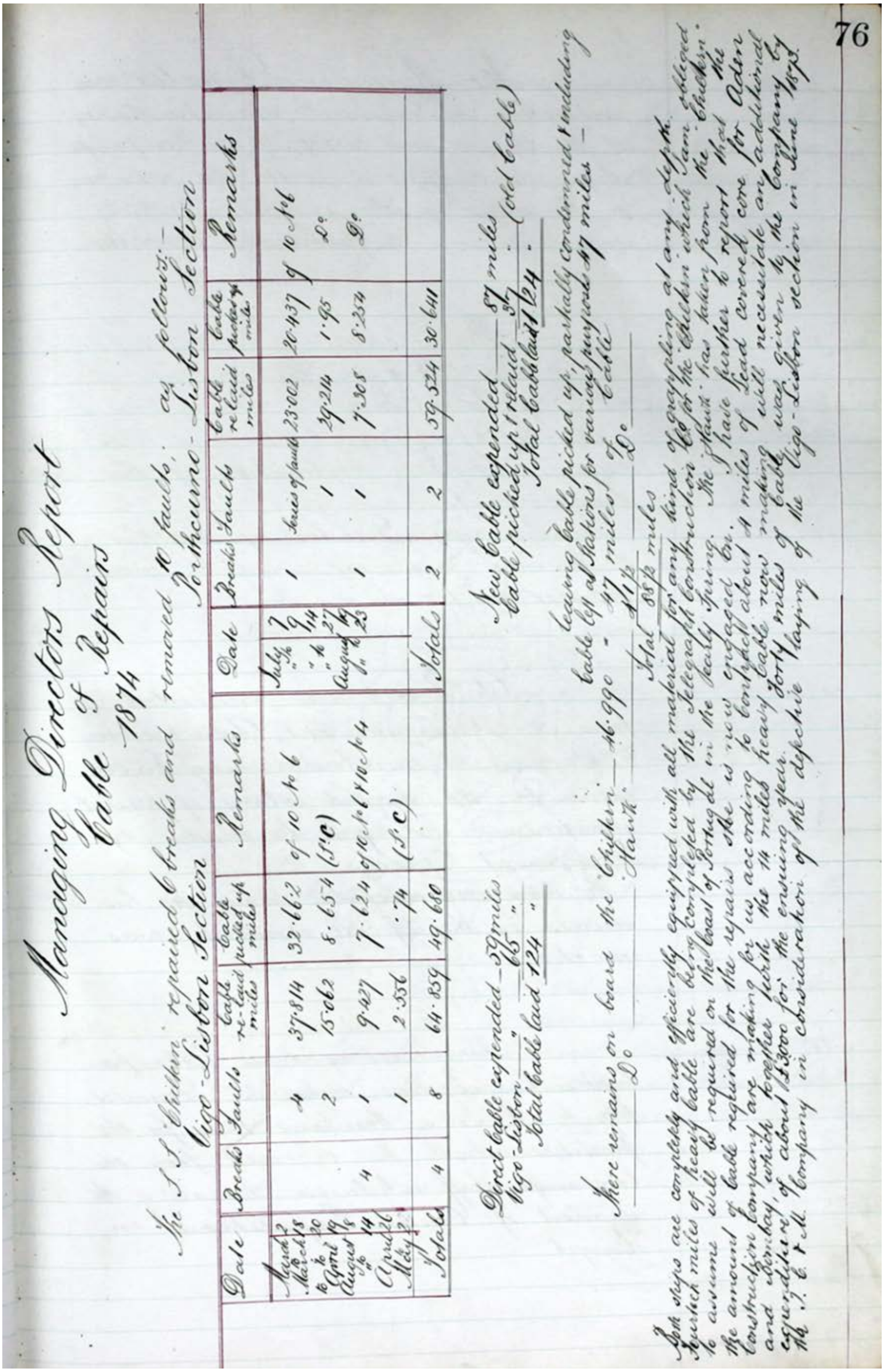
	Date of Interruption.	Date of Repair.
Puerto Plata—Martinique ...	December 19, 1895 ...	—
Perim—Obock	January 2, 1896 ...	—
Bathurst—Sierra Leone	January 14, 1896 ...	January 14, 1896
Konakry—Sierra Leone	January 14, 1896 ...	January 18, 1896
St. Thome—Loanda	January 15, 1896 ..	—
Odessa—Constantinople	January 17, 1896 ...	—
Durban—Lourenco Marques..	January 19, 1896 ...	January 22, 1896

Figure 2.11 *The Electrician* 24th Jan 1896

It is of note that only "interruptions" are listed by the *Electrician*; "faults" did not necessarily come to the attention of even the professional press as cable messages could still be passed even if at a much slower speed. Far fewer incidents reached the attention of the *Times.* In fact, there were only 13 entries relating to the ETC during the period of this thesis. Reports of cable malfunction virtually disappeared from the *Times* after 1890. The reason for this was probably the increased number of duplicate cables which were laid not only to cope with increased message traffic rates but also to provide alternative routes during cable malfunction.

An example of in-house repair and minimization of publicity in the 1870s may be seen in the troubles that the Eastern Telegraph Company had with their cables between Porthcurno (PK), in Cornwall, and Gibraltar. Her Majesty's Government originally ordered this cable as it wanted a direct cable to its large naval base in Gibraltar. Prior to the laying of this cable in 1870, communication with this important naval base and via Gibraltar to India was by a circuitous route through countries in mainland Europe which were not guaranteed to remain "friendly".[55] Cables from PK to Gibraltar became extremely important not only to the naval base but as the first step to many long distance stations via Malta, Alexandria and further to India and the Far East. The 1870 PK to Gibraltar cable had only one intermediate station at Carcavelos in Portugal. It became so busy and important that a duplicate cable was laid in 1872. Reliability problems became so frequent that, in 1874, the Managing Director of ETC asked for a summary report about these cables (which is shown in Figure 2.12).

[55] HMG ordered the cable in 1859 but war broke out with China before it could be laid. The cable was required to link Rangoon with Singapore in furtherance of military necessity. The war finished before it could be laid and the cable was eventually used between Malta and Alexandria. The first Porthcurno to Gibraltar cable was not laid until 1869, finally working in 1870.



Managing Directors Report
Cable of Repairs
1874

The S. S. "Chilkern" repaired 6 breaks and removed 10 faults; as follows:—

Vigo-Lisbon Section

Date	Breaks	Faults	Cable re-laid miles	Cable picked up miles	Remarks
March 2 / March 18		4	37·814	32·662	of 10 No 6
to 20 / April 19		2	15·062	8·654	(S.C)
August 8 / to 14	4	1	9·427	7·624	of 10 No 6 & 10 No 4
April 26 / May 2		1	2·556	·74	(S.C)
Totals	4	8	64·859	49·680	

Porthcurno-Lisbon Section

Date	Breaks	Faults	Cable re-laid miles	Cable picked up miles	Remarks
July 7 to 9	1	Series of faults	23·002	20·437	of 10 No 6
" 14 to 27		1	29·214	1·95	Do
August 19 to 23	1	1	7·308	8·254	Do
Totals	2	2	59·524	30·641	

Direct Cable expended 59 miles
Vigo-Lisbon " 65 "
Total Cable laid 124 "

New Cable expended 87 miles
Cable picked up & relaid 37 " (old Cable)
Total Cable laid 124 "

leaving Cable picked up, partially condemned & including Cable left at Stations for various purposes 47 miles —

There remains on board the "Chilkern" 46·990 = 47 miles of Cable
Do "Hawk" 41½ Do
Total 88½ miles

Both ships are completely and efficiently equipped with all material for any kind of grappling at any depth. Fourteen miles of heavy Cable are being completed by the Telegraph Construction Co for the "Chilkern" which I am obliged to assume will be required on the Coast of Portugal in the early Spring. The "Hawk" has taken from the "Chilkern" the amount of Cable required for the repairs she is now engaged on. I have further to report that the Construction Company are making for us according to Contract about 4 miles of Lead covered core for Aden and Bombay, which together with the 14 miles heavy Cable now making will necessitate an additional expenditure of about £3000 for the ensuing year. Forty miles of Cable was given to the Company by the T. C. & M. Company in consideration of the defective laying of the Vigo-Lisbon section in June 1873.

76

Figure 2.12 Managing Director’s report of cable repairs 1874 Porthcurno – Lisbon from ETC minutes 1874 p. 76.

The report concerns the section between PK and Carcavelos (the cable station for Lisbon on the estuary of the River Tejo, 12km west of Lisbon).[56] During 1874 there were six breaks and ten faults and yet judging by the complete lack of any mention in *The Times* newspaper, the ETC had managed to conceal any damaging publicity. During 1874 the only mentions of submarine cables in *The Times* were a few lines about the repair of a fault in the Bilbao – Las Arenas *electricity* cable and a general article about submarine telegraph cable manufacture and laying but nothing about interruptions in communications.[57] There was little in any of the technical professional journals. The main reason for the lack of negative publicity about the 1874 problems was that the ETC had laid another cable in 1873 which not only reduced the ever-increasing load on the single 1870 cable but acted as a back-up if communication on the original cable was interrupted. As a last resort telegrams could be re-routed overland but this would have reduced speed and security.

The duplicate routes from the UK to Gibraltar (and the Spanish peninsula) were:[58]

1870 PK – Lisbon No 1
1870 Lisbon – Gibraltar No 1
1873 PK – Vigo
1873 Vigo – Lisbon
1887 PK – Lisbon No2
1887 Lisbon – Gibraltar No 2
1897 Vigo – Gibraltar
1898 PK – Gibraltar
1919 PK – Gibraltar

Cables from the UK to Gibraltar continued to present problems for decades to come and they were often the subject of special reports to the Board but on very few occasions did these problems reach the public domain.[59]

The map in Figure 2.13 shows the telegraph routes from the UK to India. As can be seen the earliest routes, the "Indo-European" and the "Turkish" routes, involved very little submarine cable with any communication passing through countries which were often not on friendly terms with the UK and also through telegraph stations where English was not necessarily understood, nor was there any sense of urgency in relaying massages. By contrast, the submarine cable route from the UK to Bombay, India, via Gibraltar, Malta, Alexandria and

[56] "Lisbon" and "Carcavelos" were often used interchangeably in telegraphic parlance.
[57] *The Times*, 24th April 1874, p. 12 and *The Times,* 4th May 1874**, p. 7.**
[58] PK = Porthcurno, Cornwall, England; Lisbon's cable station was Carcavelos, 12km west of Lisbon
[59] For example ETC Board minute book Vol 2, 28th September 1876 (pp. 263-266). *The Times* Monday 21st Nov 1881 p. 12 (issue 30357) and a brisk correspondence over the following week.

Aden only involved cable stations which were operated by expatriate operators of the Eastern Telegraph Company.

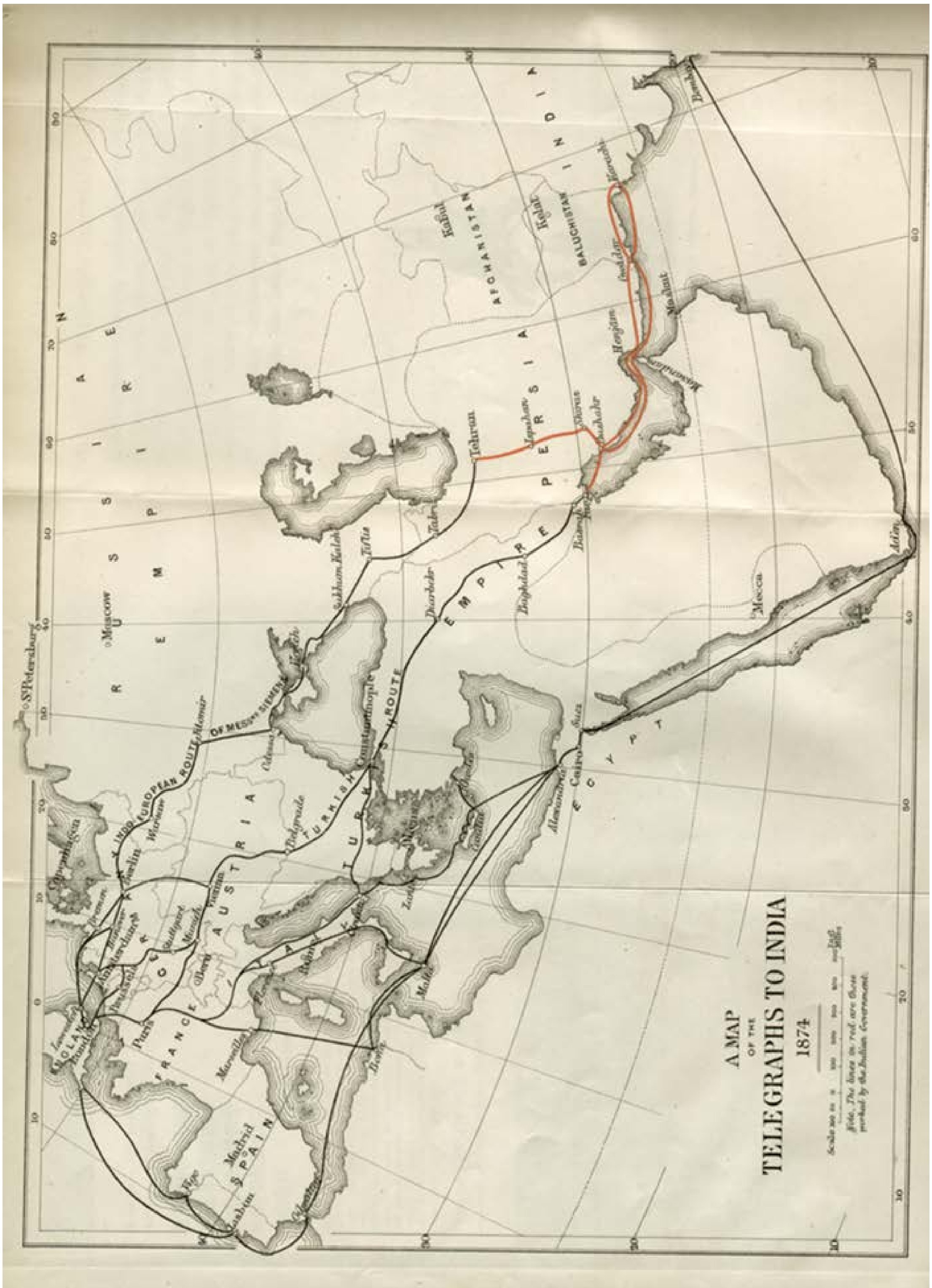


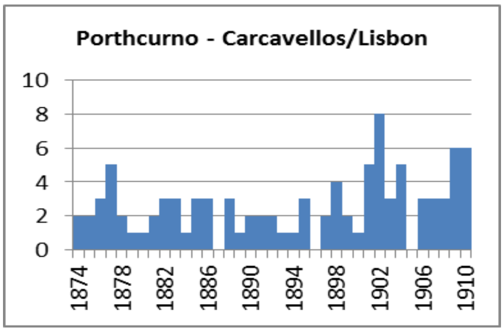
Figure 2.13 The Cable routes from the UK to India in 1874 from Goldsmid, 1874, *Travel and Telegraph,* Macmillan, London.

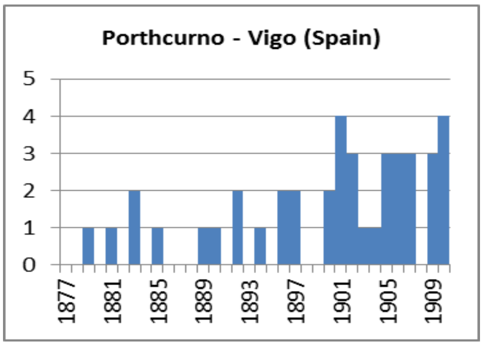
From Gibraltar to Bombay, the cables laid were:

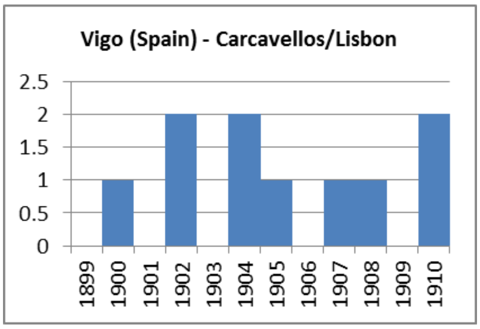
Gibraltar – Malta	1870 with duplicates in 1871, 1887,
Malta – Alexandria	1868 with duplicates in 1870 (x2), 1899
Suez – Aden	1859 with duplicates in 1870, 1876, 1883, 1890, 1891
Aden – Bombay	1870 with duplicates in 1870 (again), 1877, 1884

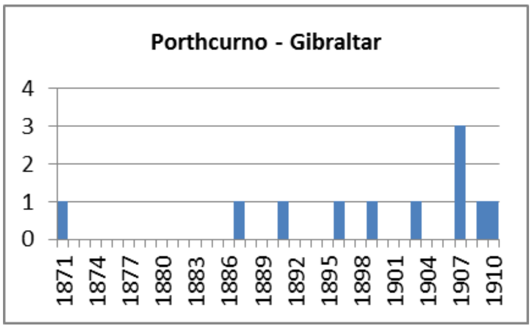
(Alexandria and Suez stations were connected by land lines)

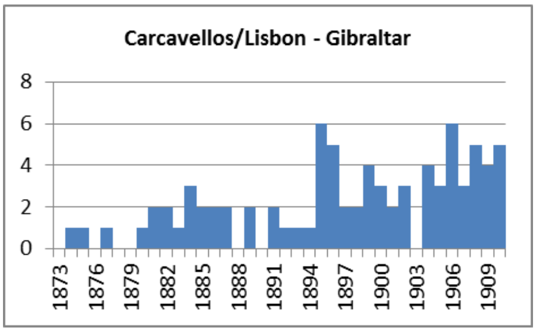
Further evidence of the reliability or otherwise of submarine cable telegraphy is shown on the charts indicating the malfunctions of the submarine cables connecting the UK and India (Figure 2.14a and 2.14b).

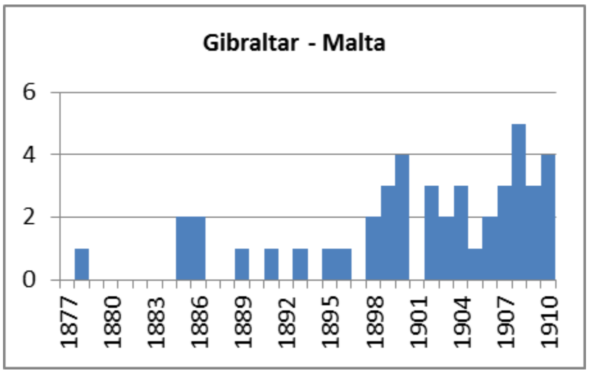


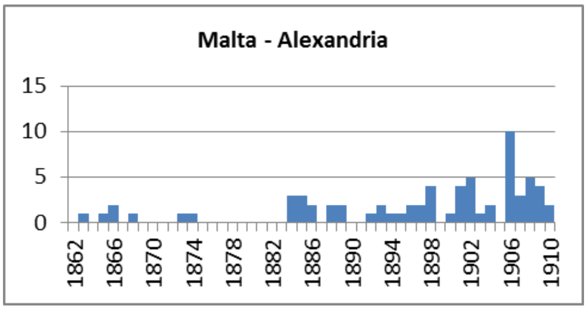












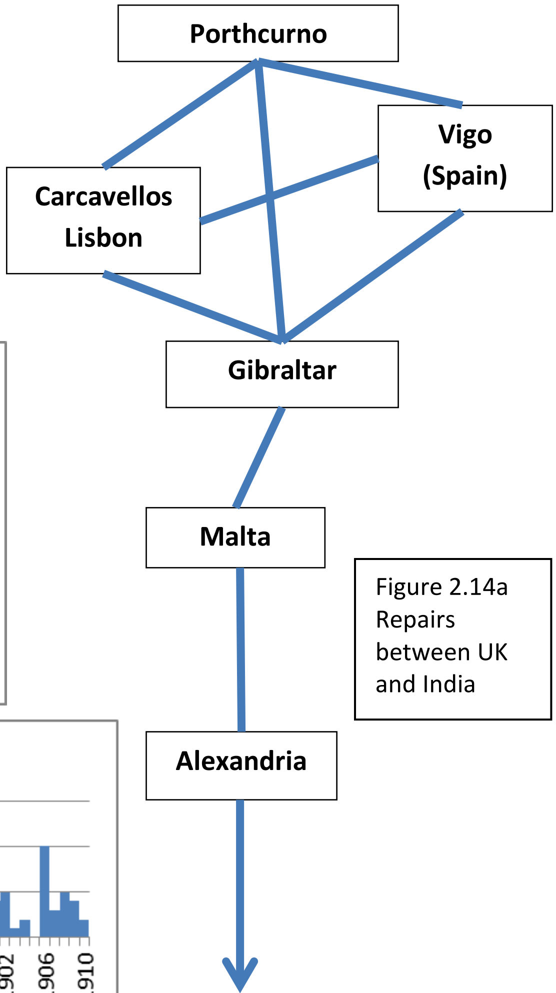


Figure 2.14a
Repairs
between UK
and India

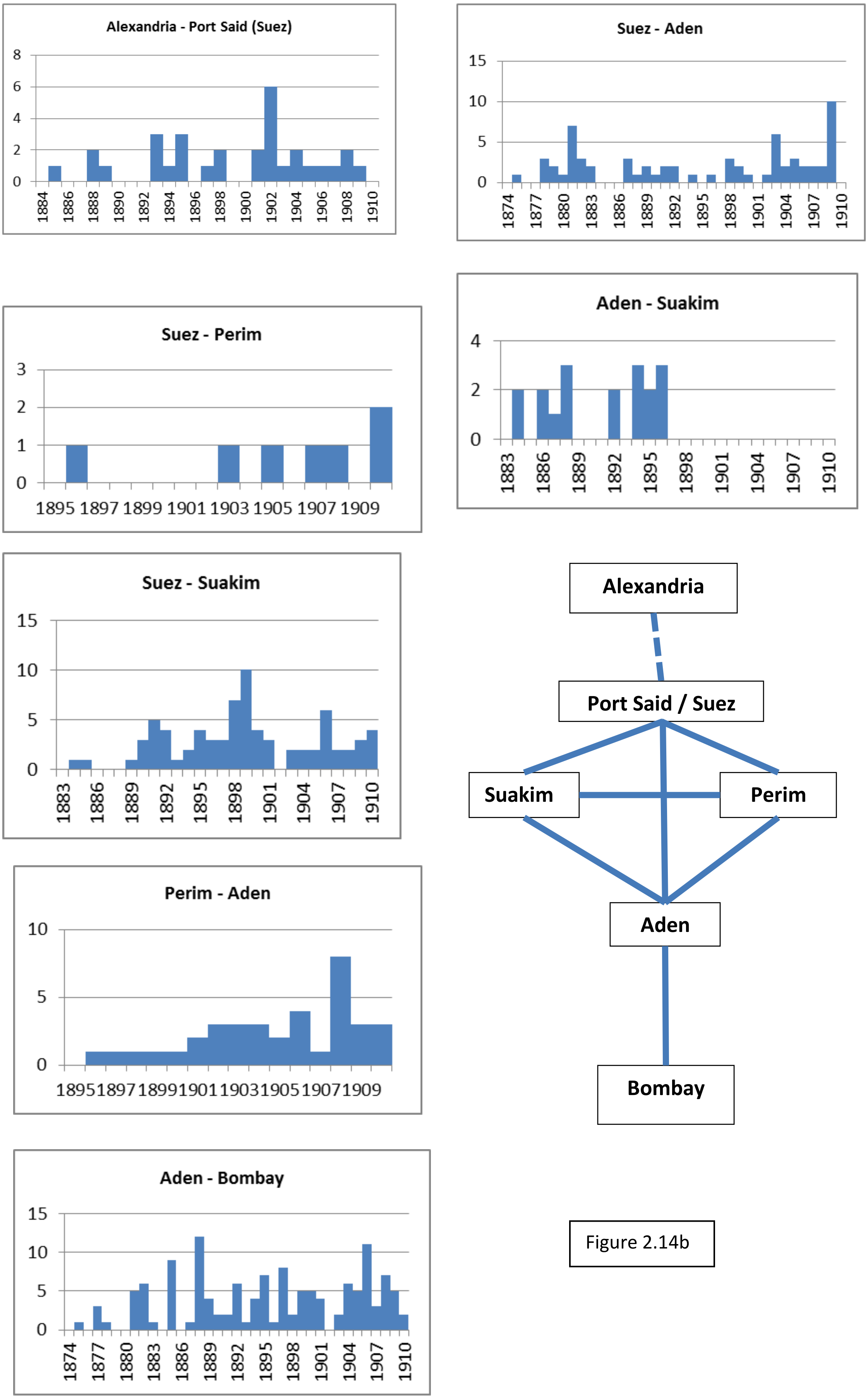

Alexandria - Port Said (Suez)
0
2
4
6
8
1884
1886
1888
1890
1892
1894
1896
1898
1900
1902
1904
1906
1908
1910
Suez - Aden
0
5
10
15
1874
1877
1880
1883
1886
1889
1892
1895
1898
1901
1904
1907
1910
Suez - Perim
0
1
2
3
1895 1897 1899 1901 1903 1905 1907 1909
Aden - Suakim
0
2
4
1883
1886
1889
1892
1895
1898
1901
1904
1907
1910
Suez - Suakim
0
5
10
15
1883
1886
1889
1892
1895
1898
1901
1904
1907
1910
Perim - Aden
0
5
10
1895 1897 1899 1901 1903 1905 1907 1909
Aden - Bombay
0
5
10
15
1874
1877
1880
1883
1886
1889
1892
1895
1898
1901
1904
1907
1910
Alexandria
Port Said / Suez
Suakim
Perim
Aden
Bombay

Figure 2.14b

None of these malfunctions and repair voyages became public knowledge if we are to judge such a matter by the coverage in *The Times*. Fewer than 10% of these repairs were reported in *The Electrician*. A contributory factor to keeping this unreliability out of the public gaze was, from an engineering point of view, the existence of duplicate cables because of increasing usage; by 1900 there were four cables between Aden and Bombay, for example. Company secrecy was another major contributor to the lack of public knowledge of the poor reliability of the cables. Individual cables were unreliable but the system as a whole was reliable.

The positions of its repairing ships were mentioned in the minutes of each ETC Board Meeting from 1874 until 1910. The regular section *Repairing Ships* in the minutes of each meeting suddenly ceased in 1910 and was replaced by "Repairing Ships" as being one of the "books on the table" at the meeting. I have not been able to locate these books and they are unlikely to have survived. It is however evident from the ETC minute books that although the causes of cable malfunction were as yet not obvious (see Chapter 5), damage by anchors and fishing was not only obvious but common and in many cases avoidable.

Some evidence that the rate of maintenance and repair continued unabated after 1909 is shown in Figure 2.15 which shows the continued rise in the number of repair ships that were at sea.

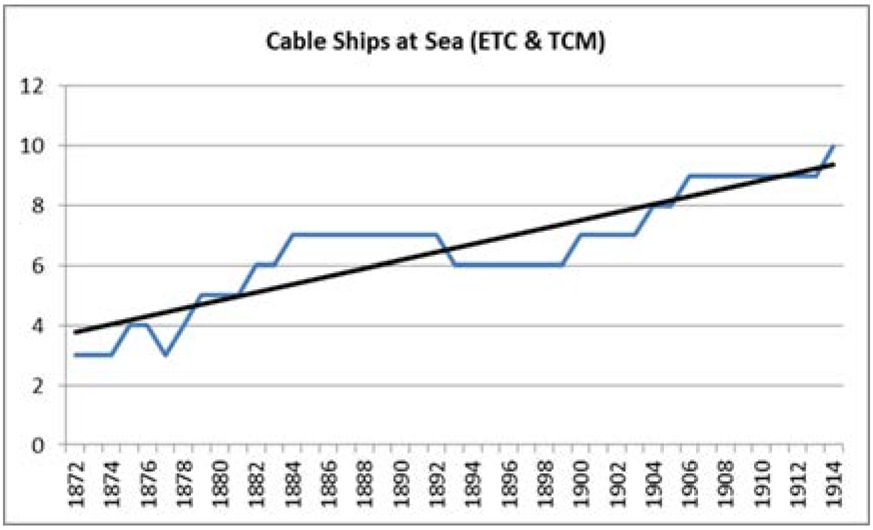


Figure 2.15 Cable ships of the ETC and TCM at sea

The black trend line in the graph accentuates the previous evidence in this chapter that there was little improvement in the reliability of individual cables after the *Inquiry* as there was a continual increase in the number of repair ships owned and operated by ETC and TCM at sea.

Again the data is too sparse to make exact numerical conclusions. Unfortunately no help with more accurate extrapolation of the rate of change of cable repairs was given by the reports of repairs in *The Electrician* as demonstrated in Figure 2.16.

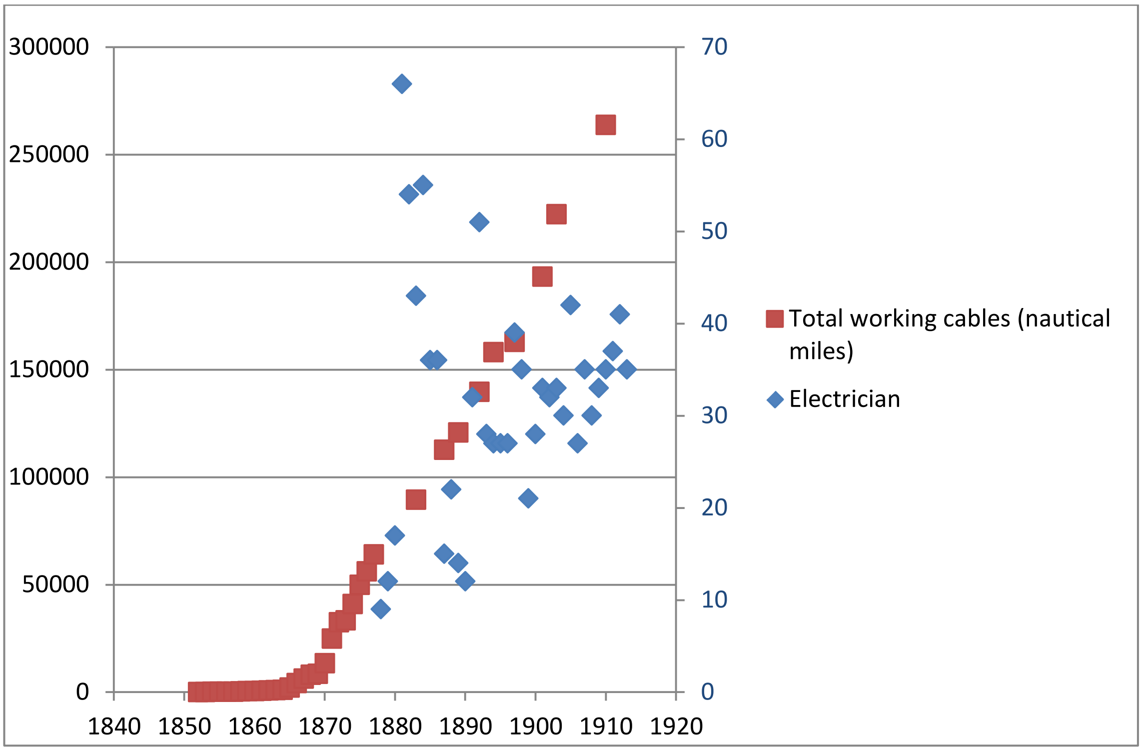


Figure 2.16 Plot of reports of cable repairs due to interruption (blue diamonds) in *The Electrician* compared with the total worldwide working cable (red squares, nautical miles).

The randomness of the plot of reported interruptions and repairs in *The Electrician* was due to a number of issues. The reports in *The Electrician* exclude (1) faults as opposed to interruptions, (2) details of interruptions in ETC cables, (3) reports of interruptions where communication was still possible by a duplicate cable. Thus it is not possible to extrapolate accurately the reliability of cables after 1910. The routine of listing interruptions and repairs in *The Electrician* ceased abruptly with the onset of The Great War.

A final deduction from the Timeline is the time each repair took (Figure 2.17).

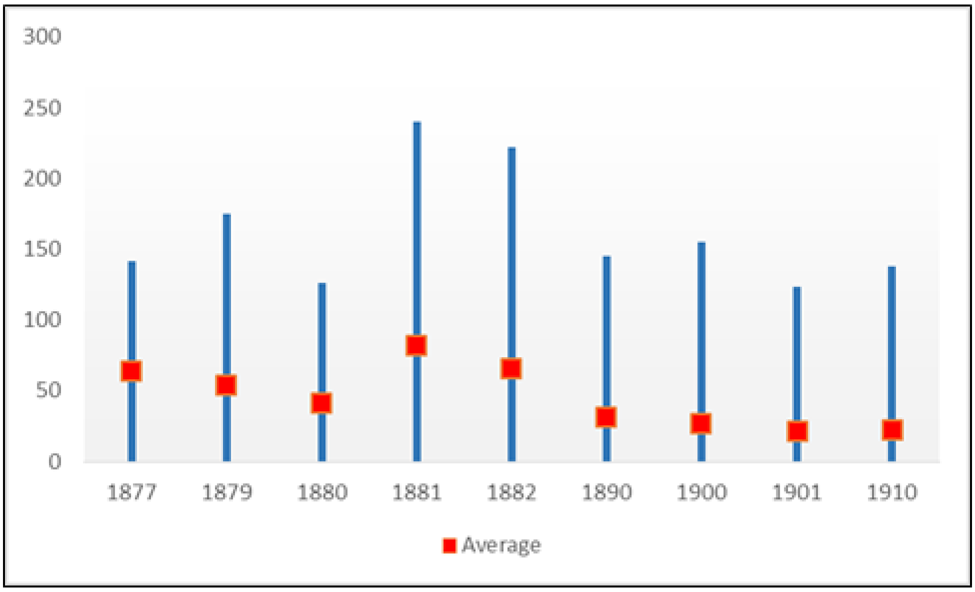


Figure 2.17 Maximum, minimum and average repair times (in days) per year, taken from the date of reported cable malfunction to its reported repair. (The shortest repair time was 1 day) NB The X-axis is non-linear

This shows that there is a decrease in the time taken to repair over the period covered in this thesis. However the data to construct this graph is not of good quality as, although the dates of repair of individual malfunctioning cables are accurate, about half of the recorded incidents lack a date when the malfunction occurred. This was understandable as in most cases of ETC cable repairs, only good news was recorded in the minutes of the monthly board meetings if at all possible. However, over the period of the thesis there is an apparent reduction in repair time. Although there are many factors which would have had an effect on repair times such as the availability and position of repair ships, there being suitable cable on these ships to effect a repair and the weather, a most important variable was the accuracy of measurements and calculations of the location of the malfunction. This important issue is dealt with in Chapter 7.

2.5 Conclusions

I have unearthed information about the individual malfunctions of submarine cables mainly from company archives which have not been previously exploited in this way. Overall consideration of the timeline has shown that the submarine cable telegraph was much more unreliable technically than is suggested by cable historians. Most cables became a patchwork of repairs within a few years of being laid and there was little improvement in reliability over the first half century of submarine cable telegraphy.

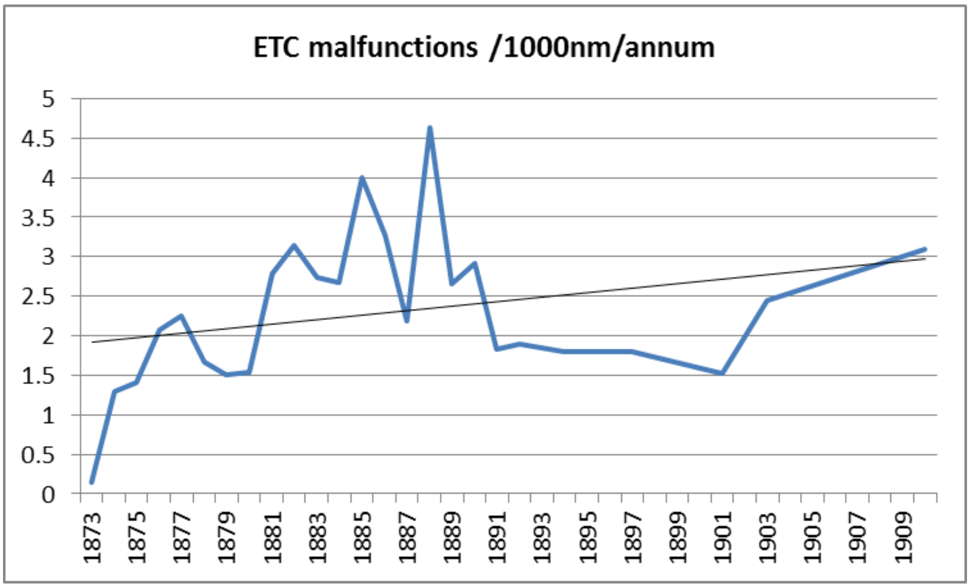


Figure 2.18 ETC malfunctions requiring repair voyages per 1000 nautical miles per annum with a linear trend line (black) showing an average of approximately one repair for every 500 nautical miles per year

However, the operating companies provided a reliable service by using alternative cable routes and by making rapid repairs via their global networks of cable ships. During the period 1873 to 1914, the Eastern Telegraph Company and Telegraph Construction and Maintenance Company had an increasing number of cable repair ships at sea. The number of repair ships at sea roughly paralleled the increase in cables in use, demonstrating that there was little improvement in cable reliability *per se* with an average of between two and three repairs per 1000 nautical miles per annum (Figure 2.18).

I have characterized how things changed over the period 1850-1914. In the succeeding chapters I will explain how and why. There was an improvement in the overall *service* reliability due to cable duplication with redundancy as judged from the decreasing number of malfunctions coming to public attention after the *Inquiry* (1860). The period 1850-1860 before the *Inquiry*, which I term the "Experimental Period" will be the subject of the next chapter.

Appendices

Appendix A – Timeline of cables laid prior to the Committee of inquiry

	Shallow Water Cables					
Year	**Cable**	**Owner**	**Manufacturer**	**Length (nm)**	**Condition immediately after being laid**	**Condition (1859)**
1851	Dover - Calais (Grisnez)	Submarine Company	RS Newall & Co	24	Good	Good
1852	Holyhead - Howth	RS Newall & Co	RS Newall & Co	65	Perfect	Abandoned after 3 days
1852	Portpatrick - Donaghadee		RS Newall & Co	15	Only 15nm laid before abandoned	
1853	Denmark (across the Belt)	Danish Govt	RS Newall & Co	18	Good	In full operation
1853	Dover - Ostend	Submarine Company	RS Newall & Co	80	Good	Good
1853-1855	Orfordness - Schevening Nos 1-4	Electric and International Telegraph Co	RS Newall & Co	119, 118, 123, 119,	Perfect	Nos 1, 2, 4, repeatedly broken by anchors and abandoned. No 3 in good working order
1853	Firth of Forth	Electric and International Telegraph Co	RS Newall & Co	5	Perfect	Perfect
1854	Corsien - Sardinia	French Govt	Glass, Elliot & Co	11	Perfect	In good working order
1854	Holyhead - Howth	Electric and International Telegraph Co	Fenton, Hyde & Co	65	Not perfect	Never in good working order
1854	Holyhead - Howth	Electric and International Telegraph Co	RS Newall & Co	65	Perfect	Failed in 1859 due to rusting iron wires
1854	Hurst Castle - Isle of Wight	Electric and International Telegraph Co	RS Newall & Co	1	Good	Perfect (2 cables were laid; the first was interrupted so many times by anchors that it was abandoned.
1854	Portpatrick - Whitehead	British & Irish Magnetic	RS Newall & Co	26	Perfect	Perfect
1854	Sweden - Denmark	Swedish Govt	Glass, Elliot & Co	13	Perfect	In good working order
1855	Black Sea: Varna - Balaclava	British Govt	RS Newall & Co	310	Good	Broken. This was a temporary cable with only gutta percha covering for use by GB Govt during Crimean War
1855	Black Sea: Varna - Constantinople	Ottoman Govt	RS Newall & Co	150	Good	Broken and repaired
1856	Prince Edward Island - New Brunswick		Glass, Elliot & Co	12	Perfect	In good working order
1858	England - Hanover	Submarine Company	Glass, Elliot & Co	280	Perfect	In good working order

1858	Orfordness - Haarlem	Electric and International Telegraph Co	Glass, Elliot & Co	136	Perfect except some sabotage during laying	In good working order
1858	Liverpool - Holyhead	Liverpool Dock Committee	Glass, Elliot & Co	25	Perfect	In good working order
1858	Weymouth - Alderney, Guernsey & Jersey	Channel Island Telegraph Company	RS Newall & Co	93	Perfect	Perfect but some problems with chafing on rocks
1858	Whitehaven - Isle of Man	Isle of Man Electric Teleg Co	Glass, Elliot & Co	36	Perfect	In good working order
1859	England - Denmark	Submarine Company	Glass, Elliot & Co	350	Perfect	In good working order
1859	Folkstone - Boulogne	Submarine Company	Glass, Elliot & Co	24	Perfect	In good working order
1859	Singapore - Batavia	Dutch Govt	RS Newall & Co	550	Good	Broken & repaired
1859	Sweden - Gotland	Swedish Govt	Glass, Elliot & Co	64	Perfect	In good working order
1859	Tasmania - Bass Strait	Australian Govt	WJ Henley	240	Perfect	Very good with the exception of a small section over a very rocky bottom
1860	Denmark (across the Belt)	Danish Govt	WJ Henley	28	Perfect	Perfect
	Deep Sea Cables					
1854	Spezia - Corsica	French Govt	Glass, Elliot & Co	110	Perfect	In good working order
1856	Newfoundland - Cape Breton	French Govt	Glass, Elliot & Co	85	In good working order	Perfect
1857	Atlantic	The Atlantic Telegraph Company	Glass, Elliot & Co and RS Newall & Co		Failure	
1858	Atlantic	The Atlantic Telegraph Company	Gutta Percha Co	2200	Poor	Failed after a few weeks
1857	Cagliari - Bona	French Govt	RS Newall & Co	125	???	???
1857	Cagliari - Malta and Malta to Corfu	Mediterranean Extension Company	RS Newall & Co	700	Excellent	Not working
1858	Dardanelles - Scio and Scio - Candia	Levant TelegCo	RS Newall & Co	450	Perfect working order	Same as when laid
1859	Athens - Syra and Scia	Greek Govt	RS Newall & Co	150	Perfect working order	Same as when laid
1859	Suez - Kossier	Red Sea & India TelegCo	RS Newall & Co	255	Good	Not working
1859	Kossier - Suakin	Red Sea & India TelegCo	RS Newall & Co	474	Good	Working well
1859	Suakin - Aden	Red Sea & India TelegCo	RS Newall & Co	629	Good	Not working
1859	Sicily - Malta	Mediterranean Extension Co	Glass, Elliot & Co	70	Excellent	Very good
1860	Aden - Hallani	Red Sea &	RS Newall & Co	718	Good	Not working

		India TelegCo				
1860	Hallani - Muscat	Red Sea & India TelegCo	RS Newall & Co	486	Good	Working well
1860	Muscat - Kurrachi	Red Sea & India TelegCo	RS Newall & Co	481	Good	Not working
1860	Barcelona - Mahon	Spanish Govt	WJ Henley	180	Very good	Very good
1860	Iviza - Majorca	Spanish Govt	WJ Henley	74	Very good	Very good
1860	St Antonio - Iviza	Spanish Govt	WJ Henley	76	Very good	Very good
1860	Toulon - Algiers	French Govt	Glass, Elliot & Co	480	Perfect	Perfect

Appendix B – Timeline of Faults, Breaks, Interruptions & Repairs (this appendix is on the attached CDROM)

3. Cable Manufacturing, Laying and Operation prior to the Committee of Inquiry.

3.1 Introduction

This chapter describes the decade 1850-1860: the period from the first submarine telegraphic connections between two countries, England and France, to the tentative link between the Old World and the New and the Red Sea cable to India. It was apparent that "instantaneous" intercontinental communication *was* feasible but more development of the technology was needed.[60] This decade began with the first cables from England to France and ended with technical and financial debacles, almost consigning this new technology to oblivion. As the government of the day was losing vast sums of money especially over the desperately required telegraph cables to India, the Upper Chamber of Parliament set up the *Joint Committee Appointed by the Lords of the Committee of the Privy Council for Trade and the Atlantic Telegraph Company to Inquire into the Construction of Submarine Telegraph Cables* which began its investigations in 1860.

Hugill has catagorized five distinct "technical periods" of submarine cable technology as mentioned in Chapter 1.[61]

- Experimental 1857-1858;
- Successful but short-lived 1865-1869;
- Low speed lines 1873-1882;
- High speed lines 1894-1940;
- Very high speed lines 1923-1928.

I revise the definition of Hugill's "Experimental Era" in submarine telegraphy to include the decade up to the appointment of the committee of inquiry.

To understand the somewhat chaotic situation that lead to the *Inquiry* being set-up, I begin with a brief description of the laying of the first submarine telegraph cables. I then relate a short history of the companies involved with cable manufacture and laying. Thereafter, I describe the principal steps in the manufacture and laying of the cables. This is followed by a description of the terminal technology and operation. Finally

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[60] Electrical communication was and often still is referred to as being "instantaneous" but is of course at speeds somewhat below the speed of light. "Instantaneous" was being used as a comparative term especially in share prospectuses. It was considered instantaneous compared with the weeks mail took to transit the Atlantic and the months to and from the Indian sub-continent.

[61] P. J Hugill. *Global Communications since 1844: Geopolitics and Technology*. Maryland, USA: Johns Hopkins University Press, 1999, p. 29.

3.2 The first submarine telegraph cables.

On the 10th May 1849, Mr. C. V. Walker FRS, telegraphic superintendent and electrician to the South-Eastern Railway Company, laid a gutta percha-covered wire, two miles long, in the English Channel. Starting from the beach at Folkestone, the cable was joined to an aerial line 83 miles in length, along the South East Railway to London. Mr. Walker, on board the *Princess Clementine*, at anchor, succeeded in exchanging telegrams with London.[62]

Jacob Brett, an entrepreneur, induced his brother, John Watkins Brett, a businessman to join him in laying the first cable between the UK and the Continent from Dover to Calais. Jacob Brett had an obsession with using a modified House Printing Telegraph (see Figure 3.1) which proved entirely unsuccessful.

Figure 3.1 House Printing Telegraph Machine. Photo by the author at the Telegraph Museum, Porthcurno

Mr. Royal E. House (1814-1895) had patented his printing telegraph in 1846 for use on the inland wire system developed by Morse as a means of replacing the skills of the telegrapher.[63] He used a piano style keyboard for input and what eventually became known as "ticker tape" for its output.[64] Text could be transmitted at up to forty words per minute over aerial land-

[62] C. Bright, *Submarine Telegraphs – their History, Construction and Working*, Crosby Lockwood and Son, London, 1898 p. 5.
[63] Royal Earl House Letter printing telegraph. US Patent 4464 1846.
[64]The House telegraph machine and that of David Hughes were both used keyboards resembling those of the piano, harpsichord and organ as these were the only keyboard devices of the time.

lines. The table in Appendix A compares the speed of land-line telegraphy and early submarine cable telegraphy. The table also mentions a special form of Morse code called *cable code*; this is described in detail later in this chapter. The number of conductors or wires excludes the “earth return” which uses the low electrical resistance earth and in the case of submarine telegraphy, the salt water of the sea, to complete the electrical pathway. The standard for measuring the speed at which Morse code is transmitted and received is based upon the 5-letter word PARIS, chosen as the standard test word as it contained the average number of dots, dashes and spaces of all commonly telegraphed 5-letter words. The speeds in words per minute (wpm) of the electrical telegraph systems are shown in Appendix A.

Land-lines had very different physical properties compared with submarine telegraph cables. As the wire conductor in a land-line was supported above ground with air acting as insulator, it had very little electrical “capacitance”.[65] However, submarine “cable” consisted of a copper conductor coated with gutta percha, the best known semi-flexible insulator, to separate it from sea water which is a very good electrical conductor; submarine cable could be likened to a (very) elongated Leyden jar or condenser (capacitor). Electrical signals therefore became much distorted, the more so the greater the length of the cable. Devices used for land-line telegraphy, including the House printing telegraph, required sharply defined input signals and it was very soon apparent that they were all entirely unsuitable for submarine cable telegraphy. Because of this distortion or “slurring”, Morse code sent by submarine cable was always very much slower than that sent by land-line. Walker had not yet noticed this effect as his submarine cable was only two miles in length and therefore of comparatively low electrical capacitance.

The House printing telegraph completely failed as it required sharp signals rather than those blurred by the capacitive effect; Walker had no understanding of this effect. Others involved in the enterprise were (later Sir) Charles Fox, Francis Edwards and Charlton J. Woolaston, who each subscribed £500 towards the project. The Hancock brothers, in conjunction with the Gutta Percha Company, coated the copper wire seamlessly using a technique developed by Messrs. Siemens in Germany. As the cable had no heavy armouring, the Bretts had to attach a lead weight every 100 yards to prevent it floating. A French peasant fisherman is alleged to have hauled a piece up, cut it and taken it to a local bar where he claimed it was a new species of sea snake with a golden spine.[66] See chapter 5 paragraph 8 for other causes of cable failure.

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[65] “Capacitance” describes the ability of a condenser or capacitor to store an electrical charge.

[66] W. H. Russell WH, *The Atlantic Telegraph,* reprinted 1972, David & Charles, Newton Abbott, 1865, p. 4.

The following year the Brett brothers made a second, successful, attempt. Finance was difficult to find because of previous failure but the project was saved by T. R. Crampton (1816-1888), a well-known civil and railway engineer and inventor "whose name should never be omitted from the early history of submarine telegraphy".[67] Firstly, he put up half the capital required i.e. £15,000; secondly he designed the cable to be laid, the essential features of which changed little for the next 50 years. The cable core consisted of four copper conductors, each surrounded by gutta percha, and was made by the Gutta Percha Company under the supervision of Samuel Statham. The four gutta percha-covered conductors were laid alongside each other with spaces between them filled with strands of tarred hemp. This combination was surrounded by a serving of spun yarn. This core was then armoured by Messrs R. S. Newall & Co with galvanized iron wires – a specialty of Newall & Co as they were rope manufacturers. It was laid by Newall's on the 25th September 1851 between Dover and Calais under the supervision of Crampton.[68] As was to become common practice, this cable was laid by a ship owned by the cable manufacturer.[69]

Laying lengths of cable or wire rope, other than for the purpose of tethering a vessel by anchor or to bollards, was a new experience. When cables was laid at depths even as shallow as 30 fathoms, the weight of the cable was too great for its paying-out to be totally under control and so cable ran out before reaching the French coast.[70] Although the connection was made temporarily, the cable was not put to commercial use for a few months whilst more cable was manufactured. On 13th November 1851 the use of the cable was opened to the public who could send telegrams to the Dover station via the inland telegraph system.[71] With short submarine cables of less than 25 miles it was just possible to communicate using a simple circuit using a standard Morse key to transmit and a basic galvanometer to receive but the signals were weak and a maximum of only five words per minute was possible. There were perceived to be three ways of improving the received signals: by increasing the sensitivity of the galvanometer; increasing the voltage of the driving battery; or enlarging the cable (by means of thicker copper wire and thicker insulation).

Problems with submarine cable telegraphy only really became apparent when *long* and *deep* connections were envisaged. When the fledgling submarine cable industry needed to extend

[67] Bright, *op cit,* p. 10.
[68] Crampton's work gave impetus to submarine cable telegraphy.
[69] K. R. Haigh, *Cableships and Submarine cables,* Standard Telephones and Cables Ltd., Greenwhich, 1978, p. 11.
[70] Bright, *op cit,* p. 12.
[71] Bright, *op cit*, p. 13.

cables for much greater distances it sought the advice of William Thomson who in 1844 had become Professor of Natural Philosophy at the University of Glasgow. His main contributions to submarine cable telegraphy were an understanding of the theory of signal transmission, a super-sensitive mirror galvanometer (patented 1858) and his siphon recorder of 1867.[72] Thomson's first contribution was to make a theoretical investigation of the behaviour of submerged insulated cables. He produced his "inverse square law" (which stated that the speed of the signal through a given cable was inversely proportional to the square of its length) and his "arrival curves" (see below). A Mr. Wildman Whitehouse MRCS jumped to the conclusion that Thomson's calculations meant that very long telegraph cables were practically and commercially a non-starter. (Edward Orange) Wildman Whitehouse, born in 1816, was a surgeon by profession, qualifying MRCS in 1840.[73] He had a reasonably successful practice in Brighton but in the early 1850s he became interested in electrical telegraphy. He became an amateur electrician but disdained theoretical niceties of the specialty. At the British Association for the Advancement of Science (BAAS) meeting in 1855 he challenged Thomson's theory of signal retardation and his law of inverse squares. Over the next few months there was a heated exchange of letters in the *Athenaeum* "which settled little but showed Whitehouse to have facile pen and little concern with theoretical niceties".[74] Whitehouse was appointed electrician for the 1857 and 1858 transatlantic cables. When the signals of the 1858 cable weakened, he tried increasing the electrical power from around 60 volts up to 2000 volts which probably destroyed the insulation. He somewhat ignominiously disappeared from the history of electrical engineering after he was made a scapegoat for the failure of the 1858 Atlantic cable.[75]

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[72] C. Smith, 'Thomson, William, Baron Kelvin (1824–1907)', *Oxford Dictionary of National Biography*, Oxford University Press, 2004; online edn, Jan 2011 [http://0-www.oxforddnb.com.wam.leeds.ac.uk/view/article/36507, accessed 22 Jan 2015]

[73] MRCS: Member of the Royal College of Surgeons

[74] B. J. Hunt, 'Whitehouse, (Edward Orange) Wildman (1816–1890)', *Oxford Dictionary of National Biography*, Oxford University Press, 2004; online edn, Jan 2011 [http://0-www.oxforddnb.com.wam.leeds.ac.uk/view/article/47160, accessed 5 June 2015]

[75] B. J. Hunt, Scientists, Engineers and Wildman Whitehouse: measurement and credibility in early cable telegraphy, *British Journal for the History of Science,* vol 29, 1996, pp.155-169.

A plethora of books have been published about the history of the first transatlantic cables. The most important and academic of them are listed in Table 3.1 below and the complete list is in Appendix B of this chapter.

Anonymous	1857	*The Atlantic telegraph: A history of preliminary experimental proceedings and a descriptive account of the present state & prospects of the undertaking.*	The Atlantic Telegraph Company Ltd, London
F. Briggs	1858	*The Story of the Telegraph and a History of the Great Atlantic Cable*	Rudd & Carleton, New York.
W. H. Russell[76]	1865	*The Atlantic Telegraph*	London: Day & Son
G. Saward	1878	*The Trans-Atlantic Submarine Telegraph: A Brief Narrative of the Principal Incidents in the History of the Atlantic Telegraph Company. Compiled from Authentic and Official Documents by the Late George Saward Secretary to the Company*	London: Printed for private circulation
C. Field	1892	*The Story of the Atlantic Telegraph*	London: Scribners
B. Dibner	1959	*The Atlantic Cable*	Norwalk: Burndy Library.
H. Clayton	1968	*The Atlantic Bridgehead – the story of transatlantic communications*	Garnstone Press, London
V. T. Coates & B. V. Finn	1979	*A Retrospective Technology Assessment: Submarine Telegraphy – The Transatlantic Cable of 1866*	San Francisco: San Francisco Press, Inc.
C. G. Hearn	2004	*Circuits in the Sea: The Men, the Ships, and the Atlantic Cable*	Westport, Praeger Publishers,

Table 3.1 The most important and academic books about the laying of transatlantic telegraph cables

Chester Hearn's *Circuits in the Sea* is an academic review of the 1857 to 1866 expeditions but is not as technical as Coates and Finn's *A Retrospective Technology Assessment: Submarine Telegraphy – The Transatlantic Cable of 1866* which is a historical case study of the technical aspects and the social effects of the successful cables of the time. *The Atlantic Cable* by Bern

[76] William Howard Russell was born in 1820 he was one of the first "war correspondents" although he disliked the term. He reported for *The Times* on the Crimean war. After a long and distinguished career he was knighted in 1895. He died in 1905. Roger T. Stearn, 'Russell, Sir William Howard (1820–1907)', *Oxford Dictionary of National Biography*, Oxford University Press, 2004; online edn, Oct 2006 http://0-www.oxforddnb.com.wam.leeds.ac.uk/view/article/35889, accessed 5 June 2015

Dibner is often cited as being an excellent academic overview and indeed the table "Summary of five expeditions" (see Figure 3.1) is excellent. It has been suggested that Henry Fields's *Story of the Atlantic Telegraph* was the main source of data for Dibner's book.[77] None of these texts have any detail about cable reliability and repair other than mentioning in passing how little preparation there was until the 1866 expedition for the eventuality of having to retrieve the cable from the depths.

[77] W. Burns Cable Bibliography. www-cable.com/bibliography.htm#cables. Last accessed 5.06.2015

SUMMARY OF THE FIVE EXPEDITIONS ATTEMPTING TO SPAN THE ATLANTIC WITH A TELEGRAPH CABLE.

Attempt	Sponsor	Expeditions	Staff on Board (C. W. Field accompanied every expedition): Engineers	Staff on Board: Electricians	Ships and Commanders: U.S.	Ships and Commanders: British	The Cable: Weight	The Cable: Tensile Strength
1857	New York, Newfoundland, and London Telegraph Company Atlantic Telegraph Company	*Lengths are nautical miles of cable laid.* At Valentia Aug. 5 Niagara 5 mi. Aug. 6 Niagara 335 mi. Aug. 8	Bright Canning Clifford Everett Woodhouse	De Sauty Morse Thomson	Niagara Capt. Wm. L. Hudson Susquehanna Capt. Sands	Agamemnon Capt. Noddall Leopard Cyclops Capt. Jas. Dayman	2,000 lbs. per mile	6,500 lbs.
1858 I	Atlantic Telegraph Company	Plymouth June 10 To mid-Atlantic June 26 6 mi. Niagara June 27 80 mi. Agamemnon June 29 255 mi.	Bright Canning Clifford Everett Woodhouse	De Sauty Laws Thomson	Niagara Capt. Hudson	Agamemnon Capt. Geo. W. Preedy Gorgon Capt. Dayman Valorous Capt. W. C. Aldham	2,000 lbs. per mile	6,500 lbs.
1858 II	Atlantic Telegraph Company	Cork July 17 To mid-Atlantic Trinity Bay, Newfoundland Aug. 5 Niagara 1010 mi. July 29 Agamemnon 1020 mi. Valentia Aug. 5	Bright Canning Clifford Everett Woodhouse	De Sauty Laws Thomson	Niagara Capt. Hudson	Agamemnon Capt. Preedy Capt. Moriarty Gorgon Capt. Dayman Valorous Porcupine Comm. H. C. Otter	2,000 lbs. per mile	6,500 lbs.
1865	Telegraph Construction and Maintenance Company	Sheerness July 15 To Valentia Valentia July 23 Great Eastern break Aug. 2 481 mi. 651 mi. 84 mi. total, 1216 mi.	Canning Clifford Temple	De Sauty W. Smith Thomson Varley		Great Eastern Capt. Jas. Anderson Capt. Moriarty Sphinx Capt. V. Hamilton Terrible Capt. Napier	3,575 lbs. per mile	15,500 lbs.
1866	Anglo-American Telegraph Company	Sheerness June 30 To Valentia Valentia Fri., July 13 Great Eastern 1852 mi. Heart's Content (Trinity Bay) July 27 Great Eastern 680 mi. Sept. 7 began, Aug. 12 lifted, Sept. 1	Canning Clifford Temple	Laws W. Smith Thomson		Great Eastern Capt. Anderson Capt. Moriarty Albany Medway Terrible Capt. Commerill	3,175 lbs. per mile Shore-end 40,000 lbs. per mile	16,500 lbs.

Figure 3.2 Summary of five transatlantic cable-laying expeditions from Dibner, *The Atlantic Cable,* (facing p. 86.)

The failure of the first two attempts at laying a transatlantic cable has been documented *ad nauseam*. The latest academic publication by Marsden and Smith, perpetuates errors which may now be corrected by the, as yet unpublished, research of Allan Green.[78] The first necessity in laying a new cable was to arrange for a survey of the proposed route. Marsden and Smith perpetuate the myth of a gently undulating 'Telegraphic Plateau' between Valentia and Newfoundland in contrast to the much greater depths further south, that proponents such as Lt. M. F. Maury of the United States Navy spoke of. Depth sounding in the 19th century was by lead weight on the end of a marked line. The time taken to sound one spot on the ocean bed was dependent upon the depth and might be more than an hour. Therefore in the wider parts of the ocean away from land there were considerable distances between sounding sites. Allan Green has produced evidence that dispels the myth of the "Telegraphic Plateau" in the North Atlantic.[79]

Working with Global Marine plc, Allan Green assembled a bathymetric chart following the route of the first transatlantic cables. The chart (Figure 3.3) shows that of depths in Maury's survey of the 1860s with that of bathymetric surveys carried out by Global Marine in 2005. The chart is initially difficult to interpret as there is so much detail. However the RED line is the 21st century plot which shows some interesting features. Firstly, the very steep transition where the Irish shelf ends. Secondly, the area around 350 nm from the Irish coast which is the zone where it was believed the major fault occurred in the 1858 cable. Also, in the centre there is a very pronounced mid-Atlantic Ridge which the two previous surveys of the 1850s had failed to detect. It can be seen from modern bathymetry that the route between Valentia and Newfoundland was anything but a 'plateau' and one could imagine that there would have been some serious doubts about the viability of a transatlantic cable in 1857 had they been aware of the Ridge. The Ridge itself runs for a great distance (North/ South) in the Atlantic extending from the Arctic as we can see on the map above. Research continues on this topic particularly to look at just how much more *was* known (or not known) about the Atlantic sea bed and the mid-Atlantic Ridge by the time of the 1865/6 successful attempts.[80] Not only has the Telegraph Plateau been shown to be a myth but the ignominious breakage of the 1857 cable "after only 300 miles" was also falsely attributed by Smith and Marsden to "an accident with the paying out machinery".[81]

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[78] B. Marsden, C. Smith. *Engineering Empires: A Cultural History of Technology in Nineteenth Century Britain*. Basingstoke: Palgrave Macmillan, 2005, p. 206.
[79] A colleague at the Porthcurno Telegraph Museum, Cornwall,
[80] Allan Green - personal communication.
[81] Marsden, Smith, *op cit*, p. 208.

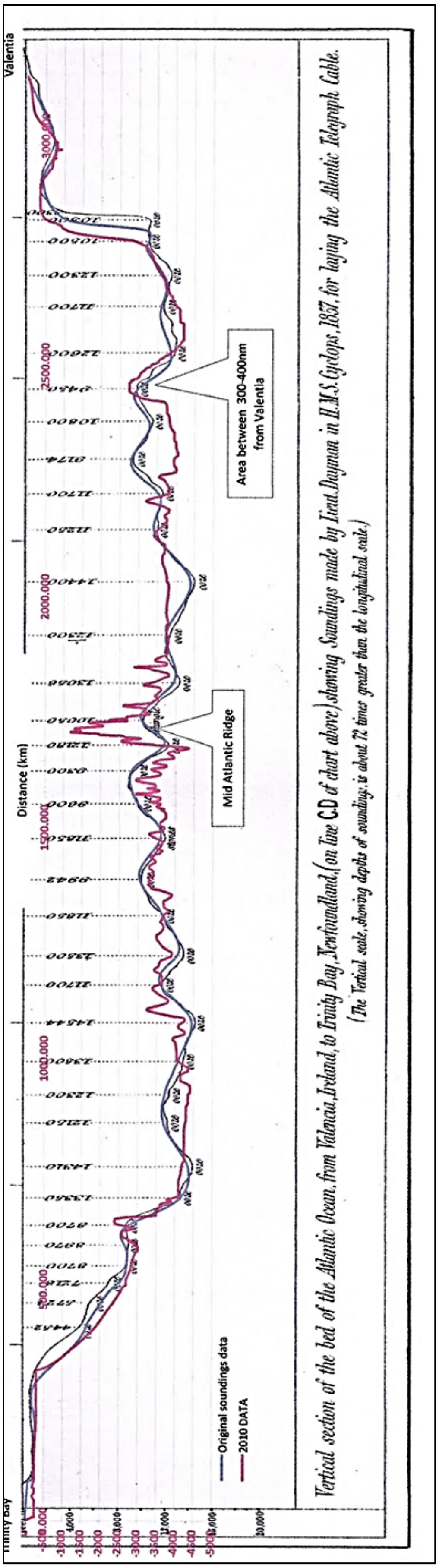


Figure 3.3 Comparison of Maury's bathymetric chart with that using 21st century depth sounding techniques. Source: Allan Green, personal communication

3.3 The Cable Manufacturing Companies (1850-1860)

Cable manufacturing consisted of a number of distinct stages: drawing the copper wire, applying the primary insulation (gutta percha); together these formed the “core”. Finally the protective armouring was applied. These stages were initially carried out by separate commercial organizations. After the first decade (1850-1860) a number of the organizations combined, so that copper wire conductors and iron or steel wires for armouring were the only independently supplied components in the industry.

Dr. William Montgomery, a surgeon with the East India Company, is always credited with the introduction of gutta percha to the UK in 1843.[82] He was a colonial surgeon in Malaya but had a lot of time on his hands to fulfil his passion for botany. He noted that the indigenous population used a number of items moulded from a black resin from the *Isonandra gutta* tree. He sent samples back to the Royal Society of Arts (RSA) in London and also presented specimens of objects made of the substance to the Royal Asiatic Society.[83] Robert Samuel Newall, who formed the **R S Newall & Co.,** claimed in a paper in 1882 that a John Colville sent specimens of gutta percha to him from Sumatra in 1848.[84] The RSA were the first to recognise the importance of the new material and sent samples to, amongst others, Michael Faraday. Marsden and Smith claim that the samples presented to the Royal Asiatic Society were those that directly led to the discovery of the insulating properties of gutta percha but this contradicts the most accurate primary source, Eugene Obach’s *Cantor Lectures on Gutta Percha* published in 1897.[85] Obach clearly stated that the samples from the Royal Asiatic Society were analysed for their chemical properties but only the sample from the RSA was investigated for its electrical properties, by Michael Faraday who immediately recognised gutta percha as an excellent electrical insulator.[86] Gutta percha was not only a good insulator but had some other very useful properties for electrical science: it was mouldable when heated but firm with some elasticity when cold. Another very useful property which only became

[82] B. J. Hunt. “Insulation for an Empire: Gutta-Percha and the Development of Electrical Measurement in Victorian Britain.” In *Semaphores to Short Waves*, edited by Frank A. J. L. James,. Royal Society of Arts, London: 1998. pp. 85–104.
[83] E. F. A. Obach. *Cantor Lectures on Gutta Percha.* London: Society for the Encouragement of Arts, Manufactures & Commerce, 1898, p. 5.
[84] R. S. Newall, *Facts and observations relating to the invention of the submarine cable between Dover and Calais in 1851*, Pamphlet published by E. & F. N. Spon, London 1882.
[85] Marsden, Smith, *op cit*, p. 201. Obach, *op cit,* p. 5.
[86] M. Faraday, On the use of gutta percha in electrical insulation. *Philosophical Magazine*. vol 32, 1848, pp. 165-167.

apparent later was that its electric insulating properties improved further when it was submitted to the extreme pressures encountered in the deep sea.[87]

As mentioned above Robert Newall formed **R. S. Newall & Company**, a wire rope manufacturer based in Gateshead. One of their specialties was a wire rope with a soft conventional rope core for added flexibility: an idea that Newall had patented in 1840. Thus, with the failure of the unprotected 1850 Dover-France cable, they were in an ideal position to replace the hempen core of their wire rope with a core of gutta percha coated copper wire, henceforward always referred to as “the core”. Initially the Brett brothers went to a Southern firm called Wilkins & Weatherly to manufacture the 1851 cable but Newall’s contested the infringement of their patent and took over the contract. Newall’s sub-contracted some of the work to Küpers, a German firm in England which held a similar patent.[88] In 1842, Johann Baptiste Wilhelm Heimann and Johann Georg Wilhelm Küper had formed a partnership called **W Küper & Co.** to manufacture wire rope located on the Grand Surrey Canal at Camberwell. Küper & Co was one of the leading wire rope manufacturers for coal mining.[89] After the patent skirmish with Newall’s, the latter subcontracted a considerable amount of work to Küper’s. W Küper & Co were eventually absorbed in to Messrs Glass, Elliot and Company.[90]

R. S. Newall & Co. prospered from the success of the 1851 Dover-France cable and became the main manufacturer of submarine telegraph cables until the Red Sea Cable debacle of 1859. This particular cable was laid from Suez to Karachi but never worked in its entirety for two main reasons. Firstly, the route was not properly surveyed and turned out to have many undersea mountains and secondly, although Newall’s had a contract for the correct length of cable, even allowing for some slack, a clause in the contract allowed them to keep any excess cable left over. So, quite naturally, it was laid as “tightly” as possible, strung out from peak to peak. This put excessive strain on the cable which therefore broke on the sharp edges of the peaks; deep sea cable was only designed to cope with the strain due to its own weight during laying (and raising for repair). So called “shore ends” were very much stronger to cope not only with movement due to currents and tides but also to withstand friction from fishing gear and *small* anchors; large anchors and powerful ships often caused even shore ends to break. Shore ends were normally laid for the first 20–30nm nearest to the shore.

[87] Reported by Sir William Siemens in 1863 and Robert Sabine in 1867. See C. Bright, *Submarine Telegraphs – Their history, construction and working.* Crosby, Lockwood & Son, London, 1898, p. 271.
[88] R. S. Newall, *Facts and Obsevations Relating to the Invention of Submarine Cable,* E. & F. N. Spon, London, 1882, p. 3.
[89] C. Bright, *op cit*, p. 27.
[90] *Ibid,* p. 156.

Shortly after the 1851 cable had been laid, Küper & Co was bought out by Richard Glass who, together with George Elliot, registered a new company called using Küper's old premises at Morden Wharf. However to expand their cable manufacturing plans, they moved to the adjacent Enderby Wharf, Greenwich, sharing the site with another cable manufacturer, **W. T. Henley**. In 1830 William Thomas Henley (1814-1882) moved to London to work as a dock labourer but he taught himself instrument making. He was fortunate to have the custom of Charles Wheatstone. His business prospered and he moved from a small workshop in Whitechapel to larger premises in Clerkenwell and thence to Enderby's Wharf in Greenwich Marshes. He shared the old rope manufacturing works with Glass, Elliot & Co. and increased his scope to the manufacture of cable with them. There were other cable manufacturers, the second largest of which was **Siemens & Halske** who bought the goodwill and order book of R. S. Newall & Co. After some disagreement Halske went back to Germany and **W. Siemens & Co.** continued to prosper in the cable manufacturing and laying industry. Stephen Winkworth Silver set up **S.W. Silver & Co.** in the 18th century as clothiers and outfitters to the colonial service and the military. Charles Mackintosh who used gutta percha to manufacture waterproof clothing formed a partnership with Silver, expanding into the manufacture of submarine cables, moving from Greenwich to Woolwich Reach on the Thames in 1860. This factory prospered to such an extent that the area became known as Silvertown.

Samples of gutta percha were also passed to a Charles Mackintosh who was a manufacturer of waterproof clothing. Mackintosh's partner, Thomas Hancock, gave samples to his brother, Charles Hancock, who was trying to develop a replacement for cork as a reusable stopper for bottles. Gutta percha was ideal and Charles partnered Mr Henry Bewley, a manufacturer of soda water, to form the Gutta Percha Company in February 1845 to manufacture the stoppers and other articles from the material. Henry Bewley developed a machine for extruding gutta percha tubes and Hancock modified this machine to apply a seamless insulation to copper wire. A fierce quarrel between the two partners developed culminating in Hancock leaving the Gutta Percha Company and establishing the **West Ham Gutta Percha Company** in direct competition.[91] A price war ensued which bankrupted the West Ham Gutta Percha Co. which was re-absorbed into the Gutta Percha Company in 1850.[92]

[91] W. Glover. "British Submarine Cable Manufacturing Companies". Available online at: www.atlantic-cable.com/CableCos/BritishMfrs/. Accessed 27 June 2011.
[92] K. R. Haigh, *Cable Ships and Submarine Cables*, Standard Telephones and Cables, London, 1978, p. 26.

In 1857 **W.T. Henley Telegraph Works Co.** entered the cable making industry specializing in manufacturing shore-ends of cables. In order to be self-reliant, Henley, right from the start installed his own wire drawing department.[93] Further expansion in the telegraph industry meant another move in 1859 to Enderby Wharf, sharing large premises with Glass Elliot & Co. Within a few months disputes between the two competing companies led to Henleys' crossing the Thames to North Woolwich.

3.4 Cable manufacture

The above mentioned cable manufacturing companies all produced a similar product: a copper wire conductor insulated with either gutta perch or India rubber - a combination which was termed the *core;* this was protected mechanically by a combination of tarred hemp and an outer *armouring* of either iron or steel wires. Apart from a few attempts to replace the armouring wire with hemp rope, there was little change in the basic design until the 1930s when synthetic insulating materials became available.

3.4.1 Copper wire

Copper wire was manufactured be reducing the diameter of a billet of copper by drawing it through dies until the required dimension was obtained. The process is described in detail below. Prior to the need for electrically-conducting copper wire for submarine telegraphy, the main business of copper wire drawers was producing the raw material for decorative objects and copper nails.[94] Although copper wire was already known to be the best conductor of electricity, demand was small because land-line telegraphy had turned its back on copper in favour of iron wire. This was because the electrical properties of iron wire were sufficient for purpose and iron wire was cheaper and less open to theft. However, the wire manufacturers, 35 of them in Birmingham alone (see Appendix C), had little understanding of the new science of electricity and the need for purity, accuracy and constancy of the diameter of their product. This was one of the multiple aetiologies of the failure of long distance deep sea submarine cable telegraphy during the period 1850-1860.

The basic concept of wire drawing is very simple and has changed little over centuries.

A short billet of a large piece of the metal to be drawn was beaten down until it just protruded through the largest aperture of a draw plate (Figure 3.4). The draw plate consisted of a steel plate with a number of conically shaped holes of progressively smaller diameter (Figure 3.5).

[93] G. Sutton, Some Events in Cable History, *The Electrician*, vol 87, 1921, p. 607.
[94] B. C. Blake-Coleman, *Copper Wire and Electrical Conductors – The shaping of a technology,* Harwood Academic Publishers, Reading, UK, 1992, pp. 103-133.

The smallest hole had the diameter required for the final product. The process for making small gauge wires required that the wire was drawn through a succession of smaller draw plates. Hanks of copper wire were then passed to the core manufacturer for coating in insulating material.

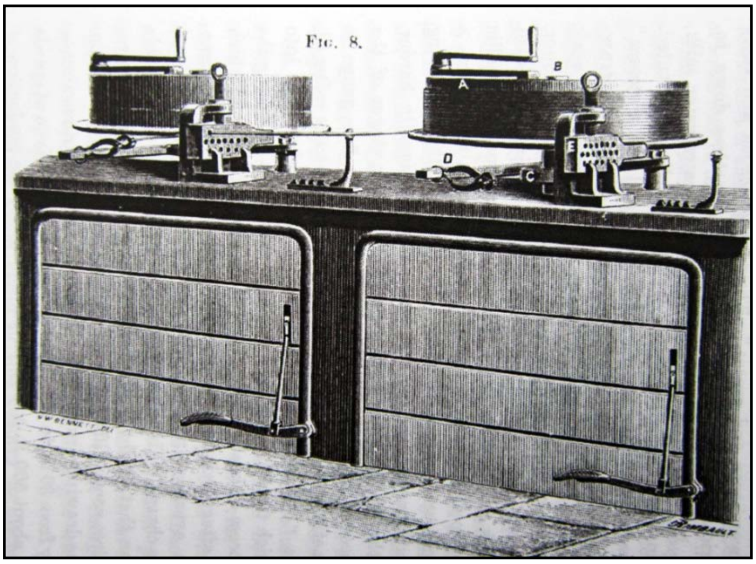


Figure 3.4 Wire drawing bench. The drawplates are marked “E”. From J. Bucknill-Smith. *A Treatise upon Wire: its Manufacture and Uses, Embracing Comprehensive Descriptions of the Constructions and Applications of Wire Ropes.* Offices of “Engineering”, London, 1891, p. 53.

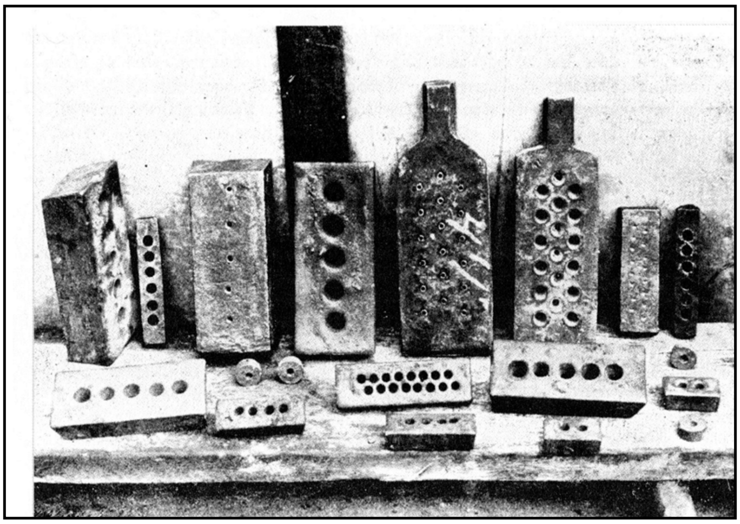


Figure 3.5 Steel and cast iron draw-plates, *circa* 1900. From B. C. Blake-Coleman, *Copperwire and electrical conductors*. Harwood Academic Publishers, Reading, UK. 1992, p82.

3.4.2 Core manufacture

Gutta percha was used as the insulator for almost all subterranean and submarine cables until the synthetic plastic material polyethylene was introduced in the 1930s. Occasionally, in the warm shallows of the tropics, India rubber had to be used for the shore-ends of cables because gutta percha became too soft and the copper wire migrated from the centre of the insulation.[95] The largest company purifying gutta percha for insulating purposes was the **Gutta Percha Company**. Unfortunately the gutta percha arrived in England in a very impure state.

> Being sold by weight, the noble but enterprising savage is prone to incorporate with it all sorts of impurities, such as bark, sand, clay and stones, or any other substance more plentiful and ready to hand than gutta percha itself – indeed even pieces of iron have been used as 'make-weights'. The raw gutta percha contained as much as 25% or even 30% of impurities. [96]

The first stage of purification was to wash the lumps of gutta percha in boiling water, a process during which many of the impurities sank to the bottom of the tank (Figure 3.6). Then the lumps were "wet masticated" initially into pieces about the size of a chipolata sausage.[97]

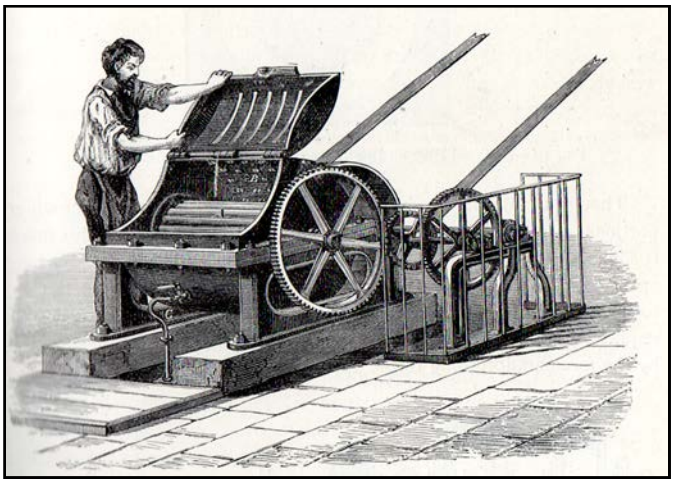


Figure 3.6 A gutta percha masticator from Bright, *Submarine Telegraphs*, p. 294

It was then "dry masticated", heat being provided by steam jets. From mastication it was then forced through a machine similar to a very large but fine meat mincer to remove the smallest solid impurities. By this stage it was pure enough to use as an insulating material. The gutta percha was then calendared into rolls of sheet gutta percha mainly for the purpose of drying, and these rolls were sent to the core manufacturer.

[95] C. Bright, Insulation Resistance, *Journal of the I.E.E.,* vol 18, 1889, p. 123.
[96] C. Bright, *Submarine Telegraphs,* Crosby, Lockwood & Sons, London, 1898, P. 285
[97] *Ibid,* p. 294.

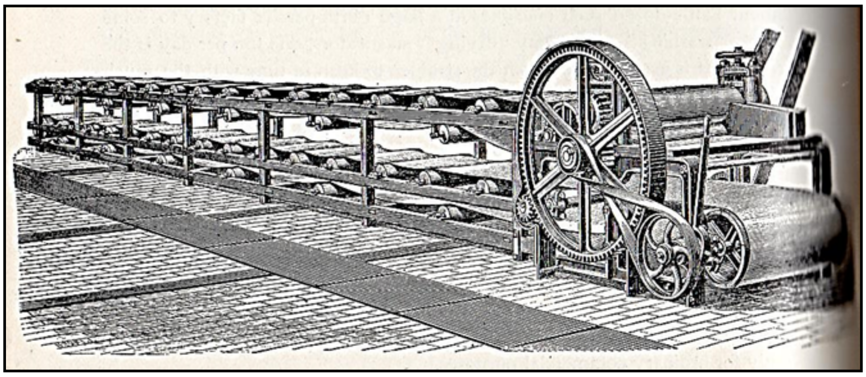


Figure 3.7 Cable calendaring machine from Bright, *Submarine Telegraphs,* p. 294.

In 1847 Dr. Werner Siemens devised and introduced a machine for seamlessly covering wire with gutta percha. He described it as being similar to a cross between a macaroni machine and Bewley's lead pipe drawing apparatus.[98] Once the "core" was complete it was then passed on to the "cable manufacturer" for the application of its protective armour.

3.4.3 Application of protective armour

The protective wire armour was applied by companies who were experienced in the wire rope manufacturing business such as R.S. Newall and Co. Layers of jute, bitumen and iron wires were applied (Figure 3.8). The strength and thickness of the armour depended upon the depth of lay and also the nearness to ports and harbours where damage from anchors, fishing gear and currents were more likely.

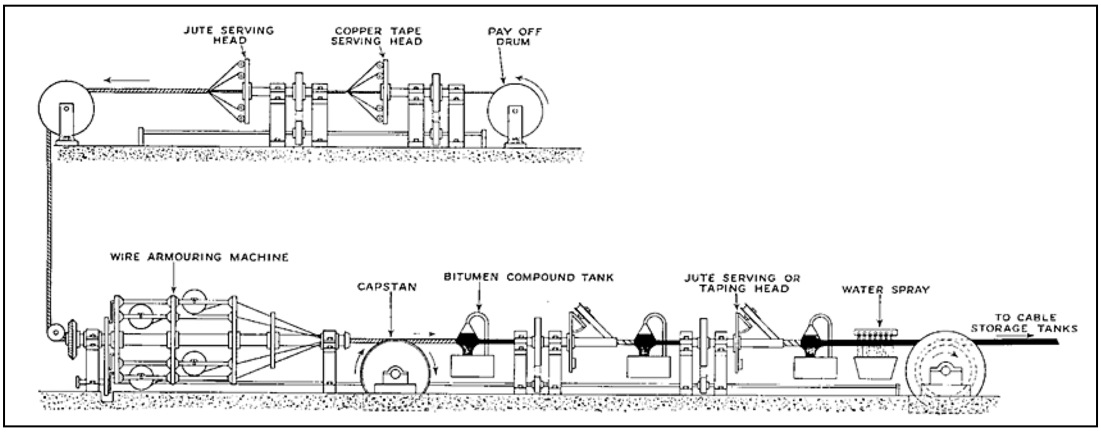


Figure 3.8 Machinery for applying the armouring to the cable core; from Bright, *Submarine Telegraphs,* p. 464.

[98] *Ibid*, p. 250 (footnote)

The least armour was necessary at great depth where the cable was unlikely to be disturbed. It was quickly found that a number of small boring sea creatures, especially *Terado navalis,* had a predilection for gutta percha and a serving of copper or brass tape had to be applied to stop their ingress. Prior to 1860, the finished cable was then stored in a warehouse or even in the open air prior to being loaded onto the cable laying ships.

3.5 Laying the cable

The first intimation of a new cable was usually in the Minutes of the operating company's board meetings. These minutes show the commercial evidence for projecting the new cable, the financial implications, negotiations with the governments for landing rights and the tendering process with the manufacturer and laying companies.

3.5.1 The ships

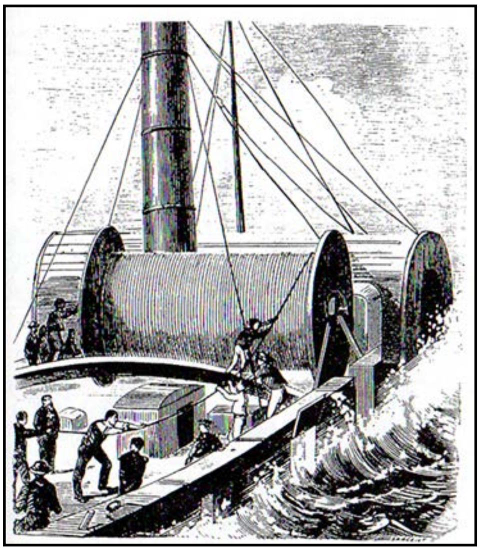


Figure 3.9 Tugboat *Goliath* laying of the First Channel Cable, 1850. From K. R. Haigh, *Cableships and Submarine Cables.* Standard Telephones and Cables, London, 1978, p. 195

Prior to 1872 cables were laid using converted ships, in some cases temporarily converted, for example *Goliath* (Figure 3.9) and *Agamemnon*, but after the first experimental cables showed that submarine telegraph cables were a feasible means of communication, permanent conversion was carried out. The "Old" *Monarch* was the first ship to be permanently converted.[99] A paddle steamer, she was built in 1830, sold to the International Telegraph Company in 1853 and permanently converted to cable laying work by R. S. Newall & Co. The "Old" *Monarch* had three holds in which the coils of cable were laid horizontally as she was

[99] Always known as the "Old" as she was still in use when a new cable ship was also named *CS Monarch.* It was not until 1872 that the first ship to be designed and built as a cable laying ship. She was the *H. C. Oersted* built for The Great Northern Telegraph Company.

before the days of specially designed cable tanks filled with sea water (introduced after the *Inquiry* – see Chapter 4).

F. C. Webb designed the cable handling equipment and his design principles can be seen cable ships even to the end of the 20th century.[100]

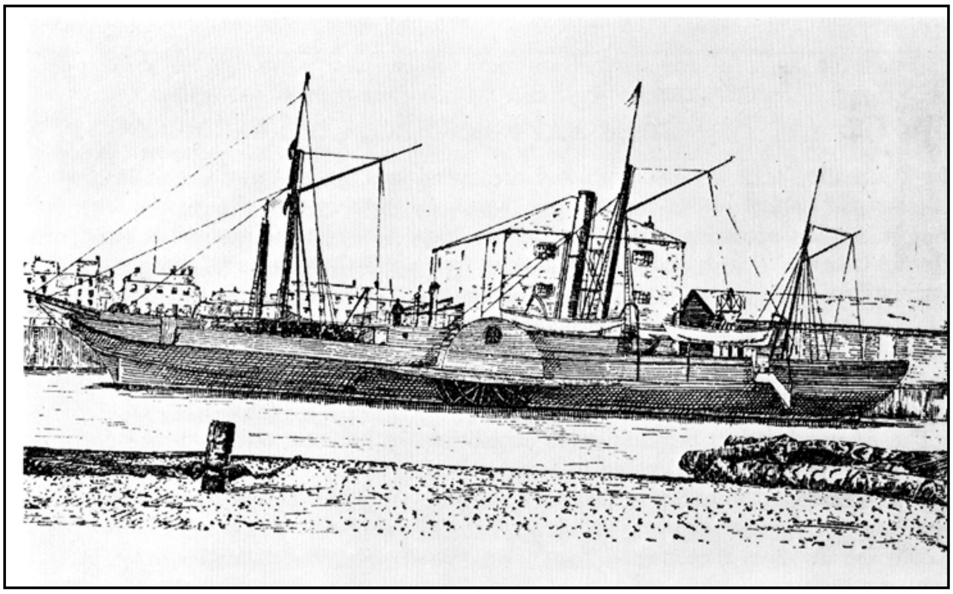


Figure 3.10 The "Old" *Monarch* from Haigh KR, *Cableships and Submarine Cables*, Standard Telephones & Cables, London 1978, p. 199

Webb described the first cable cruises with disarming honesty:

> …during [the] four years I had in charge of the cables [on the Old Monarch] only once was there a total interruption, and that only for a few hours, when during some operations I broke the last cable at night…[101]

In one of the earliest papers on submarine telegraphy given at the Institution of Civil Engineers, Webb pointed out that the best type of ship motive power for laying cables was the

[100] Frederick Charles Webb (1828-1899) initially wanted to train as a marine surveyor and spent two years on HMS Porcupine surveying ship of the Royal Navy, which gave him important insights into the problems of cable laying later in his career. But he then came ashore and worked variously on surveying and drafting for railways and harbours until he was engaged by the Electric Telegraph Company as an assistant draughtsman and engineer. In 1853 he was appointed assistant engineer to the International Telegraph Company who wished to lay cables to Holland. In 1857 he was engaged as one of the four engineers for the first attempt to lay an Atlantic cable. In the same year, working for R.S. Newall, he helped lay the cable between Malta and Corfu. The following year he worked with Prof Jenkin on other cables in the Mediterranean. He then worked for Messrs Glass & Elliott and for Charles Bright and Latimer Clark. In 1863 he was involved in cable work in India from which he returned in 1865. In 1868 he was involved in fitting out ships cable ships for work in the public Persian Gulf. 1874 saw him working for Messrs Siemens Brothers and in 1877 he was appointed electrician to *HMS Vernon* torpedo school ship at his health began to fail. He was a prolific writer contributing to The *Electrician*, The *Engineer* and the *JSTE*. Sadly he committed suicide in 1899. Obituary: Frederick C Webb, *The Electrician*, 4th December 1885, p. 66.

[101] F. C. Webb, Old Cable Stories Retold – The first cable cruises of the Old Monarch, *The Electrician,* Vol 13 May 31st 1884, pp. 55-58.

paddle steamer.[102] The *Agamemnon,* which laid the first, unsuccessful, Atlantic cables was a sailing ship; sail power was not suitable as it was difficult to keep to a prescribed track. Early screw-powered ships were much less controllable in reverse than paddle steamers and there was a much greater risk of cable damage by the propeller when compared with paddle power. It was important to have good control and high power in reverse to halt the ship quickly in the case of cable becoming jammed in the paying out equipment. The first discovery that the early cable engineers made was that the cable needed careful control as it was being paid out as the weight of the cable that had been paid out was sufficient to pull the following length out of the holds uncontrollably and so a very strong and yet delicately controllable braking system was required.[103] The cable was led from the hold through the braking system, through a dynamometer (to indicate the tension in the cable) and then over sheaves into the water. Webb then added a steam-driven winching system so that cable could be grappled and lifted for repair.

At the time of the first attempts at laying the Atlantic cable it was thought sufficient, even by William Thomson, to maintain intermittent contact through the cable whilst it was being laid as this would show up any fault quickly enough. This proved not to be the case and during the late 1850s Webb introduced continuous monitoring of the dielectric (insulation) leakage resistance.[104]

3.6 Cable operation and the terminal equipment

Prior to 1860 the electrical circuit used for submarine cable telegraphy was a very simple adaptation of that used for basic land-line telegraphy. The basic land-line circuit consisted of a power source in the form of a battery of primary cells in series with a “Morse” key, the line and some form of transducer (indicator or sounder). The circuit was completed by using the conductive properties of the soil, referred to as the *earth return*. As the line almost always took the form of a copper or iron wire suspended in free air it had virtually no electrical capacitance. Therefore the transducer responded “instantaneously” to Morse code sent by the key. However if the submarine cable was more than a few miles long, the signal was drastically altered in accordance with Thomson’s arrival curves, as shown in Figure 3.11.[105]

[102] F. C. Webb, On the practical operations connected with paying-out and repairing submarine telegraph cables. *Proc ICE,* 1857-1858, vol 17, Feb 23, p. 268.
[103] Bright *op cit,* p. 12.
[104] F. C. Webb, On the practical operations connected with paying-out and repairing submarine telegraph cables. *Proc ICE,* , vol 17, Feb 23 1857-1858, p. 274.
[105] W. Thomson. On the Theory of the Electric Telegraph. *Proceedings of the Royal Society of London*, Vol. 7 (1854 - 1855), pp. 382-399.

Thomson derived these curves from theory as in 1854 there were no practical methods of recording dynamic signals.[106]

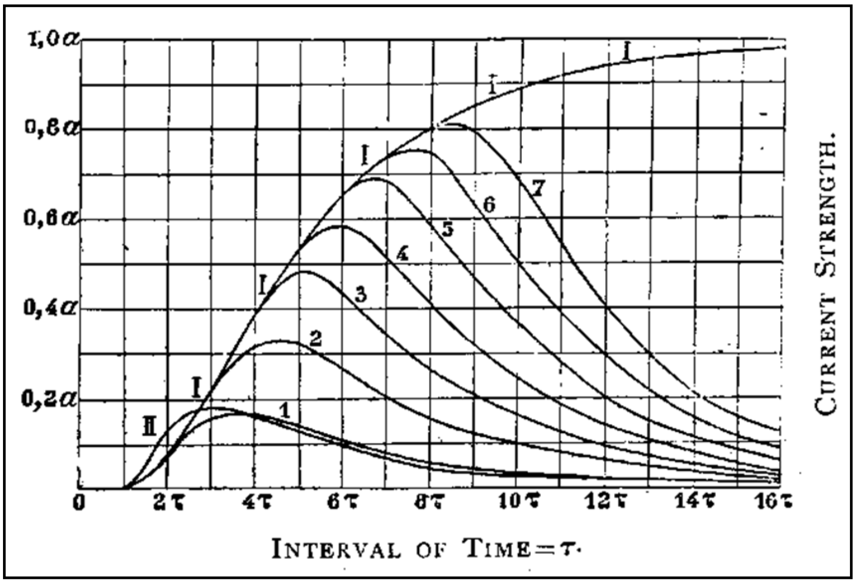


Figure 3.11 William Thomson's "Curve of Arrival". Originally published white-on-black in his paper "On the Theory of the Electric Telegraph" but conveniently reproduced in Bright's *Submarine Telegraphs* (p531) in black-on-white

Frank Scowen re-interpreted Thomson's data to make it much more intelligible in a 1977 paper[107] - see Appendix D. Because of the deleterious consequences of submarine cable capacity a modified form of Morse code was developed.

Cable code was a form of the International Morse Code except that instead of a "dash" being three times the length of a "dot" in time, a dot was positive and a dash was negative *but of the same duration*. Between either element (a dot or a dash), the cable was earthed. A comparison of the two codes for "A" and "B" is shown in Figure 3.12.

[106] Lenz published a "rotating contact method" of recording dynamic signals in 1854 (*Poggendorff's Annals* vol 92, pp. 128-152). See also V. J. Phillips, *Waveforms – a history of early oscillography*, Institute of Physics/Adam Hilger, Bristol. 1987.
[107] F. Scowen. Transoceanic Submarine Telegraphy, *Electronics & Power*, vol 23, March 1977, p. 204

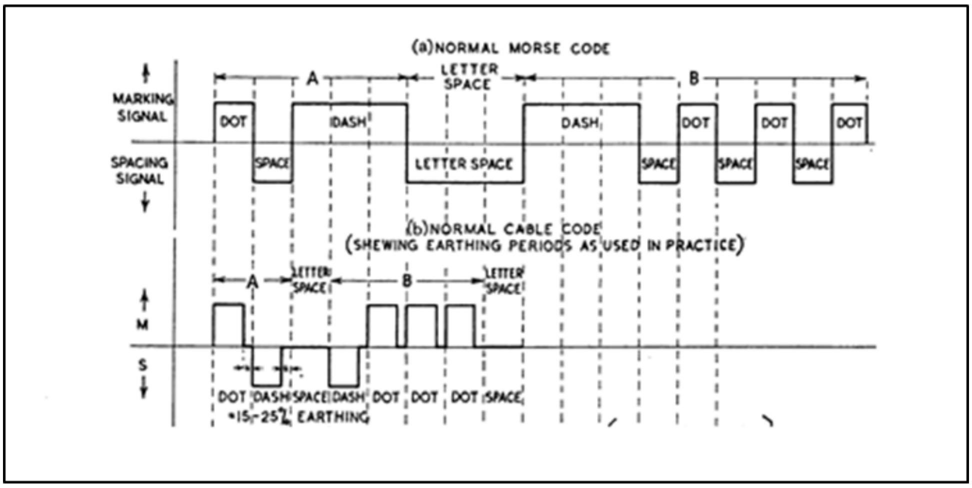


Figure 3.12 Morse code and Cable code; from Freebody JW, *Telegraphy*, Sir Isaac Pitman & Sons, London, 1958, p. 5

Combination of positive *and* negative was not a new concept as it was used in the Cooke & Wheatstone 5-needle, 2-needle and single needle instruments. Despite the use of cable code the length of a cable had a large effect on the received signal and thus it took great skill on the part of the operator to distinguish individual characters.

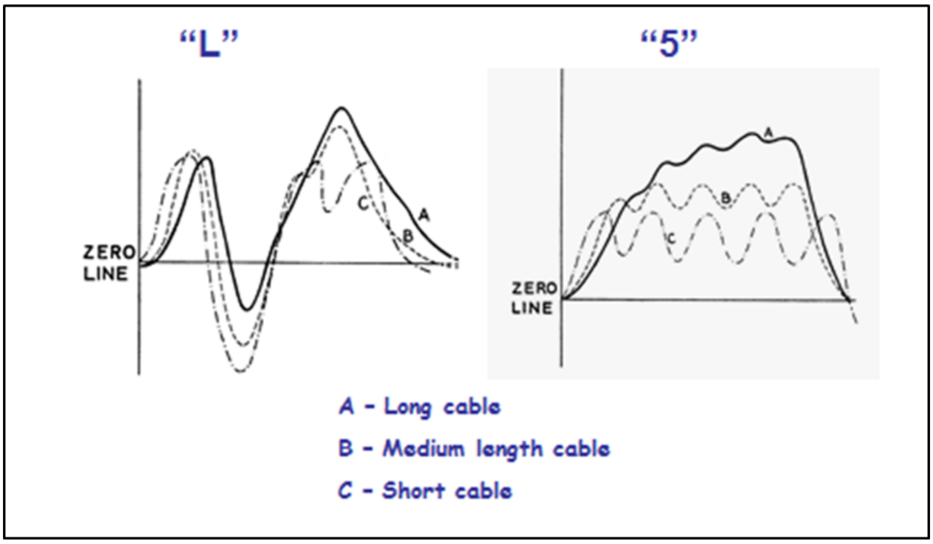


Figure 3.13 Effect of cable length on signal definition; from Freebody JW, *Telegraphy*, Sir Isaac Pitman & Sons, London, 1958, p. 676

3.6.1 The operators

The telegraphers or *operators,* as they were known as in cable telegraphy, needed different skills from land-line telegraphers because of the distortion effect described above which became apparent as soon as submarine cables of greater than a couple of miles were laid. The land-line telegrapher operated a single "Morse key" with dashes three times the 'length' of dots. Because there was no appreciable delay however long the land-line was, he or she knew exactly what the recipient of message was receiving whether it was a “sounder” or a Morse inker. Because they could hear what they were sending, and knowing that the sounder at the far end of the line would sound virtually the same, the land-line telegraphers were able to send messages at incredible speeds and regularly held competitions reaching speeds of 70-80 words per minute. The submarine cable operator used a double or “cable key”: one key for dots and the other for dashes, with both elements of the same duration. The other great difference between the land-line telegrapher and the cable operator was that he had no indication of what the operator at the receiving end could see on his galvanometer. If the transmitting operator sent too quickly, the signal would be completely blurred and indecipherable at the receiving end. Cable operators had to learn the difficult skill of transmitting at the speed the cable would work at without any feedback.

3.6.2 “Terminal” technology

The basic electrical circuit of submarine cable telegraphy had very few components (Figure 3.12). Each station consisted of a cable house close to the shore which was connected to the nearby cable station instrument room containing a source of electricity, a mirror speaking galvanometer (described in chapter 2), a cable key and change-over switch connected as shown in Figure 3.12. From the mid 1860s the galvanometer was replaced by the siphon recorder (described in chapter 1).

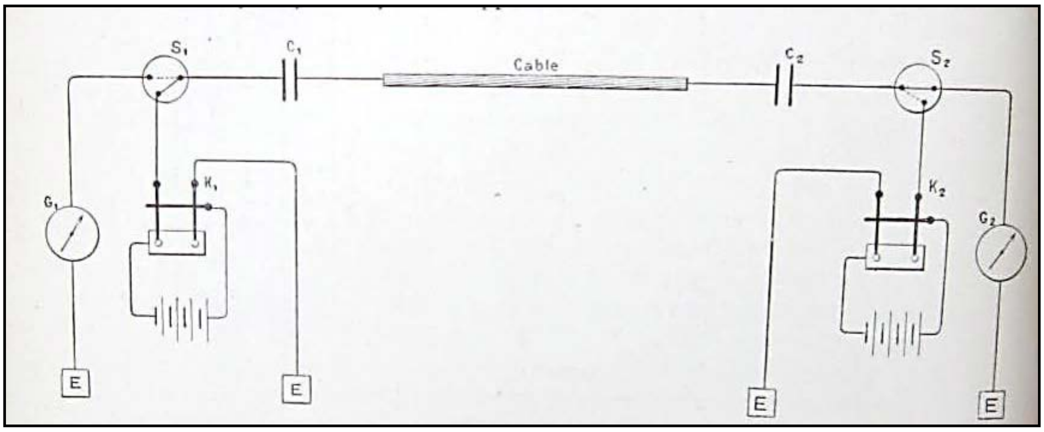


Figure 3.12 The basic electrical circuit of submarine cable telegraphy. From Bright , *Submarine Telegraphs*, P. 596

The operators of this circuit had switches S_1 and S_2 to that the operator at station 1 could transmit to the operator of the station 2. He keyed the RH lever of K_1 which then connected the positive terminal of the battery to the cable via the condenser (whose purpose is described below). The signal current passed through the condenser at the other end of the cable through the mirror galvanometer G_2, causing deflection of the mirror, to earth E. The circuit was completed through the earth (and sea) via Key K_1 to the negative pole of the battery. When the operator released the key K_1, the cable was connected to earth via the two condensers. When the operator depressed the LH lever of K_1, the reverse occurred causing the galvanometer G_2 to deflect in the opposite direction. Station 2 could transmit to station 1 by the reversal of both switches S_1 and S_2. Messages could only be sent in one direction at a time by this simple circuit.

The source of electricity

Alessandro Volta in 1793 has been credited with inventing the first primary cell and the first battery of cells.[108] I have collected data on over 250 different cells or variations of cells from then until the Great War; approximately 25 in my chronology were used in cable telegraphy at various times but only the most important to this thesis are described.[109] In 1836, Professor John Frederic Daniell, a British chemist and metallurgist, invented his eponymous cell – the *Daniell cell* (often spelt *Daniel*) which was the first really practical cell (Figure 3.13). Before this time there was no practical use for current electricity (as opposed to static electricity) except, possibly, electroplating but land-line and then submarine cable telegraphy changed lead to rapid development.

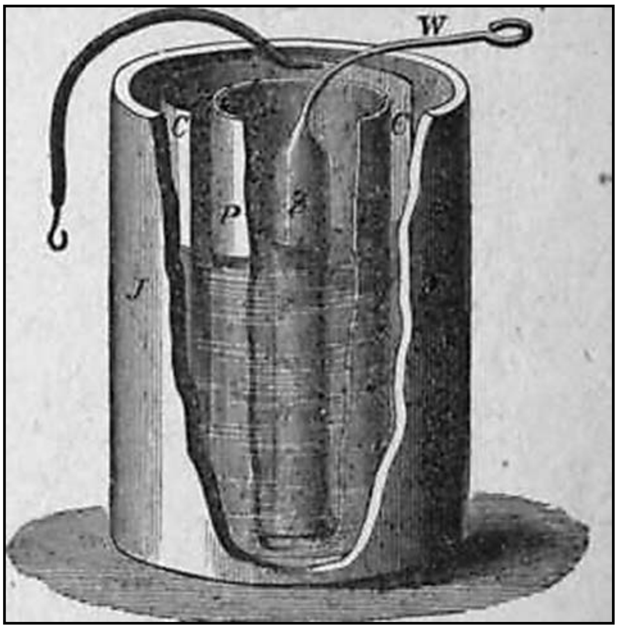


Figure 3.13 A Daniell cell from Carhart HS, *Primary Batteries*, 1891.

[108] A. M. Codd, *Practical Primary Cells,* Sir Isaac Pitman & Sons Ltd, London, 1929, p.93. NB The term "battery" has become confused with the term "cell" in recent years. The basic unit of a source of chemically produced electricity is the *cell.* The cell produces an *electromotive force* of between half a volt and two volts. In order to have a source of greater than this, a number of cells were connected together i*n series* to form a *battery (of cells).* There were and still are two types of cell: *Primary* cells are non-rechargeable whereas *secondary* cells are rechargeable.

[109] As yet unpublished.

A glass jar (j) was separated into two concentric compartments by a porous pot (p). The inner compartment contained a zinc electrode (z), which formed the "negative" element, and zinc sulphate solution. The outer compartment contained a copper, positive, element (c) with sulphuric acid solution. Daniell developed this cell in an attempt to eliminate the hydrogen bubbles produced in earlier cells; the bubbles reduced the efficiency and increased the internal electrical resistance of the cell. The Daniell cell was used in large numbers by telegraph electricians, not only for operating telegraph circuits but also for testing purposes. Often voltages were actually quoted in "number of cells" in series, as initially in cable telegraphy there was no standard unit of potential difference or emf (electromotive force). The emf of a basic Daniell cell was approximately 1.079 volts. Many derivations of the Daniell cell became popular for telegraphic use and some were developed specifically for submarine telegraphy, such as the Callaud[110] or "Crow foot" gravity cell, the Thomson Tray battery[111] and the Minotto cell[112].

The Cable Key. As can be seen from Figure 3.14, the "cable key" resembled two conventional Morse keys mounted side-by-side, the spacing being such that one key could be operated by the index finger whilst the other by the middle and ring fingers of the same hand.

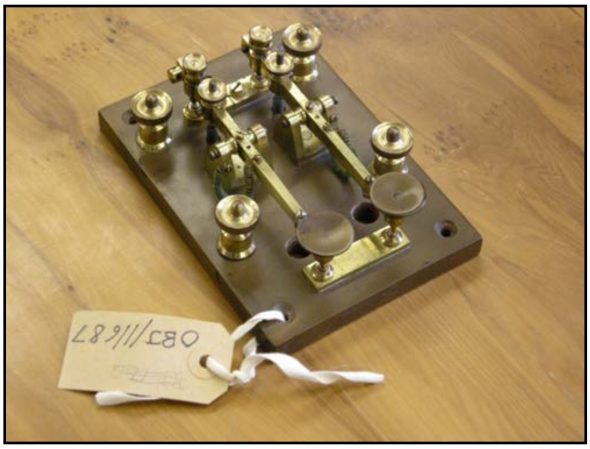


Figure 3.14 Cable code key. Photograph by the author at the Telegraph Museum, Porthcurno

Each of the two keys consisted of a lever pivoted centrally in a see-saw fashion with the finger paddles biased in the up-position by springs. At rest the "rear" contacts were closed with the

[110] . R. Bottone, *Galvanic Batteries, their theory, construction and use,* Whittaker & Co., London, 1902, p.214.
[111] *Ibid*, p. 206.
[112] *Ibid,* p. 209.

front contacts “open”. The front lower contacts were connected together and thence to one of the terminal posts. Similarly the rear lower contacts were connected together to another terminal post. The axles of the two levers were electrically isolated from each other and connected separately to the two remaining terminal posts.

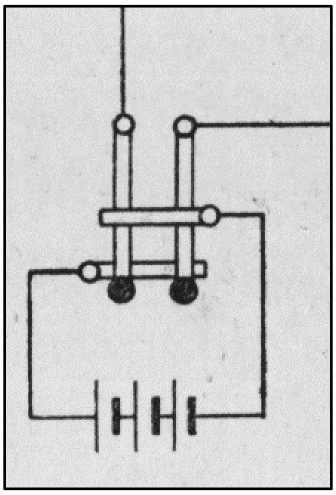


Figure 3.15 The 19th century diagram of the cable key shown did not immediately look like the photograph. The lower or front horizontal contact bar was drawn as expected but the rear contact bar was drawn across the middle of the diagram and the pivot contacts which were in the centre of the keys was drawn at the top or “back” of the schematic. (modified from Bright *Submarine* Telegraphs, p.650, Figure 115)

A word is necessary to explain the c*able key* as its function is not intuitive even to a seasoned engineer. A conventional circuit diagram of a cable key is also shown (Figure 3.15), with the left hand key for “dots” and the right hand for “dashes” in the “rest” position with both keys “up”. During the “spaces” the line was “earthed” to discharge the “inductive capacitance” of the line. If both keys were inadvertently depressed, this also earthed the line as shown in Figure 3.16.

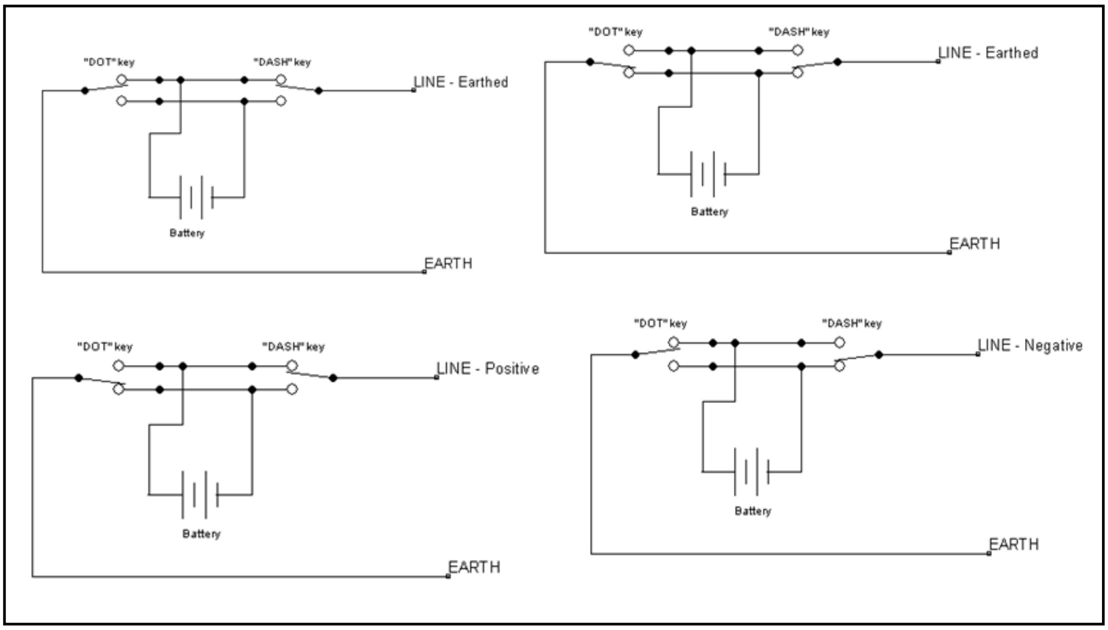


Figure 3.16 Effects of the key positions, up/down, of a cable key

The cable hut. It was rarely convenient to build the cable station on the beach where the submarine cable reached land. Therefore most cables terminated close to the water at a cable hut. This was a strongly built secure brick or stone building where the cable ended and was connected to a simple insulated land line which led to the cable station further inshore. See Figure 17.

Figure 3.17 Photographs of the Cable hut at Porthcurno; photos by the author

3.7 Unreliability and failure

By the late 1850s there was increasing concern, especially in financial circles, that submarine cable telegraphy was unreliable and therefore a huge financial risk.[113] Tables 3.2 and 3.3 are a summary of the cables laid in the period 1850–1860.

[113] Bright *op cit,* p. 59.

Table 3.2 Shallow Water Cables 1850 to Committee of Enquiry (1859 to 1860) from *House of Lords Committee of Privy Council for Trade and The Atlantic Telegraph Company to Enquire into the Construction of Submarine Telegraph Cables, HMSO, London, 1861, pp. 512-516.*

Cable	**Owner**	**Date of Laying**	**Manufacturer**	**Length**	**Outcome** (up to 1860)
Dover to Calais	Submarine Co	1851	R S Newall & Co	25 miles	Good
Holyhead to Howth	R S Newall & Co	1852	R S Newall & Co	65 nm	Abandoned
Portpatrick to Donaghadee		1852	R S Newall & Co	15 nm	Failed
Denmark (across the Helt)	Danish Govt	1853	R S Newall & Co	18 nm	In full operation
Dover to Ostend	Submarine Co	1853	R S Newall & Co	80 nm	Good
Orfordness to Schevening x4	Electric & International Co	1853	R S Newall & Co	479 nm	Nos 1,3 & 4 Failed. No 2 Perfect
Firth of Forth	Electric & International Co	1853	R S Newall & Co	5 miles	Perfect
Portpatrick to Donaghadee	British & Irish Magnetic Co	1853	R S Newall & Co	25 miles	Perfect
River Tay	Electric & International Co	1853	R S Newall & Co	1mile	Perfect
Corsica to Sardinia	French Govt	1854	Glass, Elliot & Co	11 miles	In good working order
Holyhead to Howth	Electric & International Co	1854	Fenton Hyde & Co	65 nm	Not perfect
Holyhead to Howth	Electric & International Co	1854	R S Newall & Co	65 nm	Out of order
Hurst Castle to IOW	Electric & International Co	1854	R S Newall & Co	1mile	Perfect
Portpatrick to Whitehead	British & Irish Magnetic Co	1854	R S Newall & Co	26 miles	Perfect
Sweden to Denmark	Swedish Govt	1854	Glass, Elliot & Co	13 miles	In good working order
Varna to Balaklava	British Govt	1855	R S Newall & Co	310 nm	Broken
Varna to Constantinople	Ottoman Govt	1855	R S Newall & Co	150 nm	Broken & repaired
Prince Edward Island to New Brunswick		1856	Glass, Elliot & Co	12 miles	In good working order
England to Hanover	Submarine Co	1858	Glass Elliot & Co	280 miles	In good working order
Orfordness to Haarlam	Electric & International Co	1858	Glass, Elliot & Co	136 miles	In good working order
Liverpool to Hollyhead	Liverpool Dock Committee	1858	Glass, Elliot & Co	25 miles	In good working order
Weymouth to Channel Is	Channel Islands Teleg Co	1858	R S Newall & Co	93 miles	Test perfect but iron corroded, perfect on sand

					on rocks
Whitehaven to Isle of Man	Isle of Man Teleg Co	1858	Glass Elliot & Co	36 miles	In good working order
England to Denmark	Submarine Co	1859	Glass, Elliot & Co	350 miles	In good working order
Folkestone to Boulogne	Submarine Co	1859	Glass, Elliot & Co	24 miles	In good working order
Singapore to Batavia	Dutch Govt	1859	R S Newall & Co	550 miles	Broken & Repaired
Sweden to Gottland	Swedish Govt	1859	Glass, Elliot & Co	64 miles	In good working order
Tasmania to Bass Straight	Australian Govt	1859	WJ Henley	240 miles	Good but for one bad section
Denmark (Great Belt)	Danish Govt	1860	WJ Henley	28 miles	Perfect

Total = 3380 statute miles of which 2,368 statute miles (70%) were in good working order.

Table 3.3 Deep Water Cables 1850 to Committee of Enquiry (1859 to 1860) from *House of Lords Committee of Privy Council for Trade and The Atlantic Telegraph Company to Enquire into the Construction of Submarine Telegraph Cables, HMSO, London, 1861, pp. 512-516.*

Table 3.3 ***Deep Water Cables 1850 to Committee of Enquiry (1859 to 1860)***[114]

Cable	**Owner**	**Date of Laying**	**Manufacturer**	**Length**	**Outcome (up to 1860)**
Spezia to Corsica	French Govt	1854	Glass, Elliot & Co	110 miles	In good working order
Newfoundland to Cape Breton		1856	Glass, Elliot & Co	85 miles	Perfect
Valentia, Ireland to Trinity Bay, Newfoundland	Atlantic Telegraph Company	1857	Glass Elliot & Co R S Newall & Co	2500 miles	Failure
Sardinia to Bona	French Govt	1857	R S Newall & Co	125 miles	?
Sardinia to Malta to Corfu	Mediterranean Extension Co	1857	R S Newall & Co	700 miles	Failed
Dardanelles to Scio & Candia; Scio to Candia	Levant Teleg Co	1858	R S Newall & Co	450 nm	Perfect
Valentia, Ireland to Trinity Bay, Newfoundland	Atlantic Telegraph Company	1858	Glass Elliot & Co	2500 miles	Failure
Athens to Syra & Sefo	Greek Govt	1859	R S Newall & Co	150 nm	Perfect
Red Sea and India via	Red Sea & India	1859 &	R S Newall & Co	3043	Failure

[114]Anon: 1861, *House of Lords Committee of Privy Council for Trade and The Atlantic Telegraph Company to Enquire into the Construction of Submarine Telegraph Cables*, HMSO, London, pp516-518

Alexandria, Suez, Kossier, Suskin, Aden, Hallani, Muscat, Kurrachi	Telegraph Co	1860		nm	
Sicily to Malta	Mediterranean Extension Co	1859	Glass, Elliot & Co	70 miles	Very good
Barcelona to Mahon	Spanish Govt	1860	WJ Henley	180 miles	Very good
Iviza to Majorca	Spanish Govt	1860	WJ Henley	74 miles	Very good
St Antonio to Iviza	Spanish Govt	1860	WJ Henley	76 miles	Very good
Toulon to Algiers	French Govt	1860	Glass, Elliot & Co	480 miles	Perfect
Corfu to Oranto	Mediterranean Ext Co	1860	Glass, Elliott & Co	60 miles	Very good

Total = 13,020 statute miles of which 1,825 (14%) statute miles were in good working order.

Examination of these tables suggests that the cables of the *late* 1850s were much more reliable than the earlier ones. The failure of attempts to lay transatlantic cables has already been mentioned. However the last straw that led to the governmental Committee of Inquiry was the failure of the Suez-Red Sea-India cable.[115]

Marsden and Smith state that:

> even with the 'perfect insulation' of gutta percha, [first cable to India] proved vulnerable to marine bore worms – and the line transmitted not a single message.[116]

They reference Daniel Headrick's comment:

> In 1859 the first Red Sea cable was laid. It was a single strand of copper wire coated with gutta-percha and covered with hemp, and it weighed one ton per mile. It was laid by crude machines that pulled it taut so that it hung between underwater peaks.[117]

[115] It should be mentioned here that there was already direct contact between London and the Indian Colony via one of the English Channel cables and thence overland to India. However, the British government desired a cable route to India which did not involve any non-British dependency. The existing route was entirely overland apart from the 25 miles across the English Channel. The problem with the overland route was not only were the messages received and re-transmitted at cable stations *en route* where English was not the *lingua franca* but in many cases these stations were on territory which was distinctly anti-British.

[116] B. Marsden, C Smith, *Engineering Empires – A cultural history of technology in nineteenth century Britain,* Palgrave Macmillan, UK, 2005, p. 211.

[117] D. Headrick, *The Tools of Empire - Technology and European Imperialism in the Nineteenth Century,* Oxford Univ Press, 1981, p159, quoted in [117] Marsden B, Smith C, *Engineering Empires – A cultural history of technology in nineteenth century Britain,* Palgrave Macmillan, UK, 2005, p. 211.

This clearly is a gross over-simplification as although the so-called "light-weight" cable which had no iron/steel armouring wires was tried on one section, it failed and was replaced by properly armoured cable throughout.[118] The Red Sea & India Telegraph Company unfortunately, possibly naïvely, signed a contract with R. S. Newall & Co. which allowed Newall & Co. to keep any excess cable left over after the cable had been laid. This, combined with a poor survey, led to disaster. The crew and cable engineers of the cable ship laid no slack which, as the sea bed was mountainous, meant that the cable was often suspended between submerged mountain tops. This was not normal practice. The length of cables was typically greater than the geographic distance because slack was laid to allow for variations in the depth, due to underwater mountains or trenches, and also to allow for the cable to be raised from the seabed to the surface for repairs: approximately an extra 10% was usual for shallow water cables or 20% for deep water cables. The Red Sea debacle of 1858-9 was related in great, and sometimes amusing, detail by F. C. Webb in his series of articles entitled "Old Cable Stories Retold" in the *Electrician* in 1885. Webb had first-hand experience of the of the laying of this cable as he was one of the electricians. His final words about the debacle were

> ….and this was about the last incident connected with the Red Sea and India cable of 1859-60. – RIP! [119]

Shallow water submarine telegraph cables were considered a success but deep water cables, especially long deep water cables were less so. I surmise that this was due to poor surveying which missed the existence of submarine trenches and mountains but also the inability to raise and repair cable problems in the deep ocean during the experimental period, 1850–1860. There was commercial and political need to link not just countries but also continents by this "instantaneous" means of communication but by the end of the decade the technology had stagnated; the only new developments had been in scale rather than improvements in the technology itself. 1850-1860 had been a hugely expensive experimental period. New techniques giving greater reliability and the possibility of submarine cable telegraphy to become global rather than international were needed. Questions were being asked as to whether reliable *inter-continental* submarine cable telegraphy would ever be a viable proposition. For this reason the Lords of the Committee of Privy Council for Trade and the Atlantic Telegraph Company appointed a joint *Committee to Inquire into the Construction of Submarine Telegraph Cables.* Peter Hugill identifies 1857-1858 as being the *experimental*

[118] Bright, op cit, pp. 57-58.
[119] Webb FC, Old Cable Stories Retold - a series of articles in *The Electrician* during 1884-5. The Red Sea and India Cable 1859-60.The *Electrician* vol 14, 1884, pp. 67-68 and vol 15, 1885, pp. 65-66, 428-430.

period in the technical history of submarine cable construction.[120] However I find this questionable and it would more accurate to describe the whole decade from 1850 until the Committee of Enquiry as being the definitive "experimental period".

[120] P. J. Hugill. Global Communications since 1844, Geopolitics and Technology. Johns Hopkins University Press, Maryland, USA. 1999, p. 29.

Appendices

Appendix A

Chronology of Electromagnetic Telegraphy 1840-1900[121]

Year	*Description*	*Distance (miles)*	*Speed (wpm)*	*Wires*
	Land-Line Telegraphy			
1837	Wheatstone & Cooke 5-needle telegraph	<100		5
1837	Wheatstone & Cooke 2-needle telegraph	<100		2
1837	Wheatstone & Cooke Single-needle telegraph	<100		1
1838	Morse (& Vail's) recording telegraph	<100	<30	1
1840	Wheatstone ABC	<30	15	1
1846	Bain Electrochemical Telegraph	<50	<30	1
1846	House's Printing Telegraph	<50	<30	1
1854	Morse Telegraphy using sounder	<100	<40	1
1855	Hughes' Printing Telegraph	<50	<30	1
1867	Wheatstone Automatic	<100	<400	1
1874	Baudot	<50		1

Distances for Land-Line telegraphy are quoted for copper wires.

Reduced by 80% for iron wires

From ~1850, distances could be increased by the use of repeater relays

	Submarine Telegraphy			
1850	Morse + Basic Galvanometer	<25	3	1
1858	Morse + Thomson Galvanometer (Ireland – Newfoundland)	<2500	Few words per hour	1
1867	Morse + Thomson Siphon Recorder (Ireland-Newfoundland)	<2500	6-8 words per minute	1
1898	Cable code - Long cables with automatic transmitting equipment	<2000	40 words per minute	1
1928	Cable-code - Newfoundland – Azores		2,500 characters per minute (~400wpm}	1

Speeds for submarine telegraphy are limited to 5wpm with mirror galvanometers by human factors (i.e. the speed at which it could be read) and by distance with the siphon recorder

[121] Compiled from: Moyle JTB. *A Technical hors d'oeuvre.* Porthcurno Telegraph Museum, Cornwall and *http://atlantic-cable.com/Cables/speed.htm* - last accessed 15.01.2011.

(<20 for 800 miles cables but only 5wpm with the longest cables)

Appendix B

Books and pamphlets published about the first transatlantic cables

R. D Harris, D. DeBlois,	*An Atlantic Telegraph: The Transcendental Cable*	Schoharie, NY: The Ephemera Society of America, Inc., 1994.
Anonymous	*The Atlantic Telegraph: Its History, From the Commencement of the Undertaking in 1854, to the Return of the Great Eastern in 1865*	London: Bacon & Co, 1865
C. F. Briggs, A. C. Maverick	*The Story of the Telegraph and a History of the Great Atlantic Cable*	New York: Rudd & Carleton.1858
H. Clayton	*Atlantic Bridgehead*	London: The Garnstone Press, 1968
V. T. Coates, B. Finn	*A Retrospective Technology Assessment: Submarine Telegraphy*	San Francisco: San Francisco Press, Inc., 1979
G. Cookson	*The Cable: The Wire That Changed The World*	Stroud: Tempus Publishing, 2003
H. F. Q. D'Aligny	*Outline of the History of the Atlantic Cables*	Washington, Government Printing Office, 1868
B. Dibner	*The Atlantic Cable*	Norwalk: Burndy Library, 1959
T. DuMoncel	*Notice sur le Cable Transatlantique*	Paris: Gauthier-Villars, 1869
C. W. Field.	*The Atlantic Telegraph*	London: 1856 (Prospectus)
C. W. Field.	*Prospects of the Atlantic Telegraph*	New York: 1862. 15 pp. A paper read before the American Geographical and Statistical Society.
FIELD, Cyrus W.	*The Atlantic Cable Projectors 1854-1895*	New York: Press of the Chamber of Commerce, 1895. 35 pp. A report of the session of May 23d, 1895
H. M. Field	*History of the Atlantic Telegraph*	New York: Charles Scribner & Co., 1866
H. M. Field	*The Story of the Atlantic Telegraph*	London: Scribners, 1892, 1893
C. G. Hearn	*Circuits in the Sea: The Men, the Ships, and the Atlantic Cable*	Westport, Praeger Publishers 2004
Anonymous	*The Landing of the French Atlantic Cable at Duxbury, Mass., July, 1869*	Boston: Alfred Mudge & Son, Printers, 1869.
R. J. Mann (possibly authored by Wildman Whitehouse)	*The Atlantic Telegraph: A History of Preliminary Experimental Proceedings and a Descriptive Account of the Present State and Prospects*	London: Jarrold and Sons, July 1857

	of the Undertaking	
J. Merret	*Three Miles Deep*	London: Hamish Hamilton, 1958
O. Moll	*Atlantic Telegraph Cables illustrated*	London, Waterlow and Sons, 1896
J. Mullaly	*A Trip to Newfoundland: Its Scenery and Fisheries: With an Account of the Laying of the Submarine Telegraph Cable*	New York: T.W. Strong, 1855
W. H. Russell	*The Atlantic Telegraph*	London: Day & Son, (1865).
G. Saward	*The Trans-Atlantic Submarine Telegraph: A Brief Narrative of the Principal Incidents in the History of the Atlantic Telegraph Company. Compiled from Authentic and Official Documents by the Late George Saward Secretary to the Company London: Printed for private circulation, 1878*	
J. W. Simonton, C. W. Field	*Atlantic Cable Mismanagement*	New York: 1871
D. R. Tarrant	*Atlantic Sentinel. Newfoundland's Role in Transatlantic Cable Communication*	St. John's, Newfoundland: Flanker Press, 1999
W. Thomson	*Atlantic Telegraph Cable - The Forces Concerned in the Laying and Lifting of Deep-sea Cables*	London: William Brown, 1866
Anonymous but known to have been written by Charles West	*The Story of My Life. By the Submarine Telegraph*	An address delivered before the Royal Society of Edinburgh, London: C. West, 1859. December 18th, 1865.
E. O. W. Whitehouse	*Report of a Series of Experimental Observations on Two Lengths of Electric Cable, Containing, in the Aggregate, 1,125 Miles of Wire*	Brighton 1855. [23 pp. 5 plates. Wheeler Gift #4539. Whitehouse's self-published pamphlet containing the full text of his British Association paper.
E. O. W. Whitehouse	*Reply to the Statement of the Directors of the Atlantic Telegraph Company*	London: 1858. 27 pp. Stamp, Carlton Club. A defense after his discharge by the company.
E. O. W. Whitehouse	*Recent Correspondence between Mr. Wildman Whitehouse and the Atlantic Telegraph Company with an*	Published by the author, 1858.

	Appendix Containing Every Telegram and Letter for Reference	
F. R. Window	*The Atlantic, and South Atlantic, Telegraphs*	London: Smith, Elder and Co., 1859

Appendix C

The Wire drawers of Birmingham 1849 – from Graces Guide 1849

T. Bolton, Broad Street Metal Works

S. Butler and Co, 38, Summerrow, and Saltley Wire Mills

Thomas H. Carpenter and Co, Berkley Street

W. Chaplin, 100, Lancaster Street

Cheadle Copper and Brass Co, 31, Edmund Street; William Henry Wragge, agent

Charles Clifford, 11, Snow Hill and Fazeley Street

William and Henry Cooper, 293, Bradford Street

Cornforth Brothers, Dartmouth Street Works

S. Cornforth, 21, George Street, Pard

Edelsten, Williams, and Edelsten, Newhall Works, George Street, Parade

W. Edwards, Aston Fume mls

C. Ellis and Sons, 103, Snow Hill

A. C. Emery, 8, Monmouth Street

A. Everitt and Son, Adderley Street

T. P. Hawkins, Lt. Cannon Street

G. Heaton, 48, Shadwell Street

Francis Hibell, Legge Street Works, Legge Street

E. Holt, 38 and 39, Moland Street

James Horsfall, Oxford Street, and Hay mills, Yardley

Hughes and Evans, court 39, High Street, Deritend

T. Jones, Charlotte Street Mills

Paul Moore and Co, Lister Street and Park mill, Aston

E. Nicklin, 55, Bradford Street

J. Palmer, 6, Broad Street, Islington

S. Parish, ct 54, Broad Street, Islington

John Piddock, 20, Lt. Ann Street

Benjamin Rogers and Son, 38 and 39, New Church Street

Benjamin Rollason and Son, 21, Upper Priory

Sharp and Brown, 33, Fazeley Street; William Burgess, agent

Philip M. Twells, 83, New Street

John Wakefield, Bridge Street mill, Broad Street

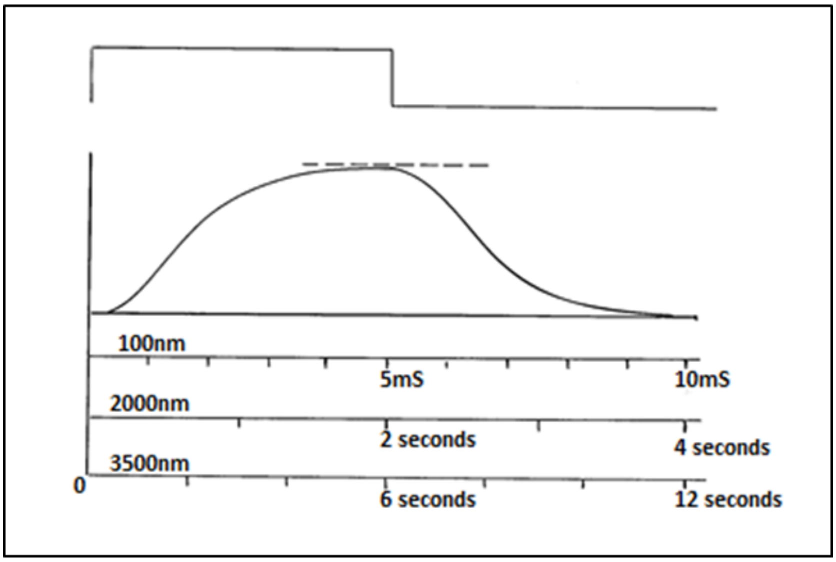
J. T. Wakefield, 75, Lichfield Street

S. Walker junior, 38, Colmore Row

C. Wilkinson 291, Bradford Street

J. Worsey, 42 and 43, Staniforth Street

Appendix D



Of the two plots shown, the upper gives an indication of electricity instantaneously applied to one end of a submarine cable for example by a Morse key being depressed and held down for a period. It is then released and the end of the cable connected instantaneously to earth. The lower plot shows what appears at the other end of the cable. As was expected with the charge and discharge of a condenser (Leyden jar, capacitor) the shape of the curve was exponential. Horizontally there were three scales for time: 0-10 thousandths of a second for a 100nm cable length; 0-4 seconds for a 2000nm cable length (approximately trans-Atlantic) and 1-12 seconds for 3500nm (approximately trans-Pacific). The vertical scale is the potential difference at the distant end of the cable. (Scowen's graph is not calibrated).

Redrawn from F. Scowen. Transoceanic Submarine Telegraphy, *Electronics & Power*, vol 23, March 1977, p. 204 with permission

4. Interrogating the Committee

4.1 Introduction

By the end of the first decade of international submarine cable telegraphy (1850-1860) there was growing concern in government circles about whether the concept of inter-continental telegraphy was viable either technically or financially. Was there a point at which further failures would become intolerable? Were the early hopes misguided? Or was the problem more to do with the execution of the techniques? This was a serious matter for the very survival of the Empire because without this near-instantaneous mode of communication it was becoming more difficult to maintain law and order and functioning in the more distant colonies. There was the possibility of Great Britain losing not only a great deal of money if intercontinental submarine cable telegraphy failed but potentially losing the Empire itself. For the government this came to a head with the failure of The Red Sea and Indian Ocean Telegraph and it therefore set up the *House of Lords Committee of Privy Council for Trade and The Atlantic Telegraph Company to Enquire into the Construction of Submarine Telegraph Cables.* In this chapter, I will discuss the reasons for the formation of the committee, the selection of its members, the evidence and the experiments that were organized. I will explore the effects of the outcome of the committee.[122]

Fig 4.1 Bright's annotation in his personal copy of the Report. Photo by this author of copy at The Telegraph Museum, Porthcurno.

It became apparent during the Inquiry that standardized units were required for electrical measurement during manufacture, laying and maintenance of submarine telegraph cables. I therefore give a very brief account of the work of the British Association for the Advancement of Science's Committee on a standard unit for electrical resistance, the unit of greatest importance to cable engineers and electricians.

[122] The copy of the Report which I studied in the Porthcurno archive is annotated as Charles Tilston Bright's own copy

4.2 Intercontinental Cable Failures

The principal cables laid prior to the inquiry were listed at the end of the last chapter. In summary, 11,364 miles had been laid since 1851 but only a little over 3,000 were actually working at the beginning of the inquiry.[123] Of the cables not working, the chief ones were the Atlantic (2,200 miles); the Red Sea & India (3,499 miles); the Sardinia, Malta and Corfu (700 miles) and the Singapore and Batavia (550 miles).

Apart from the failure of two attempts to connect the Old World with the New, the most important telegraph circuit required by Her Majesty's Government was a *secure* cable to India. Britain's wealth in the Victorian era was mainly derived from India and although it had been possible to connect England with India overland (except the 26 miles of submarine cable across the English Channel), the British government was anxious to improve the speed and more importantly the security of communication.[124] The overland route passed through many countries where English was not commonly spoken and through states which were not friendly towards the British Empire. Every few hundred miles overland any communication had to be read, transcribed and re-transmitted by local nationals. Not only did messages become garbled but also non-friendly governments became aware of private British communications. The easiest way to circumvent both of these problems was to use the submarine route with intermediate telegraph stations only on "friendly soil". In 1857 Dr Lionel Gisborne promoted the Red Sea and India Telegraph Company.[125] Despite the failure, at that time, of attempts to span the Atlantic with a submarine cable, the British Government decided to give substantial financial assistance because of the urgency of better communications with the Empire. The proposed cable was 3043nm. There were to be landings to telegraph stations at: Suez (254nm), Kossier (477nm), Suakin (645nm), Aden (717nm), Hallania Island (488nm), Muscat (477nm), and Kurrachee.[126] Dr Gisborne secured from the British Government a subsidy that amounted to £800,000 unconditionally over 50 years for what turned out to be a disastrous

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[123] *Report of the Joint Committee appointed by the Lords of the Committee of Privy Council for Trade and the Atlantic Telegraph Company to inquire into the Construction of Submarine Telegraph Cables*, London 1861, p. *v*.

[124] Levine P, *The British Empire – Sunrise to Sunset*, Pearson Longman, London, 2007, ISBN 978-0-582-47281-5, p. 61.

[125] Dr Lionel Gisborne was yet another Medical Practitioner who became involved in the submarine cable world. C. Bright, *Submarine Telegraphs: their history, construction and working*, Crosby Lockwood & Son, London, 1898, p. 57.

[126] W. Smith, *The Rise and Extension of Submarine Telegraphy*, Virtue & Co, London, 1891, pp. 67-71.

failure.[127] The cable never worked for reasons enumerated in Chapter 3. It was not until 1870 that a successfully working cable was operating.[128]

4.3 The Committee of Inquiry

The Committee of Inquiry was formed in the autumn of 1859 with members representing the Board of Trade (BOT) and the cable industry or to be more accurate The Atlantic Cable Company.

For the Board of Trade…	*For The Atlantic Cable Company…*
Captain Douglas Galton	Mr. Edwin Clarke
Mr. William Fairbairn	Mr. George Saward
Professor Charles Wheatstone	Mr. Latimer Clark
Mr. George Bidder	Mr. Cromwell Varley
Mr. Robert Stephenson	
Rt. Hon. Mr. J Stuart-Wortley	

Of these worthies, Mr. **Robert Stephenson** FRS (1803–1859), a well-known English Civil Engineer died at the age of 55, before the Committee began hearing evidence. The Rt. Hon. Mr. **J Stuart-Wortly** MP attended only the first two meetings due to serious illness.[129]

Captain (later **Sir) Douglas Galton** RE, FRS, HonMICE, KCB, GCB, LLD (1852-1899) was a nephew of Florence Nightingale. He was a Civil Engineer and a Captain in the Royal Engineers. After a distinguished career in the Army he became Secretary to the Railway Department of the Board of Trade. He eventually became President of the Institution of Civil Engineers (ICE). **William Fairbairn** (1789-1874), later Sir William, was an apprentice millwright in Newcastle-upon-Tyne when he became friends with a young Robert Stephenson and subsequently became a member of the ICE. Fairburn was a very successful civil engineer, structural engineer and shipbuilder but had no prior experience in land-line or submarine telegraphy. He became President of the British Association for the Advancement of Science in 1861. **Charles Wheatstone** (later Professor Sir Charles- 1802-1875) was the only member of the committee representing the BOT who had significant credentials in telegraphy. In 1837 he formed a partnership with William Fothergill Cooke to develop the first practical electric telegraph system, the “five needle telegraph”. Together they went on to invent the two-needle

[127] J. Ahvenainen. *The History of the Near Eastern Telegraphs before the First World War,* The Finnish Academy of Science and Letters. 2011, pp. 50-59.
[128] J. C. Parkinson, *The Ocean Telegraph to India: a narrative and a diary,* William Blackwood& Sons, Edinburgh, 1870.
[129] C. Bright, *Submarine Telegraphs: their history, construction and working*, Crosby Lockwood & Son, London, 1898, p. 59.

telegraph and the single needle version. Wheatstone also invented the "ABC telegraph system" and other developments in submarine cable telegraphy. As a professor of natural philosophy he also contributed to the science of photography, electrical generators, encryption, acoustics and music.[130] **George Bidder** (1806-1878) was a "Calculating Prodigy".[131] He was educated at Edinburgh University where he was a friend of Robert Stephenson. Unfulfilled in employment as a clerk in an insurance company, he became an engineer in the railway industry where he was credited with the invention of the swing bridge. Bidder was one of the founders of the Electric Telegraph Company.

Edwin Clark (1814-1894) started his working life as mathematics teacher. He then became a surveyor but in 1846 he became the chief engineer for the construction of Robert Stephenson's Menai Straits Bridge. This was the beginning of his fame as a hydraulics civil engineer building boat lifts on canals in Europe and in the UK which bear his name. In August 1850 Clark moved to The Electric and International Telegraph Company and patented several pieces of telegraph equipment.[132] **George Saward** (1822-1873) started his professional life in the railway industry. In 1850 he joined the newly formed British Electric Telegraph Company (BETC) as a manager and company secretary. In 1857 the BETC merged with the English & Irish Telegraph Company and Saward left to join the Atlantic Telegraph Company. After he died in 1873, his papers on the Atlantic cable were published as *The Trans-Atlantic Submarine Telegraph: A Brief Narrative of the Principal Incidents in the History of the Atlantic Telegraph Company. Compiled from Authentic and Official Documents by the Late George Saward Secretary to the Company* for private circulation.[133]

(Josiah) **Latimer Clark** (1822-1898) was the younger brother of Edwin Clark.[134] He began his working life as an industrial chemist but in 1847 he changed to surveying and then in 1848 he worked under Edwin Clark as assistant engineer on the construction of the Menai Strait Bridge. In 1850 the two brothers moved to telegraph engineering. In this specialty Latimer Clark excelled beyond Edwin with over 150 patents to his name in various countries. He worked with many worthies in the submarine cable industry including Charles Tilston Bright. He

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130 Bowers B, *Sir Charles Wheatstone FRS 1802-1875,* IEE History of Technology Series 29, 2001, IEE, London, ISBN 0-85296-103-0

131 Linfoot J, George Parker Bidder: Calculating Prodigy, *Institute of Mathematics and its Applications,* March/April/May 1987, vol23, pp 68-71.

132 S. Roberts. George Saward (1822-1873) http://atlantic-cable.com/CablePioneers/Saward/ accessed 5.6.2012

133 1885 This is now available as a facsimile from a number of sources

134 *A. F. Pollard, 'Clark, (Josiah) Latimer (1822–1898)', rev. Anita McConnell, Oxford Dictionary of National Biography, Oxford University Press, 2004; online edn, Sept 2014 [http://www.oxforddnb.com.wam.leeds.ac.uk/view/article/5469, accessed 5 June 2015]*

formed a partnership with Henry Charles Forde (1827-1897) and a Mr. Taylor. As consultant cable engineers they supervised the laying of more than 50,000 miles of cable. Clark authored many technical papers and books and was also a founder member of the Society of Telegraph Engineers. **Cromwell Fleetwood Varley** FRS (1828-1883) was a member of a large family, all of his siblings being either well-known engineers or well-known artists.[135] Varley joined the Electric Telegraph Company when it was formed in 1846 and by 1852 was its chief engineer.[136] He had previously been appointed to investigate the failure of the 1858 Atlantic Cable. During a long career he developed a number of tests for locating malfunction in submarine cables.[137]

4.4 The Composition of the Committee

The choice of professions represented on the Committee seems unbalanced. Stephenson and Stuart-Wortley had no experience of the telegraph industry. Douglas Galton was a military civil engineer and Fairbairn was a mechanical engineer and ship builder. Bidder was a mathematician and a mechanical engineer. He was also one of the founders of the Electric Telegraph Company but the archives do not show what his role in the company was. He does not appear in any technical archives as being a cable engineer or electrician. Only Professor Wheatstone had a grasp of the technical nuances of submarine cable telegraphy. It was possible that the BOT made its choices based on senior members of the *engineering* profession as electrical engineering was a very small and very new sub-specialty compared with civil and mechanical engineering in the mid-19th century. The Atlantic Cable Company chose specialists in the practicalities of laying and repairing submarine cables.

Captain William Rowett criticised the BOT's selection of the panel. Rowett, born in 1806 in Polperro, Cornwall, qualified as a Master Mariner but left the sea in 1834 to become a ship broker and then a cable maker with a factory in Liverpool. He even patented, in 1858, a "lightweight cable" which was "armoured" with hempen rope rather than iron/steel wires. It was not a success. Rowett's main criticism of the board was that although seamen did give evidence, there should have been a senior seaman on the board because only someone with such experience would ask the most penetrating marine questions. This would have been especially important as the enquiry was specifically about the design, manufacture and *laying*

[135] J. V. Jeffery. The Varley Family, *Notes Rec. R. Soc. London,* vol 51 (2), 1997, pp. 263-279. (John Varley Jeffery, the author, is a blood relative in the Varley dynasty)
[136] Bruce J. Hunt, 'Varley, Cromwell Fleetwood (1828–1883)', *Oxford Dictionary of National Biography*, Oxford University Press, 2004; online edn, Jan 2011 www.oxforddnb.com.wam.leeds.ac.uk/view/article/28114, accessed 5 June 2015,
[137]The Varleys were also deeply involved in the occult. - R. J. Noakes, Telegraphy is an occult art: Cromwell Fleetwood Varley and the diffusion of electricity to the other world. *BJHS,* vol 32, 1999, pp. 421-459.

of submarine cables. In 1865 Rowett wrote a book, *The Ocean Telegraph Cable: its construction, the regulation of its specific gravity, and submersion explained.* Half of the 123 pages of the book were a criticism of the committee, pointing out in great detail the poor choice of the BOT's representatives.

> It is true nautical witnesses have been examined and proved no doubt of much value, but how much more practical benefit would have resulted if questions had been put by a responsible nautical member of the Committee? One can imagine what would be said if a Committee of Seamen were to be appointed to sit in judgment upon some great question of electrical or engineering science: the press would justly thunder over their heads, and declare the report even of the honest tar valueless, however talented.[138]

In the second half of his book he described, also in great detail, the design and development of his rope-armoured light-weight cable. My impression of Rowett's book is that he was correct in criticising the committee but that he only made his criticism public because the cable companies rejected his light-weight cable.[139] It is possible that his rant against the Committee of Inquiry was genuine or it may have been sour grapes as he was not requested or given the opportunity to give evidence.

The minutes of evidence were printed in full in chronological order in which the witnesses were interviewed. The report itself was written in sensible order and I will summarize the findings noting the relevant evidence to clarify where necessary. Finally I will tabulate the immediate changes which were made to submarine cable telegraphy technology.

The *Report* was divided into three main parts namely: (1) an account of the principal submarine telegraph cables that had been laid, (2) the construction and laying of the cables, (3) a summary of the principles by which future cables were to be manufactured and laid. There is no evidence as to how the Committee selected witnesses; whether by request or by accepting offers to give evidence. A full list of the witnesses is attached as an appendix to this chapter.

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[138] W. Rowett. *The Ocean Telegraph Cable: its Construction, the Regulation of its specific gravity, and submersion explained.* Sampson Low, Son & Marston, London, 1865, p. 10.

[139] Their objections to it were that it was not strong enough and was difficult to lay because it was *too light* to sink quickly. It was in fact so light that it had to be hauled out of the ship's cable tanks and forced over the sheaves whereas an iron armoured cable sank by its own weight.

4.5 The principal submarine cables laid prior to the Inquiry

The committee classed cables as being "shallow water cables" or "deep sea cables". The former were cables liable to injury due to strong tidal currents, anchors and dredges from ships and fishing gear and assumed to be at depths of less than about 100 fathoms. Deep sea cables were those which were out of reach of these dangers in depths of considerably beyond 100 fathoms.[140]

4.5.1 Shallow water cables

Many of these cables were short and, although they were more strongly-armoured than those for deep sea, they did suffer damage although the location of the damage by electrical testing was more accurate than for long cables and repairs were easier. Also, because shallow water cables were shorter, duplicate, cables were often laid. Many of the shortest cables between the UK and Europe had up to four cores such that, if one copper conductor failed due to minor damage, it was often possible to use one of the remaining cores. For example it was noticed that the iron armouring wires were corroded more rapidly wherever they were exposed to *moving* sea water.[141] There were reports of severe abrasion on sharp rocks due to movement of the sea water by tides or currents and even strikes by lightning directly on to cables where they were not covered on beaches.[142]

4.5.2 Deep Sea Cables

The Committee confined its report to the following cables: Atlantic, Red Sea, Spezia-Corsica, Bona-Corfu, Dardanelles-Athens, Spain-Majorca, Toulon-Algiers and the Malta-Alexandria. The first attempts at laying a trans-Atlantic telegraph cable broke new ground both in maximum depth and overall length. Because of the lack of a large enough ship, the cable was not only laid in two halves by two different ships but half the cable was manufactured by Messrs. R. S. Newall in Gateshead, North West England, and the other half by Messrs. Glass Elliot & Co. at Greenwich. Because of the financial arrangements, and because an undertaking had been given that it be laid in 1857, little time was given to the proper design, development and testing of the cable.[143] Whitehouse stated that Cyrus Field, the chief promoter of the cable "*objected to further experiments because it would have put off the laying of the cable for*

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[140] *Report of the Joint Committee,* p. *vi.*
[141] *Ibid,* p. *vii.*
[142] *Ibid,* p. *viii.*
[143] *Ibid,* p. *viii.*

twelve months".[144] The cable was stored in the open air through a hot summer which caused deterioration because the gutta perch softened causing the copper wire to migrate eccentrically due to gravity. Part way through manufacture it was discovered that the conductivity of the copper used varied by as much as 40%. However, due to the time constraints, proper electrical testing during the manufacturing process was not adopted until the cable was almost complete.[145] The USN *Niagara* carried and laid the half manufactured by R. S. Newall and HMS *Agamemnon* was responsible for that manufactured by Glass, Elliot. Both ships proceeded from Valentia in Ireland with the *Agamemnon* laying on 7th August 1857. After 335 miles had been laid the cable broke in "2000 fathoms of water".[146] The report blames the fracture on inadequate paying-out machinery, which was poor design due to the time constraints. However, as I have shown in Chapter 3, the major cause of the fracture may now be assumed to be due to an uncharted submarine mountain peak.

After this accident, both ships proceeded to Plymouth and the cables were taken ashore and coiled into dry tanks "*for fear of corroding the outer wires with seawater*",[147] which seems peculiar as it would eventually be laid in sea-water. However as it was being inspected during transfer numerous faults were visually and electrically observed and were thought to have been caused either by the coiling/uncoiling or the original exposure to heat. It was also apparent that many of the splices (joints) were imperfectly completed. In the following spring the cables were reloaded onto the ships which then both proceeded to mid-Atlantic where the cables were spliced together and the ships proceeded under sail, the *Niagara* to Newfoundland and the *Agamemnon* to Valentia. After two abortive attempts, the ships returned to Cork, from where they started again on 17th July 1858. The lay was successfully completed on 5th August. Although communication had been maintained somewhat variably during the laying it became progressively more intermittent until it failed completely by 1st September. Before complete failure, communication was possible at about one word (of five letters) per minute using a relay to receive or two words per minute using Professor Thomson's patent "speaking mirror galvanometer". The committee attributed the failure to poor cable design owing to absence of experimental data, poor supervision during hasty manufacture with poor materials and it being "handled with insufficient care".[148] In a misguided attempt to clear the fault, Dr Wildman Whitehouse applied 2000 volt jolts to the cable which would have undoubtedly permanently breached the gutta perch insulation.

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[144] *Ibid,* p. 80.
[145] *Ibid,* p. *ix.*
[146] *Ibid,* p. *ix.*
[147] *Ibid,* p. *ix.*
[148] *Ibid,* p. *x.*

The Red Sea cable has already been discussed. In the words of the committee:

> We consider that the failure of this line is attributable to the cable having been designed without regard to the conditions of the climate or the character of the bottom of the sea over which it had to be laid; and to the insufficiency of the agreement with the contractor for securing the effectual supervision during manufacture and control of the manor of laying. It is moreover, to be regretted that the contract for laying this line was entered into without a full investigation into the question, considering that the success of the Atlantic cable was at the time very doubtful. [149]

The other deep water cables listed failed due to insufficient slack because of an insufficient length of cable; the cable breaking whilst the ship was riding at anchor throughout a storm; insufficiently powerful ships; poor surveying; a case of a hemp-only “armoured” cable and ingestion of the gutta perch by the organism *Terado navalis*.[150] The committee pointed out that:

> failures of all these submarine lines are attributable to defined causes, which might have been guarded against.[151]

They surmised that other causes of failure might become apparent in the future. A last comment by the committee, at the end of Section 1 of the report, refers to the fact that cable which had been kept in brine-filled tanks at below 50 degrees Fahrenheit immediately after manufacture. This preserved all aspects of the cable, so long as it was not allowed to dry *before* laying. If it was allowed to dry for even a short period of time, rust formation was accelerated, especially if there was more than one cycle of wetting and drying.[152]

4.6 The Construction and Laying of Submarine Cables

The Committee’s overall conclusions were that the concept of submarine cable telegraphy was sound; overall the technology was practical but there was a need for improvement at all stages from the planning, contracting and manufacture of the cable to the careful surveying of the route and the laying of the cable. These various stages will be discussed in the order in which they are dealt with in the Committee’s Report. There is no specific section of the report concerned with maintenance and repair *per se.*

4.6.1 The Conducting Wire

[149] *Ibid,* p. *xi.*
[150] bid, p. *xi.*
[151] *Ibid,* p. *xii.*
[152] *Ibid,* p. *xii.*

The first submarine cables consisted of a single conductor of No 16 gauge copper wire. Joints were lapped and soldered and a fine copper wire was then wound over the joint and silver-soldered for extra security.[153] Unfortunately these joints turned out to be very brittle. This was because it was impossible to acquire homogeneous copper wire. Consequently, impurities led to harder and softer areas in the conductor, which allowed stretching if put under tension. Once covered with gutta percha (which was very much more elastic then the copper wire), stretching beyond Hooke's Law, led to the wire buckling through the gutta percha covering once the tension was relieved. The best remedy was found to be the use of bundles of finer gauge strands of wire.[154] There were a number of suggestions for how to overcome this mechanical instability. The Gutta Percha Company embedded the strands in Chatterton's compound while Thomas Daft (1816-1878), an iron-founder and inventor, proposed coating the strands with vulcanized India rubber.[155] Latimer Clark suggested making the conductor in the shape of a solid wire divided into three or four sections longitudinally fitted closely together.[156] Newall united several strands of wire with solder [157] and Varley proposed separately insulating each strand.[158]

The quality of the copper was shown by Thomson to have an important influence on the conductivity but little research had been done before the *Committee of Inquiry* was convened.[159] The committee asked Dr Matthiessen (1831-1870), a highly respected chemist and physicist who specialized in metallurgy, to elucidate the question further. His full report was included as Appendix No 3 of the Committee's *Report*. He showed that there was a vast range of conductivities of copper from various sources which was related to the impurities therein. The summary of results is shown in Figure 4.2.[160]

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[153] "No 16 gauge" was probably Standard Wire Gauge (swg) 0.064 inches (1.626mm) diameter although SWG was not fixed by "Order of Council" until 23rd August 1883

[154] *Report of the Joint Committee,* p. *xiv*

[155] Chatterton's compound: 3 parts gutta percha, 1 part rosin, 1 part Stockholm tar. In *Report of the Joint Committee,* p. 89, it is not clear from the evidence how or why Daft was asked to give evidence as he had no connection with the cable industry

[156] Although this is quoted in the *Report*, I am unable to find it in Latimer Clark's extensive evidence. However it is mentioned in Bright's *Submarine Telegraphs* (1898) that Bright and Clarke seriously considered such a copper core in 1863.

[157] *Report of the Joint Committee, op cit,* pp. 251-259. I can find no such remarks in Newall's extensive evidence.

[158] *Ibid,* pp. 149-150.

[159] *Ibid,* p. *xv.*

[160] *Ibid,* p. *xvi.*

Quality of Copper.	Conducting Power.	Temperature Centigrade.	Cause of Diminution of Conducting Power.
Pure copper - -	100 mean	15·5°	
Specimen furnished by Mr. Tenant, cut from a piece $1\frac{1}{2}$ tons in weight -	98·78	15·5	Traces of silver. *No suboxide of copper.*
American (Lake Superior)	92·57	15	Traces of iron, silver (·03 per cent.) and suboxide of copper.
Australian (Burra Burra) -	88·86	14	Traces of iron and suboxide of copper.
Best selected - -	81·35	14·2	Traces of iron, nickel, antimony, suboxide of copper, &c.
Bright copper wire -	72·22	15·7	Traces of lead, iron, nickel, suboxide of copper, &c.
Tough copper - -	71·03	17·3	Traces of lead, iron, nickel, antimony, suboxide of copper, &c.
Russian (Demidorff) -	59·34	12·7	Traces of arsenic, iron, nickel, suboxide of copper, &c. The arsenic present may be considered the chief reason of the low conducting power.
Spanish (Rio Tinto) -	14·24	14·8	2 per cent. arsenic; traces of lead, iron, nickel, suboxide of copper, &c. The low conducting power is to be attributed to the arsenic present.
Gibraltar Core:			
Specimen No. 112 -	90·7	15·5	Traces of lead, suboxide of copper, iron and antimony.
„ „ 91 -	89·5	15·5	
„ „ 292 -	78·2	15·5	Traces of lead, arsenic (very small) iron, nickel, antimony, and suboxide of copper.
„ „ 240 -	74·4	15·5	

Figure 4.2 Summary of Matthieson's results from *The Report*, p. *xvi*

The committee concluded that it was very difficult to obtain pure copper and that there was no substance which could be added to pure copper to increase its conductivity but that it was important to use the best conducting copper in submarine telegraph cables. Alloys of copper that could increase its resistance but decrease its liability to oxidize were of benefit so long as there was uniform conductivity and the smallest variation in that conductivity with variation in temperature. These benefits were to be taken advantage of so long as the resistance did not become too high. Because of the importance of the electrical resistance, a key outcome of the Committee's deliberations was the necessity of having standardized units instead of the existing multitude of random measures of resistance.

4.6.2 The insulating covering

Insulation on land-line telegraph wires was most commonly the surrounding air, the bare wires being supported by glass or porcelain insulators. Where it was necessary for wires to pass underground or under water, they were commonly

> covered in cotton or silk laid spirally over the wire subsequently steeped in some resinous substance to protect it from the damp. Ultimately the wires so prepared were immersed in a body of pitch laid in wooden troughs or iron pipes.[161]

[161] *Ibid,* p. *xvii.*

This proved impractical for more than a few feet at a time. Another flexible insulator, *India rubber* or *caoutchouc*, which appeared almost specially intended for the purpose of insulation, was proposed.[162] However, this proposal was short-lived as light and air caused it to decompose, although very slowly. Gutta percha was much more easily worked and turned out to have greater insulating properties which improved further under high pressure but it took a lot of experimentation to purify raw gutta percha given its impurenatural state.[163] First attempts at covering wire with gutta percha suffered from air bubbles but this problem was eased by decreasing the impurities and by using several thin concentric layers applied at controlled temperature. The outer surface was then protected by a coating of Stockholm tar and the completed core was stored under water to protect it from oxidation.[164] Light exclusion also reduced the rate of oxidation. Acquiring a waterproof seal over joints (splices) of submarine cable was particularly difficult except by applying the purest gutta percha in fine strips wound longitudinally over the joint. Experiments carried out by Mr. Fairbairn FRS in Manchester at the request of the Committee showed that an increase in pressure around a gutta percha insulated wire actually improved the electrical insulation properties of the gutta percha which together with darkness of the deep and the stable low temperature at great depth, made it an ideal insulator for submarine cables.[165] Although there was a measureable absorption of fresh water by gutta percha, this was virtually nil in brine.[166] In general the Committee's conclusion was that the absorption of sea water by either India rubber or gutta percha was so small as not to constitute a problem and that the high pressure of the deep-sea environment actually improved insulation of gutta percha.

In 1854 Latimer Clark had brought the problem of electrical *induction* of long insulated cables to the attention of Faraday.[167] The problem arose because of the resemblance of an insulated conductor in sea water to an elongated Leyden jar. In modern parlance the cable acted like an elongated electrical capacitor which distorted the signal by smoothing it out, thus slowing transmission. Appendix No 1 of the *Report* discusses work done for the Committee by one of its members, Professor Charles Wheatstone, to investigate this property of the cable acting as a Leyden jar or *condenser*. A theoretical formula was derived by Thomson and given in his evidence:[168]

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[162] *Ibid,* p. *xviii*
[163] *Ibid,* p. *xviii*
[164] Stockholm tar is a high grade resin from Swedish pine trees. It was rendered more spreadable by the addition of linseed oil.
[165] *Report of the Joint Committee,* p. *xix*.
[166] *Ibid,* p. *xx* and see Appendix No 6 of the evidence
[167] *Induction* in modern parlance would be "capacitance"
[168] *Ibid,* pp. 126-127.

$$The\ electrostatic\ capacity = \frac{I}{2\ \log \dfrac{D^1}{D}}$$

where I = specific inductive capacity of the insulating material

log denotes the Naperian logarithm of

D = diameter of the copper wire

D^1 = diameter of the outside of the insulation

Hence by increasing the diameter of the wire and the thickness of the insulating covering in proportion the electrical capacitance remains the same.[169] The only advantage of increasing these diameters in proportion was to reduce the conductor resistance but this had to be balanced against the extra cost of raw materials and the weight of the cable. It was also noted that although Fizeau and Gounelle had ascertained the velocity of electricity to be 111,834 miles per second in copper and 62,130 miles per hour in iron wire, Faraday and Clark had estimated the time through 1,500 miles of subterranean wire to be two seconds; the reduced speed being due to the inductive capacitance.[170] The Committee agreed that one of the biggest problems to be solved in submarine cable telegraphy was how signals may be made to follow each other along a cable with the greatest rapidity.

The most important way of improving the speed was perfection in the preparation and application of the insulation coating.[171] Another insulating material considered was India rubber which was found to surpass gutta percha in the smallness of capacitance and perfectness of insulation.[172] Only the purest samples of gutta percha could equal the insulation of India rubber and then equality only occurred when the gutta perch was twice the thickness of rubber. Impurities in either rubber or gutta percha reduced the insulation and increased the capacitance, as did even the addition of layers of wound cotton thread, which was a poor insulator if it became slightest bit damp. Changes in temperature only affected capacitance in so far as it affected the insulation resistance. Gutta percha was to be used in the main because of its ease of application compared with rubber and because its insulating properties actually improved when under the intense hydraulic pressure of the deep seas. Deterioration of gutta percha insulation was reduced further if it was coated with a layer of Stockholm tar. However, India rubber was recommended for shallow tropical seas where the higher temperature may

[169] *Ibid,* p. *xxii.*
[170] *Ibid,* p. *xxiii.*
[171] *Ibid,* p. *xxiv.*
[172] *Ibid,* p. *xxii*, para. 6.

have caused gutta percha to soften to the extent that the copper conductor became eccentric; it was especially recommended for the shallow "shore ends" of cables in the tropics.[173] The committee also recommended that

> electrical tests should be continued during the covering of the cable and whilst it is being submerged in order that comparative results may be obtained throughout.[174]

4.6.3 The external Protection

> Gutta percha is an extremely tender material and is peculiarly liable to injury from the slightest cause.[175]

Thus the Committee stated that the *core* (the copper conductor surrounded with its coat of gutta percha) had to be protected at all times, from the moment it came out of the coating machines even before transport to the cable factory. The most effective first coat was an "ordinary tape", steeped in tar, wound spirally around it. They also pointed out that no greater strain was put upon the cable than during manufacture, transport or laying. At the cable factory a considerable thickness of hemp soaked in Stockholm tar and tallow was applied to separate the core from the tough, hard iron wire armour. The committee found that there was no better combination of layers than had been in use for at least half a decade. However, they did find that single conductor cables had been more reliable than multi-conductor cables. This was especially so near the shore and harbours where damage from anchors or fishing gear was more likely; the chance of breaking four separate cables was far smaller than breaking a single cable with four conductors.[176] For this reason the thickness and strength of the armour of the "shore ends" had to be very much greater than that of the deep-sea parts. However, the armour applied to the deep-sea parts had to be strong enough to cope with the stresses and strains of laying which were much greater than during laying in shallow water.

A further problem with very deep cables was that at a depth of three miles, the weight of the cable hanging from the sheaves of the cableship whilst being laid or retrieved for repair was sufficient to cause stretching and this occurred despite using thicker wires which of course were heavier. A thin copper conductor with only a gutta percha coat was less likely to break because its overall specific gravity was much lower. The Committee heard evidence of cables where the only protection was a hempen rope layer outside the gutta percha but Sir Samuel Canning, a highly respected cable engineer, gave evidence against the use of hemp alone as he

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[173] *Ibid,* p. *xxxiv.*
[174] *Ibid,* p. *xxxiv.*
[175] *Ibid* p. *xxv.*
[176] *Ibid,* p. *xxvi.*

judged that it would soon rot even if soaked in tar.[177] Lionel Gisborne had personal experience of the hempen rope "armoured" cable, the so called *lightweight* cable. He pointed out in evidence two serious problems. The first was that the cable tended to stretch under its own weight when being laid at great depth. This caused the copper conductor to permanently reduce in diameter with consequent increase in electrical resistance. The second problem was that over time in water the hemp would shrink which allowed the already over-stretched copper conductor to "knuckle through" the rope and often the gutta percha as well allowing contact between the copper and the sea water.[178]

Other problems encountered with the light-weight cable were its susceptibility to being eaten by marine organisms, its being easily damaged by abrasion and it becoming too weak mechanically to be raised for repair. It was also too light to lay easily, as although of greater specific gravity than water, it sank too slowly.[179] The union of hemp and galvanised iron or steel wires appeared to the Committee to be the best combination especially with an outer coating or tar to protect from rusting. The cable had to be treated with care on the laying ship to avoid kinking, which caused the core to knuckle-through. The Committee organised a large number of tests by Messrs. Gisborne & Forde and C. W. Siemens, to determine the strength and durability of the outer coverings of submarine cables.[180] Cables had been frequently laid with iron wires as armour but, without protection from the sea water, rusting rapidly occurred, except in the cases where the cable had become buried in sand or mud. The Committee organised mechanical strength tests of the various cable types available to them. A summary of the results is shown in Figure 4.3.[181]

[177] *Ibid,* p. 59.
[178] *Ibid,* p. 3. Lionel Gisborne (1823-1861) was a civil and telegraph engineer.
[179] *Ibid,* p. *xxvi.*
[180] *Ibid,* Appendix 10, pp. 391-441.
[181] *Ibid,* p. *xxviii.*

Name.	General Description of Arrangements for Strength and Protection.	Specific Gravity.	Length of Cable in Water in Fathoms equivalent to 0·5 per Cent. of Elongation.	1· per Cent. of Elongation.	Breaking Strain.
Cables in which the Strength is placed in the Outer Covering, by means of Hemp or Wires, laid on spirally.					
			Fathoms.	Fathoms.	Fathoms.
Clark, L.	Steel wire, with a slight spiral, covered with tape, shellac, and marine glue. *See* Plate, No. 5	1·92	1,610 1,119	Not reached Not reached	Not broken. 3,376
Gisborne and Forde (Gibraltar Deep Sea).	Steel wires, coated with hemp, laid spirally. *See* Plate, No. 2	1·9	1,176 2,440	1,947 3,924	Not broken. Not broken, with a weight = 5,683 fathoms in water.
Siemens	Strands of hemp, laid spirally, protected by thin copper sheathing. *See* Plate, No. 4	1·5	1,342 2,046 1,694	2,552 3,672 3,284	Not broken. Do. Do.
Cables in which the Strength is placed in the Outer Covering, by means of Hemp or Wire, laid on longitudinally.					
De Bergue	Tarred hemp lines served round with cord of hemp. *See* Plate, No. 5	1·26	5,300 —	8,124 5,908	Not broken. 16,982
Godefroy	Steel wires, coated with india-rubber, and covered with india-rubber canvass. *See* Plate, No. 3.	1·9	2,653	Not reached	3,424
Do.	Do.	1·4	2,596 2,596	3,500 Not reached	Not broken. 3,309
Hall and Wells	Hemp lines kept in place by plaited hemp. *See* Plate, No. 4.	1·35	760	1,126	4,420 4 per cent. extension.
Do.	Steel wire and hemp lines kept in place with plaited hemp.	1·6	2,499	Not reached	2,729
Do.	Do.	1·9	2,437	4,525	5,597
Silver	Steel wires, covered with plaited hemp. *See* Plate, No. 2	2·8	1,642 1,832	2,260 Not reached	Not broken. 3,213
Sinnock	Tarred hempen lines, served in a close spiral, with hemp string and iron wire. *See* Plate, No. 4	1·4	622 —	1,088 463	Not broken. 2,855
	Do.	1·7	997 —	1,782 636	— 7,132
Cables in which the Strength is placed next the Copper Conductor inside the Insulating Covering.					
Allan	Steel wires, laid spirally on copper conductor, outer covering plaited jute, saturated with marine paint. *See* Plate, No. 3.	1·6	1,519 1,283	Not reached 2,258	Not broken. 2,936
Do.	Do., outer covering india-rubber canvass.	1·38	3,405	5,555	7,484
Do.	Do., outer covering Godefroy's compound.	1·3	3,835	6,340	6,348

Figure 4.3 Summary of the results collated by Messrs Gisborne & Forde and C. W. Siemens, to determine the strength and durability of the outer coverings of submarine cables. From the *Report of the Joint Committee*, p. *xxviii*.

Illustrations of the cables listed in Figure 4.3 are shown in Figure 4.4.[182]

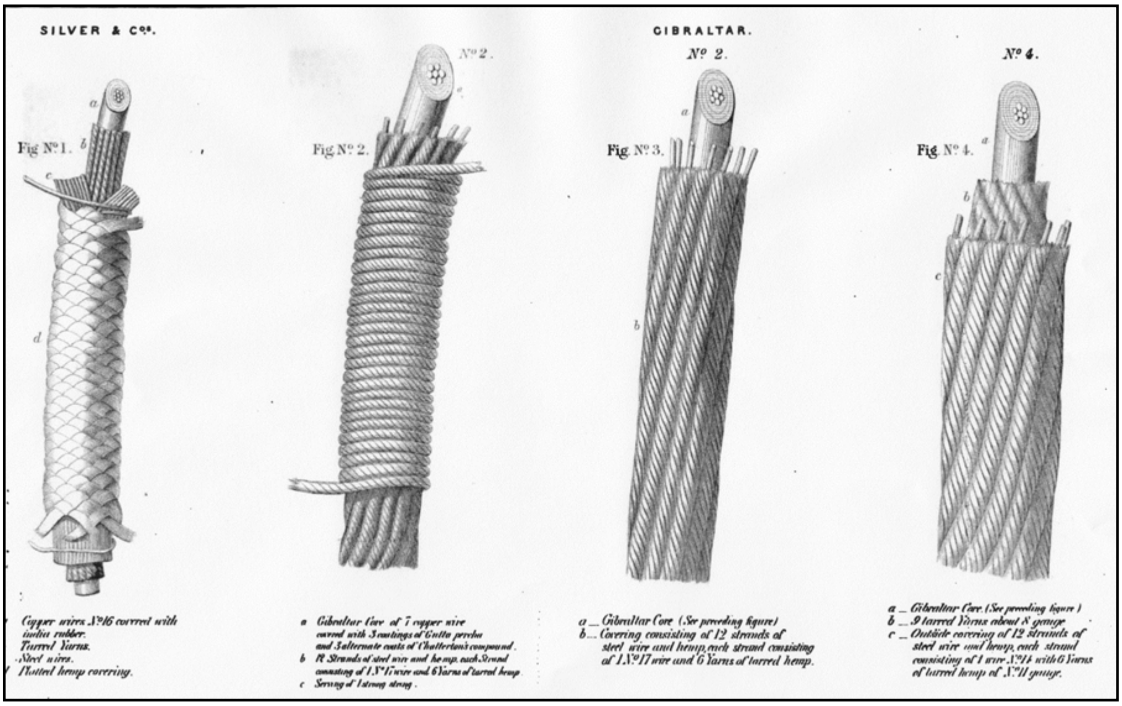

Figure 4.4a Plate No 2 from the *Report*, Appendix 9.

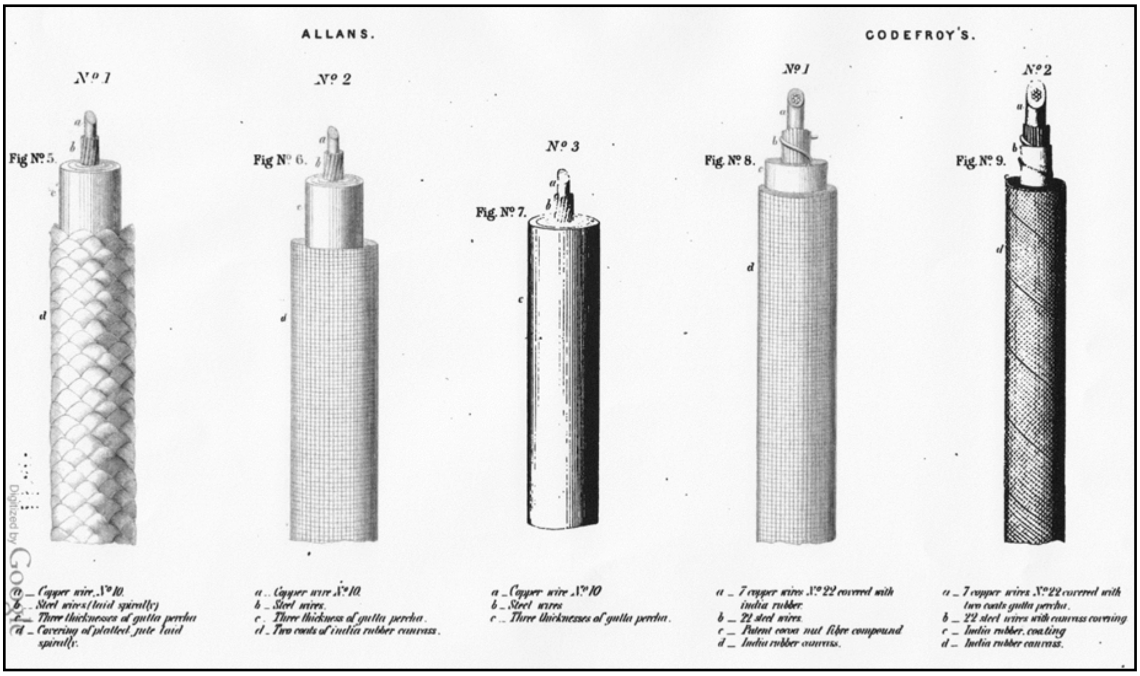

Figure 4.4b Plate No 3 from *Report of the Joint Committee,* Appendix 9.

[182] *Ibid,* Appendix 9.

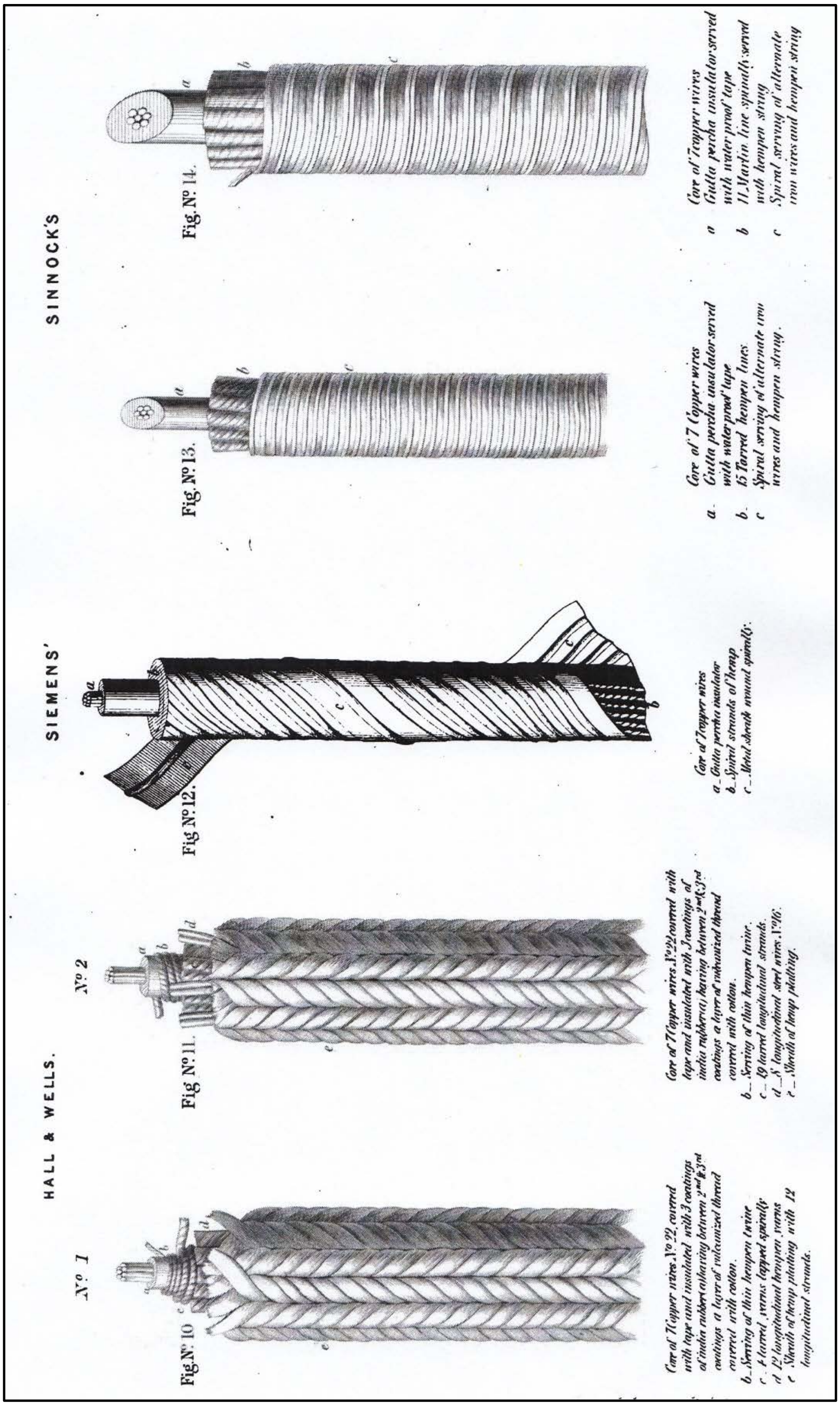

Figure 4.4c Plate No 4 from *Report of the Joint Committee,* Appendix 9.

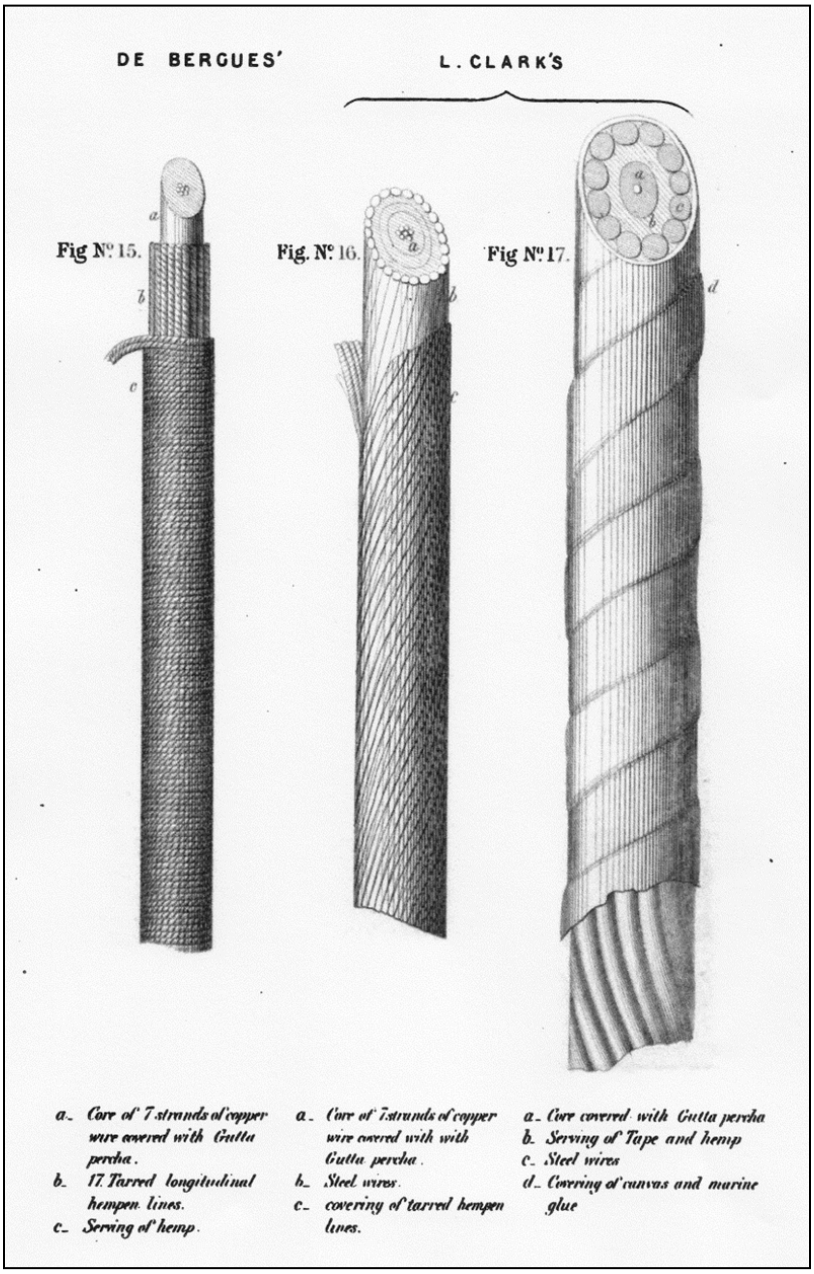

Figure 4.4d Plate No 5 from *Report of the Joint Committee,* Appendix 9.

The Committee also noted that the Gibraltar cables were easily kinked and that the kinks became permanent if tension was applied; Messrs. Clark's, De Bergue's, Godefroy's, Hall & Wells', Sincock's and Allan's cables were all difficult to kink and the kinks were unfolded by tension.[183]

The conclusion of the Committee was that the choice of the outer covering and armouring must in each case depend on the local circumstances and therefore good surveying of the route was essential. The outer coverings had to protect the internal core against injuries and strains in laying or raising for repair, against the attacks of marine animals and against abrasion on a hard bottom. It also had to be manufactured in such a way that repair and splicing could

[183] *Ibid,* p. *xxvii.*

be carried out with ease.[184] This recommendation was especially important for shallow water cables and shore ends which were subject to repeated injury caused by currents, anchors and fishing gear. Thus the armour had to be strong enough to cope with injury in shallow water but also strong enough in deep water to cope with the strain of laying (due to its weight) and raising for repair. The recommendation was also that there should be an outer coating of tarred yarn to protect the iron or steel wires from corrosion.[185]

4.6.4 Laying and maintenance of submarine cables

It was obvious to the Committee that a detailed survey of the bottom of the sea must be made before a new cable was contemplated. This survey should include an analysis of bottom samples, both for injurious chemicals and substances which might cause mechanical damage.[186] Examples were cited of where poor surveying lead to serious cable failure the Channel Islands cable, The Red Sea Telegraph and the Bona–Cagliari–Malta cable.[187] Surveys available by 1859 were very poorly distributed and indeed had only been surveyed at points 10 to 15 miles apart thus missing many deep trenches and high mountains.[188] The Committee considered that soundings should have been taken at two mile intervals and even more frequently where any irregularity had been detected. Apart from the survey problem, the Committee also pointed out some important points about the ships used to lay the cables.

Experience had shown that ships laying cables needed to have a large amount of surplus power so as to be able to make way against contrary winds and seas. To prevent damage and kinking the cable needed to be stored on the ship in the largest diameter coil possible. The space for the cable had to be perfectly clear with no cross beams or perpendicular supports. At this time all ships laying cables had been modified from other purposes. Careful conversion had to be carried out so that the stability of the ship was not compromised by the continuous alteration of the cargo weight as the cable was paid out. Many of the ships that had been brought into cable service were found to roll badly when fully laden. There had been a vogue for using large old sailing ships to lay the cable whilst being towed by a steam tug but this method proved unmanageable in heavy seas and the steering was very difficult in case of accident. If the cable became stuck between the hold and the sea then it proved very difficult

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184 *Ibid*p. *Xxxiv.*
185 *Ibid*, p. *xxxv.*
186 *Ibid,* p. *xxxv.*
187 *Ibid* p. *vii.*
188 *Ibid,* p. *xxx.*

to stop the tug and barge combination before the cable was put under intolerable strain.[189] The accurate navigation of cable ships was made more difficult because the navigation compasses were seriously affected by the large but ever decreasing amount of iron in the cable as it was paid out. Another difficult problem was the management of the heavy and inflexible cable. Cable kinking could have been eliminated by laying cable directly from the drums (from the cable manufacturer) which were unwound by rotation about their axis but this was entirely impractical on board ship.[190]

Vessels loaded with cable were found to roll to "*an inconvenient extent*", although paddle steamers were more stable than screw steamers. With existing machinery to brake the speed of the cable from the holds to the depths, very delicate control was needed to ensure that the cable was laid with the required amount of slack and without excess strain. This had proved extremely difficult in high winds or a rapid tideway. These conditions also made navigating the vessel difficult as the drag of the cable over the stern made steerage difficult at low speeds.[191] Ships used for cable laying had to be able to maintain a speed of at least six knots even when fully laden with cable. At the time of the *Inquiry,* it was still considered to be impossible to recover any cable for repair that was deeper than 300 to 400 fathoms. Also there was no evidence of under-water currents at greater depths than 60 to 100 fathoms.[192]

4.7 Contracts for Manufacturing and Laying of Submarine Cables

The committee questioned a number of witnesses about contracts between the cable manufacturers and the operators. J. W. Brett, one of the Brett brothers who laid the first submarine cables from Dover to France and had been involved in the cable industry ever since, was asked whether the contractor (manufacturer and layer of the cable) should dictate the kind of cable that was to be made. Brett thought not, as the operator should have the choice based upon "*experience and scientific principles*"[193]- this, despite the contractor having to guarantee that the cable was operational immediately after laying and for a subsequent period.[194] Sir Charles Bright considered that many cable failures were due to the contracting methods. When asked:

> Should you think it a vicious principle to make a bargain with a contractor to lay a cable that should work for a week or a fortnight for so much money and at the

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[189] *Ibid,* p. *xxx.*

[190] *Ibid,* p. *xxvii.*

[191] Steerage: The direction of a vessel is altered by adjustments to the angle of the rudder but the vessel will only alter direction when it is moving. The direction of the vessel is also determined by tides, currents and wind and by the drag of the cable.

[192] *Report of the Joint Committee, op cit,* p. *xxx.*

[193] *Ibid*, p. 57, para. 1406.

[194] *Ibid,* p. 57, para. 1407-8.

> same time allow the contractor to be the sole, or almost the sole judge as to the description of the cable to be used?

He answered:

> I should most certainly think it very objectionable.[195]

The Committee compared contracting for the manufacture of cables with that of the railway. It considered that operating companies should not approach contractors asking them at what cost they would be prepared to lay down a cable in a given position, guaranteeing its performance for a given period as though the cable was like a railway line, as there were far more confounding features.[196] All cable contracts had to have stated electrical specifications by the operating companies. Before the Atlantic cable failures, contracts only specified the weight/foot or the gauge of the copper wire with vague reference to its chemical composition. Nothing was specified about its electrical characteristics.[197]

4.8 Missing witnesses

The questions of *contracts* and *funding* lead me to consideration of those who were ***not*** witnesses, either voluntary or invited. The Committee would have benefited from evidence from the American Cyrus W. Field, who was the powerhouse behind the setting up of the Atlantic Cable Company, without whose drive the necessary funding to attempt laying the longest cable ever would not have been found, and (later Sir) John Pender, a rich cotton merchant in Manchester who was likewise the leading English protagonist for international submarine telegraph cables. There were a number of other missing witnesses.

I have already mentioned **William Rowett** who clearly thought that the composition of the committee was unbalanced. He was also aggrieved that he was not called as a witness and that his “light weight” cable had been criticised. **T. R. Crampton** (1816-1888) designed the first submarine cables between Kent and France and was described as the “father of submarine cables” by Bright as his designs were changed little for a decade.[198] Crampton began his professional life as a railway and civil engineer before being invited to join the Brett brothers. He joined the Council of the Society of Telegraph Engineers soon after its break from the Institute of Civil Engineers.

[195] *Ibid,* p. 52, para. 1307-8.
[196] *Ibid*, p. *xxxii.*
[197] B. J. Hunt. The Ohm is where the Art is: British Telegraph Engineers and the Development of Electrical Standards. *Osiris,* 2nd Series, Vol 9, 1994, p. 57.
[198] Bright, *op cit*. p. 11.

Mr. (later, Sir) **George Elliot** (1784-1863) was an industrialist and later a politician with deep roots in the cable industry. He had purchased Kuper & C. rope-makers, in 1849, in order to manufacture submarine cable which he did successfully, especially after forming a partnership with Richard Glass. As Glass, Elliot & Co. they manufactured half of the first Atlantic cables as well as many others.

F. N. Gisborne was a highly accomplished cable engineer who, although English, spent most of his professional life in Canada, which was probably the only reason for his not appearing as a witness. **Oliver Heaviside** was an eccentric electrical genius who could have provided very deep insights into the theory of submarine cables but was an abrasive character and **William Thomson** very ably provided the Inquiry with any theoretical background knowledge it required. **William Hooper** was a chemist who was first to apply vulcanisation of rubber for electrical insulation in 1849. Hooper would have been a valuable witness as no other chemist was called to give evidence (in 1870 he set up Hooper's Telegraph Works to manufacture telegraph cable).

Although there may have been misgivings, the *Report* was still considered extremely valuable. Sir Charles Bright, in his Presidential Address to the Institution of Electrical Engineers in 1887, remarked of the Committee's Report:

> I consider it to be the most valuable collection of facts, warnings and evidence which has ever been compiled concerning submarine cables and that no telegraph engineer or electrician should be without it, or a study of it – it is like boards on ice marked Dangerous as a caution to skaters.[199]

4.9 The Formulation of Electrical Standards and Units

One of the clearest recommendations of the Committee, and the subject of urgent attention, was the need for a proper universal standard unit of electrical resistance. In the year the report of the Inquiry was published as a Parliamentary "Bluebook" (1861), a very important paper was given at the British Association for the Advancement of Science by Charles Bright and Latimer Clark which had great relevance to submarine telegraph cables, especially their maintenance.[200] Bright and Clark pointed out the "*necessity of having a rational system of electrical units and to construct an equivalent standard of measurement*".[201] Land-line telegraphy only required the crudest of electrical measurement: most frequently, only the

[199] *The Report*. *op cit,* P. 61.
[200] Parliamentary "Bluebooks" were traditionally so-named; this Committee report was brown leather bound!
[201] Bright, op cit, p61.

qualitative *detection* of a current either with a simple un-calibrated galvanometer or even the human tongue. Faults and breaks in land-lines were most often located by simple visual examination of the wires. Submarine cable telegraphy required much more accurate and repeatable measurements, especially of electrical resistance for the location of faults and breaks which were, of course, normally invisible. Even well into the second decade of submarine cables, electromotive force (emf) was usually quoted in the number of cells of a particular type in series which was very inaccurate as the emf of each type of cell was different. It also varied with the current being drawn and the age of the cell. But resistance was key to the technology and a standard unit was required.

Prior to any standardization, the telegraph engineers used their own national arbitrary units of resistance…

England: English mile of No 16 gauge copper wire

France: 1km iron wire 4mm in diameter

Germany: German mile of No 8 gauge iron wire

…but no account was taken of the purity of these wires.

Academics used their own standard units:

1838 Lenz used “1 foot of No 11 copper wire”

1843 Wheatstone used “1 foot of copper wire weighing 100 grains”

1845 Buff used “1.5mm diameter German-silver wire of 75 cm in length”

These units were called “arbitrary units” because they did not relate to any of the known basic, so-called “absolute units” which at that time were length, time and mass. It was soon realized that many other quantities could be described using these basic units: area was the product of two lengths, volume that of three lengths and velocity was the product of length and time. In 1851 William Weber showed that by accepting the principle of the Law of Conservation of Energy it was possible to apply “mechanical” units to electrical or magnetic energy to define absolute units. If the permeability of air (a quantity indicating the ease with which a magnetic field could be set up in air) were fixed at unity, it would be possible to define an absolute system of electromagnetic units. Similarly if the dielectric constant of a vacuum (a quantity indicating the ease with which an electric field could be set up in free space) was fixed at unity, it would be possible to define a system of absolute electrostatic units.[202] A committee on

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[202] *Curtis HL. Absolute Electrical Measurements. The Scientific Monthly. Vol 69, 1949, p. 10.*

Electrical Standards was appointed in 1861 by the British Association for the Advancement of Science (BA) and their findings are summarised in Figure 4.5.

Description.	Name.
Absolute $\frac{\text{foot}}{\text{second}} \times 10^7$ electro-magnetic units (new determination)	Absolute $\frac{\text{foot}}{\text{second}} \times 10^7$.
Absolute $\frac{\text{foot}}{\text{second}} \times 10^7$ electro-magnetic units (old determination)	Thomson's unit ....
Twenty-five feet of a certain copper wire, weighing 345 grains...	Jacobi ....
Absolute $\frac{\text{metre}}{\text{second}} \times 10^7$ electro-magnetic units determined by Weber (1862)................................	Weber's absolute $\frac{\text{metre}}{\text{second}} \times 10^7$ ....
One metre of pure mercury, one square millimetre section at 0° C.	Siemens 1864 issue......
One metre of pure mercury, one square millimetre section at 0° C.	Siemens (Berlin) ......
One metre of pure mercury, one square millimetre section at 0° C.	Siemens (London) ......
British Association unit	B. A. unit, or Ohmad...
One kilometre of iron wire, four millimetres in diameter (temperature not known)	Digney.....................
One kilometre of iron wire, four millimetres in diameter (temperature not known)..................	Bréquet ....
One kilometre of iron wire, four millimetres in diameter (temperature not known)..................	Swiss ....
One English standard mile of pure annealed copper wire $\frac{1}{16}$ in. diameter at 15°·5 C.	Matthiessen...............
One English standard mile of one special copper wire $\frac{1}{16}$ inch in diameter..............................	Varley ....
One German mile=8238 yards of iron wire $\frac{1}{6}$ inch in diameter (temperature not known*)	German mile ....

Figure 4.5 Units of Electrical Resistance available to the Victorian Electricians.
Extracted from: Jenkin F, Report on the new unit of Electrical resistance proposed and issued by the committee on Electrical Standards appointed in 1861 by the British Association. *Proc. Royal Society of London.* 1865 Vol 14, p. 157.

The committee included Professors Williamson, Wheatstone, Thomson, Miller, Clerk Maxwell and G. C. Foster. They were joined by Sir Charles Bright, Dr. J. P. Joule, Dr. A Matthiessen, Messrs. Balfour Stewart, David Forbes, C. W. Siemens, C. F. Varley, Latimer Clark, Charles Hockin and Fleeming Jenkin.[203] This Committee's work lasted from 1861 to 1869. An editorial

[203] F. Jenkin *Reports of the Committee on Electrical Standards.* British Association for the Advancement of Science. 1864, pp. 191-199

in *The Electrician* expressed concern that the outcome of the Committee should be practical enough for the use of telegraph electricians:

> …we fear there is some danger that a system may be devised which will be followed exclusively by the eminent gentlemen at whose recommendation it is put forward. That this would prove worse than useless, in a practical point of view, need scarcely be insisted upon.[204]

Their labours produced a system of absolute electro-magnetic units from which were derived the ohm, ampere, farad, volt and coulomb. This system was finally promulgated by an International Congress in 1881 at which "*every civilized nation was represented*".[205] The most important basis of this work was that all the standards could be traced back to an *absolute* value whose unit was based somewhat confusingly upon a mechanical speed (metres/second or feet/second). Maxwell developed a method for actually measuring such a standard for resistance. However, its value was so minute as to be only useful to an academic scientist. To be useful to engineers and electricians the standard unit of resistance, the ohm, was defined as 10^7 times larger.

4.10 Conclusions

In conclusion, the opinion of the *Committee of Inquiry* adduced that past cable failures were due in the main to causes which could have been avoided had the conditions been sufficiently understood beforehand. They also "*expressed the conviction that submarine telegraphy might be as sure and remunerative in the future as it had been speculative in the past, provided that the specification, laying and maintenance of the cable were proceeded with on the lines laid down in their report*."[206] This, combined with the outcome of the BA Standards committee in producing what became universally accepted units of resistance, led to a successful future for the submarine telegraph cable technology well into the 20th century, so much so that it may be said to have led to a "technological stagnation".[207]

[204] Editorial, *The Electrician*, 9th November 1861.
[205] Bright, *op cit*, p61.
[206] ibid*,* p60.
[207] B. Finn, Submarine Telegraphy: a Study in Technical Stagnation. *Communications under the Seas – Evolving Cable Network and its Implications*, edited by B. Finn , D. Yang, The MIT Press, USA, 2009, pp. 9-24.

Appendix

List of Witnesses at the Inquiry

Thomas ALLEN

Admiral Horatio AUSTIN

Captain AB BEECHER

Captain Sir Edward BELCHER

John W BRETT

Sir Charles Tilston BRIGHT

Sir Samuel CANNING

John CHATTERTON

Joshia Latimer CLARK

Thomas Barnabas DAFT

Commander Joseph DAYMAN RN

Admiral Robert FITZROY RN FRS

Charles Henry FORDE

John FULLER

Richard Atwood GLASS

Lionel GISBOURNE

Walter HANCOCK

William Thomas HENLEY

Prof David Edward HUGHES

Fleeming JENKIN

Captain John KELL

James Atkinson LONGRIDGE

John MACINTOSH

William MAYES RN

Robert Sterling NEWALL

William Henry PREECE

Admiral Sir James ROSS

George SAYWARD

Col. TP SHAFFNER

Benjamin SHARPE

William C SIEMENS

Hugh Adam SILVER

Willoughby SMITH

William THOMSON

Cromwell Fleetwood VARLEY

Charles Vincent WALKER

Captain J WASHINGTON

Charles Frederick WEBB

Charles WEST

Edward Orange Wildman WHITEHOUSE

Frederick Richard WINDOW

William Henry WOODHOUSE

Leonard WRAY

Allen YOUNG

5. Implementing the Committee of Inquiry

5.1 Introduction

The Joint Committee Appointed by the Lords of the Committee of the Privy Council for Trade and the Atlantic Telegraph Company to Inquire into the Construction of Submarine Telegraph Cables (hereafter *Committee of Inquiry*) was a turning point in the history of intercontinental communication. I begin this chapter with a summary of the changes brought about by the *Committee of Inquiry* which concluded with encouraging remarks that intercontinental submarine cable telegraphy was an important and technically as well as financially viable enterprise. This meant that the electricians and engineers involved in this developing industry not only had to take account of the conclusions of the *Inquiry* but also had to solve new technical problems as new techniques and equipment to further improve speed and reliability came on stream. The further development of "terminal" equipment, namely the siphon recorder in 1867, the problem of earth currents, duplex circuits and - towards the end of the 19th century - early forms of automatic relay "repeaters" made the skills and knowledge required of the technical staff in the field ever more complicated and important. I then deal with the causes of failure of submarine telegraph cables. Deterioration or sudden complete loss of communication through submarine cables were far more frequent than previous publications would indicate. This lack of reporting is due to the detrimental effect such would have had on the reputation and income of the cable operating companies. Initially breakdowns were thought to be due to manufacturing faults and even sabotage during laying. It gradually became apparent, however, that there were many types of fault or breakdown ranging from anchors to sub-sea volcanic eruptions and from fish bites to the voracious appetite of the so called marine borer insects which were not predicted by the *Inquiry* and for which new solutions had to be found.

5.2 Summary of findings of the Committee of Inquiry

In 1872 Sir James Anderson, who had been captain of the SS *Great Eastern* during the laying of the 1865 and 1866 Atlantic cables and later became the managing director of the Easter Telegraph Company, gave a paper at the Statistical Society in London entitled *The Statistics of Telegraphy.*[208] He summarised the outcome of the Committee by stating that…

[208] Sir James Anderson presented and then published as a hard-bound volume his lengthy paper entitled *Statistics of Telegraphy*, mainly to excuse or justify the seemingly high tariff which was levied per word sent.

> the loss of all cables was attributable to defined causes which might have been guarded against and that they believed there were no difficulties to be encountered which skill and prudence would not overcome.[209]

Anderson was polite in not making a stronger point that the industry could have used hindsight much earlier and would thus have avoided repeating errors that had been made in the past. However submarine cable telegraphy was one of the first new complex technologies requiring practices which were at the limits of expertise in many different scientific disciplines – mass production of cable, special ships, submarine geology, special forms of seamanship, accurate navigation, electrical science and engineering. A decade after the Committee he also reported…

> that the report is full and complete and established principles which up to the present time have uniformly guaranteed success, while the neglect of them has uniformly resulted in partial loss or failure.[210]

As a result of the encouragement proffered by the *Committee of Inquiry*, the manufacture and laying of cables increased rapidly with British expertise and commercial drive allowing the United Kingdom to maintain its ever increasing world dominance in all aspects of submarine cable telegraphy. In tandem with the need to increase the reliability of cable telegraphy so that it would gain the trust of commerce and international diplomacy, there was the requirement to increase the capacity and speed (in terms of words per minute) in order to make this form of communication financially viable.

As the popularity and advantages of international cable telegraph rapidly increased, more cables were laid and methods of increasing the capacity of existing cables were introduced. Three major technological advances were soon made: the widespread use of *siphon recorders*, the introduction of *transmission and reception condensers* and the development of simultaneous communication in both directions along a single cable or duplexing. Also towards the end of the 19th century, methods for automatically "relaying" or amplifying signals, reducing the necessity of human operators at relay stations on very long sections of cable were tentatively introduced. These technologies are discussed below in detail as they had a marked effect on the number and quality of maintenance electricians that were required; the number increased at the same rate as did the length of cable in use. At the same time, the terminal equipment increased in complexity requiring more accomplished electricians.

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[209] Anderson J. *Statistics of Telegraphy*. The Statistical Society, London, 1872, p63
[210] Ibid*,* p. 64.

5.3 Siphon Recorder

Apart from the improvements to the design and manufacture of submarine cable and laying machinery, the greatest improvement in accuracy and efficiency of transcription of cable code signals was Thomson's siphon recorder. This was the first of a succession of new pieces of equipment to improve the efficiency of the system. It also was a major innovation to the work load of the station electricians who had to acquire the skills to maintain what was a very delicate device which was both more complex and less technically reliable than the mirror galvanometer. As noted in Chapter 1, Thomson designed his siphon recorder to relieve the intense concentration required of two operators and to keep a permanent record on paper tape or *slip*. The siphon recorder also allowed greater speeds of transmission as the reception/transcription rate increased. It was first introduced in 1867 (contrary to Coates and Finn's assertion that it did not appear until 1872).[211] It was not universally adopted immediately as it was very expensive in 1867. Whereas a speaking mirror galvanometer then cost £5, a siphon recorder including royalty and sole manufacturer's charges meant an outlay of £60. This price reduced to £45 for an instrument that would work on short cables and increased to £75 for a superior model fitted with a vibrating device suitable for reception on long cables and in high humidity environments.[212] There was also an ulterior motive for its development. Thomson relied on the income from licensing his inventions to maintain his life style professionally and socially – he owned and sailed a large yacht, *Lalla Rookh,* which he used both for testing navigational equipment which he invented and for enjoyment (see Figure 5.1).

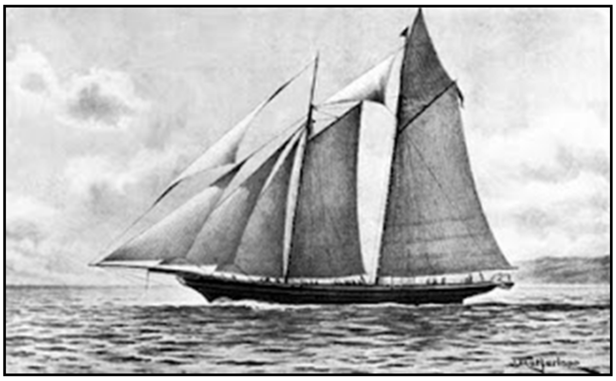

Figure 5.1 Professor Thomson's yacht *Lalla Rookh* from archives at Porthcurno Telegraph Museum

[211] V. T. Coates , B. Finn, *A Retrospective Technology Assessment: Submarine Telegraphy – The Transatlantic Cable of 1866.* San Francisco Press, 1979, , p157. A research team lead by Vary Coates and Bernard Finn wrote this highly respected book which I have found to be accurate in the main. However I find the chronology of the technological innovations to be quite inaccurate.
[212] D. Cleaver, *History of Porthcurno*.. Cable & Wireless. 1953, p. 6.

As can be seen in Figure 5.2, the siphon recorder was a very delicate electro-mechanical device which was prone to malfunction and required skilled maintenance by electricians.

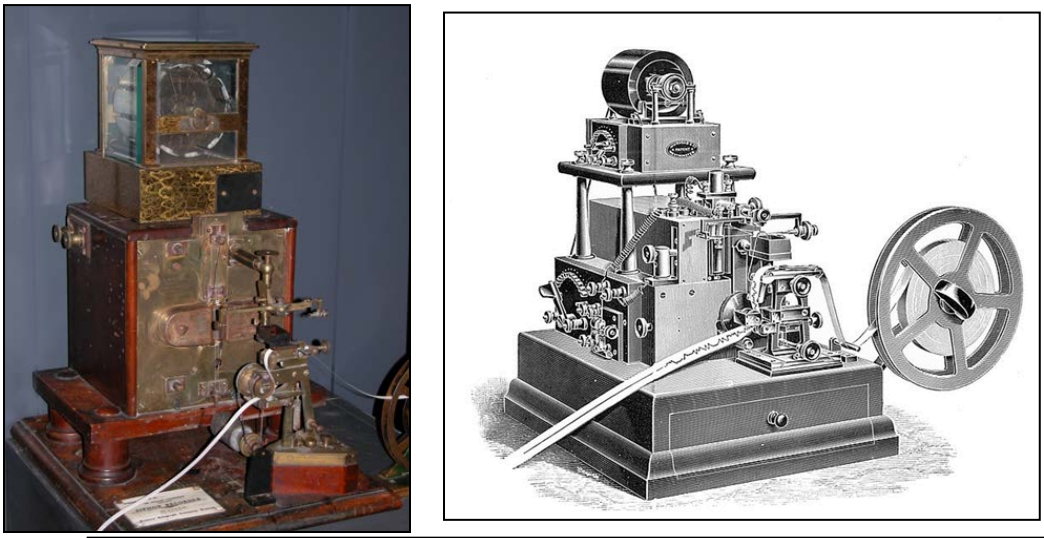

Figure 5.2 An original 1867 Thomson Siphon recorder (left) and a Muirhead version of 1903 (right) Photograph by the author at the Telegraph Museum, Porthcurno

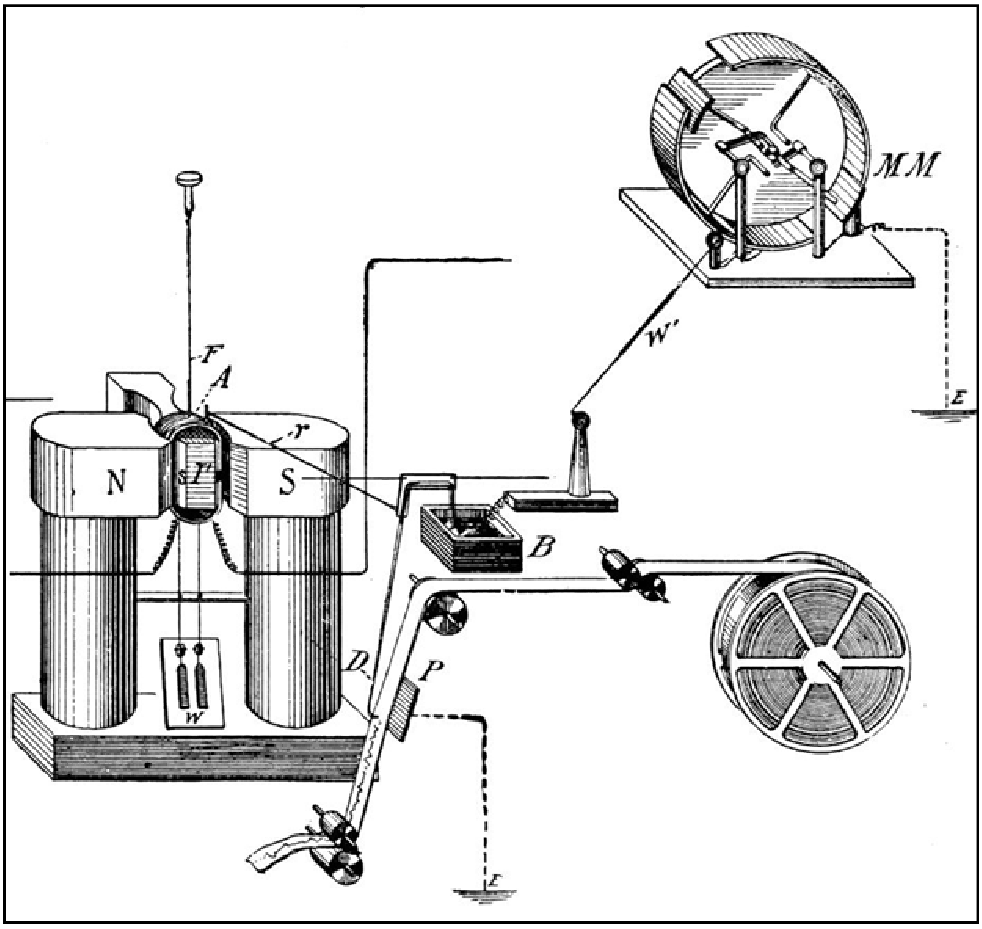

Figure 5.3 Thomson's Siphon Recorder. Functional diagram from Maver: *American Telegraphy & Encyclopaedia of the Telegraph,* p268

A functional diagram of the siphon recorder is shown in Figure 5.3.[213] It is worth description here as it demonstrated the ingenuity of Thomson and his colleagues. 'N' and 'S' were the poles of a powerful permanent horseshoe magnet. Suspended between the poles was a coil of fine wire; the fibre 'F' supported this coil which was kept centralized by two small weights 'W'. Thus was formed a "moving coil" galvanometer. Instead of a mirror or needle, the coil was mechanically connected to a fine capillary tube 'D' by another fibre 'r'. The capillary could swing 3-4 degrees either side of the vertical about a friction-free knife-edge horizontal axis. The capillary tube was arranged so that it allowed ink to siphon from a trough 'B'. The lower end of the capillary tube was directed at a moving paper tape or "slip" but was not in physical contact with it. 'MM' was the "mouse motor", so called because it looked like a mouse exercise wheel.[214] It was in fact a dynamo which produced a high voltage which was transmitted to the ink via wire 'w'. A circuit was thus completed via the earth connections 'E'

[213] W. Maver, , *American Telegraphy & Encyclopaedia of the Telegraph*, Maver Publishing Company, New York, 1892. Facsimile edition by Lindsay Publications Inc, Bradley, USA, 1997
[214] J. A. Ewing, Thomson's Siphon Recorder, *Journal of the Society of Telegraph Engineers.* , vol 5, 1876-1877, p. 192.

and the metal plate 'P' so that ink which was also conductive was drawn from the end of the capillary tube to the slip by a static charge effect with minimal friction. An electric motor drove the mouse motor and the slip drive. [215]

However, from a human point of view, the siphon recorder led to de-skilling of the operators. Fewer operators were required although the fall back method of receiving messages remained the speaking mirror galvanometer. The trace on the paper slip had to be "translated"; this was a task which could soon be learnt by a clerk. The siphon recorder was also promoted by those like Professor Airy, at the time a well-known scientist and Astronomer Royal, who was highly selective in who he trusted.[216]

5.4 The sending and receiving condensers

The cable operators on submarine cables longer than 20 miles had always noticed that the spot of light on the speaking mirror galvanometer with the longer cables often slowly (in comparison to speed of movement due to the signals) drifted from its central zero position. This effect was tolerable, if a little irritating when using a mirror speaking galvanometer, as the signal trace was still readable, the scale upon which the spot was projected being about a foot in width. However as the paper slip of the siphon recorder was less than half an inch in width, the trace often wandered off the narrow paper slip making reading of the signal impossible without continual adjustment. This problem was due to "natural" currents being induced by small changes in the earth's magnetic field and changing potential difference between the earth or ground connection at each end of a cable. These *earth currents* were first noticed in land-lines but did not become a significant problem until they competed with the much smaller signalling currents of long-distance submarine telegraphy. Earth currents became such a significant problem that the Council of the Society for Telegraph Engineers instructed the society's librarian, Alfred J. Frost to compile a bibliography of English works related to the subject and, in the period up to 1883, he listed 105 papers.[217] The currents induced in a cable

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[215] Ewing JA, Thomson's Siphon Recorder, JSTE, 1877, vol 5, 1876, p193.

[216] Sir George Biddell Airy (1801-1892) was Astronomer Royal from 1835 to 1881. He had a somewhat obsessive attitude to what was known as the "Personal Equation" which was the difference between scientific observations of the same phenomenon due to the individual observer's physiology, especially in relation to small amounts of time. He therefore made every effort to automate physical measurements. See Schaffer S, Astronomers Mark Time: Discipline and the Personal Equation*, Science in Context* 2 (1988) pp115-145.

[217] Frost is a little known character in the history of telegraphy. He was one of those stalwart folk who remained in the background without whom an organization would be very inefficient. Before becoming the librarian and archivist of the Society, he acted as the right hand man for the Secretary; he was elected a Member in 1877. As librarian he also catalogued the many electrical patents of the time and the library of books collected by Sir Francis Ronalds (1788-1873) forming the first specialist library on

shipboard must also be mentioned; these were caused by the coiled cables in the tanks of a ship being affected by movement of the ship in the earth's magnetic field during pitch and roll.[218] This was important as this continuous monitoring of the electrical condition of the cable during laying, allowed faults in the new cable to be detected immediately before the ship had progressed any distance.

There had been many anecdotal reports on earth currents but it was not until there was a prolonged period with no signals being passed along a long cable that definitive measurements could be made to assess the nature and variability of this irritating interference. Of his own volition, and typical of the entrepreneurial methods of the period, James Graves, whilst in charge of the Valentia cable station, took advantage of a transatlantic cable breakdown lasting some two months in 1871 to measure the "earth currents" at half hourly intervals for 75 days and nights.[219] He showed evidence of a diurnal variation with complete change in polarity measured at Valentia with peak at 0300-0400hrs and 1200-1300hrs and nadir at 0700-0800hrs and 1800-1900hrs. On sixty occasions the earth current exceeded 20 "cells" (the cell being his unit of measurement and of the order of 1 to 1.5 volts). This was the first rigorous, non-anecdotal published evidence of earth currents over a prolonged period. William Nosworthy, whose career was mainly in South America, also examined the earth currents affecting a 338nm length of the Western & Brazilian Telegraph Company's cable in 1875 with similar findings.[220] Both Graves and Nosworthy were highly motivated electricians at cable stations far from Head Office in London or Porthcurno, Cornwall, who took it upon themselves to investigate troublesome phenomena concurrently with their day-to-day work load. This sort of investigation was a common occurrence in the cable industry as it was often difficult to replicate conditions in laboratories.

Schwendler (1838-1882), a German electrician, in 1874 was the first to list some of these factors as *natural currents* which he defined as currents "without direct or at least intentional human agency".[221] Schwendler's list of "interfering electrical currents" included:

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the subject of electricity; A. J. Frost, Catalogue of English Works Relating to Earth Currents. *Journal of the Society of Telegraph Engineers*. vol 12, 1883,pp583-588.

[218] J. E. Young, *Electrical testing for telegraph engineers.* 2nd edition, The Electrician Publishing Company, London, p. 44.

[219] J. Graves, Earth Currents, *Journal of the Society of Telegraph Engineers*., vol 2, 1872, pp. 102-123.

[220] Nosworthy WF, Note on Earth Currents. *Journal of the Society of Telegraph Engineers*. 1882, vol 11, 382-388

[221] Carl Louis Schwendler (1838 - 1882) was a German electrician. He also published a textbook on telegraphs, and worked in British India in the Telegraph Department. He also carried out a feasibility study for the Railways about lighting Indian Railway stations by electric lamp. He was a very keen

- Galvanic action between the earth plates
- Polarization of the earth plates by the signalling currents
- Polarization of badly insulated point in the line
- Atmospheric electricity
- Thermo-electricity
- Inductive capacity
- Voltaic induction
- Earth currents

Schwendler's list may be more conveniently reduced to two groups; "earth currents" which were not "man-made" and "polarization" which was. "Polarization" currents were those generated by the formation of an electrical "cell" produced by the copper of the core in contact with brine which is also in communication with any other metal such as the iron of the cable armouring thus developing a potential difference. Schwendler used the word "polarization" – in modern parlance the word "galvanic" would be more appropriate (that is the formation of a primary cell composed of two dissimilar metals separated by an electrolyte solution). He carried out these researches whilst working for the Indian Telegraph Service and wrote a textbook for the electricians in the Service.[222]

The method adopted to minimise this slowly changing but unwanted current was to place a *condenser* in circuit between the key and the cable core conductor at the transmitting end cable and at the receiving end, between the conductor and the mirror galvanometer or siphon recorder. The condenser (or capacitor in modern terminology) allowed alternating current to pass but blocked direct current. The very slowing-changing earth current was almost "direct current" in comparison to the relatively rapid alternating cable code current. These condensers electrically isolated the ends of the cable. By careful choice of the size of the condenser it was possible, for all practical purposes, to eliminate the effect of the slowly changing earth current effect. This increased the speed of communication.

5.5 Duplex telegraphy and the "artificial cable"

5.5.1 Simultaneous Bidirectional or Duplex Telegraphy

The increase in cable traffic required the cables to be used more efficiently. Efficiency is immediately doubled if the single conductor can carry signals in both directions simultaneously. Joseph Stearns (1831-1895) is credited with the invention of the first practical

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amateur zoologist; Schwendler L, On Earth Currents , *Journal of the Society of Telegraph Engineers,* 1874 175-179

[222] L. Schwendler*, Instructions for testing telegraph lines*, vols 1 & 2., Government Telegraph Press, Alipore, Calcutta, India 1872.

duplex telegraph system for line telegraphy.[223] The simplest method was the *differential* method and required a special *differential* galvanometer which had two electrically isolated windings wound in opposite directions with exactly equal resistance. A simplified example is shown in Figure 5.4 where R is an *artificial cable*, in fact, not a cable at all but an arrangement of components that mimics the properties of a particular cable.[224] By using an artificial cable in either a differential circuit (Figure 5.4) or a bridge circuit (Figure 5.5) it was possible to nullify the effects of local transmission on the local galvanometer. [Note that the earliest diagrammatic symbol for electrical resistance was a "curly line" which would later on become the symbol for electrical inductance]. The two coils are joined at one end to a key and hence to the battery. The other end of one coil is connected to the line and the free end of the other winding is connected to earth via an *artificial cable*. The artificial cable has electrical properties exactly equal to that of the line.

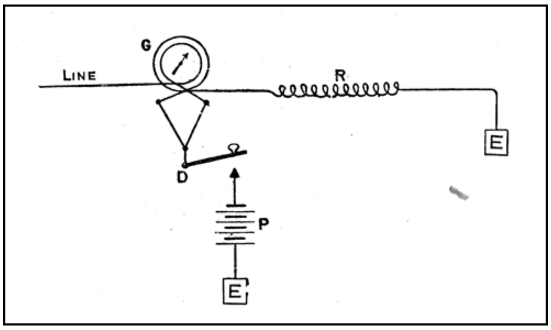

Figure 5.4 Duplex Telegraphy on the Differential Principle; Bright C, *Submarine Telegraphs – their History, Construction and Working,* 1898, p. 637.

The differential method was soon replaced (in 1858 for land lines) by the *Wheatstone Bridge* method shown in simplified form in Figure 5.5 which did not require special galvanometers or siphon recorders with differential coils.

[223]P. Strange. Duplex telegraphy and the artificial line: the beginnings of system modelling , *Physical Science, Measurement and Instrumentation, Management and Education - Reviews, IEE Proceedings A,*, volume: 132 , 1985, pp. 543-552.

[224] C. Bright, *Submarine Telegraphs- their history, construction and working*, Crosby Lockwood & Son, London, 1898, p. 637.

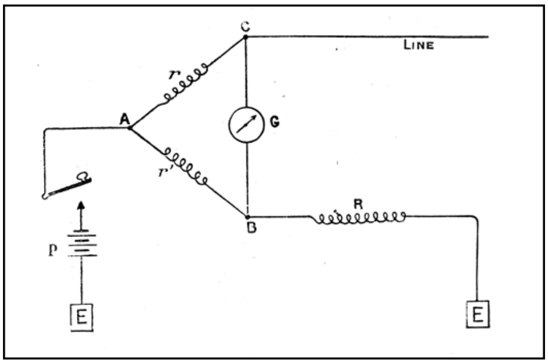

Figure 5.5 Duplex Telegraphy on the Wheatstone Bridge Principle; Bright C, *Submarine Telegraphs – their History, Construction and Working,* 1898, p. 637.

The first practical application of duplex technology to a *submarine* cable was in 1873 by J. H. Stearns who had taken out a patent the previous year. He applied the method to the 300nm section of the Atlantic Cable between Newfoundland and Cape Breton. Attempts to duplex the whole of that cable were not successful at that time as there were too many variables to simulate over very long cable lengths.[225] In 1875 duplex telegraphy was successfully applied to the ETC's Marseilles-Bona cable by Messrs. John and Alexander Muirhead, Mr. Herbert Taylor and Mr. John Munro.[226] From then on duplex technology was applied to all busy cable routes.

5.5.2 Artificial cable

Vital to either method of duplexing was the *artificial cable* and by the time the technique was attempted in long submarine cables it became obvious that it was not just the simple resistance of the conductor that had to be duplicated but all its electrical properties: resistance, capacitance and dielectric resistance. With the longest cables, such as those traversing the Atlantic and Pacific oceans, the artificial cable had to be maintained at a constant temperature as the temperature coefficient of the resistance wire used was too great to maintain the required accuracy otherwise.[227]

Stearns designed the earliest artificial cable, consisting of a number of resistors in series, the total resistance being equal to the cable conductor resistance.[228] Capacitors connected as shown in Figure 5.6 from the resistor nodes to earth gave the artificial cable the same capacitance as the actual cable.

[225] C. Bright, *Submarine Telegraphs – their History, Construction and Working,* 1898. pp121-122
[226] Ibid, p123.
[227] In modern terminology the equivalent circuit is that of a *delay* or *transmission line*.
[228] Maver *op cit*, p277.

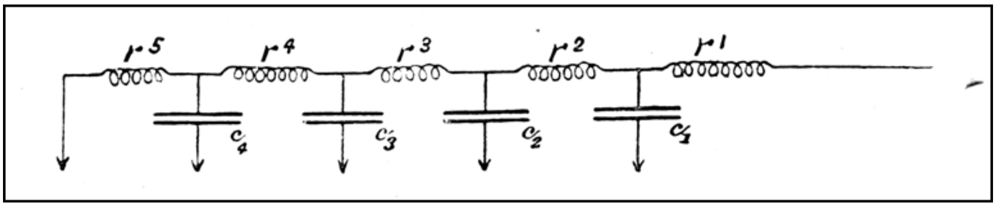

Figure 5.6 Stearn's Artificial Lines fromBright C, *Submarine Telegraphs – their History, Construction and Working,* 1898, p. 640.

The most common form of artificial cable in use was designed by Alexander Muirhead, based on what he and Taylor termed an "inductive resistance" which is now a confusing term as it was used in both the capacitive and inductance sense (see Figure 5.7).[229]

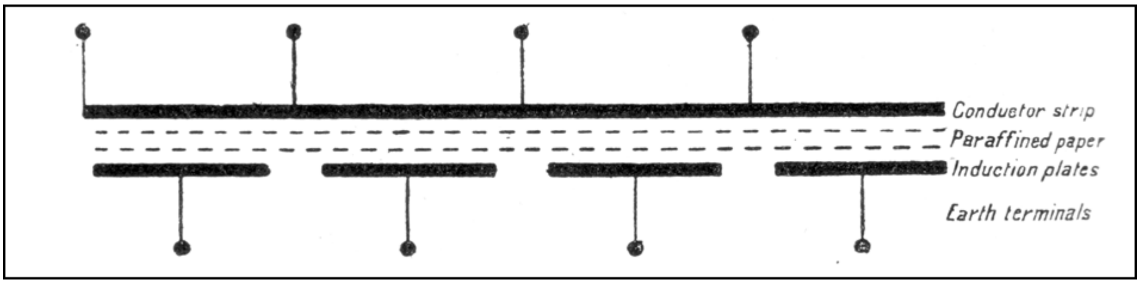

Figure 5.7 Muirhead's Artificial Cable (Bright C, *Submarine Telegraphs – their History, Construction and Working,* 1898, p. 644.)

The 'conductor strip' consisted of a resistive material. The complete artificial cable for a long submarine cable was formed from a combination of pure resistance and 'inductive resistors' as shown below. A complete artificial cable had to be made from a several sub-units (Figure 5.8) corresponding to the make-up of the cable it represented. The shore ends of all submarine cables were much thicker and mechanically stronger to protect the conductor from rocks, anchors, fishing tackle and the increased tidal movement which occur in the shallower waters.

[229] Bright, *op cit*, pp. 644-656.

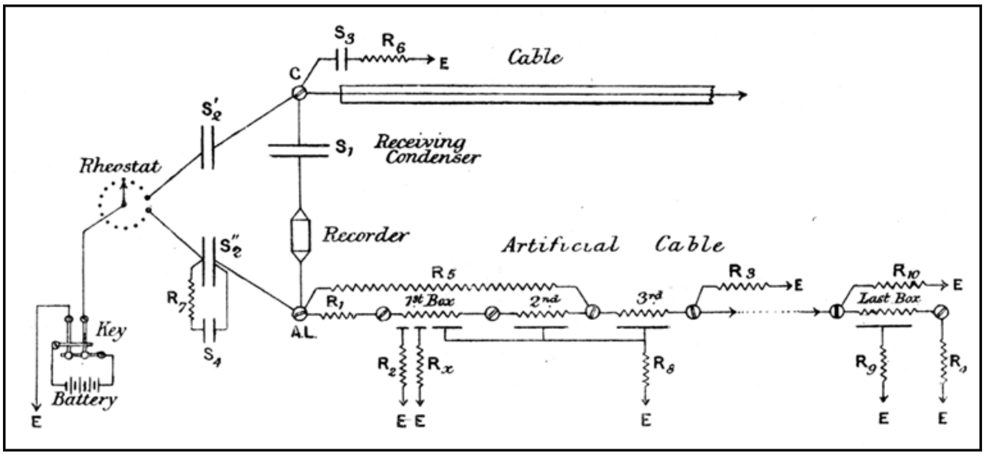

Figure 5.8 Late 1890s Duplex Telegraphy circuit from Bright C, *Submarine Telegraphs – their History, Construction and Working,* 1898 p. 651

As the capacitors and resistors of the artificial cable were physically much larger than modern electronic components, most cable stations would have a room the size of an average bathroom just for their artificial cable and this room would be strictly temperature controlled. It was a highly skilled job to set up an artificial cable and any change in the electrical properties of a cable required that the artificial cable be re-calibrated. This job was part of the regular maintenance carried out by the station electrician. In temperate climates, recalibration or "re-balancing" was necessary on a weekly basis but at stations in the tropics and in areas where there were large changes in ambient temperature during the day and night it was often necessary to carry out recalibration two or three times each day. The station's domestic cleaners were not allowed into the artificial cable room because even such an apparently trivial change as the removal of a dead spider between terminals could make a significant change in resistance causing imbalance.[230]

5.6 Further developments to increase speed and accuracy…

5.6.1 "Curbing"

As explained in Chapter 3, submarine cables had an electrical resistance and also behaved like condensers to a much greater extent than land-lines. This phenomenon, first described mathematically by William Thomson, blurred the transmitted code by the time it reached the receiving station.[231] The longer the cable, the more the signal was blurred, the slower the rate of transmission and the lower the profits for the operator. Figure 5.9 demonstrates how the signal could be degraded.

[230] J. Nash – Personal communication. John Nash is a retired cable electrician and currently is a volunteer at the Telegraph Museum, Porthcurno where he maintains working examples of cable circuits.

[231] Thomson W. On the Theory of the Electric Telegraph. *Proc. Roy. Soc.,* May 1855, vol7, p. 382ff.

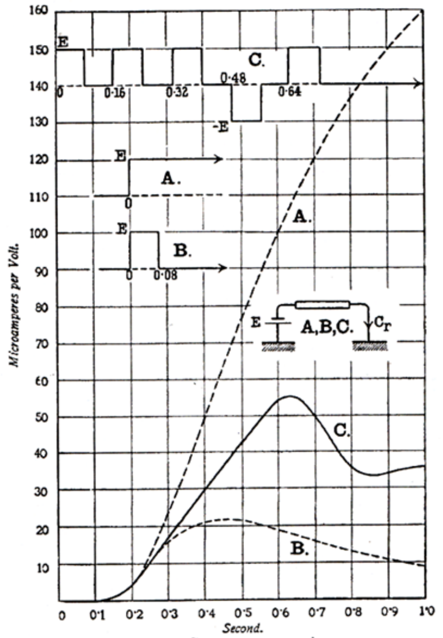

FIG. 152.—CABLE WITHOUT APPARATUS.
Curve A.—Arrival curve.
,, B.—Elementary dot curve, contact lasting 0·08 second.
,, C.—Signal "Understand."

Figure 5.9 Uncurbed operation. The "curve" C at the top of the graph shows the transmitted signal for "understand" which was three consecutive dots followed by a dash and another dot. The lower curve C shows how an un-curbed "understand" appeared at the receiving end .from H. W. Malcolm. *The theory of the submarine telegraph and telephone cable,* p. 430.

It was also William Thomson who first suggested a solution to the problem: "curbing". If a signal was keyed and, on release of the key, a very short pulse of the opposite polarity was applied it helped to discharge the cable charge more rapidly.[232]

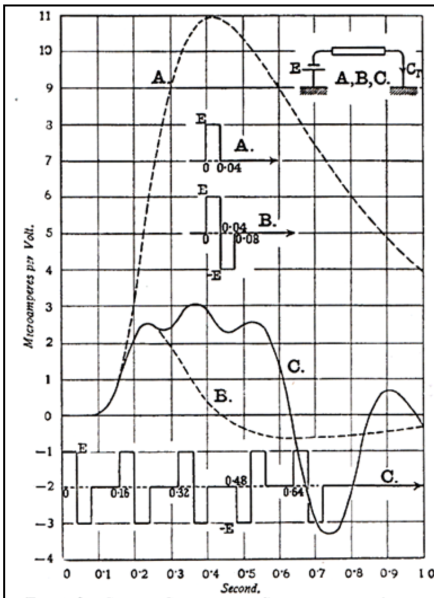

FIG. 153.—CURBED SIGNALLING. CABLE WITHOUT APPARATUS.
Curve A.—Dot lasting 0·04 second.
,, B.—Dot-dash, 0·04+0·04 second.
,, C.—Signal "Understand."

Figure 5.10 Curbed operation. In the curbed case, the lowest trace C shows "understand" as it was sent whilst the curve C above it shows clearly the advantage of curbing. From H. W. Malcolm. *The theory of the submarine telegraph and telephone cable,* p. 432

[232] W. Thomson. Automatic Curb sender. *J. Soc. Tel. Eng.*, vol 5, 1876, . 213ff. H. W. Malcolm, *The theory of the submarine telegraph and telephone cable.* The Electrician Printing & Publishing Company. 1917. p. 432.

The speed of transmission in the cable in words per minute was immediately increased by a factor of more than two. The design of a manually operated curbing key proved too complex but the answer proved to be "automatic sending".

5.6.2 Automatic sending

Professor Charles Wheatstone (1802–1875), an English scientist and inventor was known as the father of electromagnetic telegraphy in the UK. In 1858 he developed one of the first items of automation in telegraphy. His automatic telegraph transmitter converted Morse code text, represented as a series of small holes in paper tape, to electrical signals.[233] The messages were punched manually onto the tape and were then transmitted at speeds of up to 100 words per minute over land lines

Figure 5.11 Modified Wheatstone automatic transmitter. Photo by the author at Porthcurno Telegraph Museum

In 1879, Belz and Brahic were the first to modify the Wheatstone automatic transmitter (originally developed for land line telegraphy) to transmit through submarine cables (see Figure 5.11). In 1888 Herbert Taylor developed an automatic curbing transmitter. All of these transmitters used punched paper tape. These tapes were punched manually until the invention of keyboard tape punchers; Figure 5.12 shows a manual tape punch.

[233] B. Bowers. *Sir Charles Wheatstone 1802-1875.* IEE History of Technology Series 29, 2001,IEE, London.

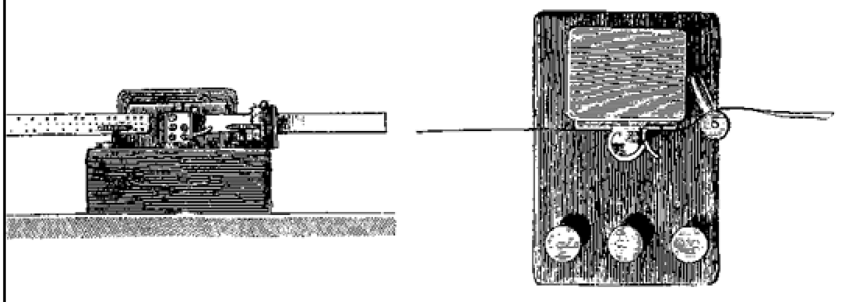

Figure 5.12 Manually operated paper tape punch. From C. Bright, *Submarine Telegraphs,* Cosby, London, 1898, p. 665.

5.7 Relays & "magnifiers"

In order to further increase speed (in words per minute) and efficiency (reduction of human error and manpower) a number of ingenious devices were developed to automatically receive and retransmit messages by long submarine cables. The term *relay,* now so commonly used in electrical engineering, is derived from the electromagnetic device developed originally in land-line telegraphy to retransmit weak telegraphy signals. The basic relay consisted of an electromagnet which, when energised by the incoming weak telegraph signal, caused a pair of very light, normally-open contacts to close for the duration of the incoming Morse dot or dash.[234] A stronger current was passed through these contacts either to operate a sounder or connected to the outgoing line to the next station. Simple relays were suitable for land-line telegraphy but were not sensitive enough to work with the very weak signals of submarine cable telegraphy. The sensitivity of a relay was increased by either increasing the electromagnetic force, by increasing the number of turns of wire forming the electromagnet, or by decreasing the force of the spring of the contacts or the friction/inertia of the mechanism supporting the contacts or by all of these means. The first super-sensitive relays suitable for short to medium length cables were the Brown & Allen relay (1878) and the Gulstad relay (1898).[235] These modified relays could not increase sensitivity sufficiently for use on very long cables.

[234] Or closed contacts to open

[235] George Allan and James Wallace Brown invented an improved relay in 1876 which was first used on the Persian Gulf Cable in 1878. In 1898 Mr. K Gulstad was the Engineer-in-Chief of the Great Northern Telegraph Company. Det Store Nordiske Telegrafselskab A/S or Gt Northern Telegraph Company was set up in Denmark in June 1869 with the intention of becoming a world-wide telegraph company. Although it never really competed with the Eastern Telegraph Group it was successful in Scandinavia and across Russia to China and Japan

5.7.1 The Brown Drum relay

The first "magnifier" used to increase the amplitude of very weak cable signals and which bore no resemblance to conventional relays of the period, was the Brown drum relay first came into use in 1899

Figure 5.13 Brown Drum relay (photograph courtesy of Science Museum, London)

Sidney George Brown (1873-1948) was born in Chicago of English parents; his mother was a direct descendant of John Napier, the inventor of logarithms. The family returned to England in 1879 and after private education Brown joined Messrs. Crompton & Co. as an apprentice, where he produced his first patent for an improved pick-up for the Edison phonograph. He studied electrical engineering at University College 1894-1896 before returning to Crompton's. In 1897, looking after the family's estate whilst his father was dangerously ill, Brown read Sir Charles Bright's *Submarine Telegraphy*. His interest in submarine telegraphy lead him to patent what became the world famous *Brown Drum Cable Relay* in 1899 at the age of 26.[236] The Drum Relay was the first of several new ways of reducing the friction component of a relay. The incoming signal passed to a moving coil galvanometer in the same manner as in the siphon recorder. The new innovation was that the moving coil operated a very light lever contact which rested lightly on a rotating drum which was rotated on a horizontal axis. This is visible in Figure 5.13 The drum can be seen to be formed of two copper discs (W and Z in Figure 5.14) separated by an insulating disc. The drum is rotated by an electric motor which greatly reduces the friction between the contact arm and the drum. Thus there is *very* little frictional force and the contact arm (T) was able to move across the surface of the rotating

[236] GB Patent No 1434 (1899)

drum with great ease. With no signal current the contact was adjusted so thit it rested upon the insulated part of the disc whilst positive or negative signals caused the contact to make contact with the left or right discs respectively. These discs were arranged to complete the circuit to provide either mark (M) or space (S) signals, greatly magnified, for onward transmission via Cable No 2.

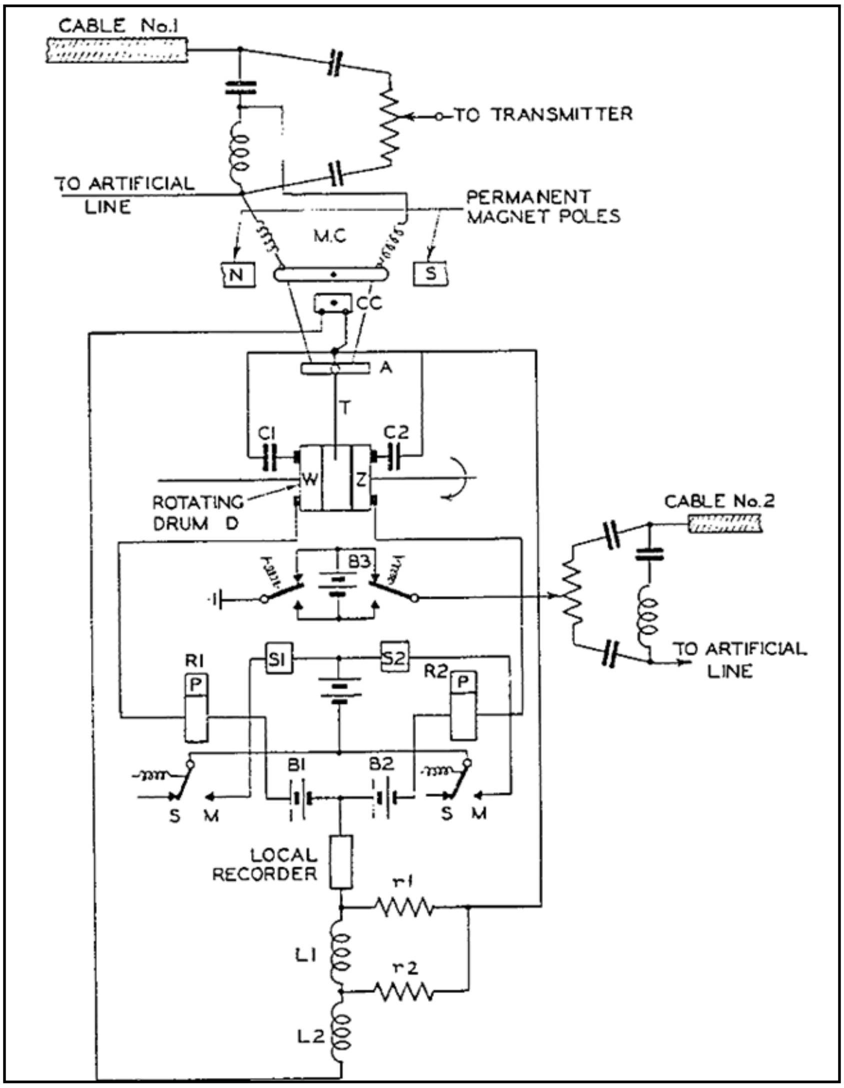

Figure 5.14 Schematic diagram of the Brown drum relay from Freebody JW, *Telegraphy,* 1958, p. 687.

Coates and Finn state that the Brown Drum Relay was introduced in 1915-1920. However Stanley Brown patented his Drum Relay in 1899 and it was in routine use worldwide within three years as can be clearly seen from his paper to the Institute of Electrical Engineers in 1902:

> The system of relay working for long submarine telegraph cables here described must not be looked upon as being in the experimental stage. It is in every-day use on some of the lines of the largest Cable companies, notably of those of the Eastern Telegraph Company, their station at Gibraltar having been first fitted up for automatically translating cable messages between Porthcurnow in England and Alexandria in Egypt.[237]

Brown made many other significant contributions to telecommunications. [238]

5.7.2 Muirhead Gold Wire relay

Dr Alex Muirhead developed his gold wire relay in 1901.[239] Like the Brown Drum Relay Muirhead's relay also relied upon the moving coil principle of the siphon galvanometer. In this version a fine gold wire was deflected by the moving coil between two silver contact pins, one for the mark and the other for the space. Muirhead chose gold and silver as materials that resisted oxidation, which might otherwise have would have produced high resistance at the contact.

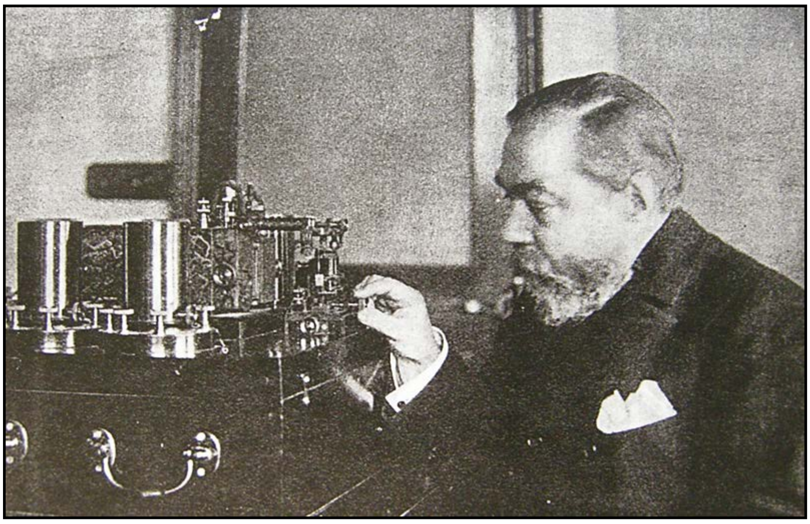

Figure 5.15 Alexander Muirhead and his Gold Wire Relay (original source unknown, held in the archive at the Telegraph Museum, Porthcurno)

[237] Brown SG, Automatic relay translation for long submarine cables, *JIEE*, 1902, vol 31, p1060.

[238] SG Brown went on to invent and patent in the areas of wireless, loud-speakers, microphones, gyroscopic compasses (which he considered his most significant contribution) and the auto pilot. He opened his own factory, SG Brown & Co, in 1911: he was the inventor and technical drive whilst his wife Alice was the business manager. Brown was elected FRS in 1914. There are over 1000 patents in his name. – Royal Society Obituary Notices. Vol 7, 1951, p. 318.

[239] Alexander Muirhead was born in East Lothian in 1848. He graduated BSc at University College, London and gained an MSc in Electricity at St Bartholomew's Hospital, London where he was credited with recording the first human electrocardiogram. He joined his father's company Latimer Clark, Muirhead & Co and advanced the duplexing of submarine cables. Later Muirhead acquired a number of patents in wireless telegraphy. He was made FRS in 1904 and died in 1920. (*Alexander Muirhead,* biography written by his widow Mary Elizabeth Muirhead, 1926 Blackwell, Oxford)

When the Muirhead relay was used on the New York to Buenos Aires cable in 1911 it enabled messages which previously took 20 minutes to be sent in 3 minutes; this increase in efficiency was due to the reduction in the number of requests for retransmission of words because of illegibility.[240]

5.7.3 The Heurtley Magnifier

In 1910, E. S. Heurtley, an English electrician developed a signal magnifier which was first used by the Pacific Cable Board on cables from Vancouver to Fanning Island in the Pacific Ocean. Again it made use of the moving coil principle but in this case it caused the minute movement of a fine resistance wire which formed two arms of a Wheatstone bridge (W1 and W2 in Figure 5.17). The wire was heated by passing an electric current along its length. Parallel to W1 and W2 were cooling air drafts (T1 and T2). Signal currents caused the wire to be deflected in or out of the cooling draft which caused its resistance to change with change in temperature. Thus the current in the bridge circuit varied with the signal and was used to operate a siphon recorder.

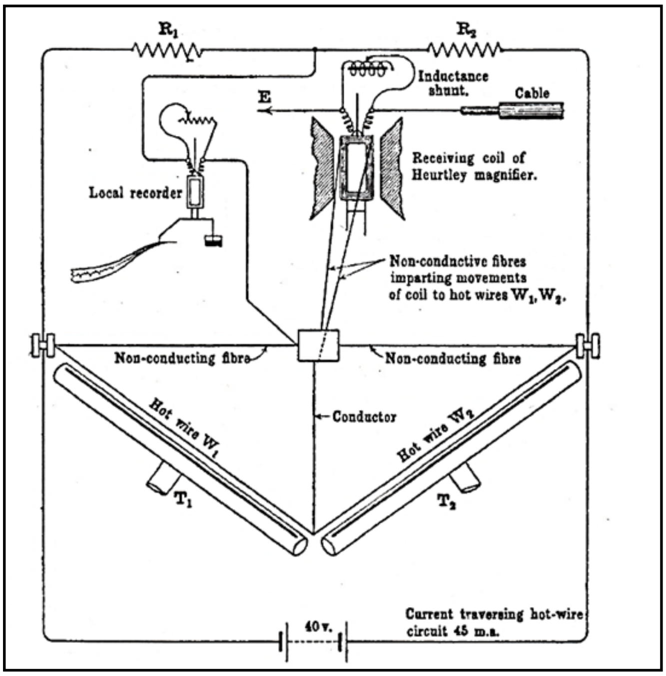

Figure 5.16 Heurtley Magnifier from J. H. Stephens, *Telegraph Cable Engineering,* 1928, p. 162.

5.7.4 Orling jet relay

Axel Orling was a Scandinavian engineer who also used the moving coil principle, in his case to deflect the movement of a needle which was being washed by a fine stream of saline, a good

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240 B. Gati. Submarine Cable Rapid Telegraphy; Ocean and Intercontinental Telephony. Presented at the Panama-Pacific Convention of the American Institute of Electrical Engineers, San Francisco. Sept 17, 1915 p2090.

electrical conductor. As the needle was deflected by changes in signal current, it also caused deflection the fine stream of saline. This was arranged to switch between different conducting areas on a glass slope. Thus a very small signal current could be made to affect a much larger current. In 1911 Orling patented this mechanism as a telegraphic relay as shown in Figure 5.17

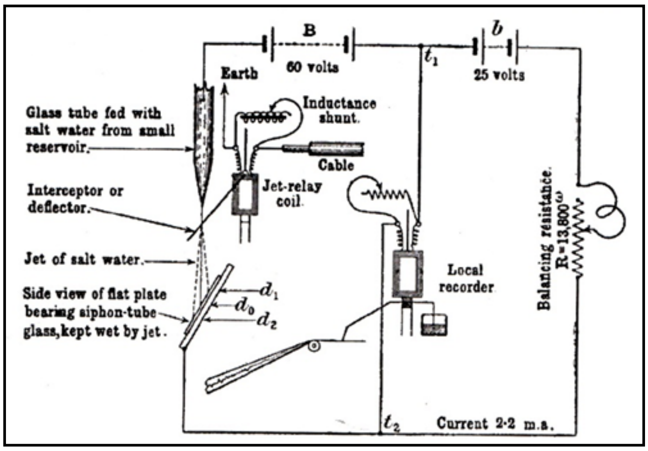

Figure 5.17 Orling Jet Relay from J. W. Freebody, *Telegraphy,* 1958, p. 688

These "magnifiers" were used both for automatic relaying of on long cables and to increase the signal strength in a cable so that less delicate and therefore more robust recorders could be used. However there was, by the Great War, already some concern amongst telegraph operators that these automated techniques may in future reduce the number of people required to run the system.

These relays and magnifiers were key to increasing speed and accuracy in submarine cable telegraphy. They also produced significant positive financial benefit to the operating companies because of increased traffic and a reduction in the number of skilled telegraph operators. However, although fewer operators were needed at each cable station, it was necessary to increase the number and skills of the electricians in order to maintain the delicate instruments. These individuals were becoming an increasingly valuable commodity within the industry and this will be covered in Chapter 7 of this thesis.[241]

Early versions of these signal enhancing devices were known to be temperamental and so were initially tested at Porthcurno before being brought into use further afield. If they showed any promise of increasing speed of communication and thus financial income, they were quickly produced in quantity to install at more remote cable stations. With heavy use at these remote stations previously unforeseen maintenance problems often became apparent and the electricians had to develop new maintenance schedules "on the hoof" and then send details

[241] After the First World War, highly complex "regenerators" were developed, much improving the signal rate and efficiency but causing large redundancies among operators but this is beyond the scope of this thesis.

back to head office for dissemination. One can imagine the concern and dread of the lone electrician presented with a new piece of equipment using principles from the forefront of electrical science, arriving on a ship with very little documentation. This was a common occurrence in the submarine telegraphic world as the technology was developing so rapidly. The popularity and usefulness of intercontinental submarine cable telegraphy lead to an ever increasing overall length of submarine telegraph cable. As the amount of cable increased, so too did the range of different causes of malfunction.

5.8 "Foes of the Wire"

In his 1893 book, *The Romance of Electricity*, John Munro entitled a chapter "Foes of the Wire", referring to conditions which caused interruption or down-grading of communication by electric telegraphy, most notably the submarine telegraph cable.[242] Munro's book was for the education of the general public. From a professional point of view, much had been written before this time about the location and repair of interruptions and faults, but not about their *causes.* A more professional approach was published much earlier by Sir James Anderson in 1872.[243] Anderson pointed out that many failed cables had never worked properly. This was due to (a) imperfect manufacture, (b) attempting to lay cables with sailing ships, (c) inexperience in paying out cables, (d) the want of experienced engineers at all stages, from design through to post-laying testing.[244] Sir Samuel Canning added that

> the great secret was to keep a cable quiet from the time it was made to the time it was laid…..every time a cable is coiled or uncoiled it sustains more or less injury.[245]

Anderson then addressed the causes of damage to cables which were likewise the subject of Munro's chapter. It had always been foreseen that near land the entire depth of water moved as a result of tides and storms, causing cables to rasp on rocks and generally be worn through but it was assumed that the only harm that could come to a deep sea cable was the misfortune of a sinking ship landing thereon.[246] Also foreseen was damage by ships' anchors and fishing gear, again in reasonably shallow water. Munro relates the unforeseen damage that was wrought by the fauna of the deep (and shallows).

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[242] Telegraphy by wire has always been referred to as submarine *cable* telegraphy or land-*line* telegraphy.

[243] J. Anderson. *Statistics of Telegraphy*. The Statistical Society, London, 1872. Sir James Anderson became Senior Captain of the Cunard Line before being invited to captain the SS Great Eastern for the laying of the 1865 and 1866 Atlantic Cables. He eventually joined the Board of Directors of the ETC.

[244] *Ibid*, p. 65.

[245] *Ibid,* p. 65.

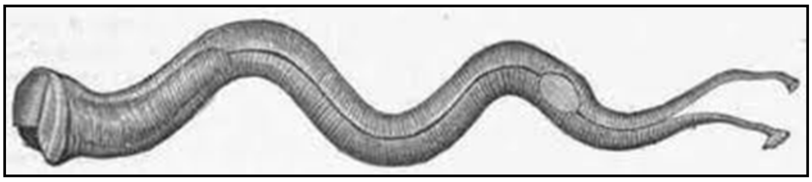
[246] J. Munro. *The Romance of Electricity*, The Religious Tract Society, London, 1893, p. 230.

5.8.1 Cable damage by marine fauna

Although large sea creatures such as sharks, whales and other large creatures occasionally wrought havoc, it was small macroscopic and microscopic animals that caused the most damage. The classes of small marine organisms responsible for terrible amounts of damage to telegraph cables were generally either crustaceans or molluscs. These were aided and abetted by certain bacteria.[247]

Marine borers had long been known to cause serious damage to wooden structures at sea. Christopher Columbus lost all the ships on his fourth voyage to boring damage and had to be rescued from Jamaica. In 1730 Drake's *Golden Hind* sank when these small creatures critically weakened the hull and in the same year near catastrophe occurred in the Netherlands when the wooded dyke walls began to collapse when similarly damaged. Indeed it is surmised that numerous wooden ships disappeared when their weakened hulls were excessively stressed by stormy seas.[248]

The most widely reported borer was the *Terado navalis* or "ship worm" which was not a worm at all but belongs to the *Teredinidae* family of bivalve molluscs, which also includes the *Bankia* species of borer. *T. navalis* was the commonest marine borer and favoured a diet of hemp and/or gutta percha when wood was not available.



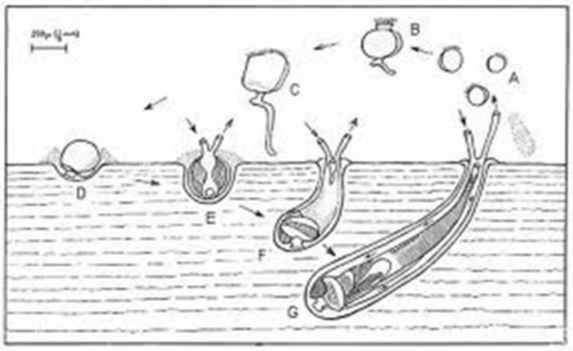


Figure 5.18 *Terado navalis* from Mance H. Experiments conducted for the purpose of ascertaining whether the terado borer prefers gutta percha to India rubber. *Teleg J & Elec Rev,* vol 3, 1875, pp. 278ff.

[247] J. S. Muraoka. *The effects of marine organisms on engineering materials for deep-ocean use*. Technical Report R182. U.S. Naval Civil Engineering Laboratory, Port Hueneme, California. 7th March 1962.

[248] J. R. Harris, Copper and Shipping in the Eighteenth Century, *The Economic History Review,* New Series, vol 19, 1966, pp.550-568.

From the engravings (Figure 5.18 it is obvious why *T. navalis* was called a "worm". It could be up to 2cm in length with sharp, hard boring plates or "teeth" at the head end (left) with which it bored into and along both wood and the organic materials used for cable insulation. *T. navalis* could be found in all the world's oceans. Other molluscs that were enemies of the cables were *Xylophaga, Bankia* and *Martesia*.

The commonest crustacean which caused damage to cables was the *Limnoria* genus, especially *Limnoria lignorum*, colloquially known as *gribble (see Figure 5.19)*.. *Limnoria* were also spread around the world's oceans courtesy of wooden hulls.

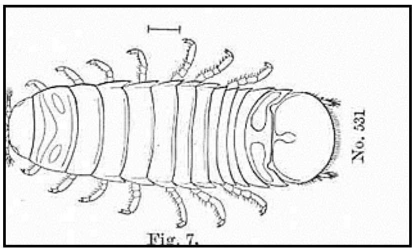


Figure 5.19 *Limnoria lignorum*. 1-4mm in length from Mance H. Experiments conducted for the purpose of ascertaining whether the terado borer prefers gutta percha to india rubber. *Teleg J & Elec Rev,* vol 3, 1875, pp. 278ff.

The mandibles of *Limnoria* are rasp- and file-like. Whereas the *Teredo* species bored holes and channels in wood and cable, the *Limnoria* nibbled away at the surface but of course the "surface" was also the area bared by their previous meal. Gribbles are commonly 1-4mm in length but can grow up to 10mm in cold sub-Arctic waters. Marine bacteria also played an important role in cable damage in that they coat surfaces thus affording a foothold for other animals and providing a food source for barnacles.[249]

The first publication specifically related to marine borer damage to cables was a paper by Charles Siemens given at the BAAS meeting in 1865 in which he reported that cables in the Black Sea and the Mediterranean between Toulon (France) and Algiers had failed after less than a year because *Xylophaga* had penetrated and destroyed the hemp and had entered the gutta percha.[250] This damage had occurred at between 1000 feet and 1800 feet depth. In 1872, "*Teredo* of all kinds" were reported to have attacked both hemp and gutta percha of cables recovered from 7500ft depth also in the Mediterranean.[251] Henry Mance reported "severe damage" by "marine borers" in Karachi Harbour.[252] He also conducted experiments

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[249] J. S. Muraoka. *The effects of marine organisms on engineering materials for deep-ocean use.* US Naval Civil Engineering Laboratory Technical Report R182, p. 7.
[250] Siemens CW. On the Outer Covering of Deep-Sea Cables. *Report of the BAAS Meeting,* 1865, vol 35, pp187-190.
[251] J. Anderson. Statistics of Telegraphy - An account of Marine Cables Laid. Appendix 1, *Journal of the Statistical Society*, vol 35(30), 1872,pp. 313-321.
[252] H. Mance, On Cable-Borers, *Teleg Journal & Electrical Review.*, vol 3(68), 1875, p. 278.

showing that India rubber was less susceptible to damage than gutta percha.[253] William Preece in the same year reported that the hemp between the steel armouring wires was eaten away and the gutta percha core penetrated to various depths by *Xylophaga* and *Limnoria lignorum*.[254] Preece said that infestations had been found in the Mediterranean, around the European and British coasts and as far west as Florida. Bontemps confirmed cable infestations of *Teredo*, *Xylophaga* and *Limnoria*, in the Persian Gulf, Indian Ocean and off the Irish coast.[255] Yet another species of cable borer was cited by the Italian, Emanuel Jona when, in 1896 he observed *Cheluria terebrans* attacking cable in the Mediterranean Sea.[256]

The earliest attempts at protecting wooden hulls of ships entailed covering the outer surface with an expendable layer of wood or sheet lead. However the lead plus sea water reacted badly with the iron used in bolts. In 1708 Charles Perry suggested applying sheet copper but the Navy Board considered this too expensive though in 1761 they gave in and tried it on HMS *Alarm* with complete success. Although the Brothers Bright mentioned the use of a very thin metal spirally-wound tape in a patent in 1852, surprisingly there were no serious attempts to protect gutta percha insulation from the ravages of marine borers until the use of brass tape sheathing wound in a spiral fashion around the gutta perch layer in 1879 on the Penang-Malacca-Singapore-Java cable laid by the Eastern Extension Telegraph Company.[257] The brass tape, which greatly increased the cost of the cable, was so successful that its use continued until the 1930s when gutta percha was replaced with synthetic materials such as polyethylene which were less palatable to marine borers.

5.8.2 Other cable predators

Large fish were at times found entangled with cable or left part of their anatomy attached, for example sawfish which might weigh between 10 and 100 pounds and sword fish weighing around 100 pounds (see Figure 5.20).

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[253] H. C. Mance. Experiments conducted for the purpose of ascertaining whether the terado borer prefers gutta-percha to India-rubber. *J Soc. Teleg Eng.* , vol 6, 1875, pp. 361-363.
[254] G. E. Preece. Cable Borers. *J Soc. Teleg Eng.*, vol 6, 1875 pp. 363-375.
[255] C. Bontemps. Telegraphic sous-marine: la destruction des cables. *Nature (Paris)*, , vol 5, Part 2(233), November 1877, pp. 387-389.
[256] Jona E. *Cavi telegraphici sottomarini.*. Milano, 1896, unpaged map.
[257] E. B. & C. T. Bright, British Patent 14331 dated 1852.

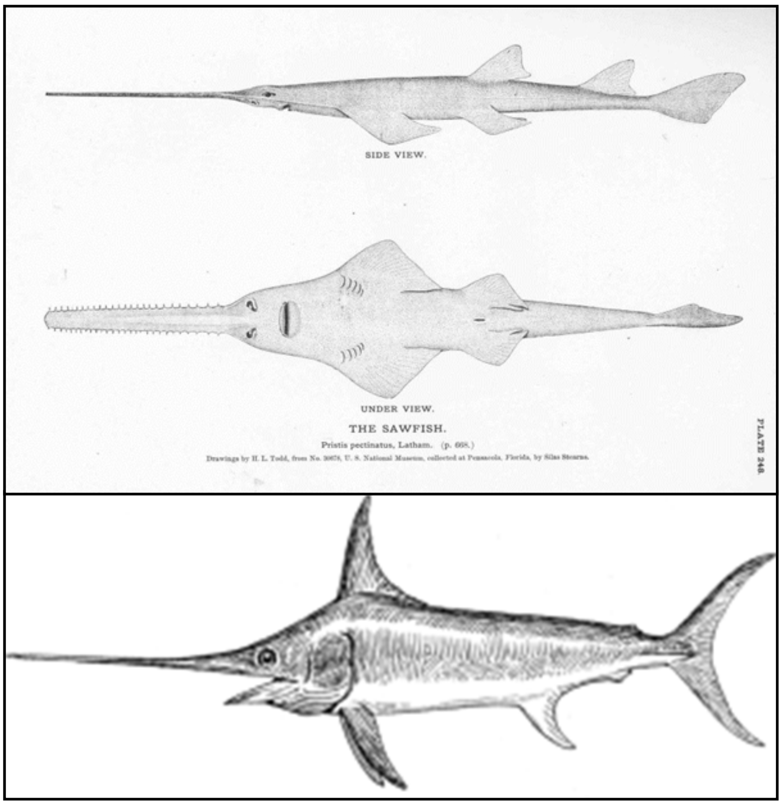

Figure 5.20 Swordfish (from Mubro JM. Fish-bite faults in submarine cables. *The Electrician*. 6th August 1881, pp186-187 and Grey GW, The Bottom of the Ocean Is "Main Street" to Him. *The American Magazine*, January 1925.

These fish were found particularly around river estuaries on the Brazilian and other tropical coasts.[258] A retired Captain W. G. S. de Carteret, veteran skipper in the transatlantic cable service, when interviewed for *The American Magazine*, related the entanglement of a whale…

> On one repair off the coast of Newfoundland, we hooked the cable, began to lift it, and found the weight enormous. The dynamometer, which should have shown a strain around two tons, was dangling up into infinity. We couldn't understand it. But the grapnel held and the hoist continued to lift, and presently up came the cable-with a 60 foot whale on it…… that was looped in that cable as neatly as any bosun's mate could have done the job. The cable passed through his mouth and over his back, where it crossed another diagonal of cable, which was looped and crossed over its tail…….We had a time of it before we got rid of him too. He had been drowned only three days, but the stench was terrific. Our men had to work with cloths tied over their noses. Finally we cut the cable, and the hulk drifted away.[259]

Bruce Heezen (1924-1977) a famous American marine geologist and oceanographer collated reports of known whale entanglements (Table 5.1).[260]

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[258] J. M. Mubro. Fish-bite faults in submarine cables. *The Electrician*. 6th August 1881, pp. 186-187.
[259] G. W.Grey, The Bottom of the Ocean Is "Main Street" to Him. *The American Magazine*, January 1925.
[260] B. C. Heezen, Whales entangled in deep sea cables. *Deep Sea Research.* Vol 4, 1953. pp. 105-115.

Year of damage by Whale*	Cable
1884	Cable belonging to the West Coast of America Telegraph Co (later part of ETC)
1887/1888	Kurrachee (Pakistan) - Owadur Cable
1897	Rio de Janiero Cable (Western Telegraph Cable)
1900	"Brazilian Cable"
1919	Hammel (New York) - St Pierre Cable in the Cabot Strait
1931	Cable off Valparaiso belonging to the All American Cable Company
1931	Buenaventura (Columbia) - Santa Elena (Ecuador) 1882 cable 15nm from Esmeraldas (Ecuador)
1932	Balboa (Canal Zone) - Santa Elena (Ecuador) 1913 Cable
1932	Patia (Peru) - Chorillos (Peru) 1882 Cable
1935	Salina Cruz (Mexico) - La Liberstad (San Salvador) 1882 Cable
1940	Patia (Peru) - Chorillos (Peru) 1882 Cable
1944	Santa Elena (Ecuador) - Chorillos (Peru) 1893 Cable
1955	Santa Elena (Ecuador) - Chorillos (Peru) 1893 Cable

Table 5.1 Whale damage (from Heezon 1953). *Cables *laid* during the period 1850-1914 have been included in this list, showing evidence of the longevity of submarine cables

From the collated reports, Heezen sketched a hypothetical sequence of how whale entanglements occurred as in all these reports the whales were drowned and their rotting carcasses were lifted entangled in cable.

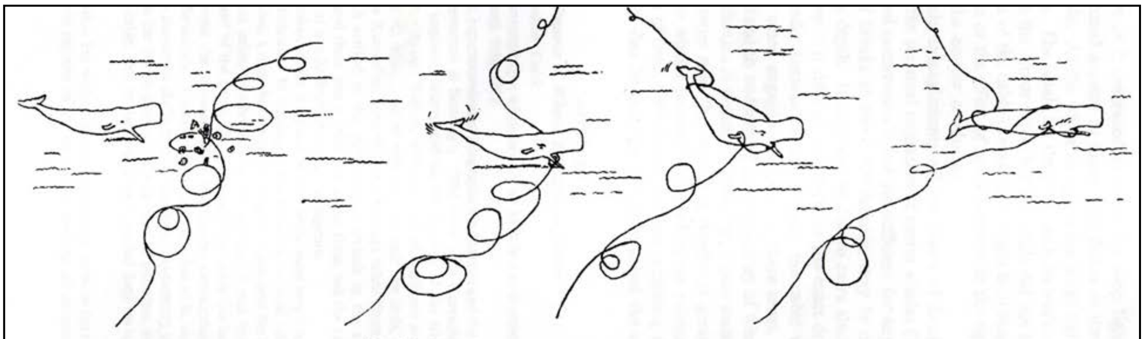

Fig. 3. Hypothetical sequence of whale entanglement.
Left to right : 1. Whale skimming along bottom with lower jaw in sediment searching for food. 2. Whale gets lower jaw in loop of slack cable. 3. Whale struggles and gets fin and flukes in adjacent loops of cable. 4. Whale completely entangled dies on sea floor.

Figure 5.21 Whale entanglements from Heezen BC, Whales entangled in deep sea cables. *Deep Sea Research.* Vol 4, 1953. pp. 105-115.

Other biological causes of cable damage included corrosion accelerated by iodine liberated from seaweed which had become attached.[261]

[261] Bright, *op cit,* p. 164.

5.8.3 Malicious damage & sabotage

Malicious damage was not unknown. James Graves cited malicious damage to cables during manufacture and laying as a cause of the immediate failure of some of the early deep-sea telegraph cables. He examined closely faults during the laying of the 1865 Atlantic cable where the brittle iron armouring wires were broken and had pierced the insulation. He surmised that although some of these faults were accidental, on other occasions the damage was deliberate.[262] This became a huge problem to the submarine telegraph cable industry. In June 1874 a fault occurred on the Malta – Alexandria Duplicate cable which, when located and raised to the surface by the CS *La Plata*, was found to be due to a three and a half inch knife slit between a pair of the armouring wires. This incision had probably been made before the cable was laid but the outer protective layers were tight enough to allow the cable to operate satisfactorily for many months before the deterioration in its insulation became troublesome.[263]

5.8.4 Anchors and fishing damage

Damage to cables by anchors and fishing gear was predicted from the earliest days of cable telegraphy, though evidence of anchor damage is much sparser in the archives available than might be expected. The only available data is from the minutes of the Eastern Telegraph Company and even then many of the "interruptions" were caused by unknown agents. This data is shown in the spreadsheet *Faults, Breaks, Interruptions and Repairs* (Appendix B, Chapter 2 on attached CD-ROM) An unknown proportion of interruptions near ports and harbours were due to anchors and those on the continental shelves due to bottom-fishing. The graph in Figure 5.22 shows the number of anchor chain incidents reported in the ETC minutes but these reports only relate to interruptions *known* to have been caused by anchors.

[262] J. Graves, On the causes of failure of deep-sea cables, *J. S. T. E.,* vol. ol 13, 1884, 119-126.
[263] ETC Minutes of Board Meetings, Volume 2, p16, 25th June 1874 . ETC Archives at The Telegraph Museum, Porthcurno.

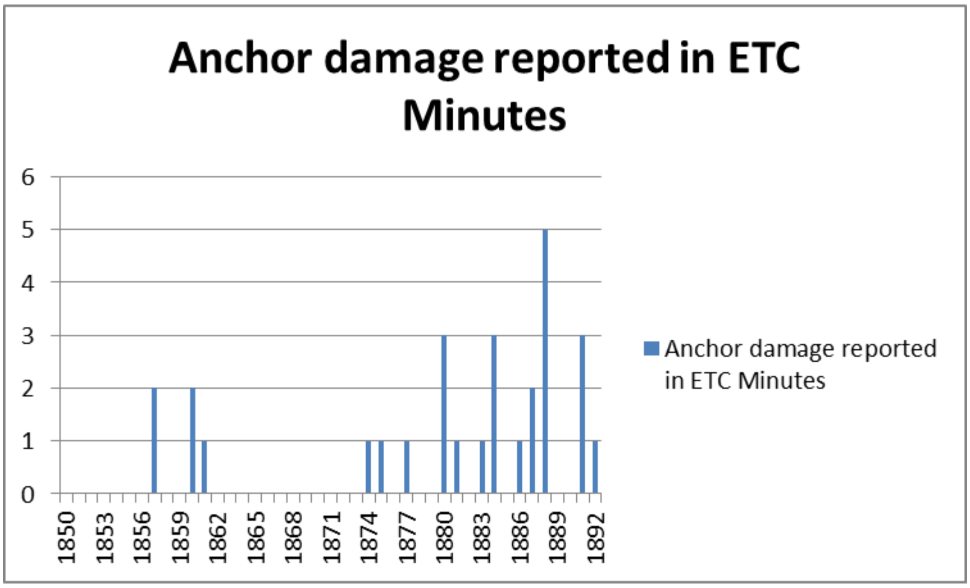

Figure 5.22 Anchor damage reported in ETC Board Minutes

That anchors and fishing were obviously more of a problem than the historical evidence shows is borne-out by the passing of the Submarine Telegraph Act in 1885 – "an Act to carry into effect an International Convention for the Protection of Submarine Telegraph Cables" i.e. the UK Parliament giving its assent to International Law.

Article 2 stated…

> It is a punishable offence to break or injure a submarine cable, wilfully or by culpable negligence, in such a manner as might interrupt or obstruct telegraphic communication, either wholly or partially, such punishment being without prejudice to any civil damages.
> This provision does not apply to cases where those who break or injure the cable do so with the lawful object of saving their lives or their ship, after they have taken every necessary precaution to avoid so breaking or injuring the cable.

Article 7 stated…

> Owners of ships or vessels who can prove that they have sacrificed an anchor, a net or other fishing gear in order to avoid injuring a submarine cable shall receive compensation from the owner of the cable.

This Act seemed to be almost un-enforceable. It was very likely that there were many incidents of interruption caused by anchors and fishing gear but only those captains who were actually observed to be guilty by a third party were recorded. There seemed to be no reduction in the number of incidents recorded in the ETC board minute books as a result of the Act.

5.9 Submarine Geology

A frequent cause of faults was sharp and jagged edges of rocks which were either unavoidable or had been missed during the pre-laying survey. If there were no strong deep currents, trouble did not occur for many years but even small currents which produce little movement of cables often chaffed through the insulation in due course of time. The “Burlings”, which was the English matelots’ name for an archipelago of 10 small islands amongst a large area of submerged rocks off the coast of Portugal, wreaked havoc with cables between the UK and Portugal and Gibraltar (see Figure 5.23).

Figure 5.23 Location of the archipelago of the Berlengas. Image © Sémhur / Wikimedia Commons / CC-BY-SA-3.0 (or Free Art License):http://en.wikipedia.org/wiki/File:Arquip%C3%A9lago_das_Berlengas-en.svg . Last accessed 26.05.2015

Poor surveying caused many cables to fail even before they had entered service. Two most noteworthy episodes were the so-called “telegraph plateau” in the north Atlantic already mentioned and the very mountainous sea bed of the route of the first Red Sea Cable. Another cause of cable damage was abrasion by ice caused many faults and interruptions around the Newfoundland Banks and Cape Breton Island.

Sudden cable breaks occurring sometimes after long periods of successful operation could be attributed to several causes. Forde, a notable consulting telegraph engineer, suggested that this type of failure was most commonly due to cable being suspended from peak to peak of submarine mountains without enough slack cable to follow the terrain thus inducing unnecessary tension. This was caused by inadequate surveying.[264] Convincing evidence for such suspended cables came from lengths of cable which, when raised from the depths, were

[264] H. C. E. Forde in the discussion (p513) following Trott S & Hamilton FA, Submarine Telegraph Cables: their Decay and Renewal. *JSTE*, vol 12 1883, pp. 495-532.

covered in large amounts of weed and even coral.[265] Trott and Hamilton attributed these late breakages to "wringing phenomena" or the twisting or untwisting of the armouring wire by more than 50 turns per nautical mile, during laying. Fleeming Jenkin laid great stress on the fact that if, the wires were covered in a tight sheathing, "no sensible untwisting ever does occur; about 40 or 50 turns are, at most taken out per mile".[266]

> ….the following were of frequent occurrence … suddenly the continuity of the electric current ceased, and the electricians declared that the cable had broken at the bottom . . . .. It snapped close to the ship. . . . . The electricians on board reported that continuity had ceased. . . . . When suddenly it snapped, 'without any perceptible cause, under a strain of only 2,200 pounds. . . . . The strain one-third less than breaking strain, everything favourable, and yet the cable parted, silently and suddenly.

Graves further pointed out that if slack continued to be laid when the laying ship was at a stand-still, then kinking was likely to occur if it was subsequently raised. Tightened kinks weakened the cable dramatically making it more susceptible to breaking.[267] However there were many instances of interruption of deep cables where the cause of the failure remained unknown.

5.9.1 Interruptions of cause unknown

Trott and Hoffman quoted Dr W.H. Russell in *The Atlantic Telegraph*; speaking of one disaster in particular, Russell said:

> The two other breaks might be accounted for and guarded against for the future,……. the latter not so easy of explanation, and which seemed to point to some mysterious agency existing in the depths of the ocean, beyond the perception of science out of man's control.

Unfortunately remarks such as these are missing from the reports of other cable expeditions although they are bound to have occurred.[268] Possible causes of the mysterious breakages during laying or recovery included kinking and corrosion of the iron wires when there was no protective outer covering. Trott and Hamilton were criticized in the discussion on their paper for using Russell's data as it was based on the first early attempts at Atlantic cable laying, data that was a decade old, on a cable that was known to have been poorly made and mishandled before it was laid. Hemp, which was often used in the protective coverings, was practically indestructible *except when in contact with iron.* Sir William Thomson also stated at the time

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[265] J. Milne. Sub-Oceanic changes. 1897. *The Geographical Journal.* Vol 10 p270

[266] F. Jenkin in his Cantour Lecture at the Society of Arts, Feb 5th 1866. Quoted by J. Graves in *JSTE&E* , vol. 13, 1884,

[267] Graves *op cit,* p. 124.

[268] S. Trott, F. A. Hamilton, Submarine Telegraph Cables: their Decay and Renewal. *JSTE&E*, vol 12, 1883, p. 497.

that the presence of carbonic acid in water was a great cause of iron being corroded. This problem was compounded by there being high levels of carbonic acid in many parts of the Atlantic. However, the most likely cause of damage to these deep-sea cables was movement of the sea bed. Because of these issues, the study of *submarine* geology was driven from the 1870s onwards by the telegraph industry. Prior to the needs of the telegraph industry, interest was mainly related to trying to predict tsunamis in order to protect life. But the cable engineers needed to know not just the depth and qualities of the surface of the sea bed but what else could have been interrupting the cables.

By the mid-1870s, geologists had gained some understanding of the enormous forces which could disrupt submarine cables, namely land-slides, earthquakes and volcanoes. Submarine land-slides were found to be relatively common in the vicinity of volcanic islands, due to their sloping shape under the water. Other areas susceptible to submarine land-slides were large land masses with long slopes beneath the ocean and with steep gradients; indeed those with gradients of >1:35 were also at higher risk of earth quakes (Table 5.2).[269]

West coast of South America, near Aconagua	1 in 20.2	Highly seismic
The Kurils from Urap	1 in 22.2	Highly seismic
West coast of Japan	1 in 30.4	Highly seismic
Sandwich Islands Northwards	1 in 23.5	Highly seismic
Australia generally	1 in 91	Non-seismic
Scotland from Ben Nevis	1 in 158	Non-seismic
South Norway	1 in 73	Non-seismic
East coast of South America	1 in 243	Non-seismic

Table 5.2 Gradients and Seismic Activity (from Milne 1897)

Masson *et al* have listed historically documented initiating factors for submarine landslides.[270]

- Historically documented
  - Earthquakes
  - Hurricanes or cyclic loading
  - Loading or over-steepening slopes
  - Under-consolidation (overpressure)

[269] J. Milne, Sub-Oceanic Changes. *The Geographical Journal.*, vol 10, 1897, p. 135.
[270] D. G. Masson, et al Submarine Landslides: Processes, Triggers and Hazard, *Philosophical Transactions: Mathematical, Physical and Engineering Sciences*, vol. 364,No. 1845, Extreme Natural Hazards (Aug. 15, 2006), pp. 2009-2039.

  - Rainfall (where landslides have a subaerial extension
  - Slope parallel weak layers in bedded sequences
- Suggested but less well documented
  - Gas hydrate dissociation
  - Sea level change
  - Volcanic activity

Thus land-slides usually occurred on or near continental shelves. Cables interrupted by land-slides often showed evidence of being stretched and/or crushed. Cable fracture in the deep oceans was more likely to have been due to earth quake or volcanic action. Milne in his classic paper of 1897 demonstrated his great depth of understanding of the importance of submarine geology to the telegraph cable industry.[271] On the question of deep-sea fractures he compared interruptions with the dates and location of earthquakes and found many coincidences. He was able to make these comparisons because of recent advances in seismometry.[272] The first seismometer that detected *and* recorded seismic events was built by Cecchi in Italy in 1875; from that date onward rapid advances were made and the surprising frequency of under-water earthquakes became apparent. It was not only the case of research into submarine geology helping submarine cable telegraphy but also vice-versa…

> ….three cables running in parallel lines about 10 miles apart, broke at points nearly opposite each other on the same straight line…….This may have been due to a sudden change in the configuration of the sea bed….[273]

This case provided strong evidence that major seismic activity had occurred covering an area of more than ten miles. Volcanic eruption also occurred in areas of high seismic activity. Not only did this damage or fracture submarine cables but also the evolved heat could melt the gutta percha insulation, as happened near the Lipari Islands in the Mediterranean and between Java and Australia in 1888.[274]

5.10 Competition

So far in this chapter I have shown that there was a steady increase in the complexity of submarine cable telegraph technology leading to increasing speed and efficiency of the service. This required a continuous increase in the skills and knowledge of the electricians and cable engineers. With the introduction of more sophisticated instrumentation the electricians

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[271] Milne *op cit*, pp129-285

[272] Seismology is a science driven by earthquakes. The earliest "seismoscope" was invented by the Chinese in 132BC; it detected seismic events but did not record or measure strength of same. "Western" science showed little interest in seismology as it advanced in non-seismically active parts of the globe. This changed in 1755 when >70,000 were killed by an earthquake in Lisbon.

[273] Milne *op cit*, p. 262.

[274] W. G. Forster. Earthquake Origin. *Transactions of the Seismic Society of Japan.*. vol 15 1890, p. 73.

had to maintain increasingly delicate equipment. As an industry, the future looked bright, profitable and secure. However during the final few years of the 19th century there was increasing concern about competition from two new technologies, namely, telephony and wireless (or wire-*less*) telegraphy. Telephony, during the period of this thesis, had little effect upon cable telegraphy due to its limited range. However it caused a marked reduction in land-line telegraphy.[275] The effects of wireless telegraphy (W/T) were much more of a concern to the senior echelons of the Eastern Telegraph Company management. However, the perceived interference was potential rather than actual.[276] It soon became clear that W/T had the major disadvantages of lack of secrecy, inability to provide many simultaneous channels of communication and unreliability both from the equipment point of view and the propagation of wireless signals being affected by weather and the sun. The greatest concern to the cable operating companies was the comparatively vast expense of cable maintenance requiring a fleet of cable ships, whereas the non-existent cost of maintaining the air. Although powerful long range W/T transmitters such as Poldhu in Cornwall proved that very long distance point-to-point communication was then possible, W/T showed its greatest advantages in ship-to-shore and ship-to-ship communication. I have been unable to find evidence of when the cable operating companies took advantage of this new technology to communicate with their cable ships. One might suggest that would that have been a step too far.

5.11 Conclusions

In this chapter, I have demonstrated the rapid advances that were made after the publication of the *Committee of Inquiry*. Suddenly there was a much greater impetus both to lay more intercontinental cable and to improve the instrumentation: more cable to inter-connect nations and improved instrumentation to increase the speed and accuracy of communication. However, as more cable was laid, the awareness of different causes of malfunction increased beyond volcanoes and anchors. This increased awareness allowed more avoidance of problems by, for example, better surveying.

However, competition for the former monopoly of international cable telegraphy was on the horizon by the end of the century. The competitor was wireless telegraphy (W/T) which, as its name implied, did not rely on fallible submarine cables which were expensive to maintain. Submarine cable telegraphy maintained its importance because of the confidentiality in transmission it afforded, traffic capacity and non-reliance on the vagaries of propagation. In

[275] F. J. Brown, *The Cable and Wireless Communications of the World*. Sir Isaac Pitman, London, 1927, p. 5.
[276] *Ibid* p. 6.

the following chapter I present case studies of two voyages of repair to show how the cable malfunction was managed in order to minimize interruption to both communication and financial income.

6. Late Nineteenth Century Cable Repair Expeditions: Two Contrasting Case Studies

6.1 Introduction

In this chapter I compare and contrast two examples of repair expeditions. The two examples have been selected because, while typical of other repairs, the data available is unusually complete rather than fragmentary. As explained in the introductory chapter, the term "maintenance" is an over-arching term I apply to preventive maintenance in the cable telegraph system which may include both renewals and repair of breakdown/faults in the telegraphy. In general for technological systems: the better a system was maintained, the less it was necessary to repair. Continuous monitoring of the electrical properties of a telegraph cable made it possible in many cases for the engineers to predict certain types of fault, allowing replacement or "renewal" of a section of cable before communication was completely interrupted. In this chapter I look into a number of issues surrounding the location and repair of faults and breaks in the early global network of submarine telegraph cables. These were not predicted and therefore caused interruption of communication with consequent loss of revenue to the operating company who owned the cable and of trust in the service by customers. What were the differences between laying and repairing of the cables: the type of ships that were used; locating and repairing the breakdown? Who were the personnel involved and what sort of skills were required and to what level? How did men of different disciplines and skills interact and how much was this interaction based upon trust?

Given the systematic management of telegraph systems, with every cable there would originally have been the charts of the original laying of the cable and the engineer's report at the time of laying. Accordingly, those later investigating a breakdown would have a record of exactly where the cable was and all its electrical properties when it was first laid. Thus comparison of the original cable data with electrical tests in its faulty condition was used to determine on the chart the location of the breakdown. An engineer's report after location and subsequent repair would then have been available as required for any further breakdowns. However, very little complete data of fault localization and repair can be found in the archives searched.[277]

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[277] As previously mentioned, there is often confusion in the literature about the definitions of "fault" and "break". Contemporary electrical testing textbooks state that the term *break* referred to a complete break in the copper conductor such that no signal could be received even if the sending voltage was increased. The ends of a break may be in contact with the sea or may remain insulated within a still-intact gutta perch sheath. A *fault* referred to a breakdown in the insulation allowing electrical contact with sea water but with the conductor remaining in continuity. With a fault, signals may still be passed between two stations but with the need for an increased sending current and being

One of the Telegraph Construction & Maintenance Company's (TCM) cable engineer's log books (held in the National Maritime Museum archives), concerns a breakdown of a cable between St Vincent in the Arquipelago de Cabo Verde and Pernambuco - now known as Recife - in Brazil. This corresponds to a narrative found in a small BSTC in-house magazine entitled the *Monthly Correspondent.* This publication, like many other periodicals in the Victorian era, ran for only 48 editions between 1883 and 1887.[278] It was originally produced by the staff of the Brazilian Submarine Telegraph Company (BSTC) at the Madeira Cable Station for BSTC staff at all the stations of their one cable from Lisbon to Pernambuco. Somehow a copy reached *The Electrician*.[279] It may, of course, not have met with BSTC's board's approval that many of the comments in the *Monthly Correspo*ndent were read by those outside the organization. Reports of this cable breakdown can also be found in the minute books of BTSC board meetings.[280] A deeper search of an un-catalogued part of the archive at Porthcurno has unearthed not only the Engineer's report of the laying of this cable in 1873 but also the laying charts and the final Engineer's report to the board of BSTC. This combination of archive materials give otherwise unpublished detail of the methods used by the technicians to find and repair breaks in submarine telegraph cables in mid-ocean.

A second example of a much less well documented repair is that of the Porthcurno – Lisbon-Vigo cable in 1888. In this case the cable was *owned* by the vast Eastern Telegraph Company who used their own cable repair ship CS *Electra;* the breakdown was nearer to land and therefore in shallower waters. Although no ship's log book is available, the archives at Porthcurno contain the letter copy books for the period 1888 – 1897 of Mr Harold Ansell an Eastern Telegraph Company's (ETC) electrician. These letter copy books contain copies of his hand-written letters and reports of cable repair voyages. Very brief notes in the ETC board meeting minute books report the whereabouts of each of their cable ships. No other information was written, presumably because scrutiny of the minute books would have been open to a wider readership than the board would have considered wise. It is a challenge to the historian that none of the station diaries or log books has survived; nor have the results of the

received more weakly at the receiving station. However the terms seem to be used interchangeably by the technicians at the time. Archives searched: Porthcurno Telegraph Museum, Cornwall; National Maritime Museum, Greenwich; Archives of the Science Museum (London) at Wroughton; Maritime Museum, Liverpool.

[278] Waterloo Directory of English Newspapers and Periodicals. www.victorianperiodicals.com. (last accessed 14.10.2010)

[279] *The Electrician*, 12th January 1884, p. 195.

[280] Para 1223 in BSTC Board Minute Book Vol 2. PK Archive DOC/BZSTC/1/2

regular electrical tests which were done on every cable by the station electricians on a fortnightly or monthly basis.[281]

Notwithstanding the absence of much key information on the maintenance and repair of submarine cables, it will become clear that three professions and a “trade”, namely navigation, mechanical (cable) engineering and electrical engineering and the trade of cable jointing, were vitally important in locating and repairing a breakdown in any submarine telegraph cable. Their roles, skills and mutual trust are very apparent in the narrative that follows. The location and repair of submarine cable faults is a prime example of the integration of the roles of exponents of a number of professions and highly skilled trades within the system of telegraph maintenance and repair.

6.2 St Vincent to Pernambuco section of the Lisbon to Pernambuco Cable

I now turn to the first of my case studies to illustrate these points. The largest amount of archival data that I have found about submarine cable repairs concerns a break in the Lisbon to Pernambuco cable which was laid in 1874. The first mention of telegraphic connection between South America and Europe without involving North America occurs in 1857.[282] The Ministry of Agriculture in Rio de Janeiro had granted an exclusive 20 year concession to Baron de Mauá for the establishment and operation of a submarine telegraph cable between Brazil and Portugal. There was an understanding that the concession could be made over to a new enterprise and Baron de Mauá transferred it to TCM who then set up a separate company, the Brazilian Submarine Telegraph Company, which was incorporated in London on the 8th January 1873. Part of the contract with the Ministry was that if an average of 300 messages a day was reached by 1885 then a second cable was to be laid. The cable company was entitled to employ its own staff with no restrictions as to nationality.[283]

Viscount Monck was made chairman of the new company and among the Directors were Sir James Anderson, the managing director of ETC, and Sir Daniel Gooch, the chairman both of the Great Western Railway and TCM.[284] This follows a common plan whereby new cable companies were set-up at arm’s length financially from the ETC but would eventually become

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[281]Personal communication with John Nash, retired C&W cable electrician. The Station logbooks at ETC’s station at Ascension Island have been found on Ascension Island but have suffered the ravages of 100 years at 85% relative humidity and temperatures of 80^{o} to 100^{o} Celsius – perfect conditions for their almost total destruction by white ants. They are unfortunately totally illegible and remain in the Museum on Ascension Island.

[282] J. Ahvenainen, *The European Cable Companies in South America before the First World War.* 2004, Academia Scientiarum Fennica, Finland, P. 11.

[283] *Ibid,* p. 93.

[284] R. B. Wilson, *Sir Daniel Gooch – Memoirs & Diary*, David & Charles, Newton Abbott, 1972, pp. 108-9.

part of the ETC Group when it was apparent that they were financially viable. See the algorithm in Appendix A.

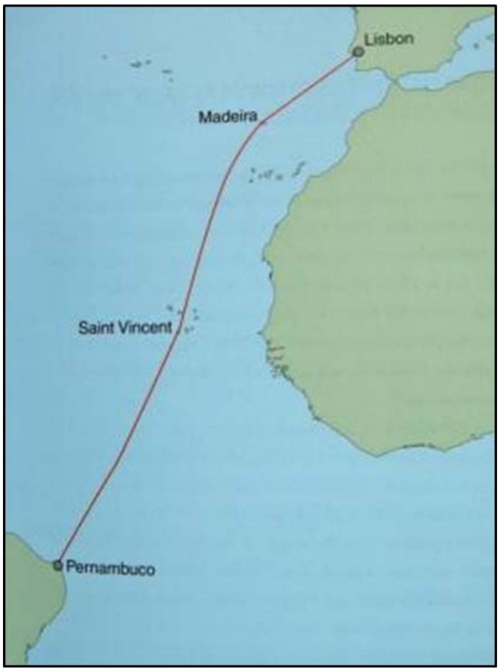

Fig 6.1 Cable route from Lisbon to Pernambuco J. from Ahvenainen, *The European Cable Companies in South America before the First World War.*, Academia Scientiarum Fennica, Finland. 2004, P. 91.

The Portugal to Brazil Cable of the BSTC was laid in three parts by TCM. The maximum length of submarine cable over which telegraph signals could be reliably transmitted was about 2000 miles before the signals became too weak to be detected. Any greater length of cable required some form of amplification in the form of "repeaters". The available technology in the second half of the nineteenth century required "human repeaters" – telegraph stations on convenient islands.[285] At these stations, such as at St Vincent, the telegraph signal could be received using either a "speaking" mirror galvanometer or siphon recorder, transcribed by a skilled operator and then retransmitted by another operator to the next telegraph station, which might be the destination station or another repeater. In the case of this cable, the intervening repeater cable stations were at Madeira and St Vincent. The first section was from Carcavelos (CAR, the cable station for Lisbon), Portugal to Madeira (MAD) and was laid in 1873 by the cable ships CS *Seine* and CS *Minia*; the second section was from Madeira (MD) to St Vincent (SV) in the Cape Verde Islands laid in 1874 by CS *Hibernia* & CS *Edinburgh*; the last section from St Vincent (SV), Cape Verde Islands, to Pernambuco (PB) (Recife), Brazil, was also laid in 1874 by CS *Hibernia*, CS *Edinburgh*, CS *Seine* and CS *Investigator*.[286] The entire CAR-PB Cable came into operation on the 23rd June 1874.

[285] Unmanned subsea repeaters were not available until well into the electronic thermionic valve post World War II.
[286] The 2 or 3 letter abbreviations were used for all the cable stations and later for the wireless stations of the Cable and Wireless organization, for convenience in manual and later automatic routing of messages. They were also naturally used as a short-hand in company documents.

This cable operated successfully without incident for the next nine years. However, at 0030 on the 21st Sept 1883 the SV-PB section of the cable failed – as evidenced by the complete cessation of incoming and out-going signals. At 0130 an operator at SV reported this failure to the Madeira station with a mixture of sadness and hilarity:

> Here's a nice go! We can't get PB and there is nothing to eat in the house.[287]

Perhaps this was unofficial code to hide the true nature of the seriousness of the breakdown to the wider world to protect the company's reputation and especially its share price. "Nothing to eat in the house" may have been a coded message that the cable had completely failed; if so this would imply that the copper conductive core had been fractured and that no messages could be passed. This can be contrasted with damage to the insulation, in which case signals would have become weaker and weaker but remain intelligible for days or even weeks.

The Electrician – a periodical for the electrical engineering and shareholding community regularly reported cable interruptions in their short news "notes". On the 29th of September 1883 this column reported…

> The Brazilian Submarine Telegraph Company notify the interruption of their St Vincent-Pernambuco cable. As an alternative route [from Europe] has just been established, messages can now be sent direct to the Brazilians or any part of South America by any of the Atlantic companies' lines, via New York and Galveston.

It is unclear whether the BSTC did actually notify *The Electrician* or whether a mole inside BSTC did so. The break was similarly reported in the *Electrical Review* as having been "*notified* by BSTC".[288] There was quite obviously a "mole" in BTSC, judging by a remark the next edition of The Electrical Review referring to "our Stowaway Special Correspondent".

A little over a month later the *Electrical Review* of the 3rd November 1883 elaborated in more detail…

> New Cables – Considerable activity is manifested in this branch of electric work at the present time. The Telegraph Construction and Maintenance Company has, we understand, an order for 260 knots for the repair of the St Vincent- Pernambuco section of the Brazilian Submarine Company. Report also states that the Construction Company is likewise making 3000 miles to duplicate the Madeira-St

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[287] *Monthly Correspondent* No 1 December 1883, p. 2. PK PUB//TCOM/47
[288] *The Electrical Review*, September 29th 1883, p. 245.

> Vincent and the St Vincent-Pernambuco sections although the official order has not yet been given.[289]

The same edition bears the report of the 20th ordinary general meeting of the shareholders of the BSTC at which the Chairman reported the sudden breakdown of the SV-PB section on the 22nd of September. This was followed by the rather more revealing concession by the Chairman that…

> I have received a printed circular – an anonymous circular – on this subject, and I have no complaint whatever with the tone of this circular… But one of the criticisms made in this circular is that no preparation were made for such a catastrophe as has happened.[290]

He then dealt with the criticism that the BSTC did not keep a stock of spare cable for such an eventuality. He said that for a single-cable company it would have required and inordinate amount of capital to be tied up maintaining a stock of spare cable of each of the types used; further that it was unusual for the type of cable used at 2000 fathoms to fail as it was out of harm's way from anchors and fishing tackle. Viscount Monck also rebutted the criticism of the lack of a repair ship waiting in the wings by saying that a comparatively small repair ship would not have been big enough to cope with raising and lowering cable to and from such a great depth.[291] A Mr Spicer, a major shareholder, put forward a vote of no confidence in the board over the lack of preparedness and the board's wishing to spend money on laying a duplicate cable. This was seconded by another shareholder, Mr Bryce, and put to the vote but comprehensively defeated, Spicer and Bryce being the only supporters.

The BSTC Board at their meeting on Friday the 5th October minuted the break occurring on the 22nd September 1883 at 12.20 am and that arrangements made by the Managing Director for repair were approved.[292] The report was very short and matter-of-fact, which was prudent of BSTC especially as this was the only cable that they owned and operated. This would have been to conceal the disastrous effect that its failure was having on the income and reputation of the company.

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[289] *The Electrical Review*, November 3rd 1883, p. 348.
[290] *The Electrical Review,* November 3rd 1883, pp. 348-349.
[291] The vast majority of cable breaks and faults occur on the continental shelves. The deeper the cable has to be raised or lowered, the more powerful winching and breaking gear has to be.
[292] BSTC Board Minute Book No 2 1883 paragraph 1233. PK DOC/BSTC/1/2. It will be seen that there is a 24 hour discrepancy between the date of the breakdown as noted in the *Monthly* Correspondent and the minutes of the BTSC board for which I can find no reason; it could have been a mistake or a 'typo'.

This break in the cable seemed to have occurred without warning – at least such premonitory signs as were available were not apparent to the electricians at the relevant cable stations. An electrician at each station specialized in maintaining all the equipment, regularly carrying out electrical tests on cables terminating at the station and balancing the artificial cable.[293] Artificial cables were an important part of the circuitry which allowed a single cored submarine cable to pass messages in both directions simultaneously. Electrically, the artificial cable was formed from resistors in series representing the copper core and capacitors in parallel simulating the capacitance between the core and the sea water. The components of the artificial cable had to be adjusted on a regular basis to exactly match the electrical properties of the cable.[294] There was an artificial cable at each end of a section of cable. Small cable stations with solely a "repeater" function such as the St Vincent station had only one electrician to carry out all these roles, whereas larger stations usually had enough electricians to make sure that one was on duty 24 hours per day. The results of conductor resistance and dielectric resistance tests were recorded every week and plotted on graphs.[295] Any trends in these values were used to predict possible fault development which could be prophylactically attended to before there was a complete breakdown in communication and therefore loss of income. However, in the case of a catastrophic complete break in a cable, such as one due to subsea geological disturbance or damage by anchor, no such warning was available.

The station electricians, Howe at PB and Lawson at SV, attempted to "touch-up the cable by reversals" of increased intensity from Leclanché cells, but to no avail.[296] "Touching-up by reversals" was a technique which sometimes improved faults temporarily. Electric current coming into contact with the sea water at the fault could produce miniscule bubbles of hydrogen which would improve insulation temporarily if the current was passing in one direction. In the case of a fracture in the conductor, passing a current in the opposite direction would cause cupric chloride crystals to form between the opposing ends of a break in the copper conductor reforming an albeit high resistance connection between two ends of a conductor fracture if the gap between the two ends was *very* short. A combination of these

[293] "Artificial cables" were part of the equipment at each end of a section of cable allowing communication in both directions simultaneously. Artificial cables were exact electrical simulations of the cable's resistance and capacitance and formed part of a bridge circuit. It was necessary to keep them "balanced", adjusting their components to match changes in the cable which occurred mainly due to changes in sea water temperature. In temperate climates this balancing may only be required once a week but in tropical areas as many as six times a day.

[294] This would have been done on a weekly basis with short cables in temperate climates but may have to be repeated several times a day on long cable especially in the tropics.

[295] "Dielectric" was, and still is, term used by electrical engineers for "insulation" especially that of condensers (now known as capacitors)

[296] Monthly Correspondent No 1 December 1883 p. 2. PK PUB//TCOM/47.

two effects might allow signals to pass temporarily in the case of a *very* small injury to the cable. But in this case there was too big a gap between the broken ends to affect a temporary repair.

Lawson was able to easily report his findings to head office in Great Winchester Street, London via MD (Madeira) – CAR (Carcavellos, the cable station for Lisbon) – PK (Porthcurno). Because the CAR – PB cable was single however, Mr Howe (of PB) had to send the results of his measurements to Porthcurno by an extremely circuitous route via Galveston in the USA and the North Atlantic cable system. The electricians at the two stations then made very careful electrical measurements from each station in order to estimate the location of the break. These measurements were of electrical resistance. The copper conductor of the cable had a finite resistance per unit length and this was recorded on the laying chart. When a break in the cable occurred the measured resistance was altered by the alternative path from the end of the conductor at the break via the sea water which was a very good conductor. I explain the history of the development of the tests used in the next chapter. Their first estimate was that the break had occurred at 1000nm from SV.[297]

By some means, Siemens Brothers and Company – a direct competitor of TCMs' - became aware of BSTC's problem and their Board wrote to BSTC's chairman on the 6th of October offering their services for repair and duplication of the faulty cables. The BSTC board instructed the company secretary to reply that they were "unable to accept the services of Messer's Siemens Bros & Co.".[298] TCM would have been the natural and most expedient choice for the board to make as Sir Daniel Gooch was on both boards of directors. TCM did not have small cable repair ships in its fleet and a large cable laying ship would have been more appropriate to deal with such a mid-ocean breakdown. Rather revealingly, there is no mention of this episode in Gooch's published diaries although one cannot tell whether the episode was left out by Gooch or the editor of his published diaries which were written for a mass readership.[299]

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[297] Monthly Correspondent No 1 December 1883 p2. PK PUB//TCOM/47
[298] Minutes of BSTC board meeting dated 19th October 1883, Minute Book No2, 1883, para 1243.
[299] R. B. Wilson editor., *Sir Daniel Gooch – Memoirs and diary.* David & Charles, Newton Abbott, 1972,

Between the 22nd of September and the end of October 1883, TCM manufactured extra cable specifically for the repairs and a formal contract between BSTC and TCM for the repairs was drawn up and signed on the 30th of October.[300] Paragraph 15 of the contract states:

> The Engineer [sic] of the Company for the purposes of this contract shall be Josiah Latimer Clark, Henry Charles Forde, and Herbert Arnaud Taylor, Esquires or any or either of them.

Clark, Forde & Taylor had formed a partnership as Consulting Engineers and were involved in many cable-layings and repairs in the Victorian period. Latimer Clark (1822-1898) was also chief Electrician to TCM.[301]

The cable was loaded on to TCM's ship the SS *Scotia*. The Engineer's Final Report states that the *Scotia* was commanded by Captain Cato and that Mr Frank Lucas was the Engineer in charge of the repair.[302]

> both of these men having had great experience of repairing cables in deep water, the company were fortunate to be able to secure their services on this occasion. Mr R E Peake accompanied the expedition as representing our firm [Clark, Forde & Taylor] and your company [BSTC].

Sir Daniel Gooch commented in his diary for the period...

> I have been very much pleased with Lucas, having found him a well-informed and very intelligent man. We are fortunate in having so good an officer.[303]

The responsibility of the Cable Engineer and his staff on the cable ship was related to everything mechanical as opposed to electrical, concerning the laying and raising of telegraph cable to and from the sea bed and the care of the cable during loading and whist it was stored on board. CS *Scotia* left Enderby's Wharf, Greenwich at 1330 on the 1st of November 1883.[304] Forty two nautical miles of Type C cable (see Appendix B) and 260nm of "new Type C" cable

[300] Copy of the contract appended to: Messrs. Clark, Forde & Taylor, Engineers. *BSTC St Vincent-Pernambuco (1874) Cable – Engineers Report upon the Repairing Operations of 1883* dated 10th January 1884. PK Archives (not catalogued)

[301] Many of the cable engineers were competent cable electricians and this could certainly be said of Latimer Clark (1822-1898) who formed a partnership with Henry Charles Forde (1827-1897) and later Herbert Arnaud Taylor (1841-1915) as Clark, Forde & Taylor, Consulting Engineers, of Gt Winchester Street, London and under his supervision laid some 100,000 miles of cable.

[302] Messrs. Clark, Forde & Taylor, Engineers. *BSTC St Vincent-Pernambuco (1874) Cable – Engineers Report upon the Repairing Operations of 1883* dated 10th January 1884. PK Archives (not catalogued)

[303] Wilson RB, editor, *Sir Daniel Gooch – Memoirs & Diary*, David & Charles, Newton Abbott, 1972, ISBN 0-7153-5609-7, p322

[304] CS *Scotia* was 379 ft. in length and 47.8 ft. beam drawing 20 ft. Her gross tonnage was 3,871. She had compound engines of 2,200 ihp driving twin screws and a brig sailing rig. CS Scotia was originally Cunard's last paddle steamer and indeed held the Blue Riband from 1861-1867. She was sold to TCM and converted to a twin screw cable ship. She eventually ran on to the Spanish Rocks at Guam and was wrecked.

were on board coiled in *Scotia*'s No 2 tank.[305] This piece of cable had been especially manufactured for this repair.[306] This delay in the repair whilst cable was manufactured was due to the smallest operating companies' unwillingness to buy and store cable as spare for any eventuality.[307] The *Scotia* arrived at St Vincent at 0700 on Sunday 11th November; by then the cable had already been out of action for 51 days.

Mr Brown, the station's electrician, the contractor's electrician and Mr Peake repeated the electrical measurements. The position of the break was calculated first as a function of electrical resistance. From these results the distance in nautical miles of cable was calculated from the electrical resistance data recorded during original manufacture and laying in 1874. The break was estimated to be at Latitude 2° 38' 0"N, Long 30° 32' 30"W. In view of the expense of prolonged searching for the break Mr Willoughby Smith, the chief electrician of TCM, was also consulted.[308] On the 12th of October he stated that the latest and most reliable tests taken independently placed the break in the SV-PB cable 1045nm from SV and 802nm from PB.[309] After consulting the laying charts the break was estimated to be at Latitude 2° 41' 42" N, Long 30° 29' 22" W, 1043.8nm from St Vincent.[310] Brown, the electrician at St Vincent, gave results of his tests estimating the break to be 1050nmfrom SV. Frank Lucas calculated the break to be 1043.78 nautical miles *of cable* from SV and 801.05 nm *of cable* from PB. These discrepancies were probably due to different understandings of "accuracy", "precision" and "range of error" in measurements in the late 19th century and the use of 5- or 6-figure tables of logarithms.[311] It was common practice in the late 19th century to use excessive significant figures as an indication of the *care* which had been taken in measurement rather than the

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305 Extract from BSTC's MD in *Monthly Correspondent* No 5, April 1884, p1, PK PUB//TCOM/47

306 Lucas F, Diaries, 29th October 1883, "Brazilian Repairs". Science Museum Archives, Wroughton, MS462 vol 1

307 Submarine telegraph cable was expensive to manufacture and store: 3-4 different types were required for every total cable, it needed to be stored in huge tanks containing cool brine and its shelf-life on shore was very limited.

308 Willoughby Smith joined the Gutta Perch Company in 1848 (about the same time that Michael Faraday called attention to the superb insulating qualities of gutta percha) Mr Smith was engaged in the manufacture and laying of the first Dover-Calais cable. He continued to be in the forefront of the science and engineering of the submarine cable industry for the rest of his career. He was sent to by Sir Richard Glass the MD of TCM to accompany the Great Eastern in 1865 and designed the system for continuously testing submarine cables on board ship whilst laying was in progress. He eventually became electrician in chief of TCM – From the Electrician's Directory for 1885 p124-126.

309 F. Lucas Diaries "Brazilian Repairs 1883" Archives at the Science Museum, Wroughton.

310 *Brazilian Submarine Telegraph Company – Charts.* PK Archive (not catalogued).

311 All quantitative measurements were quoted to far higher significance than would be justified by our understanding of these terms now. Lecky STS, *Wrinkles in Practical Navigation*. Revised & enlarged edition, 1884. George Philip & Son, Liverpool, p287

modern understanding of errors in measurement.[312] The electricians and the cable engineer compared electrical results of tests during the laying of the cable on the laying charts and the significance of the miles of cable takes into account the deliberate slack of the cable which may have been up to 20% of its total length. During laying both actual distance traversed and the length of cable laid had been recorded every hour by the cable engineer. The difference between the two measurements was the mandatory slack in the cable. The slack in the cable was deliberate to allow for undulations in the sea bed and also for sufficient cable for a bite to be raised if necessary for repair without putting undue strain on the cable as a whole.[313] Knowing the time of day at which the suspect piece of cable was laid, its position could be estimated by knowing the position of the laying ship by noon sun sightings before and after the estimated laying time. Frank Lucas had transferred this laying data to his diary from the laying engineer's report and chart of 1874 copies of which were kept at both ends of every section of every cable.[314,315,316] The discrepancies in the calculated location of the break in the cable were possibly due to overstated accuracy in measurement (electrical resistance, cable length), inaccuracy in the original laying chart which was published in 1861 and overstated accuracy in navigation during laying. In reality, as will be seen below, the discrepancy in the estimates of the location was due to there being two complete breaks which probably occurred simultaneously due to volcanic action causing disruption over a large area.

Before leaving St Vincent on the 12th of November, Frank Lucas told the station staff when CS *Scotia* was expecting to be at the site of the break and therefore to commence keeping watch for signals from her on the cable from that date.[317] Lawson gave him the exact position of the "observation stone" in front of the Telegraph Office as Latitude 16° 53' 20.12"N Longitude 24° 59' 22.3"W, as a reference for dead reckoning navigation. The sea charts of the area or "ground"[318] of the break down available then as now were called Passage Charts. The most up-to-date chart available when the cable was laid was published in 1861. The skill of the

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[312] G. J. N. Gooday. *The Morals of Measurement – Accuracy, Irony and Trust in late Victorian Electrical Practice*. Chapter 2: Meanings of Measurement and Accounts of Accuracy. Cambridge University Press. 2004.

[313] A "bite" of cable was a loop that can be at the end of the rope or cable or anywhere along the length of the rope or cable.

[314] F. Lucas, Diaries, November 1883, "Brazilian Repairs". Science Museum Archives, Wroughton, MS462 vol 1

[315] BSTC St Vincent – Pernambuco Cable' Engineers' Final Report & Appendices, 1874, PK – uncatalogued.

[316] *Brazillian Submarine Telegraph Company – Charts.* PK Archive (not catalogued).

[317] H. D. Wilkinson, *Submarine Cable Laying and Repairing*, The Electrician Printing and Publishing House Ltd, London 1896, p. 11.

[318] A term that they commonly used for the area in which they had been searching and eventually repairing submarine cables.

Scotia's navigating officer, and that of all of his colleagues, when searching for a mid-ocean cable breakdown was second to none. Marine navigation was a highly skilled practice that entailed navigating a safe ship's passage from one land mass to another and then "piloting" accurately to an exact destination using bearings taken off lights, buoys or other land-based objects.[319] Charts used for maritime navigation fall into two categories: large scale charts for accurate *piloting* near the coast and small scale passage charts for *navigating* across oceans. *Passage Charts* are very small scale as they cover vast areas of "empty ocean" and as their name implies are strictly for use in crossing oceans; near land much larger scale maps are used. The only reasons for large scale maps of vast areas of empty sea are the laying of cables and naval warfare. Even the current Admiralty Chart for the area No 4215 *Recife to Dakar* has a scale of 1:3,500,000.[320] At this scale, the thickness of a thin pencil line (0.5mm) plotted on the chart corresponds to approximately one and a half kilometres. This alone, apart from any inaccuracy in the charts or the laying plots, made searching for a cable of about 30mm diameter, like looking for the proverbial needle in a haystack. Thus the skill of the cable ship navigating officer on cable repair duties was higher than most, and when searching for cable breakdown he had to work very closely with the cable engineer who interpreted the cable plot from the laying chart, and the cable electrician who was able to re-estimate the location of the fault more accurately whenever a bite of the cable was raised.

The *Scotia* left SV at 1810 on Monday the 12th November and reached the estimated position of the break at 1300 on Friday the 16th of November where it laid a marker buoy M1 anchored at 1650-1700 fathoms at a "supposed position" of Latitude 2° 46' 0" N, Long 30° 26' 40" W.[321,] There were no land marks to sight for hundreds of miles. Using a combination of dead reckoning and celestial navigation, the crew of the *Scotia* were confident that she was at the estimated position of the break.[322] Bathymetric navigation would have been another possibility but not in such poorly charted waters. (see Maury's chart Figure 6.2)

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319 W. E. May, *A history of marine navigation.* WW Norton & Co, Inc., New York. 1973, p xiv

320 Compare with Admiralty Chart No 969 *Recife and Approaches* which has a scale of 1:15,000

321 Lucas *op cit*.. "Dead reckoning" is a method of navigation used when there were no physical objects in sight to take bearings from and no visible astronomical bodies to take sights of. It relied on accurate compass work and deriving distance from speed and time. The navigator also had to take the speed of sea currents into account and this was the greatest cause of error with this method of navigation. TCM Cable Engineer's Log No 145 St Vincent – Pernambuco (1874) cable Repairs Nov 1883 p2. NMM TCM/8/

322 "Celestial navigation" required skill in the use of a sextant to measure the declination of celestial bodies which obviously had to be un-obscured by mist, fog or clouds. It also required the use of a marine chronometer which was a very accurate timepiece in synchronism with Greenwich Mean Time.

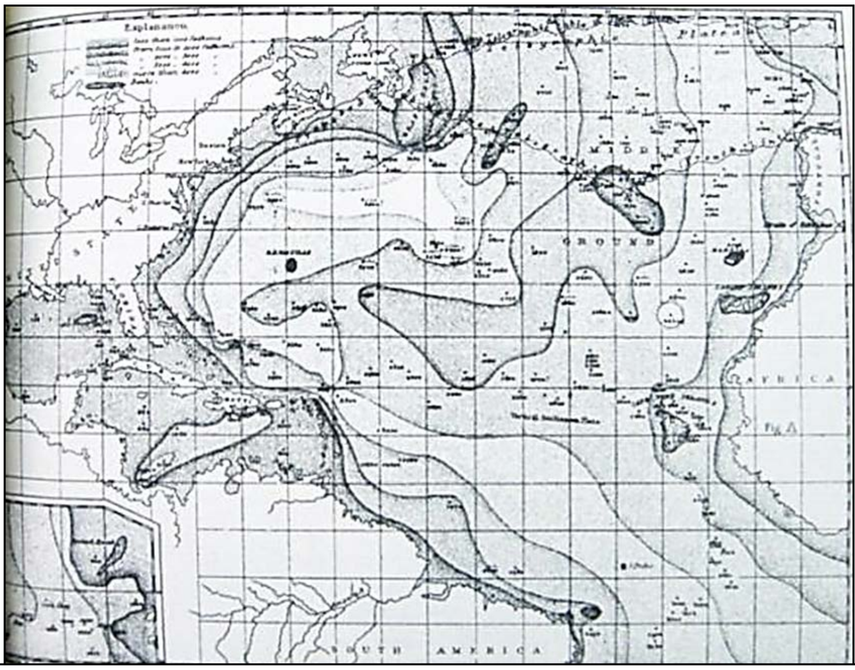

Figure 6.2 The Bathymetric chart available to the navigating officer of the cable ship laying the SV-PB section in 1874. It can be seen that the position of the lines of equal depth are estimated from very few discrete soundings. From: Schlee S, , *The Edge of an Unfamiliar World – A History of Oceanography*,Clark, Irwin & Co. Ltd, Toronto, 1973, pp. 56-57.

Accuracy with a sextant was +/- 0.1 of a minute of arc. One reason, as noted elsewhere in this thesis, is that the greater the number of significant figures any measurement was quoted - the greater the amount of care taken in acquiring that measurement. The Almanac page for 16th-18th November 1883; the Greenwich Hour Angle (GHA) and Declination of the heavenly bodies quoted in degrees and *tenths* of a minute of angle – not the great accuracy quoted in the log book but because of the 5 or greater significant figures of the tables used.[323]

At noon the following day, the 17th, the exact position of buoy M1 was verified by sighting the sun as Latitude 2° 47' 0"N, Long 30° 29' 30"W.[324] Soundings were then taken under steam towards the SW of buoy M1 for 30 nautical miles parallel to the estimated track of the cable then returning to a point 5.5 nautical miles NE of M1 at 0830hrs on the 17th of November. They did this in order to accurately ascertain the depth and the nature of the bottom to see if there was a comparatively shallow and rock-free area over which to grapple, the best possible conditions for grappling and cable laying being mud or globigerina ooze.[325] Fortunately conditions were found to be favourable. Copies of these sounding results were also kept for future laying of a duplicate cable and for the information of the Admiralty Hydrographic Office

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[323] www.tecepe.com.br/nav for 16th-18th November 1883

[324] Lucas F, Diaries, *op cit,* 17th November 1883.

[325] Clark, Forde & Taylor, Engineers: *St Vincent to Pernambuco (1874) Cable – Engineers Final Report upon the Repairing Operations of 1883.* 10th January 1884, p3 PK Archives as yet not catalogued.

in England as it can be seen that the 1861 chart in use had very sparse spot depths compared with a current chart of today.[326]

After steaming back to buoy M1, sighting the sun at noon and putting a light on the buoy, *Scotia* steamed S39E for 6nm by 1340hrs and sounded at 1775 fathoms. Lucas chose a "Centipede" grapnel originally developed by Messrs Johnson & Phillips but modified by him, out of a selection of different grapnels carried (see Appendix C).[327] The choice was governed by the soundings which had shown that the bottom was rocky. When simple grapnels were drawn across rocks by the searching ship, the prongs were regularly broken off so that even if the grapnel came in contact with the cable there was a high chance that it would not be hooked. When a prong broke off the centipede grapnel, the strain on the rope/chain supporting the grapnel noticeably reduced at which time the grapnel would be hauled in and the prong quickly replaced by the cable engineer's staff.

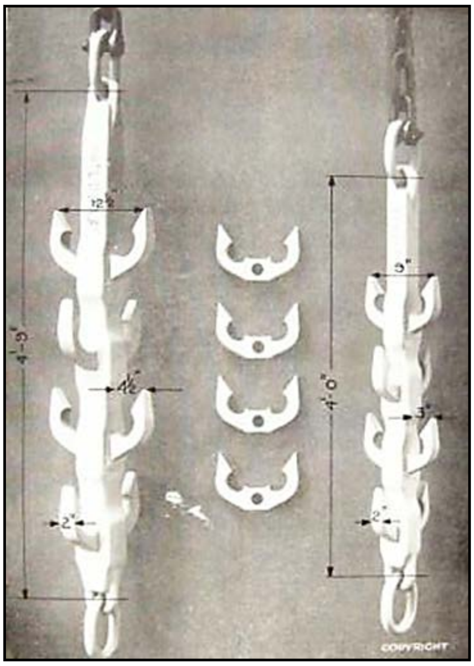


Fig 6.3 Lucas Centipede Grapnel.
PK Archive: From Notes on Cable work – compiled from material furnished by the Commanders of the vessels of the Companies Fleet. Eastern and Associated Telegraph Companies Ltd, 1916, Electra House,

Four or six individual prongs were retained in the longitudinal rails by a shackle at each end. The removal of one shackle allows quick replacement of a prong. The crew having lowered the grapnel to the sea bed at 1450hrs with buoy M1 bearing N38W 6 nautical miles away began the first "Drift", westwards across the expected track of the cable. The Master allowed the ship to drift or "dredge" at 1-2 knots, the maximum speed suitable for grappling a cable at

[326] Clark, Forde & Taylor, Engineers: *St Vincent to Pernambuco (1874) Cable – Engineers Final Report upon the Repairing Operations of 1883.* 10th January 1884, Appendices iv-vi. PK Archives as yet not catalogued.
[327] Wilkinson, *op cit*, pp. 19-20.

these depths.[328] The captain and navigator kept a constant eye on M1 as this was the only visible reference point and the cable engineer watched the strain of the rope/chain of the grapnel. A dynamometer measuring the strain on the rope/chain was an essential part of the cable winching gear, both to protect the cable from being over-stretched and, as in this case, to detect either successful grappling of the cable or snagging on underwater obstructions. The cable engineer, Lucas, claimed to have kept continuous watch on the dynamometer, skilfully interpreting variations in the strain of the grappling line which would indicate smoothness/softness of the seabed, obstruction by rocks and hopefully indication of the cable being hooked.

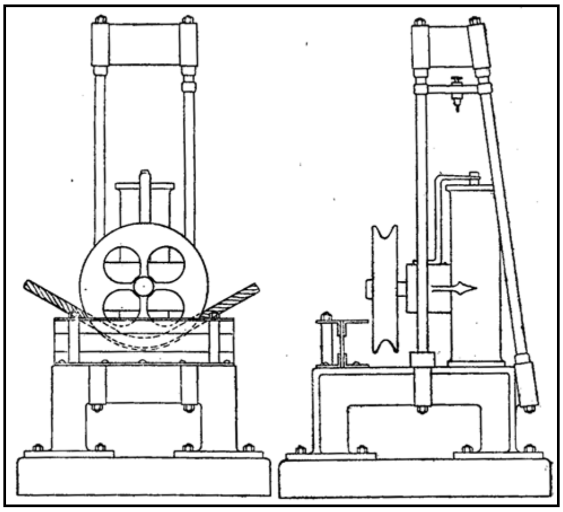


Fig 6.4 The *dynamometer* was a comparatively simple device which indicated the strain in the hawser supporting the grapnel or the cable itself during laying. The hawser passed beneath a free running pulley or sheave. The shaft bearing the sheave was free to move in a vertical direction but for a weight tending to keep it down. As tension in the hawser increased the sheave moved vertically upwards against the downward force of the weight. The side view of the dynamometer shows a pointer which would be pointing to a scale, the strain the cable being indicated in hundredweight (cwt). (Wilkinson HD, *Submarine cable laying & Repairing,* 2e, 1908, p213)

Sudden increases in strain required immediate reduction of the ship's movement for fear of breaking the grapnel line in the case of fixed obstructions or snapping a hooked cable. This "continuous watch" may have been a case of Stephen Shapin's "invisible technicians" where intentionally, or because it was current practice at the time, there was no mention of the senior engineer's subordinate staff in the report.[329] Cables at such enormous depth came under much greater strain when being lifted than when being laid. Deep sea type C cable weighed 28cwt per nautical mile in air and 15cwt in water (See Appendix B).[330] When new type C cable was being laid at a depth of approximately 2 miles, the maximum strain on the cable would have been 30cwt or 1.5 tons. When a bite of such cable was being *raised* from 2 miles depth the strain increased as it was raised, to at least 60cwt or 3 tons. The strain would have been higher if the cable was buried in silt or covered in coral or other marine growth. In

[328] Clark, Forde & Taylor, Engineers, *op cit.* .p. 3.
[329] S. Shapin., The Invisible Technician. *American Scientist,* vol. 77, 1989, pp. 554-563.
[330] Wilkinson *op cit*, p. 52.

practice, slack was deliberately laid: around 10% extra on shallow cables and up to around 20% on the deepest cables, although the amount of slack actually laid was always very variable. Another problem was that the armouring of the cable would have been weakened by chaffing or corrosion. During manufacture, cable engineers measured and recorded the breaking strain of every few miles of every cable manufactured. This record formed part of the data available to the repairing expedition.

The cable was hooked on the first dredge. This shows the amazing skill of the navigating officer, as the last sighting of land had been more than 1000nm previously. It also demonstrates the trust and cooperation between the Master, the navigating officer and the Cable Engineer. My experience of reading many engineering reports of cable laying and repair voyages in the archives, gives me the distinct impression that the Cable Engineer, in this case Lucas, was the manager of the whole operation, second only to the Master. But this impression may only be because the final report of each expedition is signed by the Cable Engineer and countersigned by the Captain, who was often referred to as the Commander.

Lucas raised the cable to 600 fathoms when it broke with both ends sinking back to the murky dark depths. The next day it was hooked again and raised to within 200 fathoms of the surface when depressingly it again broke. As the strain on the 10 year old cable proved to be excessive, Lucas again grappled the cable but instead of attempting to raise it to the surface thought it advisable to raise a bight of cable 500 fathoms from the seabed and support it from a buoy (B1). The next day, the 19th, they eventually raised to the surface 1.6 knots south of buoy B1 without the cable breaking as the strain on it had been reduced.[331]

Lucas's men, having secured a bite of the cable, cut it and connected the core of each end to the electrician's test cabin where the electrician's tests showed that it was electrically perfect to St Vincent and therefore the fault must have been a little further south.

[331] When I spoke at a meeting of the UK Cable Protection Committee on the 30 Sept 1010, many were surprised that this method of relieving the strain when raising cables for repair was used in the 1880s. – This just goes to show that all engineers should learn some history to save them from re-inventing the wheel.

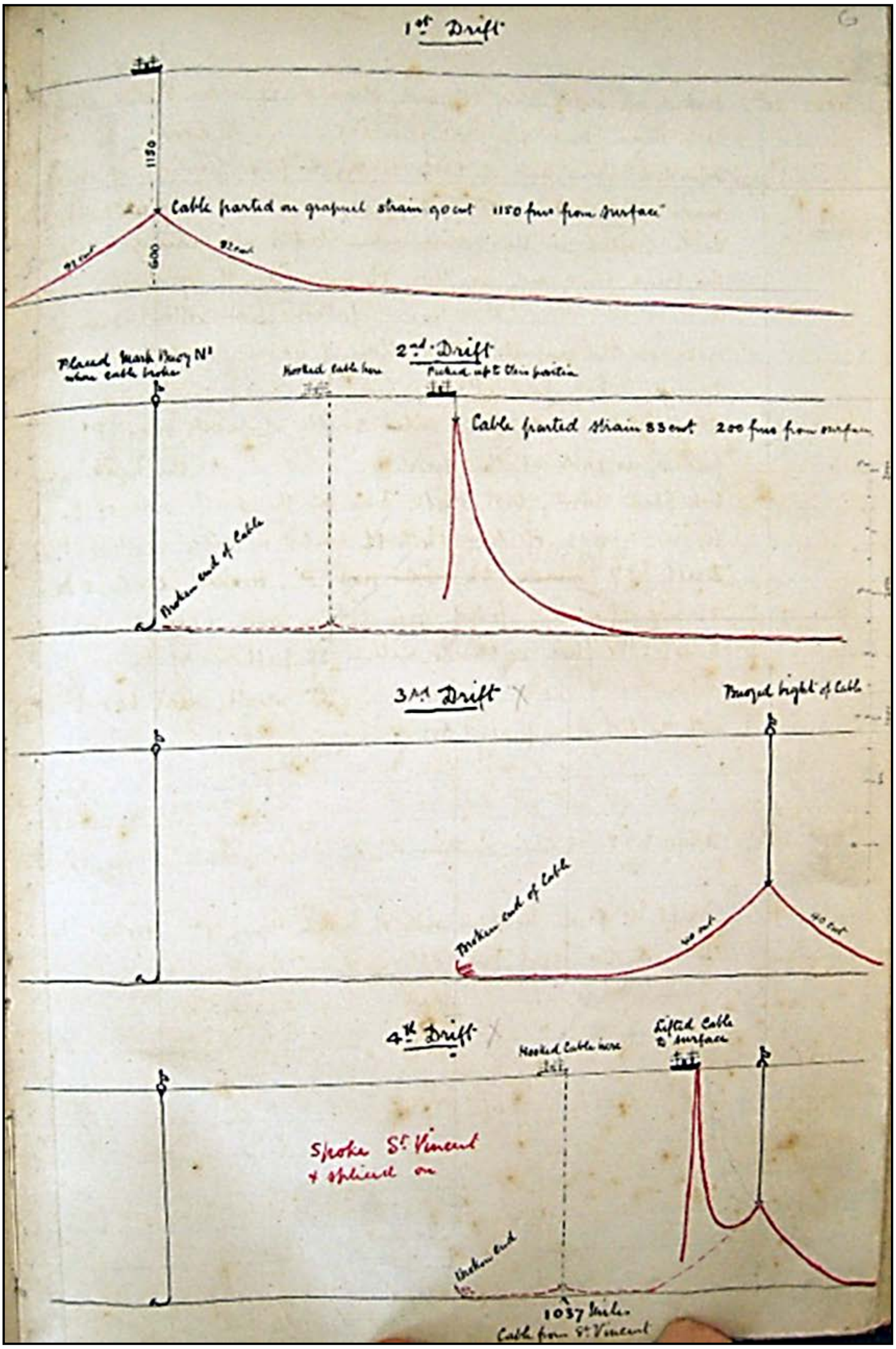
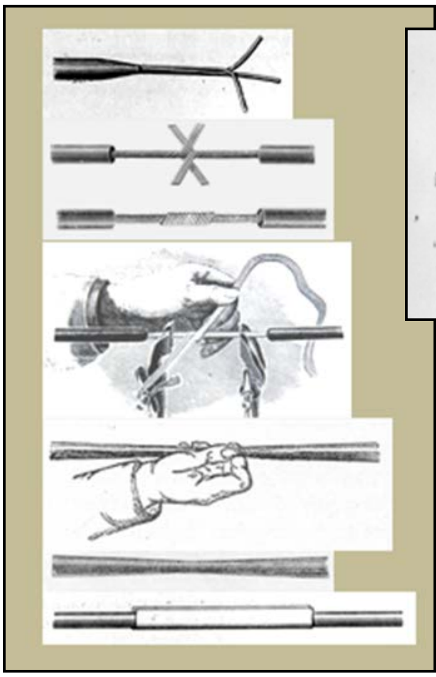


Fig 6.5 A page from Lucas's diary from which he wrote the final report. It illustrates the first 4 drifts with the cable breaking and then the problem being solved by the raising of a bite of cable by 600 fathoms and buoyed to relieve the tension.

As they were near the fault, rather than re-join the cut ends, the cable jointer and his assistant then spliced one end of the new spare cable on to the end from St Vincent and paid out a length of 9.26 nautical miles and buoyed the end (buoy C1). Splicing of submarine cable was a highly skilled operation carried out by a chief cable jointer and his assistants. The cable jointers had a 3-4 year apprenticeship in the cable factory before they joined the repair team at sea. A cable joint or splice in the factory took at least an hour to complete and would be tested immediately. Cable jointers at sea had to carry out a splice in less than half the time and often on a pitching and rolling deck. Great trust was placed in the jointer's skill at sea by all from the board down to the ship's crew as testing of the result was not so easy as on land and could only be carried out if one end of the cable was still aboard the ship. Once a splice had been committed to the deep it would have been very expensive to bring it to the surface for re-working and so only men of the utmost integrity were trained for this role.[332] Training of the cable jointers took place at the cable factory as long submarine cables were made in sections of maximum length 50 nautical miles.

Fig 6.6 The Cable Jointer and his assistant preparing to splice two lengths of submarine cable at a jointer's bench. This photograph was taken in 1910 but the technique used was identical to that in 1883. Only the hats would have been different! PK Archives photo 0400

[332] C. Bright, *Submarine Telegraphs – their history, construction and working.* 1898, Crosby, Lockwood & Son, London pp. 356-7.



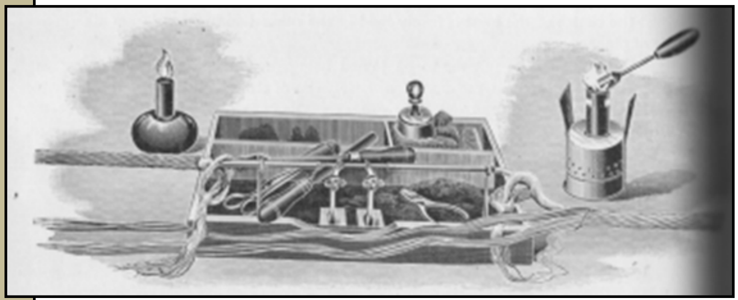


Fig 6.7 The two ends of the cable to be joined were clamped on the jointer's bench (above). The central core was 6.6 The Cable Jointer and his uncovered the central core, preserving the armouring wires, the copper conductor was scrupulously cleaned, bound together with a layer of copper wire. This was then soldered and covered in gutta percha. (mages from Bright C, , Submarine Telegraphs – their history, construction and working. Crosby Lockwood & Son, London 1898, pp. 361-7.

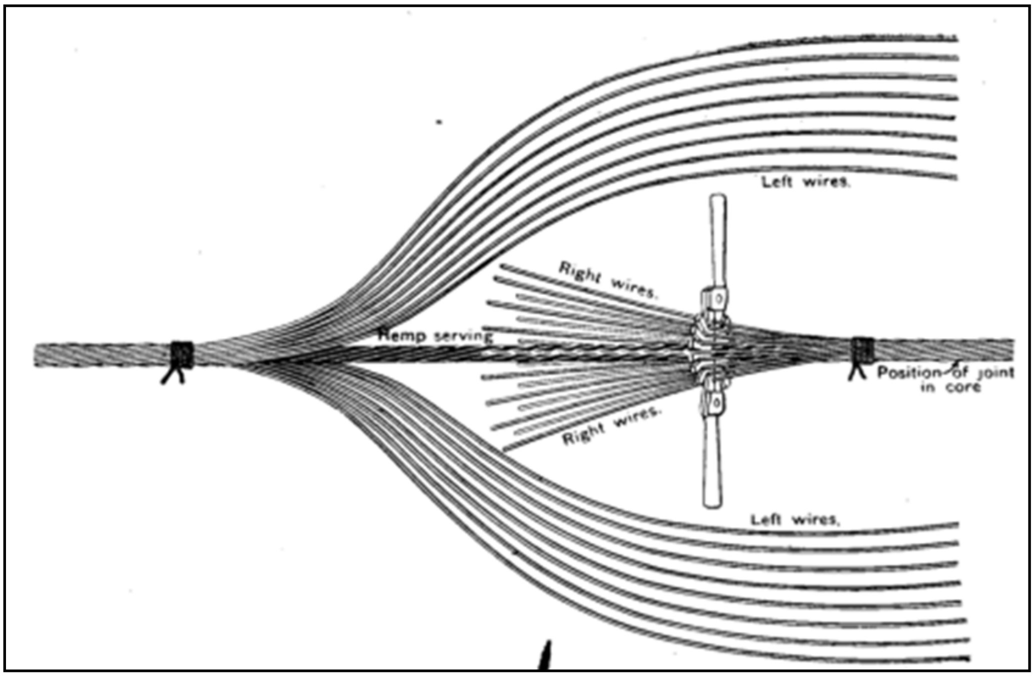


Fig 6.8 After layers of tarred hemp were served, the armour wires were carefully intertwined and re-applied.

The Cable Jointer and his assistant, who was usually a trainee jointer, were essential to the repair of the cable. His role was an elite trade in submarine telegraphy. It was not only a great skill but enormous trust was placed in their ability and integrity. They had only one chance to 'get it right', as when their handiwork had been committed to the deep, it would have been very expensive to find, raise and remake a joint.

In fact trust was a feature of the whole cable repair exercise. The Board of Directors had to place enormous trust in the whole team involved in the location and repair of a failed cable. Not only was trust placed in people but also in the instruments used to make the tests to locate the location of faults. Speed was also of the essence to the survival of small cable companies, especially those like BSTC which had only one cable. There was also very close cohesion and trust amongst the members of the cable ship's crew.

On the morning of the 20th the ship left to grapple the Pernambuco end. At noon the navigator took sightings and a marker buoy (N2) was put down at Latitude 2° 29' 37"N, Long 30° 36' 45"W. During the period of the evening of the 20th to the evening of the 24th they hooked and lost the cable five times over very rocky ground despite soundings that showed a soft seabed. At midnight on the 24th the crew secured the end of the cable from Pernambuco on board the *Scotia.* Tests done by the electrician Mr Brown suggested a second break 4-12 nautical miles between their present position and Pernambuco. When 300 fathoms of cable had been recovered, the cable broke on the drum of the picking up machine and the end was lost overboard. Lucas was of the opinion that the movement of rocks on the seabed had trapped the cable, producing a sudden catastrophic increase in strain.[333] Grappling recommenced at 0600hrs on the 25th. At the second attempt the cable was brought aboard again. Samples of the bottom showed it to be volcanic rock instead of the expected ooze which was safest for the cable. The second fault was found to be further south; attempts to raise more cable succeeded in breaking the cable again at a depth of 4 miles. Over the next two days and nights multiple soundings showed smooth soft seabed interjected with many rocky outcrops of a volcanic nature and many more unsuccessful dredges.

On the 27th they attempted grappling 10nm further along the route of the cable. After several unsuccessful attempts the cable was hooked and brought on board at 1535 hrs. Tests in the direction of Pernambuco showed that the rest of the cable electrically perfect. On the 3rd of December the cable jointer spliced spare cable on and it was paid out towards St Vincent. This was then spliced onto the buoyed end and at 1452 hrs on the 4th of December communication between PB and SV was restored. A total of 83.44nm of new cable had been laid in mending the cable after its break.

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[333] Clark, Forde & Taylor, Engineers*op cit*, p. 9, PK Archives as yet not catalogued.

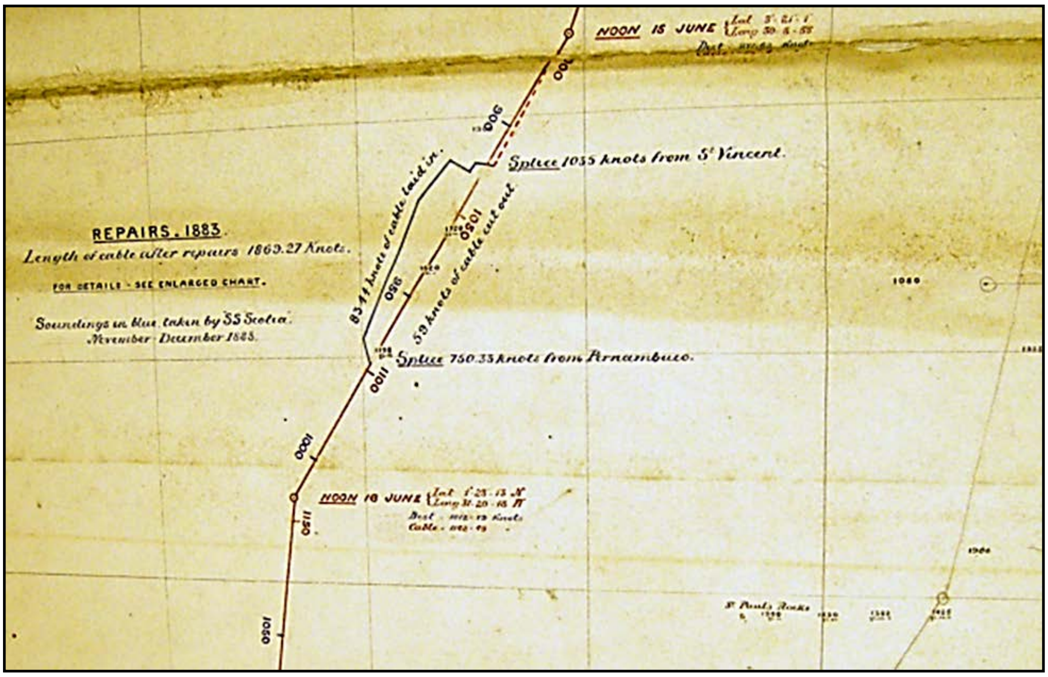


Fig 6.9 Enlargement of the repaired section of the SV-PB cable showing the original and the replacement section. The figures in blue along the cable are the distance in nautical miles whilst those in red indicate the length of cable laid. As there was no large scale chart available of the area, Clark Forde & Taylor, Consulting engineers had to draught one (of which this is a small part). Uncatalogued chart in the archives at the Telegraph Museum,

The chart (figure 6.9) shows that there were very few soundings available. Compare this with a 2007 chart of 1:3,500,000 shown below (figure 6.10).

Fig 6.10 Portion of Admiralty Chart No 4215 Recife – Dakar, 2003, Hydrographic Office, UK with the 1874 cable route marked in red and the repair in blue

Before returning to the UK via St Vincent, Captain Cato, the navigating officer and the Cable engineer (Frank Lucas) decided to sail towards St Peter and St Paul's archipelago and 50 nautical miles to the east of it, taking regular soundings and sampling the seabed in order to assist in planning the route of a duplicate cable.[334]

[334] Clark, Forde & Taylor, Engineersp17.

The repair had taken 18 days 18 hours on the "ground". A total of 28 dredges had been made with the cable being hooked 15 times. 35 soundings had been taken and 13 buoys had been put down and picked up. The cost of the repair expedition to the BSTC was £21,289.14.0d which the Board authorised to be paid to TCM on the 25th of January 1884.[335]

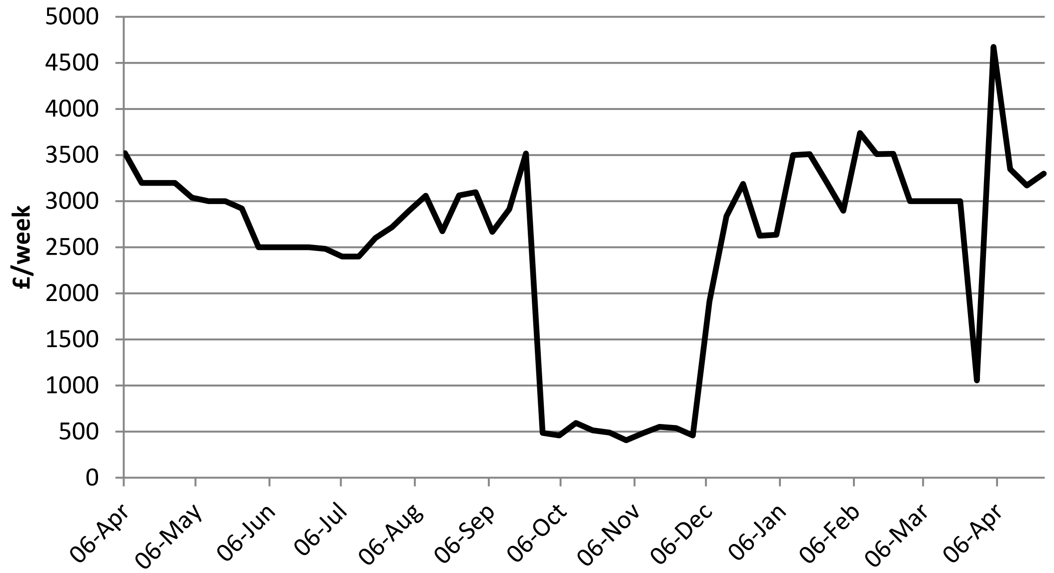
The staff at St Vincent were glad to get back to work after the repair of the cable. They had "spent two months – with the exception of a week or two – on the veranda having at least an ever-changing scene in the harbour to overlook".[336] Most of the staff also spent a couple of weeks at a house at Pé de Verde, two or three thousand feet in altitude. Time there was spent walking amongst "peaks, wild tomatoes and water-melon" but otherwise boring scenery. One gets the impression that they were all getting tired with the lack of work. This raises the question as to why the operating staff and electricians at St Vincent were forced to take a two month break on the island. Presumably the staff at the Madera station were treated similarly. This may have been because such a small company did not have other stations on other cables where they could have been temporarily employed or the estimated repair time was much shorter. It is also possible that keeping the staff isolated at St Vincent and Madeira may have been thought of as one way of reducing the risk of publicity about the cable breakage. This spectacularly failed because it gave the staff more time to write about their trials and tribulations in the *Monthly Correspondent*. [337]
The Managing Director reported to the BSTC board that...

> There was no absolute proof of the cause of the break, it seems most probable that it was broken by some landslip or submarine disturbance, probably volcanic as the cable is laid evidently across a chain of volcanic mountains. [338]

The graph below shows the weekly income from telegraph traffic with the prolonged fall during the long break in communications from SV to PB. Some income accrued from redirection of traffic.

[335] BSTC minute book v2. para 1279. PK DOC/BSTC/1/2
[336] "Smike" in the *Monthly Correspondent* Edition 1, 1883, p4, - not quite what the BSTC board would have liked becoming public knowledge! PK PUB//TCOM/47
[337] *The Monthly Correspondent* 1883 – 1887An 8-12 page monthly in-house magazine originally intended for the staff of the Brazilian and South American subsidiary of ETC but quickly increasing its circulation throughout the ETC group of companies. In common with many Victorian periodicals in was only published for a few years. PK PUB//TCOM/47
[338] Extract from the BSTC's MD's Report No 8 1883. PK Arichives, not catalogued.

Fig 6.11 BSTC Weekly Traffic (April 1883-1884)



The distinct nadir and the peak in March 1884 were due to a further breakdown which was swiftly rectified. It would suggest that many users, hoping that the breakdown was to be a brief one, delayed sending correspondence for a week.

Over the same period as the graph above, the effect of the breakdown on BSTC's share price is demonstrated with that of ETC as a comparison. The effect of such a long period of disruption on BSTC, which only had one cable, caused a fall in the value of the company on the stock market which took many months to recover.

The Electrician on the 3rd of November noted

> This company's shares are the subject of much attention, a great deal of questionable business being done daily in them. During the last few weeks the shares have fallen from 12 to about 9, and the cable is the subject of anonymous circulars urging holders of the shares to sell, &c., on the ground that the breakage of cables will sweep away the reserve of £407,000 which had been accumulated, and the directors have got rid of their holdings. It may be pointed out however that the reserve was accumulated for no other purpose than to restore the plant of the company when requisite, and enquiry as to the reduction of one or two of the directors' interests elicits complete and satisfactory explanations.[339]

This report in *The Electrician* may have amplified the instability of the BSTC share price as it was more unstable after its publication. This can be seen in the graph below where BSTC's share price is compared with the relatively more stable share price of the ECT.

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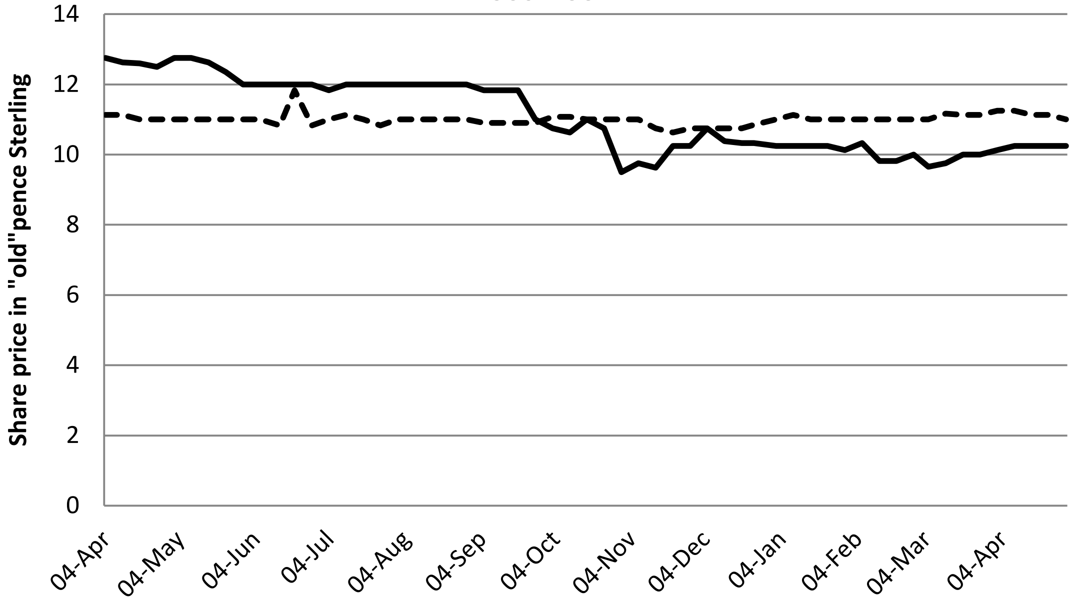
[339] *The Electrician,* 3rd November 1883, p. 578.

Fig 6.12 BSTC Share Price (continuous) compared with ETC (dotted) April 1883-1884



6.3 PK to Lisbon & Lisbon to Vigo Faults

I now narrate a second contrasting cable repair. There were three main contrasting features namely the scale of the expedition, the time taken and the available evidence. The only source of detailed information about the faults on the Porthcurno to Vigo cable is the letter copy book of Harold Ansell which apart from copies of his correspondence also contains copies of his reports to the Managing Director of ETC of various repair voyages. There is a striking difference between these repairs and that of the SV-PB repair. This was mainly due to the cable being owned by ETC and the use of an ETC-owned repair ship. Harold William Ansell was the son of Mr W. T. Ansell who also worked for the Eastern group from 1870.[340] Successive generations of families were common in the telegraph service.[341] "Keeping it in the family" may have been to maintain company information confidential or may indicate that the employees found that ETC was a good company to work for – this aspect of employment is dealt with more fully in Chapter 7. Ansell trained at "The School of Telegraphy" in Hanover Square in London before working for TCM in Wharf Road. He served on *CS Seine* as a cable engineer on two repair voyages. Then he joined ETC in November 1882 as assistant electrician on *CS Volta*. In 1888 he

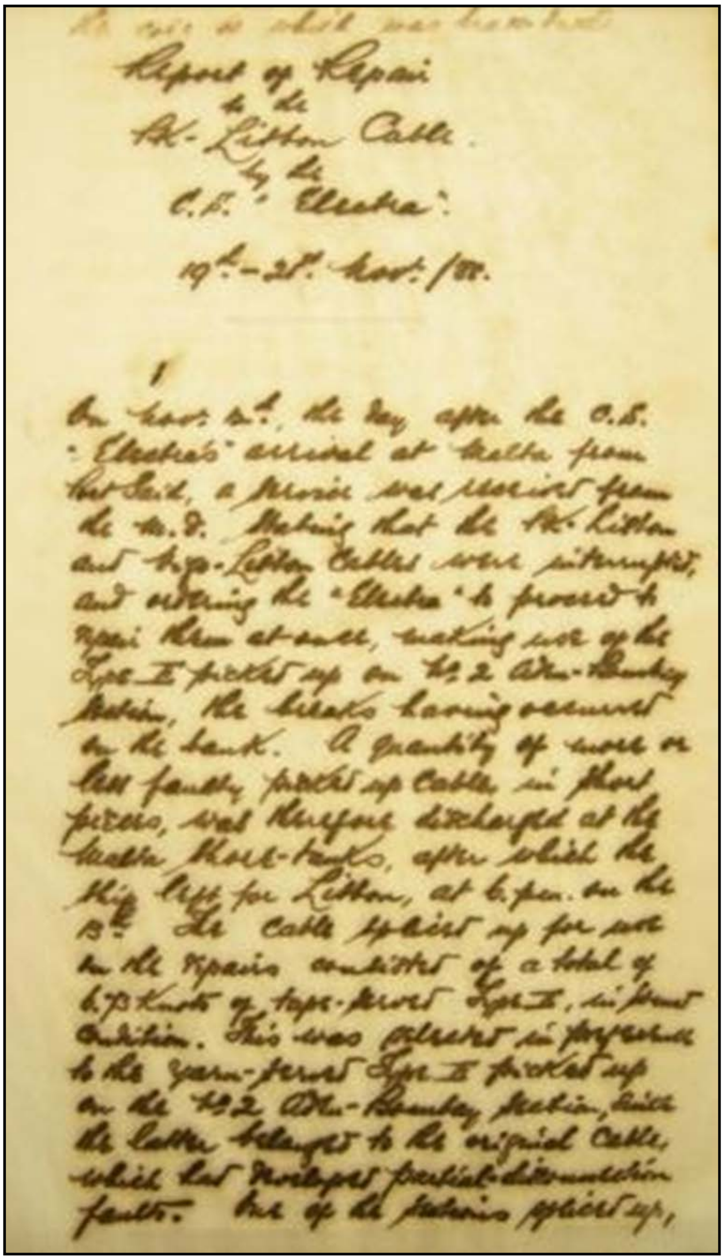
[340] Anon, *Zodiac – the staff paper of the Eastern Associated Telegraph Companies' submarine cable service*. Vol 15, No 177 April 1923, p303

[341] Harold Ansell's father William Thomas Ansell was born in 1822 and spent some years on his father's estate in the West Indies before returning to England in 1846 to join the ETC. He eventually became the first "Traffic Superintendent", a post he held for many years, died in 1904. The Staff records in the archives of C&W held at Porthcurno Telegraph Museum show many examples of 2, and even more generations of the same family in their employment.

was appointed Chief Electrician on *CS Electra.* He also served on *CS Chiltern, CS John Pender* and *CS Great Northern.* In 1897 like his father, ill health made him return to land-based employment and he became ETC's representative at TCM's cable factory at Greenwich, a role he also filled for ETC with other cable manufacturers. He retired from ETC in 1923.

CS *Electra* was owned by the ETC and at 1,236 tons was less than half the size of the *CS Scotia*. She was 237.4 ft. in length, 32 ft. beam and drew 16.6 ft.; a compound engine drove a single screw and her maximum speed was 11 knots. The *Electra* was normally stationed at Gibraltar. The smaller vessel had much lower coal consumption and therefore much lower running costs. She could, none-the-less, carry adequate spare cable for any repair and as these vessels were cheaper, it was possible for large operating companies to have a number of such vessels on standby at their major cable stations around the world.

A typical repair voyage report written by Harold Ansell relates to the repairs to the PK to Lisbon and the Lisbon to Vigo sections of cable by the CS *Electra* during November 1888. As this is the copy of a final report on the repair to the ETC board, it does not contain the same amount of detail as the Log book of the BSTC repair. The report is hand-written, the original being sent to head office and the only copy remaining being in a "letter copy book" – the only method of making copies of documents in the 1880s. An example of such a copy is shown below and in the Appendix D there is a description of the technique. As can be seen in the example there is difficulty in deciphering this material as the ink has "bled" into the copy paper. The report also lacks important detail for the historian in that it does not even mention which PK to Lisbon cable was at fault there being three at the time; the first was laid in 1870, a second in 1873 and the third in 1887 as it was such a busy route.



Report of Repair
to the
PK-Lisbon Cable
by the
C.S. "Electra".
19th–21st Nov. /88.

1

On Nov. 12th, the day after the C.S. "Electra's" arrival at Malta from Port Said, a service was received from the M.D. stating that the PK-Lisbon and Vigo-Lisbon Cables were interrupted, and ordering the "Electra" to proceed to repair them at once, making use of the Type E picked up on No. 2 Aden-Bombay Section, the breaks having occurred on the bank. A quantity of more or less faulty picked up Cable in short pieces, was therefore discharged at the Malta shore-tanks, after which the ship left for Lisbon, at 6 p.m. on the 13th. The cable shipped up for use in the repairs consisted of a total of 6.73 knots of tape-served Type E, in good condition. This was selected in preference to the yarn-served Type E picked up on the No 2 Aden-Bombay Section, as the latter belonged to the original Cable, which had developed partial-insulation faults. One of the sections spliced up,

Fig 6.13 *Letter Copy Book Process* The first page of Report of Repair to the PK-LB Cable by CS Electra, 19th – 21st November 1888 transcribed below. Ansell HW, Letter Copy Book 1886-1890 p. 80. Archive the Telegraph Museum, Porthcurno

"On Nov 12th the day after the CS Electra's arrival at Malta from Port Said, a service was received from the MD stating that the PK-Lisbon and the Vigo-Lisbon cables were interrupted and ordering the "Electra" to proceed to repair them at once making use of the Type E picked up on the No 2 Aden-Bombay Station, the breaks having occurred on the bank."

One might detect a sense of annoyance in that on the 12th of November 1888, the day after their arrival at Malta from Port Said; the MD ordered that they immediately sail out of the Mediterranean to repair the PK-LB- VG cable.

A quantity of more or less faulty picked up cables in short pieces, was therefore discharged at the Malta shore tanks after which the ship left for Lisbon at 6pm on

> the 13th. The cables spliced up for the repairs consisted of a total of 6.74 knots of tape-served Type E in sound condition. This was selected in preference to the yarn-served Type E picked up on the No 2 Aden-Bombay section, since the latter belonged to the original cable, which had [illegible] partial [illegible] faults. One of the sections spliced-up, [illegible]% knots of was brass-taped, was found, on turning over to contain a fault which on removal appeared to be a puncture through the brass tape and g.p. [gutta percha] presumably caused by a terado [worm].[342]

This paragraph brings to the fore some interesting issues. Normally new cable was used for repairs. Stocks of new cable of various types were stored at major cable stations. Spare cable had to be stored in large tanks of sea water to reduce deterioration and to keep it at ambient sea temperature. If the cable was left to heat up in the sunshine, the main insulator, gutta percha, quickly became soft, allowing the central copper conductor to migrate under gravity becoming eccentric and possibly shorting out electrically against the copper or brass tape surrounding it. It is not clear from the report whether the cable from Port Said repair was just unloaded at Malta and other new cable was picked up from the tanks there. The terado fault implied that is was previously used cable.[343] Further evidence is found in an annotation in Ansell's' report of the second part of this repair at the Lisbon-Vigo fault...

> Paying out to the Vigo end buoy commenced at 8pm [21st November 1888] and 3.4 knots (Type E, tape-served, picked up No 2 Ad-Bombay) was layered in.[344]

...which implied that this was not new cable but part of the Aden-Bombay No 2 cable which had been retrieved.

> The ship reached Lisbon at sundown on Sunday the 18th, and the tests were obtained the same night at the Carcavelos CH [cable house] placing the break at a distance of 275 ohms and that of the Vigo cable of 534 ohms from the CH.
> Information having been sent to the MD the ship left for the ground at 8.15 am and commenced operations at noon in fine weather with a heavy NW swell running. Several sweeps were made over a very rock bottom without success and during the night of the 19th swing[?] the lamps on the marker buoy giving out, and the heavy weather, the Vigo-Lisbon cable was hooked but was slipped again without injury.[345]

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[342] H. W. Ansell, Letter Copy Book, 1886-1890, p. 81. Telegraph Museum, Porthcurno

[343] *Terado navalis*, also known as "ship borer" or "cable borer" worm, had a penchant for gutta percha leaving small holes which allowed ingress of sea water, making connection between the sea and the conductor. A layer of brass tape was applied between the gutta percha and the cable armouring in order to obstruct the worm.

[344] Ansell HW, *op cit*, p87 PK

[345] The "distances" are quoted in units of electrical resistance and this would then be compared with the electrical parameters of the laying chart by Ansell assisted by his electrician.

It is not clear whether ‘injury’ refers to the cable or to personnel.

> At 11.45 am on the 20th the PK-Lisbon cable was hooked and the PK end buoyed, testing at 3 $^{\Omega}$ab the break being to the S (0.186kt) due to a chafe, the ends of the wires being needle pointed.

The symbol “$^{\Omega}$ab” represented “megohms” which would be the normal range for dielectric resistance. The end of the iron/steel wires used for the armouring classically ended in needle points when there was chafing due to sea bed currents moving a cable from side to side.

There followed the tribulations of rough seas which caused the snapping of several bites of cable on grappling because of the weakened state of the outer armouring and indeed they had to replace 3 nautical miles of the cable with a stronger type normally reserved for “shore ends”.[346]

> During the operation an insulation test was constantly maintained showing a value of 3 megohms as before observed. At 12.30 pm, when both ends were ready for the final joint, the PK end was found to have developed a small fault reducing its insulation to about 20,000 ohms under a negative current of 30 volts to [Wheatstone] bridge, sealing to up to 60,000 ohms with the positive current.

This “sealing” of a small imperfection in the cable insulation occurs by the generation of small hydrogen bubbles forming and insulating barrier.

> A rough CR test was taken which in conjunction with the observed DR indicated that the fault was not on the ground of the repair. But ?further tests being attended with the risk of breaking down the fault, it was [illegible] prepared to put the [illegible] thought test to put the line through, [illegible] PK’s signals were unaffected.

As the communication between LB and PK seemed unaffected by this minor fault which was some distance further north, no further time and therefore money was wasted.

I had hoped to discover the annotations on the original charts but although the laying charts are in the PK archives they show that there were duplicate cables and the repair was not marked on either cable on the chart. Either the repair chart has been lost or because it was an ETC repair on an ETC cable done in a great hurry there is no documented chart to be found. There was no mention of this fault and repair in either the ETC minute book or in *The Electrician, The Electrical Review* or the *Times* which means that ETC did not suffer any adverse publicity or reputation that I can detect.

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[346] See Appendix B

6.4 Conclusions

There are many interesting differences between these two repair voyages. The BSTC was a small company compared with ETC; the break was more than 800 nautical miles from land with no landmarks in sight; a large cable-laying ship was used rather than a smaller cable repair ship. The depth of the SV-PB cable break was greater than 1700 fathoms compared with several hundred fathoms in the case of the PK-Lisbon breakdown. The effect upon the smaller company from a business point of view – this was a major section of their only cable – was much greater than the ETC's cable breakdown as the ETC had many cables and the cable in question was already duplicated.

With regard to the two month delay between the break in the SV-PB cable and its repair, this was the common lot of the small cable companies. They could not afford to maintain their own repair ships, nor tie up capital in keeping a stock of spare cable. In order to be ready for any type of cable breakdown, it would have been necessary to keep sufficient lengths of each cable type (see Appendix) used in the company's operating cables. And cable stored on land had to be kept coiled in large diameter storage tanks full of seawater to prevent heating and deterioration of the cable. Because of the lack of repair ship and cable the BSTC had to order the manufacture of spare cable from one of the handful of companies who could manufacture *and* lay submarine cable. TCM was the obvious choice in view of common members of their boards. This would also have reduced publicity of the cable failure. However, delay was also caused by the necessity for lawyers to be involved to draw up a contract for the cable manufacture and repair, even though TCM may have already agreed verbally to begin the manufacture. This verbal agreement was probably the reason for an emergency board meeting not having been called. In the case of the PK-Vigo repair, the positioning of ETC's CS *Electra* meant that the PK-Vigo breakdown could be located and repairs effected with much greater rapidity and much more economically than the use of, for example TCM's *CS Scotia,* which would have been based on the Thames. However even ETC would have called upon TCM with its bigger ships to deal with such a deep repair.

The breakdown in communication of ETC's cable between Porthcurno (PK) and Vigo illuminates the differences between repairs to small companies' cables and those of the mighty ETC & Associated Companies. ETC repair ships were scattered around the globe awaiting such eventualities; stocks of spare cable were available stored at major stations; no expensive legal shenanigans were necessary to commence any repair. Because of the contract, BSTC received case-bound copies of the final engineer's report of the SV-PB repair, whereas ETC Head Office received only a six page hand-written report of the PK-Vigo repair from Harold Ansell. News of the PK-Vigo cable fault did not reach the *Electrician*, the *Electrical Review* or *The Times* because of the relatively secure communication between the cable stations, Head Office, and *CS Electra*. Security was also helped by the fact that there was already a duplicate cable between PK and Vigo and therefore customers would not have even noticed that there was a cable fault. In later years further attempts at increasing security were formalized in the ETC & Associated Companies *Traffic General Order Book.*[347]

Interruption Code & Code for Cable Stock.

G. O. 31 Interruption Code.

1. The practice of the Associated Companies is not to notify interruptions of any cables or land lines officially when communication can be maintained by alternative routes at equal tariffs.

2. Notices of interruption or disturbances to any of the Companies' cables or associated lines must not as a general rule be communicated to Government Authorities or the public: when, however, abnormal delay exists the Government authorities and the public should be informed that owing to an interruption, delay may be expected and that traffic will be disposed of by other means (when other routes are available).

3. In the following code, as a general rule, the first three letters of the Stations forming the section have been joined to make one word and the three or more letters at the commencement of each code word in the interrupted column represents the Station nearest Great Britain (telegraphically); in the restoration column this position is reversed, the letters representing the distant Station being quoted first.

4. The index has been added to give information to all Stations as to the interruption or restoration notified.

An example page is shown below.

[347] ETC *General Order Book – 1924*, p75-76, PK Archives – not catalogued. These company orders may have been formalized earlier but the *ETC General Order Book*s have not survived.

Western Company's Cables and Connections.

STATIONS AND SECTIONS.	INTERRUPTED.	RESTORED.
CARCAVELLOS—		
Madeira 1	Carmad one	Madcar one
Madeira 2	Carmad two	Madcar two
FAYAL—		
St. Vincent	Fayvin	Vinfay
MADEIRA—		
St. Vincent 1	Madvin one	Vinmad one
St. Vincent 2	Madvin two	Vinmad two
ST. VINCENT—		
Pernambuco 1	Vinpern one	Pernvin one
Pernambuco 2	Vinpern two	Pernvin two
Ascension 2	Vinasc two	Ascvin two
ASCENSION—		
Rio de Janeiro	Ascrio	Rioasc
Buenosaires	Ascbaires	Bairesasc
PERNAMBUCO—		
Maceio	Pernmac	Macpern
Bahia 1	Pernbah one	Bahpern one
Bahia 2	Pernbah two	Bahpern two
Rio de Janeiro	Pernrio	Riopern
Ceara	Perncear	Cearpern
Maranham	Pernmara	Marapern
Para	Pernpar	Parpern
Noronha (French)	Pernnor	Norpern
Noronha-Dakar (French) ...	Nordak	Daknor
CEARA—		
Maranham	Cearmara	Maracear
MARANHAM—		
Para	Marapar	Parmara
Barbadoes	Marabarb	Barbmara
Barbadoes-Miami	Barbmi	Mibarb

Fig 6.14 ETC General Order Book – 1924, p75-76, Telegraph Museum, Porthcurno, Archives – not catalogued

The mighty ETC group learnt by experience to formalize commercial security.

These two examples show the two extremes in the amount of evidence available to the historian. However by reading many fragmentary reports of cable repair expeditions, I have been able to surmise that there were only small advances in the techniques used to find, raise, repair and re-lay cable breakdowns between the mid-1860s and the First World War. However there was continuous improvement in the methods used by the electricians to estimate the location of faults and breaks and this is the subject of the following chapter.

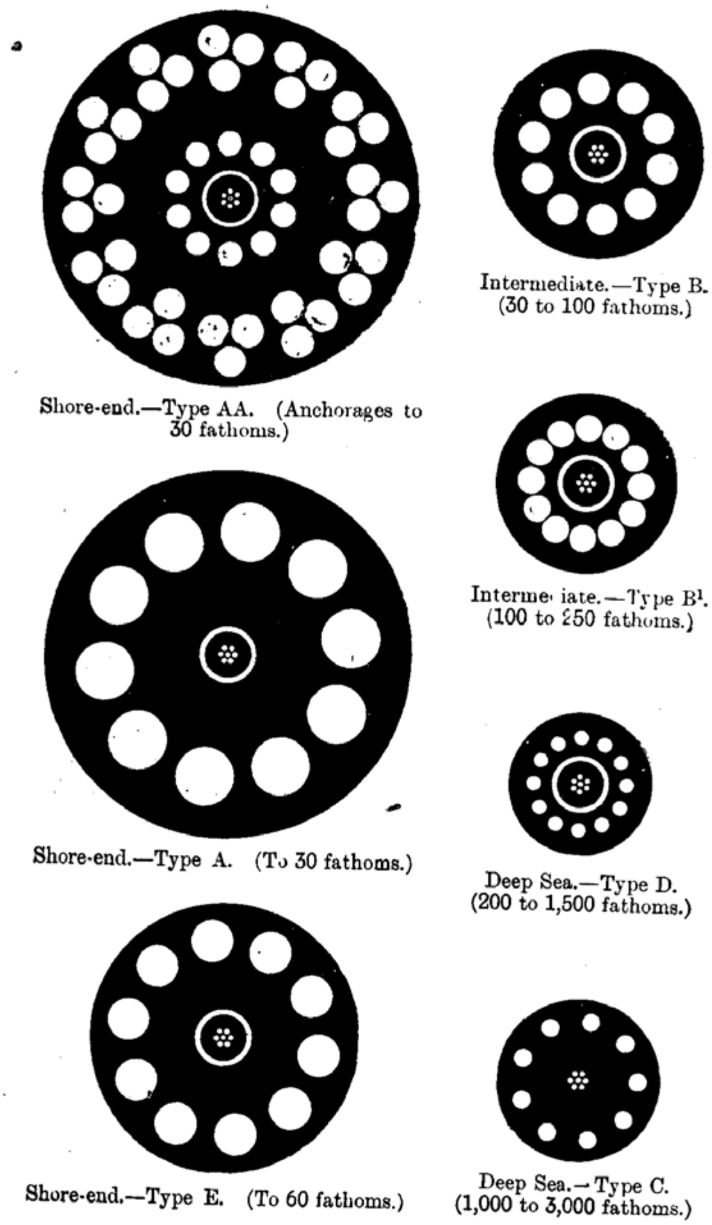
Appendices

Appendix A

The Falmouth, Gibraltar and Malta Tel. Co. Ltd. (1869) The Marseilles, Algiers and Malta Tel. Co. Ltd. (1870) The Anglo-Mediterranean Tel. Co. Ltd. (1868) The British Indian Submarine Tel. Co. Ltd. (1869)	Merged to form:—	The Eastern Telegraph Co. Ltd.	(1872)
The British Indian Extension Co. Ltd. (1869) The China Submarine Tel. Co. Ltd. (1869) The British Australian Tel. Co. Ltd. (1870)	Merged to form:—	The Eastern Extension, Australasia and China Tel. Co. Ltd.	(1873)
The Brazilian Submarine Tel. Co. Ltd. (1873) The Western & Brazilian Tel. Co. Ltd. (1873)	The Brazilian Sub. Tel. Co. Ltd. name changed to:—	The Western Telegraph Co. Ltd.	1899
Companhia Telegrafica Platino-Brasiliera (1872)	**Taken over and became:—**	**The London-Platino Brazilian Tel. Co. Ltd.**	(1878)
		The Eastern & South African Tel. Co. Ltd.	(1879)
		The African Direct Tel. Co. Ltd.	(1885)
		The West African Tel. Co. Ltd.	(1885)
		The Europe & Azores Tel. Co. Ltd.	(1893)
		The West Coast of America Tel. Co. Ltd.	(1877)
		The River Plate Tel. Co. Ltd.	(1865)
		The Pacific & European Tel. Co. Ltd.	(1892)
		Societé Anonyme Belge de Cables Telegraphiques	(1914)

THE EASTERN AND ASSOCIATED TELEGRAPH COMPANIES

Appendix B Classification of Submarine Cables



The diagram shows cross sections of the common types of cable manufactured and used. The first thing that is noticeable is that the classification is not in the alphabetical order one might expect.[348] This is because for many years type A (shore-end), B (intermediate) and C (deep-sea) were the only types in use. The strongest, most protected cable (A) was used closest to shore where the cable was at greatest risk from tidal movement and currents causing chafing and from ships anchors and trawl fishing. Further out to sea where the above risks were less a lighter intermediate (B) cable could be used. The deep-sea (C) cable was much less protected from movement and anchors. However it still needed considerable mechanical strength as it

[348] H. D. Wilkinson, *Submarine Cable Laying and Repairing*, The Electrician Printing and Publishing House Ltd, London 1896, p. 49.

had with-stand the strain of its own weight when being laid or raised for repair. Other variants of cable were required as the years passed and hence types AA, B1, D and E were developed.

The *core* is the central copper conductor and its gutta percha coating. Gutta percha was the insulation of choice from 1850 until the development of polythene and other flexible synthetic "plastics" well into the 20th century. The ratio of conductor to gutta percha varied dependent upon the signalling speed and length requirements. The cable was also designated by the *number of pounds of copper per nautical mile / number of pounds of gutta percha per nautical mile.*

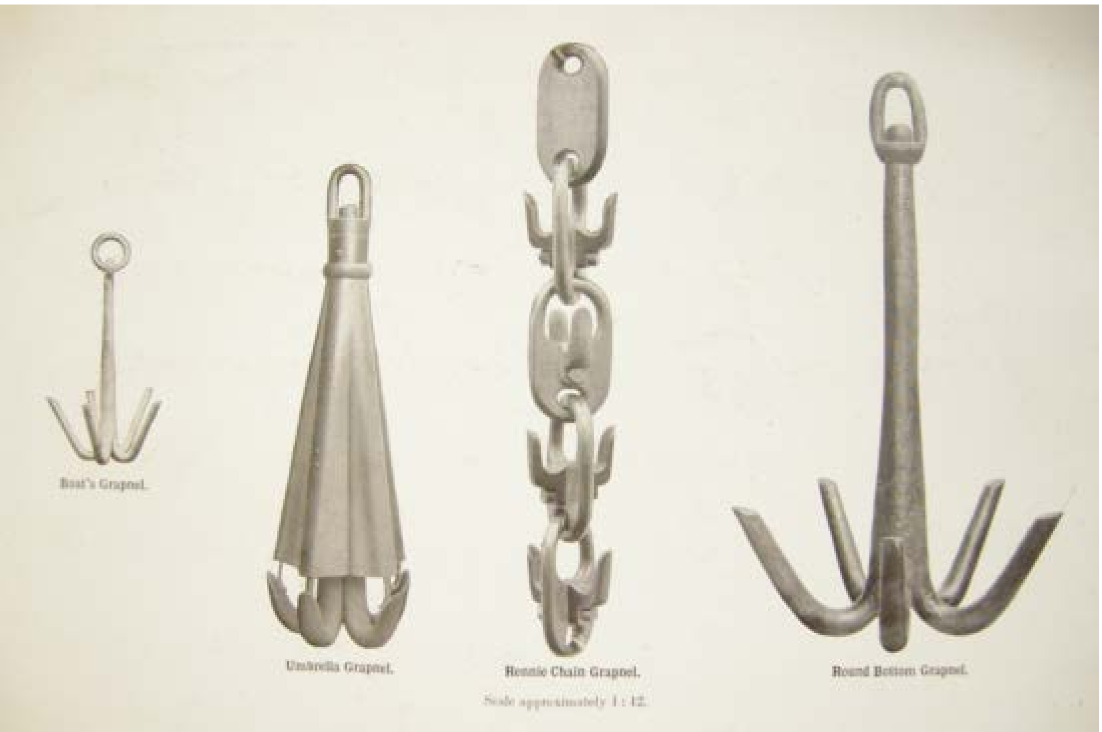
Weights per mile of these types of cables in air and water are[349]...

Cable type	Weight in air	Weight in sea water
AA	20 tons	15 tons
A	12 tons	9 tons
E	7 tons	5½ tons
B	75 cwt	54 cwt
B1	60 cwt	40 cwt
D	40 cwt	23 cwt
C	28 cwt	15 cwt

[349] Wilkinson, *op cit*, p52.

Appendix C

Grapnels[350] (except for the mushroom anchor which was added by mistake by ETC!)



[350] From *Notes on Cable work – compiled from material furnished by the Commanders of the vessels of the Companies Fleet.* Eastern and Associated Telegraph Companies Ltd, 1916, Electra House, London

APPENDIX D

Letter Copying Book Process[351]

The letter copy book was the commonest method making single copies of letters, reports etc. in the second half of the 19th century. Otherwise copies of documents would have had to be made by long-hand copying which was much less economical.

The *letter copy process was* originally patent by James Watt in 1780. To make a copy of a document, a sheet of tissue paper was dampened with water from a brush. The original document which had been written with glutinous ink was then placed face up behind the dampened page. This was then compressed with a powerful screw press for a half to one minute. On separation a copy of the original was visible through the tissue paper which was then kept as a copy. From the 1850s *letter copying books* were used to keep copies on a large scale. These leather bound books were manufactured usually with a thousand numbered tissue paper pages with blank index pages at the front. To copy a document a sheet of lightly greased grease-proof paper was inserted, greasy side in contact with the upper surface of a dampened blank tissue page. The document to be copied, written in ink (dry) was then placed "face" up behind the dampened tissue page. The book was then closed and subjected to pressure from a screw press of approximately one minute. The original and the grease-proof paper were then removed and the book left open until the tissue paper had dried. An image of the original was then visible through the tissue paper. The process only finally completely disappeared in the 1940s. Unfortunately, over the years the ink tends to "bleed" and the writing becomes very blurred. I have tried to enhance photographs of individual pages using Adobe Photoshop to increase contrast and sharpness with only a little improvement.

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[351] L. Nadeau, Chapter 16, Office Copying and Printing Processes, *Guide to the identification of prints and photographs – featuring a Chronological History of Reproduction Technologies*, 2002

7. Locating Cable Malfunction

7.1 Introduction

In the last chapter I described how the electricians, Messrs Howe at Pernambuco and Lawson at St Vincent carried out a number of tests from each end of the broken cable to determine the location of the interruption.[352] In common with almost all repair voyages there is no record of which tests were used and often not even the results of the tests. This chapter deals with the development of both the tests and the skills of those who applied them, namely, the electricians, and exploring reasons why new tests became necessary and why some fell into disuse.

In 1837, Charles Wheatstone and William Fothergill Cooke formed a partnership to develop and produce their 5 needle land line electric telegraph. Before the electric telegraph, electricity had been a scientific wonder and a source of entertainment but suddenly telegraphy became the first major practical use of this new medium. This led to a great expansion in the discipline of electrical engineering in the Institution of *Civil* Engineers (ICE) as described in Chapter 1. The ICE tried to dominate all forms of engineering including this new telegraphy with its essentially younger exponents. William Preece (see below), in the discussion following a paper by Mance, made a telling statement in 1884, implying that the grandees of the ICE were almost ignoring this exciting new field:

> …but would express the very great regret that in those early days that Mr Latimer Clark has referred to there was no Society of Telegraph Engineers to enable the young men of those days to record the results of their very hard work. It must be remembered that the period of which Mr Latimer Clark spoke was that between 1853 and 1863 (a period when many now present were not born), and when there were no two more earnest, more ardent, and more determined workers in this field than Mr. Latimer Clark and myself. Unfortunately for us there was then no Society of Telegraph Engineers, there was not even a Journal, and there was no encouragement of any sort or kind to spur us on to record our results, and therefore they simply remain dormant in our memories.[353]

The telegraph engineers split away from the ICE and formed The Society of Telegraph Engineers (STE) in 1871. The STE evolved into the Society of Telegraph Engineers *and Electricians* in 1880 and eventually became the Institution of Electrical Engineers in 1887.[354] One of the most important reasons for this split was to allow the STE to publish its own scientific journal. This was important to the telegraph engineers because the editor of the *Proceedings of the ICE* had only occasionally allowed papers relevant to telegraphy to be published. However, more important sources of what is known about testing submarine telegraph cables were the *Journal of the Society of Telegraph Engineers* and the trade periodicals *The Electrician* and *The Telegraphic Journal & Electrical Review.* A few publishers of

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[352] They deferred to Mr Latimer Clark, the Telegraph Construction & Maintenance Company's chief electrician in their final calculations of the exact location of the break as they produced results which did not equate with each other. As it turned out both determinations were correct as the cable was broken in two places.

[353] H. C. Mance. , Method of measuring the Resistance of a Conductor or of a Battery, or of a Telegraph-Line influenced by unknown Earth currents, from a single deflection of a galvanometer of unknown resistance. *JSTE,* May 1884, p352

[354] The IEE changed its name yet again to the Institution of Engineering and Technology in 2006.

technical or scientific books printed a number of specialist textbooks describing the various tests used by the electricians to locate faults or breaks in submarine cables. However, no historian has hitherto examined the chronology of test development, nor described the reasons for the development of so many tests which seemingly have the same function.

Frederick Webb (1828-1899), one of the first cable engineers and electricians to be involved with long-distance submarine cables, also bemoaned the lack of published information about the techniques used in the location of malfunction.[355]

> He [the author] regrets, however that the difficulty of obtaining information and drawings, from those who have at times laid down cables, will prevent him from giving such detailed descriptions as he would desire, of any of those operations on which he has not been personally engaged. So long as the submerging of cables remains a matter of private contract the details of the operations will, it is to be feared, be kept as much as possible from publication; for the experience and information gained at considerable expense involves in its publication pecuniary interests and it becomes therefore a matter of trade.[356]

Here Webb not only complained about the sparsity of information in the wider professional domain but the necessity or otherwise of "trade secrets". At the time of the presentation of this paper at the ICE, Webb had already been involved with the Electric Telegraph Company, India Rubber, Gutta Percha and Telegraph Works Company, the International Telegraph Company, RS Newall's and had been one of the "engineers" involved with the first Atlantic Cable – a man of great practical experience in submarine cables despite his youth. His experience was in manufacture, laying and repair. He noted that the lack of published information was the result of there being very few cable operating companies in the 1850s. Also these companies were reluctant to divulge any commercially vital skills that their staff had acquired, retaining them as "trade secrets". It was therefore very difficult for anyone outside the companies to learn of new test techniques as they were more likely to be passed on by word of mouth than published for others to learn. Webb continued:

> Where, however, civil engineers are employed by a Telegraph Company, without the intervention of a contractor, no such interests can intervene; the company simply requires their cable to be laid and when that is accomplished, the publication of the operation can in no way interfere with their interests. It is hoped, therefore, that where engineers have charge of such operations, details of

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[355] Frederick Charles Webb (1828-1899) initially wanted to train as a marine surveyor and spent two years on HMS Porcupine surveying ship of the Royal Navy, which gave him important insights into the problems of cable laying later in his career. But he then came ashore and worked variously on surveying and drafting for railways and harbours until he was engaged by the Electric Telegraph Company as an assistant draughtsman and engineer. In 1853 he was appointed assistant engineer to the International Telegraph Company who wished to lay cables to Holland. In 1857 he was engaged as one of the four engineers for the first attempt to lay an Atlantic cable. In the same year, working for Mr RS Newall, he helped lay the cable between Malta and Corfu. The following year he worked with Prof Jenkin on other cables in the Mediterranean. He then worked for Messrs Glass & Elliott and for Charles Bright and Latimer Clark. In 1863 he was involved in cable work in India from which he returned in 1865. In 1868 he was involved in fitting out ships cable ships for work in the public Persian Gulf. 1874 saw him working for Messrs Siemens Brothers and in 1877 he was appointed electrician to HMS Vernon torpedo school ship at his health began to fail. He was a prolific writer contributing to *The Electrician, The Engineer* and the *JSTE*. Sadly he committed suicide in 1899.

[356] F. C. Webb, On the practical operations connected with paying-out and repairing submarine telegraph cables. *Proc ICE,* , vol. 17, Feb 23 1857-1858, p. 262.

> the machinery employed, and of the mode of carrying out the work, may, from time to time, be published for the advancement of this branch of the profession.[357]

William (later Sir William) Preece (1834-1913), a young engineer to the Post Office, was by the time Webb was writing, a well-known and influential engineer.[358] He extolled the skills of the electricians of that first decade and no doubt he was attempting to raise their profile and status as being vital to the expeditious maintenance of this new technology. My quotations from Webb and Preece are drawn from papers given by them at meetings of the ICE. It was a prestigious matter to give a paper at this forum and it is indicative of their precocity that at the time they gave their papers Webb was only 30 years of age and Preece, 26. That such youthful practitioners could present papers as authorities to civil engineers often more than twice their age demonstrates the great interest of the civil engineering profession as a whole on this new technology and how young engineers could rapidly progress to seniority in it. Thus, for example, Preece had already made a name for himself in the engineering hierarchy of the Post Office and his testimony mattered greatly because his paper was given at a time when the industry eagerly awaited the outcome of a Committee of Inquiry into the failure of a number of newly laid intercontinental submarine cables.

In its earliest years, test development of was led by entrepreneurs, experimenters and tinkerers rather than by academics.[359] These innovators initially devised tests in submarine cable telegraphy from the simple tests already established in land-line telegraphy from the 1840s. It was not until natural philosophers such as Professor William Thomson and trained electricians became increasingly involved that the problems of accurate fault location in submarine cables were addressed as a matter of engineering specialism and tests developed over the ensuing years.[360] Little documentary evidence exists on the earliest electrical tests used in submarine telegraphy, presumably because details were passed around by word of mouth and practical demonstration amongst a comparatively small group of interested parties which may have been limited by the operating companies in order to maintain commercial secrets. As the developments from land line cable tests became more complicated it became necessary to put them on paper both because of their complexity and in order to standardise their application.

In the 1850s a few test procedures were patented, for example by Charles Bright (see later). As the industry grew, new pieces of equipment were carefully patented but tests were eagerly published without patenting. I surmise that this was due to a number of factors: “getting one’s name published”; altruism or eagerness to “spread the word”; the expense of patent lawyers;

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[357] *Ibid.*
[358] William Preece trained under Michael Faraday and was great believer in experimentation and physical reasoning. He went on to become Engineer-in-Chief to the Post Office. Tucker DG. WH Preece: nineteenth century telegraph, telephone and power station engineer. , *IEE History of Electrical Engineering Weekend Meetings*, vol 10, 1974, p. 1. Preece dominated British Post Office engineering through the 1880s and 1890s and concurrently assisted in the development of public lighting systems by his private practice as a consulting engineer. He was less successful as a research engineer or scientist.
[359] N. McCarthy, , *Engineering,* One world Publications, Oxford, Chapter 5, 2009, pp. 120-140
[360] William Thomson disliked the term “scientist” and always referred to himself as a “natural philosopher” (Graeme Gooday – personal communication)

and that the early telegraph engineers were "Civils".[361] An individual electrician would have thought long and hard before patenting as he would lack the financial resources of the rich cable operating companies to cover the costs. This would explain why there were so few patents in early British telegraph compared with the many patents in electrical engineering, lighting, the telephone and subsequently wireless. These slightly later technologies developed after the split from the ICE. Also with these other technologies intellectual property was much more likely to be stolen by the many small companies involved.

7.2 Skills

Skills are often taken to mean the alliance of practised dexterity backed up with theoretical knowledge. Charles More (1980) refined the term to mean some combination of manual skill and knowledge, not necessarily very considerable, which was useful to industry.[362] But I find more descriptive Renold's definition from 1928 "Any combination, useful to industry, of mental and physical qualities which requires considerable training to acquire" – generally "a combination of conscious knowledge and dexterity". He also suggested that "satisfaction from work comes from two things: the doing well of something that is difficult and the freedom to exercise some degree of choice".[363] Skills using this last definition were the driving force in submarine telegraph cable technology during what I have re-defined as the "experimental period" of the 1850s. The early cable electricians of this period such as Samuel Canning and Willoughby Smith and Charles Tilston Bright found their way into submarine cable telegraphy by modifying skills originally developed in land-line telegraphy and certainly by taking advantage of the freedom to exercise a degree of choice. It was they who enlisted the academic and practical help of William Thomson and Fleeming Jenkin. An exception to this form of entry into the world of submarine cable telegraphy was the distinctly amateur Wildman Whitehouse, a successful surgeon in Brighton who acquired his electrical skills from the widespread use of electrotherapy in the mid-19th century.

7.3 Tests during manufacture, laying and for location of "malfunction"

Most primary and secondary texts create confusion by using the terms "fault", "break" and "interruption" interchangeably. I prefer to use the term "*malfunction"* to include all three as strictly a cable *fault* still allows some communication even if weak and slower than normal. The terms *interruption* or *break* may be used interchangeably when there is a complete loss of communication. These different meanings are described further later in section 7.7.

Throughout the period under discussion (1850-1914) there was a continual increase in the accuracy, precision and complexity of the electrical tests. This was driven by the necessity of locating the causes of malfunction as quickly and accurately as possible in order to reduce the duration of any diminution of speed or complete interruption of communication and avoid damage to reputation or income for the operating companies. However, during the "experimental period" scientific knowledge was insufficient to allow accurate fault location. As I will demonstrate there were initially simplistic views of how simple tests of resistance

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[361] This last factor may have been the most influential. It was beneath members of the ICE to patent; publish definitely but patent – No. I see some loose similarity here with the Royal College of Physicians. *Fellows* of the RCP (FRCP) are not allowed to sue for un-paid consultation fees.

[362] C. More, 1980, *Skill and the English Working Class 1870-1914,* St Martin's Press, New York.

[363] C. G. Renold, The nature and present position of skill in industry. *The Economic Journal*, , **38**, No 152, 1928, pp. 593-604.

alone could accurately locate damage to a cable. Also, there were successively three distinct methods of measuring resistance developed over the period, as electrical engineering as a whole progressed, namely (1) by comparison (2) by (Wheatstone) bridge and (3) by combination of the bridge and accurate current measurement.

Throughout the period 1850-1914, there were distinct differences between the tests undertaken during the manufacture and laying of cables and those necessary to locate faults on completed cable systems. During manufacture, *both* ends of the cable were accessible and in close proximity, either as just the core (copper conductor and gutta-percha insulation) or as the complete cable. The completed cable was stored under salt water in tanks but not under the extreme pressure or very low temperature at which it would eventually work. There was no way of testing the newly manufactured cable under these conditions before it was laid.

During both manufacture and cable laying, *continuous* electrical monitoring was carried out in order to detect and locate faults quickly, although during laying only the end of the cable on board ship was available for testing. This monitoring saved time and money on fault-finding post-installation. This was an even greater consideration during laying where lack of continuous testing might led to missed faults resulting in many miles of cable having to be raised from the sea bed to correct a problem. Further, new faults could occur during laying as a result of mechanical handling of the cable from the storage tanks at the factory to the tanks on the laying ship and the manipulation of the cable from the ship's hold to the sea bed. The testing required to detect and locate faults or breaks after a cable had been laid required more skill and care as the problem could be at a far greater distance. The Cable Electricians who carried out these tests began their training in the cable factories before graduating to assisting at sea and finally becoming Station Cable Electricians where in many cases they were the sole electrician (Chapter 8).

7.4 Location by "comparison"

At the age of only 17, Charles Tilston Bright patented some tests in his famous patent No 14,331 in 1852. He was the first to use a calibrated resistance box on submarine cables, nine years later in 1861 when testing the cable laid between Malta and Alexandria.

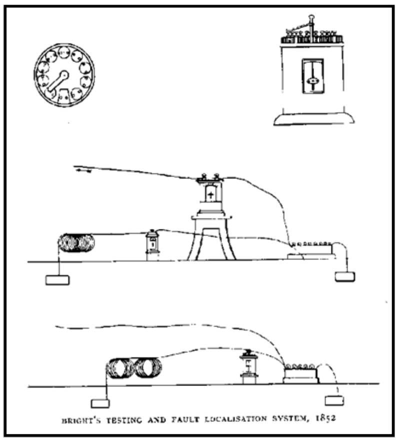

Figure 7.1 Diagram from Bright's patent No 14,331 (1852)

Although not particularly obvious from his schematic shown above, Bright compared the core copper resistance which was earthed at the fault/break with the resistance of a set of standard coil resistances in order to estimate its location.[364] This was the first test to be patented (and therefore 'published') in relation to fault-finding of submarine telegraph cables but there is no documented evidence about its use or accuracy in fault location. A simpler diagram and description was redrawn and published by Maver in 1892 in his *American Telegraphy - & Encyclopedia of the Telegraph* (see Figure 7.2).[365]

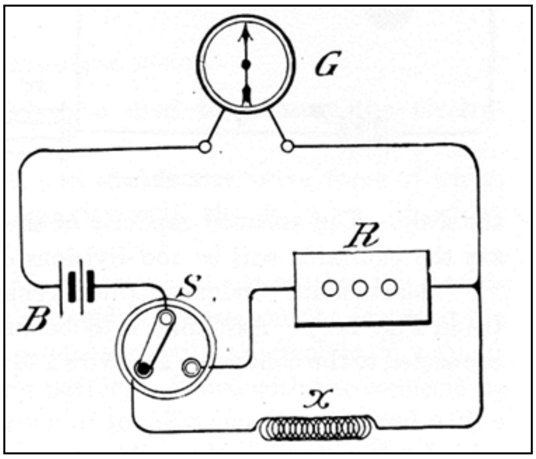

Figure 7.2 Simple circuit which compared the deflection of a galvanometer, G, when in series with either the unknown resistance, x, or the calibrated resistance box, R. From W. Maver, *American Telegraphy.* 1912, p. 121.

By the time Webb[366] gave his "public" paper at the Institution of Civil Engineers, only a few international submarine telegraph cables had been laid. The paper he gave was only the third publication on submarine cable technology. Previous papers by Mr FR Window[367] on the effects of lateral induction and Mr Longbridge & Mr Brooks a mathematical explanation, had been theoretical rather than practical.[368] Webb, who was not an operating company employee, wrote about testing a cable which had not by then been handed over to the operating company whereas the operating company's staff kept very quiet about technicalities which could possibly be patented. They found that patenting test techniques was economically unsound and that secrecy made more sense.

Webb was the first cable electrician to publish tests for locating *submarine* telegraph cable faults and breaks with evidence of results. Others had published earlier but in relation to land lines. Some of the earliest tests for submarine cables were derived from these tests. Webb's earliest published test was on the cable between the UK and the Hague.[369] During the manufacture of this cable he had measured the deflection with a very simple and insensitive galvanometer in circuit with the cable core and a single cell. He recorded the deflection of the galvanometer in degrees with every 10 statute miles of cable during manufacture, the deflection ranging from 52° at 0 miles to 12° at 120 miles. He was then able to compare these

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[364] C. Bright, *The Life Story of Sir Charles Tilston Bright,* 1908, Revised and abridged edition, Archibald Constable & Co Ltd, London, p7.
[365] W. Maver, *American Telegraphy - & Encyclopedia of the Telegraph.*, Maver Publishing Company, New York, 1892, p. 131.
[366] F. C. Webb, On the practical operations connected with paying-out and repairing submarine telegraph cables. *Proc ICE,* 1857-1858, Vol. 17, Feb 23, p262.
[367] Minutes of *Proceedings of Inst Civil Engineers*, 1855-56 vol 16, 188-202
[368] ibid 1857-58, vol 17, 3-34
[369] Webb *op cit.*, pp. 288-9.

results with those obtained in laid cables where a break had occurred leaving the copper core in contact with the sea. Webb recognised how inaccurate these results were as they were only within 10 miles of the actual break, an inaccuracy that increased with the length of the cable. He noted in his paper that much of the inaccuracy was due to the size of exposure of the copper conductor at the location of the break which was, of course, unknown until the damaged portion of the cable had been raised for inspection. Webb also realised there were other inaccuracies caused by the resistance of the return pathway (sea water and earth) and that of the earth plate/seawater interface compounded with the resistance of the copper wire to the fault.

William Preece, the rising star in Post Office engineering looked further into the lack of accuracy in fault location and pointed out that the basis of all the tests for the location of breaks was electrical resistance which was proportional to length of the copper core, accuracy of location depended upon uniformity of the core resistance.[370] No conductor was perfect; copper was the best available at the time but was of variable quality, the relevant measure of this being its resistivity. *Electrical resistivity* is an intrinsic property that quantifies how strongly a given material opposes the flow of electric current. Any variation in the resistivity of the copper (or its "purity") affected the overall resistance of a given length of wire, as did the cross-sectional area in the manner shown in figure 7.3. The quality of copper varied with However, its resistivity, which was then referred to as "specific resistance", depended on its purity.

$$R = \frac{LC}{S}$$

where R = the resistance

L = the length of the wire

C = resistivity

S = its cross-sectional area

Fig 7.3 The relationship between resistivity, cross-sectional area, length and resistance of a piece of wire.

Thus it was important that the quality of the copper *and* its cross-sectional area were constant throughout the length of the cable. Without these conditions having been fulfilled, it was impossible to either improve the accuracy of fault location or to have a cable working at its most efficient. The specific resistance of the copper wire used by the Atlantic Telegraph Company in their first two attempts (1857 & 1858) varied by as much as 40% along its

[370] W. H. Preece, On the maintenance and durability of submarine cables in shallow waters. *Proceedings if the Institution of Civil Engineers*, vol 20, 1860, pp. 26-50 especially, p.37.

length.[371] The question of the quality of the copper used has already been discussed in Chapter 3.

The second test that Webb developed (or adapted from Bright's method above) for location of breaks in submarine cables involved the use of two identical galvanometers, or preferably, a differential galvanometer.[372] The differential galvanometer had two identical coils which were electrically isolated from one another. Webb connected the coils in such a way that the current in one creates the reverse or opposing magnetic field and thus deflection from the other. Hence, with equal and opposing currents the needle indicated zero. He connected a battery with one pole to earth and the other connected to both galvanometer coils such that the current would pass around the differential coils in opposite directions. The other end of one coil was connected to the cable core whilst the free end of the second coil was connected to earth via a standard resistance box (see Figure 7.4).

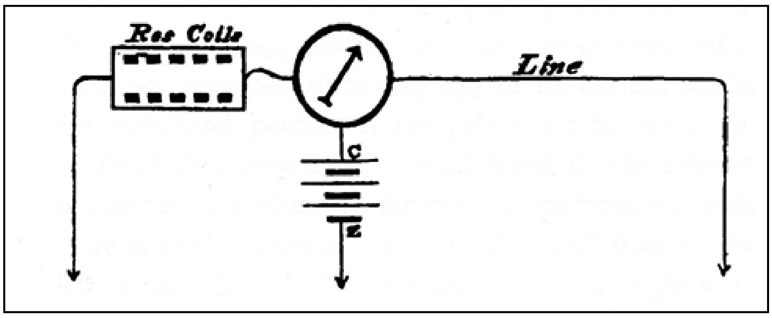

Fig 7.4 Differential Galvanometer set up to compare the resistance of a line with a resistance box. From Clark L, *An elementary treatise on electrical measurement*. E&FN Spon London, 1868, p. 54.

When the electrician adjusted the resistance box so that there was no galvanometer deflection (that is, the current in both galvanometer coils was the same) the conductor resistance was equal to the value indicated on the resistance box. The electricians had to be very experienced and skilful as the measured resistance included not only the resistance of the conductor from the station to the break or fault, from which the location could be calculated, but also other interfering resistances such as the earth resistance and the resistance between the exposed conductor at the break and the sea water.[373]

A much more accurate method of locating a fault was Varley's "Loop" test (1859). The advantage of this test was that it was independent of the resistance between the exposed

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371 *Ibid* p. 39.

372 Webb *op cit.* p. 288.

373 If copper conductor of a cable was exposed to sea water and a positive current was sent along the cable the exposed copper became oxidised and coated with copper chloride. If a negative current was then sent through, the copper chloride dispersed and afterwards hydrogen evolved from the surface of the copper. Both these so-called polarized states increased the resistance between the copper and the sea water. This resistance was at a minimum just at the moment that all the copper chloride had dispersed but before the bubbles of hydrogen increased it again and it took great skill to recognize this moment (see also: Clark L, Electrical tables and formulae for the use of Telegraph Inspectors and Operators, E & F Spon, London, 1871, p. 52.

conductor and the sea at the fault; the disadvantage was that it was necessary to have an identical line or cable in good working order with exactly the same electrical properties (see Figure 7.5). This condition was much more common with land-lines than with submarine cables.

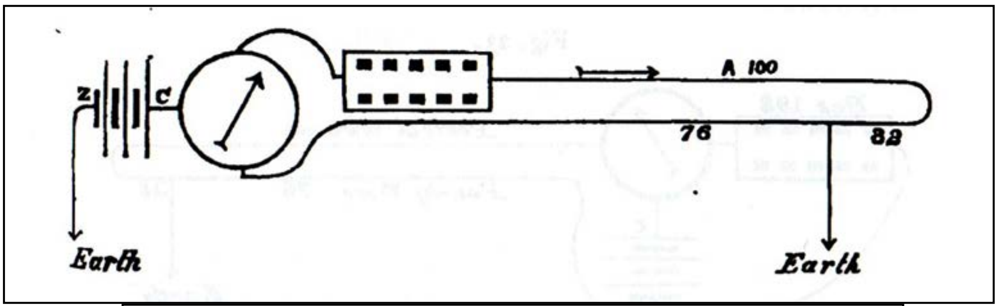

Fig 7.5 Varley's Loop Test using a differential galvanometer. From Clark L, *An elementary treatise on electrical measurement*. E&FN Spon London, 1868, p. 73.

To carry out this test, the electrician used measurements taken when the cable was laid, and those of the parallel wire, to ascertain the resistance of the faulty wire before it had been damaged. Then with the connections above he measured the resistance of each limb and calculated the distance to the fault. There were several versions of the Loop Test (e.g. the Murray loop test) and accuracy of location was further increased by using the Wheatstone bridge.

7.5 After the Experimental Period

With the formation of the breakaway Society of Telegraph Engineers in 1871, and more importantly to this thesis, the publication of the *Journal of the Society of Telegraph Engineers* (*JSTE*) in 1872, it became much easier for cable electricians to publish new testing techniques. The *JSTE* became the main organ for electricians in the cable industry to discuss with their colleagues and peers both tests in regular use and experimental ideas. Some of these ideas got no further than the pages of *the JSTE*; for example Emile Lacoine described "a new method for the determination of the distance of a fault in submarine cables" which was intended to avoid the influence of both polarization and "natural" or earth currents"[374]. Lacoine wrote:

> The influence of polarization at the fault is entirely avoided, as well as that due to the presence of natural currents. The distance to the fault is obtained without making any comparison with previous tests and there is no correction to be made for the temperature of the cable and therefore its conductivity at the time of the experiments. This method is likewise independent of variations which may take place in the emf or resistance of the batteries.

[374] E. Lacoine A new method for the determination of the distance of a fault in submarine cables, *JSTE,* , vol 4, 1875, pp. 97-101.

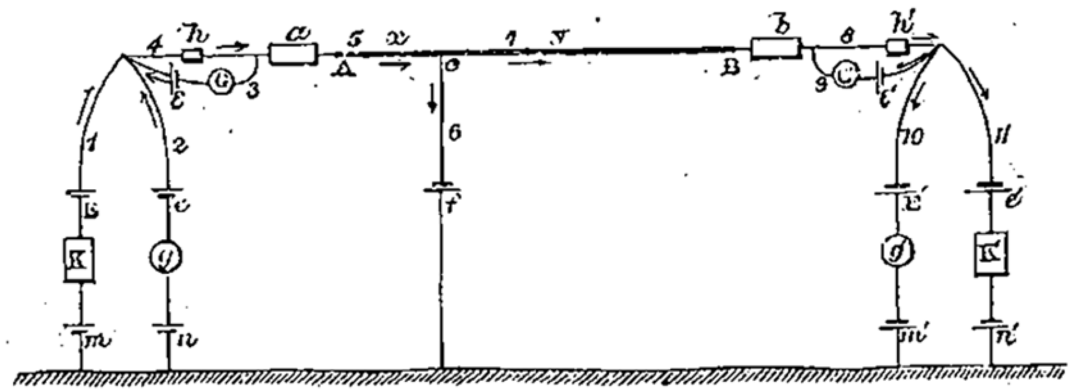

Fig 7.6 Circuit of Lacoine's experimental test method (from Lacoine E. A new method for the determination of the distance of a fault in submarine cables, *JSTE,* vol 4, 1875, p. 98.

Lacoine's test was not seen or heard of again. It required no less than four identical Thomson galvanometers, four calibrated resistance boxes, two un-graduated variable resistors and eight Daniel cells and the simultaneous services of at least two highly skilled electricians - measurements had to be taken simultaneously at each end of the faulty cable. Not surprisingly, it was not universally adopted.

It was not until after the *experimental period* that textbooks specifically about testing submarine telegraph cables began to be published; the authors aimed these textbooks at the student and practicing electricians. Most of them ran to two or more editions which demonstrated their popularity and the exponential increase in the cable industry. Table 7.1 shows details of such textbooks published during the period.

		1e	2e	3e	4e	5e	6e	7e	8e
L. Clarke[375]	*An Elementary Treatise on Electrical Measurement: for the use of Telegraph Inspectors and Operators*	1868							
O. V. Hoskiaer[376]	*Guide for Electric Testing of Telegraph Cables*	1878	1889						
H. R. Kempe[377]	*Handbook of Electrical Testing*	1876	1881	1884	1887	1892	1900	1907	
H. L. Webb[378]	*Practical Guide to the Testing of Insulated Wires & Cables*	1891	1895						
H. D. Wilkinson[379]	*Submarine Cable Laying and Repairing*	1896	1908						
J. E. Young[380]	*Electrical Testing for Telegraph Engineers*	1898	1913						
H. K. C. Fisher & J. C.H. Darby[381]	*Student's Guide to Submarine Cable Testing*	??*	??*	1903	1908	1920			
G. M. Baines[382]	*Beginner's Manual of Submarine Cable Testing and Working*	??*	1904	??*	1921				
U.S. Army[383]	*Notes on Laying, Repairing, Operating and Testing Submarine Cables*	1902							
J. H. Stephens[384]	*Textbook on Telegraph Cable Engineering*	1925							

Table 7.1 Textbooks about maintenance and repair of cables (*see text below)

375 L. Clark, *An Elementary Treatise on Electrical Measurement: for the use of Telegraph Inspectors and Operators,* E&FN Spon, London, 1868,

376 O. V. Hoskiaer, *A Guide for Electric Testing of Telegraph Cables,* E & F Spon Ltd, London, 1873, 1889. Hoskiaer was in the Danish military and was associated with The Great Northern Telegraph Company..

377 H. R. Kempe, *A Handbook of Electrical Testing.* E & FN Spon, London, 1876 and ran for 7 editions.

378 H. L. Webb, *Practical Guide to the Testing of Insulated Wires and Cables.*, Van Nostrand Company, New York. 1891.

379 H. D. Wilkinson, *Submarine Cable Laying & Repairing*, The "Electrician" Printing Co, London*,* 1896.

380 J. E. Young, *Electrical Testing for Telegraph Engineers*, 2e, The "Electrician" Printing Co, London, 1913.

381 H. K. C. Fisher, J. C, H. Darby, *Students Guide to Submarine Cable Testing*, The Eastern Extension, Australasia & China Telegraph Co Ltd, London; 1e, The "Electrician" Printing Co, London, 1895.

382 G. M. Baines, *Beginner's Manual of Submarine Cable Testing and Working.* 2e, Not dated, The Electrician Printing & Publishing Co, London.

383 U.S. Army Signal Corps. *Notes on Laying, Repairing, Operating and Testing Submarine Cables.* 1902.

384 J. H. Stephens (editor), *Textbook on Telegraph Cable Engineering*, in 3 volumes, Waterlow & Sons Ltd, London for The Eastern Associated Telegraph Company, 1925 and multiple editions thereafter.

The earliest book specifically on testing submarine telegraph cables was written by Latimer Clark in 1868. Clark (1822-1898) had joined the Electric Telegraph Company in 1850 as assistant engineer and, on the retirement of his elder brother in 1857, became chief engineer, in which capacity he was involved with much of the in-land telegraph system in the UK. In 1884 he conducted a large number of experiments on retardation of signals on subterranean cable between London, Leeds and Liverpool. In 1860 he formed a strong professional relationship with Charles Tilston Bright. Clark left the Electric Telegraph Company in 1861 and went into private practice as a consulting engineer.[385] He also gave evidence and did experiments for the Committee of Enquiry and these form the basis of his book. He stated in the Preface that he wrote his "little manual to accompany some instruments [galvanometers] designed for a special purpose" but felt that some background theory was necessary. The second half of this book forms an appendix listing different tests specifically available for submarine cables. He obviously felt able to publish these technical details as he was by then a consulting engineer rather than in the employ of a cable operator. Clarke only published one edition; one can only surmise that this was due to a heavy workload in his partnership as evidenced by his name appearing in many engineer's logbooks of cable laying especially as consultant to the ETC.

7.6 Change in secrecy policy

After the *Board of Inquiry* there appears to be a change in the policy of the operating companies with regard to secrecy about the details of highly confidential tests and measurements, as a number of textbooks were published by authors who were quite obviously still in the employ of the major operators. There were a number of possible reasons for this change of policy. As there was an exponential growth in the industry, evidenced by the annual increase in total length of functioning cables, there was likewise a growth in the number of electricians required in the manufacture, maintenance and repair of the system. Texts were needed for training (see Chapter 8) and for reference by qualified electricians. The main source of specialist information about the testing of submarine cables, the *JSTE,* was supplemented by other periodicals such as *The Electrician* and the *Telegraphic Journal & Electrical Review.* It is possible that the large operating companies actually encouraged their own electricians to write textbooks. Such publications not only advertised the company but demonstrated to customers and shareholders alike that they took maintenance and hence reliability very seriously. The authors themselves enjoyed the heightening of their professional reputation which led to requests for their advice and this also enhanced their employer's reputation. If the author already had a good reputation in the field then they were more likely to be commissioned by a publisher.

Kempe's *Handbook of Electrical Testing* became the most respected text which was cited by most that followed and ran to seven editions. Harry Robert Kempe (1852-1935) was educated at Westminster School and Kings' College London before being articled to Sir Samuel Canning who was chief engineer to the Telegraph Construction and Maintenance Company. He then was apprenticed to Robert Sabine and also Sir Charles Wheatstone. In 1871 Kempe was taken on by William Preece at the telegraph service of the Post Office based in Southampton. When Preece was knighted and became chief engineer of the Post Office, Kempe moved to London

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[385] Clarke and Bright worked together as engineers on the 1865 and 1866 transatlantic cables for the Anglo-American Telegraph Company. Their partnership ended in 1868 and Latimer Clark formed Clark, Forde & Taylor – Consulting Engineers - who were involved in many future cable layings.

with him.[386] Despite a very heavy workload, mainly involving submarine telegraphy, Kempe found time to write seven editions of the *Handbook of Electrical Testing* between 1876 and 1908.[387] In the Preface of the first edition in 1876, he explained that his book was based on articles he had written in the *Telegraphic Journal & Electrical Review* entitled “Resistances and their Measurement”. He assumed that the reader “possessed a certain knowledge of electrical terms and expressions”, suggesting recent works including Ferguson’s *Electricity*,[388] Noad’s *Student’s Textbook of Electricity*[389] and Deschanel’s *Electricity and Magnetism*[390] for basic knowledge, though none of these touch upon the subject of electrical *testing*. The first edition of the *Handbook* contained 198 pages but by 1900 it reached 646 pages. New editions were called for as new tests were developed though very few tests disappeared over the years. Kempe’s *Handbook* was the most successful of the texts for cable electricians because of his clear elucidation and his reputation and experience. It was cited by the majority of other British authors on the subject.[391]

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[386] V. Carse – unpublished biography of HRK by his grand-niece, 1991, Porthcurno Telegraph Museum Archive (un-catalogued)

[387] He also wrote *Engineers Pocket Book* in 1890, *Alternating Currents* in 1916 and *The Engineers Year-Book* which first appeared in 1894 and he continued to edit for 36 years. Kempe was a full member of the Institutions of Electrical Engineers, Civil Engineers and Mechanical Engineers which also reflected his broad engineering knowledge. He was also a very *practical* engineer. Despite this, he was a shy man, avoiding the lime-light, a man of deep Christian faith.

[388] R. M. Ferguson, *Electricity,* 1866, 1867,1873, 1882 & 1887, W&R Chambers, London.

[389] H. M. Noad, *Student’s Textbook of Electricity,* 1867 & 1879, Crosby Lockwood & Co, London.

[390] A. Privat-Deschanel, *Deschanel's Natural Philosophy Part III - Electricity and Magnetism*

[391] Some of the textbooks also cite Fleeming Jenkin’s *Electricity and Magnetism* for the theory behind the tests. Fleeming (pronounced “Fleming”) Jenkin was one of the few academic electricians who, with Professor Sir William Thomson, were involved with submarine telegraphy from its earliest days[391]. *Electricity and Magnetism* was first published in 1873 and its popularity meant the by 1887 it was in its 9th edition. Biographical details found in the 1885 edition of *The Electrical Trades Directory*, published annually and colloquially known as the “Blue Books”, pp108-9. Although born in Kent he was educated in Edinburgh, Frankfurt-am-Main (1846), Paris (1847) where he witnessed the French Revolution and Genoa (1850) returning to England in 1851. After an apprenticeship with Fairbairns in Manchester he gained experience in civil and marine engineering before joining RS Newall & Co, the cable manufacturer and layer. At Newalls’ he was entrusted with the design of cable laying and grappling apparatus. He was involved in the first Atlantic and Red Sea cables and a number of Far East and Mediterranean cables. Together with William Thomson he worked on electrical standards and was elected FRS in 1865

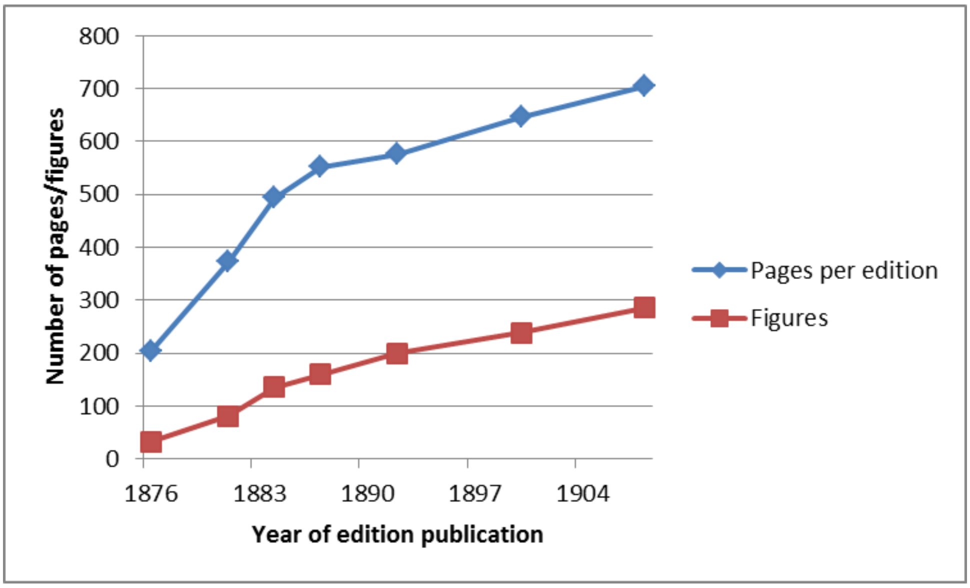

Figure 7.7 Parallel increase in pages and figures in consecutive editions of Kempe's *Handbook of Electrical Testing*

Figure 7.7 shows the progressive increase in pages and figures which each new edition. It is interesting to note that with each new edition *very* little was edited out, though many new tests and additional details of existing tests were added with successive editions. The original 32 figures were still apparent in the last edition. During the 1880s the method of typesetting by printers changed from manual, where each letter of type was hand-selected and mounted in a composing stick to semi-automatic "hot metal" typesetting which was much quicker, easier and cheaper than the manual method. These advantages could have led to a step increase in edition pages but this is not evident. All the figures were engravings or photomechanically produced printing plates and as such were re-used in each successive edition. None were half tones in any edition; half tones were much more expensive without adding any information to such a textbook. It is a measure of respect for Kempe that his book ran to seven editions. All editions of Kempe and Latimer Clark's textbooks were published by E & FN Spon of 46, Charing Cross Road, London, as were Hoskiaer's books. As will be shown below, it was not unusual for publishers of technical books in the Victorian era to have competing titles simultaneously on their lists.

The motive for Hoskiaer to write his texts may have been not his own but that of the Danish government. Captain (later Colonel) Otto Valdemar Hoskiaer of the Royal Danish Engineers was also chief electrician to the Great Northern Telegraph Company (GNT), the only other large telegraph company but still not of comparable size to the Eastern Group.[392] He wrote *Guide for Electric Testing of Telegraph Cables* and a similar book aimed more at cable engineers than electricians entitled *Laying & Repairing of Electric Telegraph Cable* (1878). Both of these titles were published as hard-back pocket books.

It is of note that seven of these textbooks have English authors, one a Danish author and only the little 70 page booklet of the US Army Signal Corps is North American. Both editions of

[392] The GNT was established in 1869 for the purpose of telegraphic communication between Europe, China and Japan mainly by land-line over the Russian continent.

Webb's *Practical Guide to the Testing of Insulated Wires & Cables* were published by Van Nostrand Company in New York and indeed, the Preface of each edition was apparently written in the same city but although published in North America, Herbert Laws Webb was a son of the well-known English cable engineer F.C. Webb who, in company with Cyrus W. Field, selected the landing place at Valentia for the first Atlantic cable. H.L. Webb compiled his little textbook based upon articles he wrote for the American periodical *Electrical Engineer* which was the American version of *The Electrician.* Editions of Fisher & Darby and of Baines are undated; this was a common habit of publishers especially in the 19th century to avoid their books appearing to become out of date. For five years it was the only published text on the subject of testing.

The authors of the textbooks listed were all practicing cable electricians. Wilkinson's, *Submarine Cable Laying & Repairing,* first published in 1896 with a second edition in 1906, covers all the engineering aspects of cable manufacture, laying, testing and repair in one volume. Henry D. Wilkinson was born in 1857 and he trained in London and Cornwall in mechanical and electrical engineering. He then worked for divisions of the Eastern Telegraph Company in the Far East setting up cable stations and laying submarine cables.[393] He also published a text book with Professor Arthur Kennelly.[394] Wilkinson died in February 1932[395] but the popularity and longevity of his *Submarine Cable Laying & Repairing* is demonstrated by the inscriptions on the title page of the copy in the archive at the Porthcurno Telegraph Museum:

S.G. Jenkins – Rodriguez [cable station] 1909
K.E. Jennings – PK [Porthcurno] 1957
F.E. Lowe – CS *Cable Venture*
F.D.E. Vith – Captain, CS *Pacific Guardian* March 2006

These inscriptions demonstrate the book's long history of usefulness; even in 2006 it was considered a worthwhile reference manual to be carried on a cable ship. It really only became slightly dated in the late 1930s with the change from gutta percha to synthetic insulating materials. This could also contribute to evidence demonstrating a degree of technical stagnation. *Submarine Cable Laying & Repairing*, as its title suggests, not only has a very practical chapter on the location of cable malfunction but also chapters on the maintenance and repair of them. Both editions were published by "The Electrician" Printing and publishing Company, publishers of the weekly trade journal *The Electrician* in London. This publishing house was another which published a number of very similar books concurrently, for example *Electrical Testing for Telegraph Engineers* by J. Elton Young and *Student's Guide to Submarine Cable Testing* by Fisher and Darby. Young's textbook, which was specifically about submarine cables, ran to two editions whereas Fisher and Darby's *Student's Guide to Submarine Cable Testing* ran to five editions. A thinner text by Baines entitled *Beginners Manual of Submarine Cable Testing and Working* was popular enough to run to four editions. Its popularity was due

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[393] This was followed by life as a senior mechanical engineer for Davey, Paxman & Co working on steam electricity generation plants. In 1898 he was called in by the Eastern Telegraph Company again as a consultant to deal with cable problems around South Africa. He was a prolific writer on electrical subjects as diverse as telegraphy, electrical generation, electric traction and theatre lighting.

[394] A. E. Kennelly, H. D. Wilkinson, *Practical Notes for Electricians,* The Electrician Publishing Co, London, 1890.

[395] Obituary *Journal of the Institution of Electrical Engineers* vol 71, 1932 p. 991.

to the efforts of Baines, who was electrician at Carcavellos (the ETC cable station for Lisbon) to specifically avoid more challenging algebra in the text.

There were no specific text books written for the electricians involved in testing cables during manufacture. However, a comprehensive series of twenty three episodes in editions of *The Electrician* published in 1882-1883 entitled "A Guide to Practice in the Submarine Cable Testing Room"[396] covered this important subject including testing during transfer to the cable ship and testing during laying. The author remained anonymous until the end of the series when his identity was revealed as F.S. Beechy.[397]

All of the authors listed in the table above described the tests used by the electricians but unfortunately none gave a chronology of their development which would have provided an insight into the increasing complexity of the skills required of the electricians. This was probably due the authors' belief that historical background to the tests was unnecessary in what were essentially technical guides.

In 1925 The Eastern Associated Telegraph Companies published a three volume comprehensive *Textbook on Telegraph Cable Engineering* "strictly for private circulation only" which listed the "Fault Tests" and "Break Tests" (see Table 7.2) which had stood the test of time, but gives no chronology of their development.[398] I include it here, despite its late publication date, as it demonstrates that the majority of tests in use then and indeed into the 1950s were developed before 1900 as will be shown.

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[396] F. S. Beechey, The Electrician, Sept 23rd 1882 – 12th May 1883

[397] Frederick S. Beechy "Telegraph Engineer" also wrote a small textbook entitled *Electro-Telegraphy* published by E&FN Spon, London, 1876. Of only 176 pages it was aimed at a general rather than specialist readership. It received a mediocre review in *Nature* 12th October 1876 issue number 524.

[398] *Textbook on Telegraph Cable Engineering*., The Eastern Associated Telegraph Companies. Published in 3 volumes for internal company use. 1925.

Fault Tests

By resistance measurement

Balancing false zero
Quick reversals test
Blavier's test
Murphy's Theorem
Anderson & Kennelly's overlap test
Jordan & Schonau's test
Varley Loop test
Murray's Loop test
Simultaneous Current test
Stacey's Correction

Break Tests

By measurement of resistance

Kennelly's two current test
Kennelly's 3-current test
Schafer's test
Mance's Test
Black's test
Lloyd's test
Lumsden's test
Jona's test

By measurement of Capacitance

Comparison of swings
De Sauty
Gott

Table 7.2 Electrical tests in *Textbook on Telegraph Cable Engineering*. 1925, The Eastern Associated Telegraph Companies. Vol. 1 of 3 pp. 526-594

The tests listed have accrued since the 1850s and are indeed still used in automated form in the present day.[399] The only tests that have fallen completely into disuse were those used before Charles Wheatstone had developed his bridge method of measuring resistance. In 1925 there was a very clear-cut classification between fault tests and break tests; this belies the fact that many of the tests were used to locate both faults and breaks. The Eastern Group had by 1925 grown so large that it needed to standardise training of its electricians and hence published its own textbook: *Textbook on Telegraph Cable Engineering* in three large volumes.
Embossed on the cover of each volume are the words: "The Eastern Associated Telegraph Companies – *For Private Circulation only*". This was presumably due to concern that if the book became generally available, it may have suggested a lack of reliability in cables which would therefore have harmed the Group's public relations. However, the existing secondary literature does not examine the tests from a historical perspective, discussing neither the chronology of the tests nor *why* each was developed. It is my aim to correct this deficiency.

[399] Although some of the tests are still in use today, the most common current test is pulse reflection which is similar to radar. A very short pulse of electricity (in the case of copper cables) or light (in the case of fibre optic cables) is injected along the cable under test and any reflection from a fault or break is observed. As the pulse travels at a finite speed, the distance to the fault/break can be calculated.

7.7 "Faults", "Disconnection faults", "Interruptions" and "Breaks".

By the beginning of the First World War, malfunctions in submarine telegraph cables were defined as either *faults* or *breaks.*[400] Prior to then a *fault* in a cable was a puncture in the insulation/dielectric establishing a salt water connection with the conductor. This was distinguished from a *disconnection fault* (later defined as a *break)*, which was a complete discontinuity in the copper conductor. A *disconnection fault* was indicated when no current at all could be received. The resultant electrical properties of the cable depended upon whether one end of the conductor (or both) at the break was in contact with the brass tape surrounding the core or the metallic sheathing or whether it was in contact with clean sea water or buried in silt, mud or sand. There was also the possibility that the dielectric remained intact protecting the two ends of the conductor at the fracture site.[401] Disconnection faults were caused by anchors, trawls, earthquakes, strain on a cable following corrosion of the sheathing or chaffing due to waves and currents. The probable reason for the use of the term "disconnection fault" rather than "break" was that the former sounded less drastic or serious than the latter.[402]

In a cable *fault* the conductor remained intact but there was damage to the core insulation. A fault caused an increase in the strength of outgoing current *and* a decrease in received current but the cable still functioned and it was still possible in the early stage of fault development to pass messages. Faults had numerous causes. Submarine boring animals (usually the *Teredo navalis* "worm"); chemical action (the core perished due to improper storage before laying); fish bites; defective manufacture; defective joints; punctures due to other causes; lightning strikes; fouling by anchors. There was almost competition amongst cable engineers to find obscure causes of damage to cables. Henry (later Sir Henry) Mance even wrote to the S. T. E. from Karachi saying that he "had the honour" to report to the Society that he had found the tooth of a sword fish embedded in a cable. [403]

From 1850 onwards, tests were developed and modified to enhance the accuracy and speed with which malfunctions appearing on submarine cables could be analysed and located geographically and then repaired within the minimum time. Speed was of the essence as interruptions in the use of a cable were also interruptions in its ability to earn money. Furthermore the commercial and diplomatic reputation of the operating company was at risk. During the first few decades of the period, the same fleet of cable ships carried out repairs, as were used to lay cable. By the 1870s, because fault-finding and repair did not require ships that could carry large lengths of cable, the larger operating companies, for example the Eastern and Associated Telegraph Group of companies, employed their own fleet of much smaller vessels which were stationed around the globe so that wherever trouble occurred the time to get a repair ship to the fault was reduced sometimes by months.[404]

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[400] Stephens *op cit*, p526
[401] Fisher *op cit,* p.113.
[402] R. Noakes – personal communication
[403] Mance H. Letter. *JSTE* 1882, vol XI, p150
[404] K. R. Haigh, *Cableships and Submarine Cables,* Standard Telephones and Cables Ltd, Greenwich, London. 2nd edition. 1978.

Kempe, in the first edition of his *Handbook*, states: “The theoretical methods of testing for the localities of faults are comparatively simple but their practical application presents some difficulties.”[405] The vast majority of faults were localized by the measurement of electrical resistance and comparison of the results of these tests with those recorded during the laying of the cable. The location of a cable fault or break required great skill and experience because the fairly straight forward electrical tests were made much more difficult by a number of factors.

At first glance, during the first decade of transoceanic telegraph cables, the skills required by the electrician may appear fairly straight forward. To locate a fault or break he measured the resistance of the core and converted that resistance to miles of cable. However there were a number of other resistances and sources of electromotive force present in a broken cable which confused the result. Although some of these were recognised early in the history of cable maintenance it was decades before they were fully understood and the development of tests continued to eliminate their effects and thus increase the accuracy of break/fault location. Storey, in a paper to the Institution of Electrical Engineers in 1939, summarised the resistances and voltages potentially present in a broken cable.[406]

The most obvious occurrence during a fault condition was the change in electrical resistance compared to that immediately after it was laid. Indeed this was the main way of calculating the geographical position of the fault. However there were other resistances which interfered with this measurement. Firstly there was the contact resistance between the exposed copper core at the fault and the sea water which completed the circuit to the tester. This contact resistance varied with the area of exposure of the copper to the sea water: the greater the area, the lower the contact resistance. The size of the contact area at the fault was unknown until the fault had been raised to the surface. Then there was the resistance of the return circuit itself – the seawater and the quality of the contact made with the sea water at the testing site. To confuse matters further the fault itself acted like a primary “cell” formed of copper/brine/iron (usually about ⅓ volt).[407] Hydrogen gas could form minute bubbles on the copper surface due to electrolysis caused by the electric current used by the electrician’s test. If the electrician had then reversed the polarity of the test current, the hydrogen bubbles would have been replaced by a layer of copper chloride. Either of these situations, which were termed “polarization”, would have increased the contact resistance. Sudden reversal of the electrical polarity could burst the film or remove the deposit causing a reduction in fault resistance. This phenomenon was first reported by Fahie in 1874; the mechanism was explained by Alexander Adams during the discussion following Fahie’s paper.[408] It happened either where an intact copper conductor was exposed to sea-water due to a fault in the dielectric or at the ends of the copper conductor of a complete break. If the perforation of the dielectric was minute, the fault might even have improved as the bubbles of hydrogen gas could cause a separation of the conductor and the sea water. Another confounding feature which would have made accurate estimation of location difficult was the possibility of a

[405] Kempe *op cit,*. p. 77.
[406] A. L. Storey, The localization of exposed breaks in submarine cables. *JIEE*, , **85**, No 513, 1939, p. 411.
[407] The word “cell” is commonly confused with “battery” as in “batteries included” which actually should say “cells included”. A “battery” is a number of cells connected in series.
[408] J. J. Fahie, On faults in submarine telegraph cables. *JSTE,* vol 3, 1874, pp. 372-404 and pp. 391-393.

difference in the potential (voltage) of the earth at the site of the fault compared with the earth potential at the cable end where the tests were being undertaken. Further to the resistances and potential differences (voltages or electro-motive forces) listed, there was the "inductive" capacity of the cable which was either charged or discharged by these interfering voltages and by the electric current of the test procedure. For the benefit of the 21st-century engineer the equivalent circuit of a cable break is shown in Appendix 1.

It was not until the early 1870s that the senior management and the accountants of the operating companies realised that they *had* to involve the electricians in the choice of sites for new telegraph stations. Only the electricians understood the importance of the geology under the stations to the quality of communication. This was especially the case where more than one cable terminated at a station. Apart from the geological and building problems, the electrical *resistivity* of the ground where the earth plates were placed had to be taken into account (see Table 7.3).

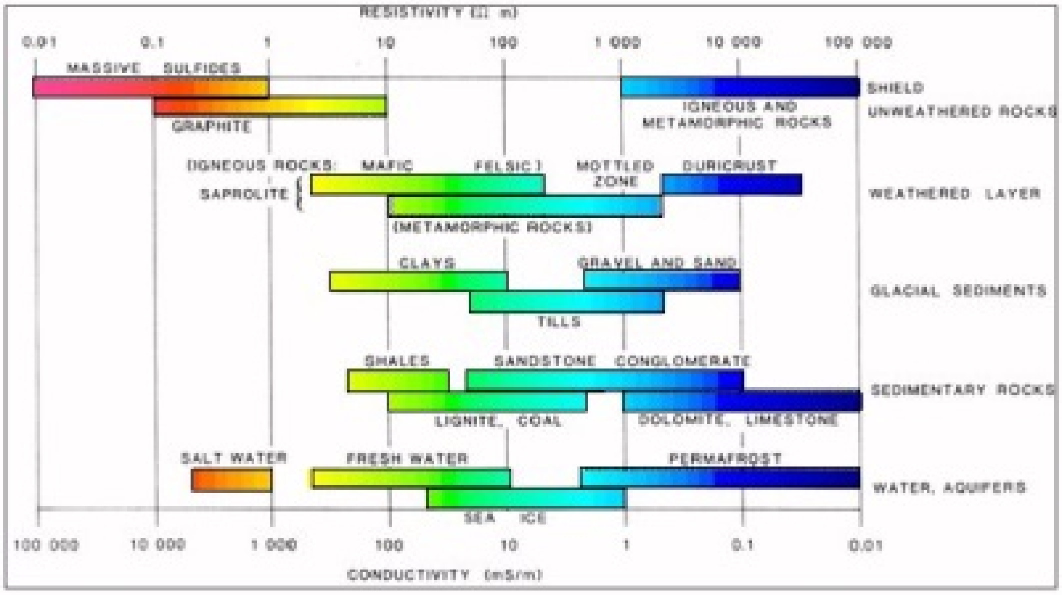

Table 7.3 Electrical resistivity(and its reciprocal, conductivity) of various soils. Adapted from Palacky GV. Resistivity characteristics of Geologic Targets in *Electromagnetic methods in Applied Geophysics*, 1987, vol 1, Theory, p. 1351.

The lower the value of ohm-metres, the better was the conduction. These values varied with electrolyte concentration, moisture and ground temperature. The problems created by the geology were brought to light by James Graves, a senior electrician and manager of the Valentia Cable station of the transatlantic cables. On moving to a new site at Valentia he had great problems with interference between the cables and land lines.[409] This interference turned out to be caused by the new station having been built on a large bed of peat in a basin of clay about 140 yards in diameter with all of the earth-return plates in the peat. The problem was not resolved until the earth return-plates were moved outside the peat area. Preece who was present at the reading of Graves' paper said that similar problems had occurred in Derbyshire, Torquay and Salisbury. Further, Fleeming Jenkin, also present, described an "insulated island", at St Pierre in France.[410]

In summary, there were many natural and man-made factors that made the application of simple tests far from accurate. Thus the skills of the electricians were far greater than just technicians following simple test protocols and, in the period 1850 to 1880s, they seem to have had considerable autonomy in carrying out their own experimental ideas. Many of the early tests used to maintain the submarine cables were identical to those used in land-line telegraphy and it was the electricians at the factories, on the cable laying ships, and at the cable stations who, realizing the inadequacies of the land-line tests, modified them or developed new tests for use on the cables. The more experienced these electricians, the greater their accuracy in locating faults, meaning repairs could be instituted more rapidly thus saving revenue and reputation.

Regular tests were made on working cables by the station electricians to check for early barely detectable signs of faults which, although having little effect on the working of a cable, would,

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[409] J. Graves, On vibrations due to earth plates. 1875, vol 4, *JSTE*, pp. 34-51.
[410] *Ibid* p. 41.

in time, develop into more serious trouble, reducing operating speed and eventually leading to complete failure – the antecedents of prophylactic maintenance.

7.8 Historically important tests

In the following section, I will describe in detail and chronological order the principles involved in the most important tests; some of these have not stood the test of time but they were important steps. There are certain concepts which are essential to understanding these tests. *Resistance* is the obstruction which materials offer to the free passage of electricity and it may be said to represent both conduction and insulation.[411] *Capacitive induction* refers to the property of electricity storage in the condenser (capacitor) formed by the gutta percha insulation or "dielectric" between two conductors namely the copper core and the brass tape, iron armour wires and the brine. Tests involving the measurement of electrical resistance in a variety of ways were frequently sufficient to detect and locate a fault or break because at the site of the problem the central copper conductor had come in contact with sea water. Very occasionally, the central copper conductor had broken but remained insulated from the sea by the gutta percha which had stretched over the break. When this occurred the measurement of electrical capacity was the only method available to calculate the location of the break.

7.8.1 Resistance

The methods of measuring resistance evolved through three distinct stages: (1) Comparative or Substitution methods; (2) methods based upon the Wheatstone Bridge or "null rests"; (3) Wheatstone Bridge *plus* measurement of current with a calibrated milliammeter. These stages occurred as standardized units were developed and as instruments calibrated in these standard units became available. The first measurand to be shackled to a reproducible standard was that of resistance.

Date	Name of Unit From↓ To→ Multiply by↘	Absolute foot/second x10^7	Thomson's Old Units	Jacobi	Weber's absolute metre/second x10^7	Siemens	BA Unit or Ohm	Digney	Bréguet	Swiss	Mathiessen	Varley	German Mile unit
(<1871)	Absolute foot/second x10^7	1	0.952	0.4788	0.3316	0.3197	0.3048	0.3289	0.03123	0.02924	0.02243	0.0119	0.005307
(<1871)	Thomson's Old Units	1.505	1	0.5029	0.3483	0.3358	0.3202	0.03455	0.03279	0.03071	0.02357	0.01251	0.005574
1848	Jacobi	2.088	1.988	1	0.6925	0.6675	0.6367	0.06869	0.0652	0.06106	0.04686	0.02486	9.01108
(<1871)	Weber's absolute metre/second x10^7	3.015	2.871	1.444	1	0.9635	0.9191	0.9919	0.09416	0.08817	0.06767	0.03591	0.01655
<1860	Siemens	3.129	2.979	1.498	1.038	1	0.9536	0.1.30	0.0977	0.0915	0.07026	0.03726	0.0166
1864-1872	**BA Unit or Ohm**	**3.281**	**3.123**	**1.57**	**1.088**	**1.0486**	**1**	**0.1079**	**0.1024**	**0.959**	**0.0736**	**0.03905**	**0.01741**
(<1871)	Digney	30.4	28.94	14.56	10.08	0.0971	9.266	1	0.9491	0.8889	0.6822	0.362	0.1613
1867	Bréguet	32.03	30.5	15.34	10.62	10.23	9.76	1.054	1	0.9365	0.7187	0.3814	0.17
1867	Swiss	34.21	36.56	16.38	11.34	10.93	1-.42	1.125	1.068	1	0.7675	0.4072	0.1815
(<1871)	Mathiessen	44.57	42.43	21.34	14.78	14.23	13.59	1.66	1.391	1.303	1	0.5306	0.2365
(<1871)	Varley	84.01	79.96	40.21	27.85	26.83	25.61	2.763	2.622	2.456	1.885	1	0.4457
1848	German Mile unit	188.4	179.4	90.32	62.48	60.21	57.44	6.198	9.882	5.509	4.228	2.243	1

Table 7.4 Units of Resistance from L. Clark, R. Sabine, *Electrical Tables and Formulae for the use of Telegraph Inspectors and Operators*, E & F Spon, London, 1871, p.8.

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[411] W. H. Preece, On the maintenance and durability of submarine cables in shallow waters. *Proceedings of the Institution of Civil Engineers*, , **20**, 26-50, 1860, p. 37.

Table 7.4 shows the multiplicity of units for electrical resistance available up to 1871.[412] However it can be seen from the table that there were many "standards" to choose from. This led to the formation of the Standards Committee of the British Association for the Advancement of Science (BAAS) being set up with a majority of members of the committee being telegraph men, as discussed in Chapter 3. The BAAS eventually settled upon the "BA ohm" although the Siemens unit was used for some years by those associated with the Siemens company. Despite the improving standardization of units of resistance, the operating companies continued to use whichever units of resistance had been used when a cable was manufactured, throughout the operating life of that particular cable. At the time of the laying of any cable the electrical resistance of the cable was measured and recorded wherever and whenever one length of the cable was joined to the next. These records were updated throughout the life of the cable for fault/break detection and location.

Steady improvements in the *detection* of even tiny amounts of electric current by galvanometers, and the development of accurate resistance boxes meant that bridge methods of resistance measurement became possible. The final advance in fault location in submarine cables during the period of this thesis, that of using known pre-set current values across the fault or break, only became possible with the development of *calibrated* milliammeters in the 1880s. Electricians of the time had previously only used "indicating" devices (showing whether a current was passing or not, qualitatively) such as the galvanometer rather than *quantitative* "measuring" devices such as the voltmeter and ammeter. Also the galvanometers used for sensitive indication of small currents were of the tangent type which required care in setting up and were very sensitive to external magnetic fields. The first *directly* calibrated milliammeters were developed by Ayrton and Perry of the Finsbury Technical College in London between 1879 and 1884.[413] In the early 1850s the only method of resistance measurement available to cable electricians was therefore by comparison or substitution.
These tests by comparison/substitution were the earliest tests and have already been described. These tests were very crude and more accurate methods had to await the Wheatstone Bridge after the Committee of Inquiry.

7.8.2 Interruption of the core conductor with intact insulation

Unfortunately there were occasions when a cable broke but the end or ends of the copper wire did not make contact with anything conductive (i.e. sea water or iron sheathing wire). This occurred especially if the cable had been stretched sufficiently to fracture the copper wire but not enough to cause a leak in the insulation. The commonest cause was when the cable had been 'caught' by an anchor or fishing gear. On rare occasions, the cable was completely fractured but the ends were so deeply buried in ooze on the sea bed that no connection was made with sea water.[414] The usual resistance tests did not provide any information as to the

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[412] L. Clark, R. Sabine, *Electrical Tables and Formulae for the use of Telegraph Inspectors and Operators*, E & F Spon, London, 1871, p. 8.
[413] G. J. N. Gooday, The morals of Energy metering in *The Values of Precision* edited by Wise MN, Princetown University Press, USA, 1997, p. 240.
[414] **Ooze:** deep-sea sediment of which at least 30 percent is composed of the skeletal remains of microscopic floating organisms. Oozes are basically deposits of soft mud on the ocean floor. They form on areas of the seafloor distant enough from land so that the slow but steady deposition of dead microorganisms from overlying waters is not obscured by sediments washed from the land. The oozes

location of the break because there was no "earth return" to complete the test circuit. Then the less accurate capacitive tests were used.

A submarine telegraph cable behaved electrically like an elongated condenser or Leyden jar; the central copper core was one electrode whilst the other electrode was formed from a combination of the brass tape, the iron or steel wire and the sea water. The dielectric was formed mainly of the gutta percha and to a smaller extent by the pitch and other insulating layers. The earliest test of capacity was by "comparison of swings". Using the simple circuit shown in Figure 7.10, either the cable or a standard condenser were charged from a battery and the number of divisions of the galvanometer scale traversed over a fixed period for each gave the ratio of the capacity of the cable and the standard condenser (see Figure 7.9). If the charging of the cable was very slow, a lot of the charge was lost via the dielectric resistance. Therefore this simple test was only applicable to cables of 200 nautical miles or less.[415]

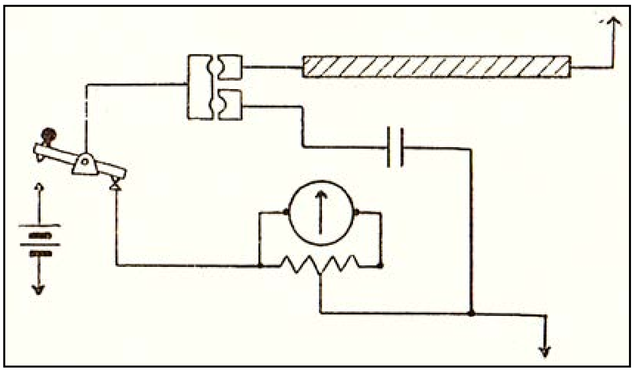


Figure 7.10 Circuit of Thomson's capacity test. The arrow-heads indicate connection to earth. From J. H. Stephens *Telegraph Engineering,* 1925, p. 499.

7.8.3 Bridge or "Null" Tests

The *comparative* test methods could be refined no further to improve the localization of faults or breaks; nor was there a complete understanding of the confounding factors. This situation did not improve further until the Wheatstone bridge was adopted by the submarine telegraph electricians. As just elucidated, the most important electrical measurement required by submarine cable telegraphy electricians was measurement of resistance. Samuel Hunter Christie (1784-1865) developed what he called the "diamond method" in 1833; this was the basis for the Wheatstone bridge. Professor Sir Charles Wheatstone (1802-1875) had many scientific interests including: optics, acoustics and electrical engineering.[416] Although Wheatstone's interest in telegraphy was first kindled by Ronald's demonstration in 1816 he did not become personally involved until he was approached by William Fothergill Cooke in 1837.[417] Between them they developed the five needle telegraph which found first application on the railways. However Wheatstone's name became immortalized by his development of

are subdivided first into calcareous oozes (containing skeletons made of calcium carbonate) and siliceous oozes (containing skeletons made of silica) – from *Encyclopaedia Britannica* 2014.

[415] W. Thomson, On the Measurement of Electrostatic Capacity. *JSTE,* vol 1, 1872, pp. 394-398.

[416] B. Bowers., *Sir Charles Wheatstone FRS 1802-1875,* IEE History of Technology Series 29, IEE, London, 2001.

[417] *Ibid*. p. 118.

his eponymous bridge method of measuring resistance in 1843.[418] The accuracy of the Wheatstone bridge improved markedly when, later in 1843, Joule made a high quality and very sensitive tangent galvanometer. The Wheatstone bridge required a galvanometer with a high degree of sensitivity but did not rely on calibration. Circuit diagrams drawn in the 19th century are not easy to understand as the draughtsmen drew what would now be referred to as "block" or "wiring" diagrams which show components in the positions they would be assembled rather than in such a way that they may be easily understood. The circuit diagram of a Wheatstone bridge is shown below: [419]

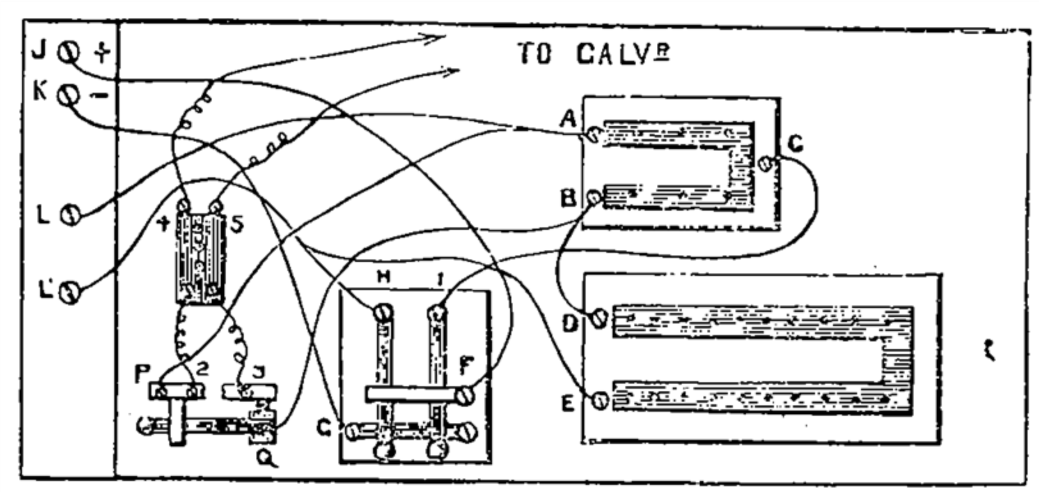


Figure 7.11 Circuit diagram of a Wheatstone bridge from *The Electrician*, 1882 Sept 30th p. 474.

It looked complex even then but neither the galvanometer nor the battery has been included in the drawing. Nor were there standard symbols; in fact some of the symbols used bore little resemblance to actuality; for example, the battery reversal key (H, I, G & F). The "battery reversal key" used in many of the tests was almost identical to the cable key described earlier in this thesis. The only major difference was that each side could be locked in the down position by the small black levers (see Figure 7.12). Both the "*both*-up" and "*both*-down" modes took advantage of the fact there was a complete electrical short circuit which could be used to discharge capacitance without short-circuiting the battery.

[418] Wheatstone's involvement with telegraphy continued with the invention of the 2-needle and single needle telegraphs mainly used on the railways; the ABC telegraph (1840); a printing telegraph (1841) and the most-developed form of the ABC in 1858.
[419] Anon, A guide to practice in the submarine cable testing room – part 2, *The Electrician*, 1882 Sept 30th p. 474.

Figure 7.12 The battery reversal key was very similar to the cable key apart from the two small black levers (one show up and the other locked down) which were used to lock the keys in either position during the duration of a test. (Photo by the author at Porthcurno Telegraph Museum)

A clearer understanding of the Wheatstone bridge will be gained by examining the circuit using modern symbols shown in Figure 7.13a.

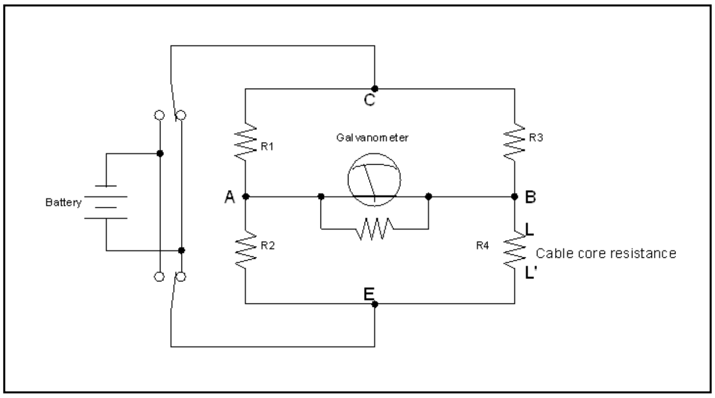
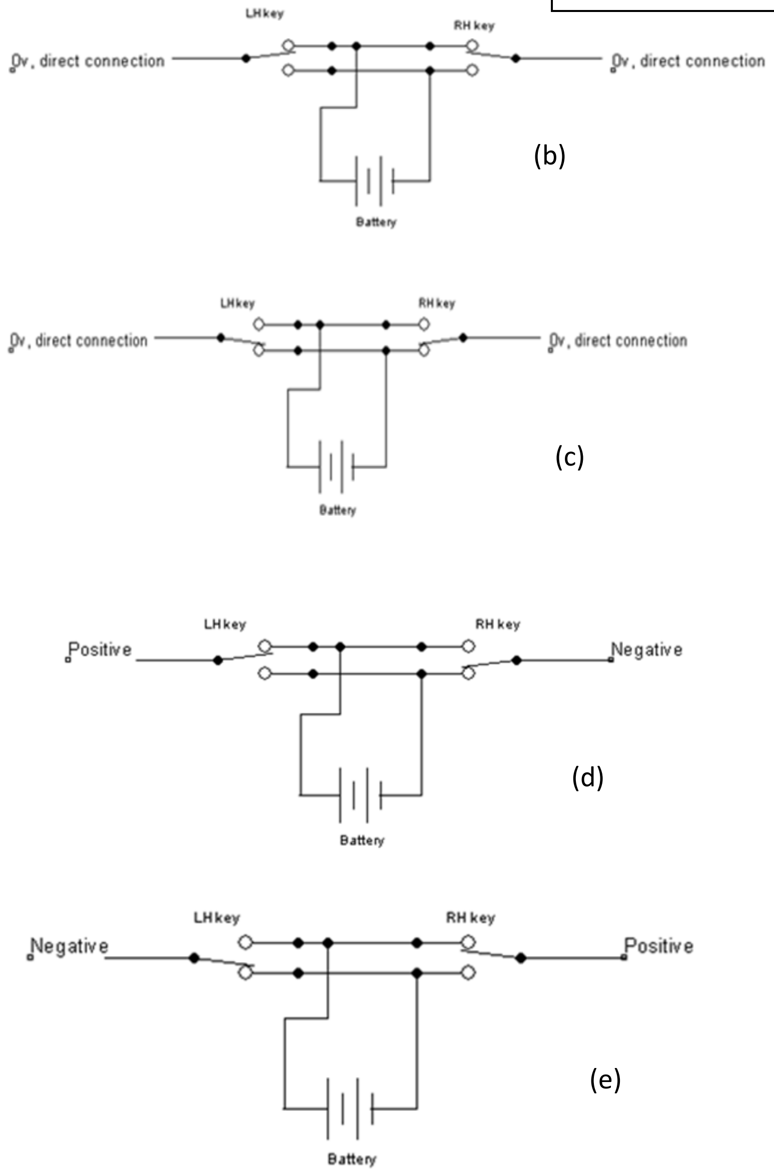


Figure 7.13a   A modern depiction of the Wheatstone Bridge circuit diagram

Figure 7.13 b-e. Battery reversal key



The battery reversal key requires some explanation (see Figure 7.13 b-e). In both (b) and (c) positions of this two-pole biased double-throw switch, the finger knobs are either both in the up position (b) or both held in the down position (c), the battery of cells are out of circuit and replaced by a short circuit which will discharged any stored electric charge in the cable. In diagrams (d) and (e) the battery is applied to the bridge with opposite polarity. The main advantage of the Wheatstone bridge method of measuring resistance was that there was no need for a *calibrated* meter or even a power source of known stable *electromotive force,* (voltage). The only components needing a known stable value were the resistors. The bridge is "balanced" when the potential at "A" is equal to the potential at "B" and this is indicated when no current flows through the galvanometer (indicated by the needle being in the centre or zero position). When it is balanced the ratio of R1 to R2 is equal to the ratio of R3 to R4. If only one of these resistances is "unknown" then its value may be calculated from the other three. The resistances R1, R2 and R3 are made up from standard calibrated resistance boxes. The main disadvantage of the Wheatstone bridge method was the time it took to make the measurement and excessive time may have induced inaccuracy by polarization at the site of the fault. The Wheatstone Bridge was the basis of most of the tests developed to locate faults and breaks in submarine cables.[420] Electricians measured the electrical resistance of submarine cables at each stage of manufacture and laying and they recorded these values on the charts. Once a cable was laid and in use the resistance of the core and the dielectric were measured and recorded regularly as a means of observing the "health" of the cable. When a fault or break occurred the electricians at either end of that cable or section of cable compared the values of resistance on the laying chart with values in its malfunctioning state and thus could locate the fault or break geographically. The main advantage of the bridge method of measuring resistance was that it was not necessary to have a high quality source of electrical power of accurately known potential difference, or to accurately measure electrical current with a calibrated ammeter. Location of faults and breaks in submarine cables were thus *highly* dependent upon there being accurately calibrated resistances available and a universal unit for the measurement of resistance. Because of this the submarine telegraph cable industry exerted pressure for the development of a universal unit of resistance.

The majority of the submarine cable industry settled on the BA Ohm from the 1860s until the end of the gutta percha insulation era. It was necessary to use the same unit of resistance throughout the life of a cable, from manufacture to its final retirement, as the resistance values recorded by the electricians in manufacture and laying were needed for comparison during cable monitoring and repair. Standardization of the unit of measurement was only important within each cable company but the vast majority of the world's cables were laid and maintained by the Telegraph Construction and Maintenance Company and the Eastern group of companies.

7.8.4 The Galvanometer

The principles of galvanometry have been described in an earlier chapter. In the cable industry there were two groups of galvanometer users: the *Operators* who sent and received the communication or telegrams, and the *Electricians* who maintained the system. Telegraphic operators required galvanometers of appropriate sensitivity for the cable in use but the indication of electric current only needed to be qualitative rather than quantitative. The scale therefore did not need to give a linear indication of the strength of current and did not need to be calibrated. The electricians had different requirements; as the necessity of accurate location of faults and breaks became more commercially important, the cruder types of galvanometer had to be replaced by devices of good linearity. High sensitivity was also needed. Mirror galvanometers again fulfilled the requirements but were also designed to have linear scales and dead-beat movements. As Kempe explained in his *Handbook*:

> The needle of an ordinary form of galvanometer when under the influence of a constant current, does not settle down at once to an angle of deflection which it eventually takes up, but oscillates to and fro several times before it finally comes to rest once again; it acts in the same way when the current is taken off and the needle returns to the zero point. These oscillations often cause considerable inconvenience and loss of time in testing and the object of the dead-beat galvanometer is to get rid of these inconvenient movements.[421]

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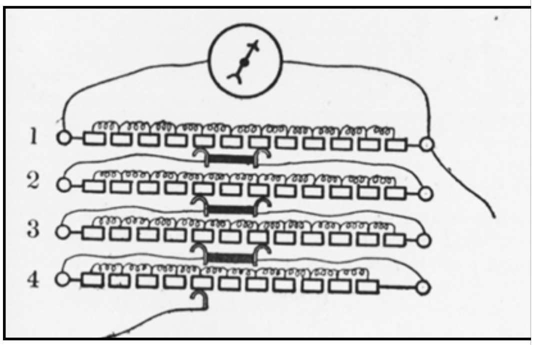
[420] Even up until the 1950s.
[421] Kempe HR, *Handbook of Electrical Testing.* 6th edition. E&FN Spon, London. 1900, p. 65.

The most commonly used galvanometer for test work after 1880 was the Sullivan type shown in the photographs below. Before the Sullivan was available the electricians had to use galvanometers similar to those used by the operators.

Figure 7.14a These photos show a Sullivan galvanometer of the type used from 1880 and still in use at Porthcurno in the 1950s. The small circular mirror is visible at the top of the oblong aluminium coil frame. The light source shown below the scale reflected off the mirror back to the scale. Photographed by the author at the Telegraph Museum, Porthcurno

Figure 7.14b Light source mounted below the scale upon which the “spot” was observed. Photographed by the author at the Telegraph Museum, Porthcurno

The galvanometer was always associated with a variable resistance, known as a shunt, and a normally-closed switch or key. The galvanometers used were necessarily very sensitive and delicate and could easily be permanently damaged by excess current passing through them (See Figure 7.15).



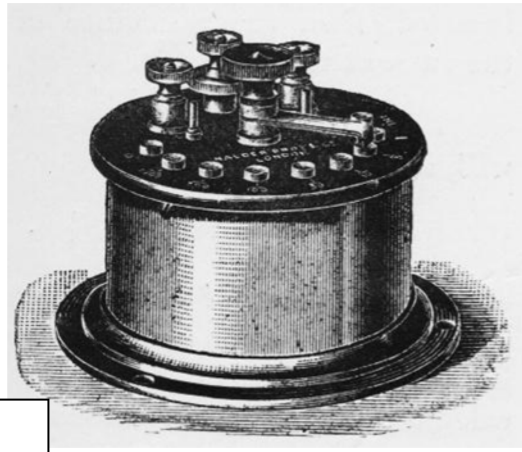


Figure 7.15 Ayrton & Mather's Universal shunt from Kempe HR, *A Handbook of Electrical Testing*, 6e, 1900, Spon Ltd, London. Pp. 91 & 99.

Therefore they were protected by a switch or key which normally provided a short circuit when a reading was not being taken. Also when a circuit was off balance the shunt passed most of the current with the key open making the galvanometer relatively insensitive. As the electrician brought the circuit nearer to balance, the galvanometer was made more sensitive by increasing the resistance of the shunt so that an increasing proportion of the current passed though the meter movement. In March 1884, Ayrton and Mather presented their development of a calibrated variable "universal shunt" the main advantage of which was that the galvanometer always had the same value of shunt resistance across it even though the value of the bypass resistance and hence the sensitivity was variable. H.W. Sullivan developed a version which combined a universal shunt and the calibrated variable resistance to form a complete bridge circuit (Figure 7.16b).

7.8.5 "Resistance boxes" – key to accuracy of location

In the measurement of resistance for malfunction testing on submarine cables, the only calibrated instrument required was the resistance "box".

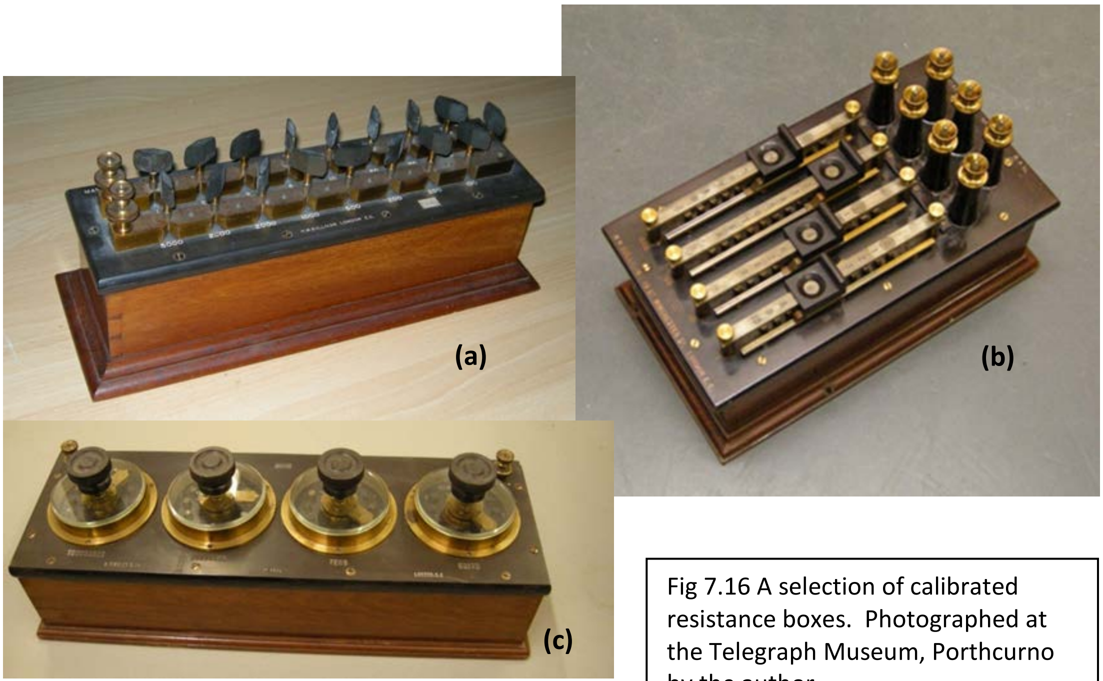


Fig 7.16 A selection of calibrated resistance boxes. Photographed at the Telegraph Museum, Porthcurno by the author

The resistances in the boxes all formed from a series of individual, accurately calibrated, resistors made from resistance wire connected in series.[422] In the earliest boxes (Figure 7.16a) a wooden box supported a brass bar which had been cut into segments. Beneath the bar each segment was connected to the junction between two resistances. Thus electricians placed brass shorting plugs to short out each of the resistance coils. These resistance boxes were carefully calibrated by the manufacturers using standards of the era. This type of box was used for the "fixed" elements of the bridge. Later models used slider contacts to adjust the resistance (Fig 7.16b) or rotary switches (Fig 7.16c). The components described above were the basis of many of the fault location tests used in submarine cable telegraphy, for example Blavier's Test.

[422] Resistance wire was made from alloys chosen for their resistivity and low temperature coefficient.

7.8.6 Blavier's Test

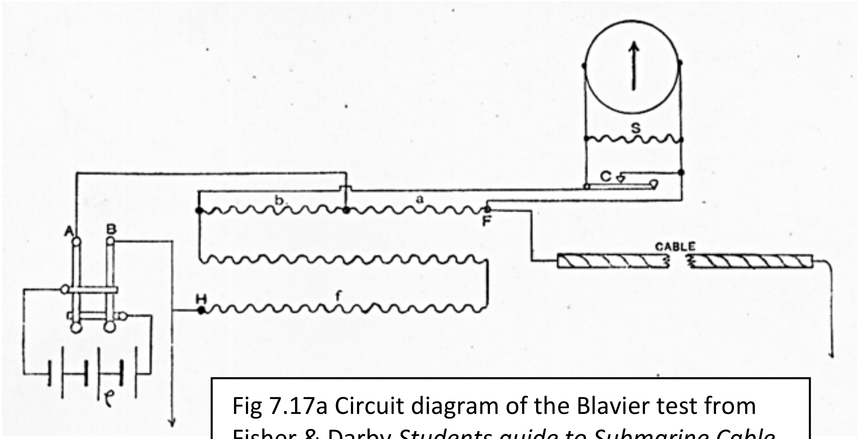


Fig 7.17a Circuit diagram of the Blavier test from Fisher & Darby *Students guide to Submarine Cable Testing,* p. 156.

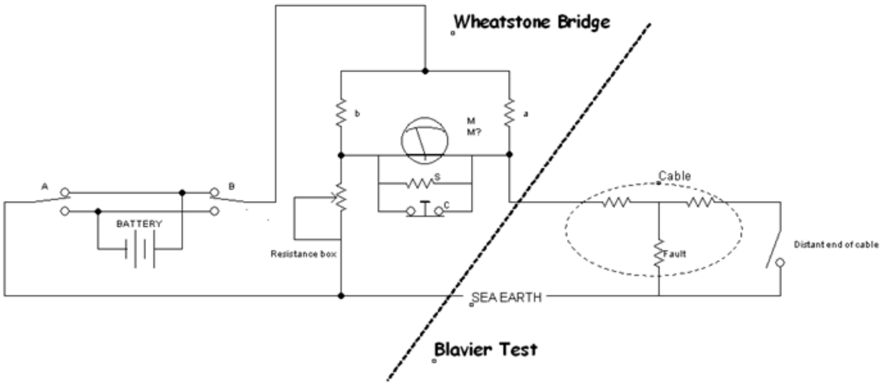


Fig 7.17b Modern depiction of the circuit of Blavier's test to show the application by Blavier to the Wheatstone bridge

Blavier introduced his test around 1857. [423] It required electrical measurements from one end of the faulty cable only. The electrician at the distant end of the cable was required to alternately free and earth his end of the cable at pre-arranged intervals. The electrician at the near end of the cable had to balance the bridge circuit for each of these conditions by varying the resistance box "f". Then the distance to the fault in ohms was calculated by the formula:

$$= E - \sqrt{(L - E)(F - E)}$$

where E = resistance when the distant end is earthed
F = resistance when the distant end is free
L = resistance of the cable when it was new.

[423] Edouard Erneste Blavier 1826-1887 was an inspector and later Inspector-general of telegraph lines for the French government and an author of several books on electricity and telegraphy the most famous being *Cours Théorique et Pratique de Télégraphie* Électrique published in 1857. He was Director of the Superior School of Telegraphy in Paris He developed the test originally for fault finding on land lines but it was soon adapted for submarine cables. See also Kempe HR, *Handbook of Electrical Testing*, 6e, , Spon, London, 1900, p. 269.

The electrician then determined the location of the fault by examining the resistance readings on the original laying chart. As with many other tests, Blavier's was originally developed for land lines but it was adapted by the cable electricians for submarine cable fault location. The problems with the simple Blavier test were inaccuracy because it did not take account of the other variables listed (see Appendix 1) and that it could not be employed when there was a complete break in the core of the cable

C.F. Varley developed several other methods of locating defects in submarine cables by measurement of the copper conductor resistance which he published in 1859. His preferred method used a standard resistance box and a differential galvanometer.[424] The differential galvanometer looked like a centre-zero galvanometer but had two identical electromagnetic coils which were always connected in circuits such that when the current in each coil was equal in strength and opposite in polarity the needle remained at centre-zero. The more the currents differed, the greater the number of degrees the needle was deflected from zero. For his basic test, Varley used one battery of a few cells with one of its poles connected to earth and the other to one end of each of the galvanometer coils. The other end of one coil was connected to the core conductor of the cable under test whilst the opposing end of the other galvanometer coil was connected to earth via a resistance box. The resistance was then varied until the galvanometer indicated identical but opposing currents. The resistance indicated on the resistance box was then equal to the core resistance. If "no resistance coils to hand" Varley crudely estimated the conductor resistance by using an insensitive galvanometer whose resistance was known.[425] Firstly he connected a Daniel cell directly across the galvanometer and noted the deflection. Then he added the cable core in series, using a good earth return connection. He then added more Daniel cells in series until the deflection was the same as without the cable.

7.8.7 Balancing to a "false zero"

One of the commonest ways of cancelling the effects of the unwanted voltages or "earth currents" was by "balancing to a false zero". The "false zero" was the position of the light spot of the galvanometer when the source of electricity (battery) used in the test was disconnected and the galvanometer shorting key was open. Thus any deflection on the galvanometer was caused by the unwanted voltage. This point was marked on the galvanometer scale and used as the zero when the bridge was balanced. The electricians required great skill and experience as the earth current continuously varied, sometimes so rapidly that average values had to be used. When fault locating, the skill required of these electricians was not just technical but an art. None more so than where there were rapidly changing earth currents.[426]

Another skill required of the electricians was that of estimating the temperature of the cable which would not have been constant throughout its length, as the resistivity of the copper conductor varied with temperature. Their calculations also had to take into account the

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[424] C. F. Varley, On some methods adopted for ascertaining the locality and nature of defects in telegraphic conductors. *Trans. Brit. Assoc. for the Adv. of Sc.* 1859, p. 252.
[425] ibid
[426] A. L. Storey, The localization of exposed breaks in submarine cables. *JIEE*, vol 85, No 513, 1939, p. 410.

temperature of the cable at manufacture and storage before laying (usually around 75^{O}F) at which temperature the base resistance of the cable was measured.

7.8.8 The resistance of the copper/brine interface

In 1862 Latimer Clark confronted what had become a well-recognised problem, that of the unknown and varying resistance of the fault itself rather than that of the copper core up to the fault or break.[427] He observed that the resistance of the copper remained constant whatever the number of Daniel cells used in series in testing but that the resistance of the copper to brine interface reduced as the number of cells was increased. However, it also varied dependent upon the area of the copper brine interface.

Lumsden's Test was probably introduced in 1867 and, although a similar test was applied by Clark and Laws in Aden 1862.[428] It was always known as "Lumsden's Test" and was one of the earliest tests developed for the location of breaks in submarine cables.

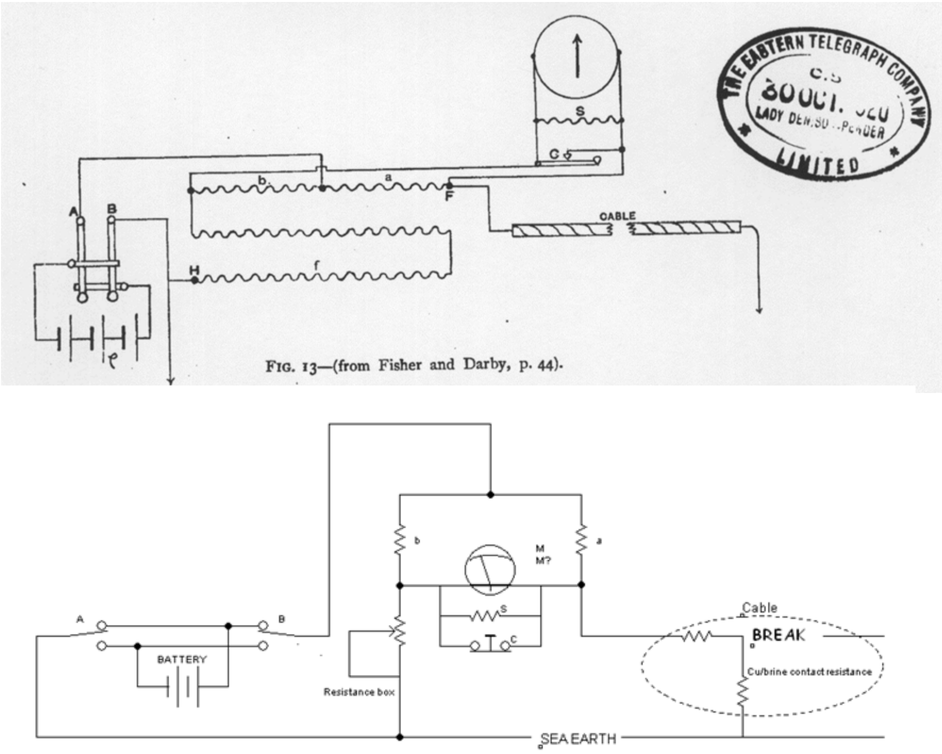

Fig 7.18 Circuit diagram of Lumsden's test

[427] L. Clark, On testing Submarine Cables, *The Electrician*, September 19th, 1862 pp. 230-231 and L. Clark, *An Elementary Treatise on Electrical Measurement: for the use of Telegraph Inspectors and Operators,* E&FN Spon London, 1868, pp. 125-127.

[428] Lumsden's personnel records are not held at Porthcurno as he was employed by the India Rubber, Gutta Percha & Telegraph works Company before it became TCM but records of a Marshall Smith Lumsden (1898 – 1923) and a Douglas Coutts Lumsden born in 1901 were both employees of Eastern Telegraph and were more than likely members of the same family. See also Footnote in JSTE Nov 11th 1874 p399

Lumsden used the Wheatstone bridge to locate complete breaks in submarine cables (Figure 7.18).[429] His technique applied a negative or "zinc" current to the line to "clean" the end of the copper wire at the break by producing hydrogen bubbles thus reducing the copper/brine resistance, followed by the application of a positive current to replace the production of hydrogen by a layer of copper chloride which caused the resistance to rise. This cycle was repeated every 12 to 24 hours for several days. The rise and fall of resistance was followed on the bridge. The nadir in this copper/brine resistance was then taken as the "false zero". Accuracy of the Lumsden test was affected by the area of the copper exposed to the sea water; it was most accurate with a comparatively large area of exposure at the break or fault.[430] Also it was not suitable for testing at sea when a cable was grappled as it required the ship to be stationary for up to 24 hours. Another disadvantage of Lumsden's test was that it indicated the resistance up to the break *plus* the resistance between the exposed copper wire and the brine. This latter resistance varied with the surface area of the copper exposure. Lumsden's test had been handed down verbally and had not been presented by him as a publication or a patent. Sadly Lumsden died in the company's service in 1893, drowning whilst trying to land the shore end of a cable in a storm.[431] Third Officer Combe on *CS Silvertown* gave a very moving account in the ship's journal. [432]

In 1866 Willoughby Smith developed a method for continuously testing an underwater cable as it was being laid. This was an improvement on the usual intermittent testing carried out during laying, which often meant that the laying ship had to backtrack many miles if a fault was detected. For his test circuit, Willoughby Smith needed a semi-conducting material with a high resistance and he selected selenium rods for this purpose. The selenium seemed to do the job properly in the laboratory but, in actual use at sea, the device gave inconsistent results. Upon investigation, it was discovered that the conductivity of the selenium rods decreased significantly when exposed to strong light.

[429] Fisher & Darby *op cit*, p. 44.
[430] Wilkinson *op cit,* p. 421.
[431] "We have had a very sad accident here, we had to wait three days before we attempted to lay the shore end of the Cable on account of very heavy sea and surf: after that we thought it had moderated so lowered four of our best boats; two cutters two surf boats and the Steam launch: we put the lines into these that were to haul off the Cable to shore and put a rocket and line into one of the surf boats so she could let go her anchor and fire the line ashore as it was impossible for any boat to go through the surf then: the steam launch had to keep the cutters well out of the surf while the went further in. One surf boat that had the rocket in was manned with four strong Lowestoft men. Mr. Lumsden the Cable Engineer who was in charge, was just going to fire the rocket when a tremendous swell came along and before they could do anything in the boat caught her stem on tearing the anchor off the ground and turning the boat right over. It was dreadful to see all this, as we could from the ship, the boat floating upside down and two or three men's heads in the very middle of the surf: then another sea came and split the boat completely in halves: then we saw the shore party run into the surf and pick out two of the men and the steam launch let go the cutters after anchoring them safe and went straight to the place: she picked up one more man. But Mr Lumsden and the other poor fellow were never seen again. The sailor was a married man and we collected 350 pounds later on to be sent home to Lowestoft to his family. Poor Mr Lumsden was to be married on our return home. This of course cast a gloom on the ship for some days; we offered a large reward for their bodies, but they were never washed ashore". (Third Officer Combe's Silvertown Journal - 1892/3: Page. 50…" 3rd. Reference to tragedy on May 1st. 1893 http://atlantic-cable.com/Article/Combe/silvertown.htm last accessed 27.1.2011.)
[432] Smith described the "Effect of Light on Selenium during the passage of an Electric Current" in an article that was published in the 20 February 1873 issue of Nature**.** Smith W, The Effect of Light on Selenium During the Passage of an Electric Current". *Nature* vol 7, No 173, 1873, p. 303..

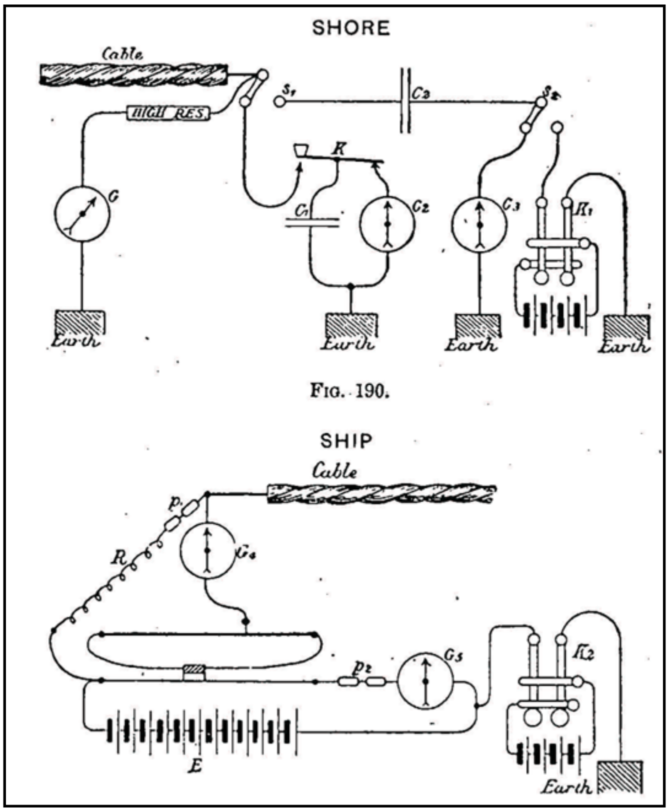

Fig 7.19 Diagram of Willoughby Smith's circuit for continuously monitoring a cable whilst it was being laid from p449 of Kempe's *Handbook of Electrical Testing,* 6th edition published in 1900. His original circuit was still being used in the 1920s.

Continuous monitoring during laying saved many hours, sometimes days retracing the route to locate faults occurring during the laying process.

The application of the Wheatstone bridge to the measurement of capacitance was also beneficial to speed and accuracy either when resistance tests were inappropriate or to confirm a location ascertained by resistance measurement. In 1868 Mr C V de Sautey, the senior electrician at the Trinity Bay Station, developed an alternative bridge method measuring the electrical capacity of a cable as shown in Figure 7.20.

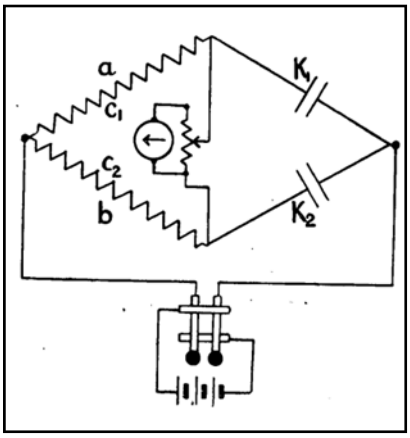

Figure 7.20 De Sauty's bridge method of measuring capacitance: a and b were resistances of about 10,000 ohms each, one being adjustable. K_1 was a standard condenser and K_2 the condenser or cable under test. The variable resistor was adjusted until there was no deflection as the 2 condensers were charged or discharged. At that point the time constant aK_1 was equal to bK_2.

The resistances were adjusted until there was no movement of the galvanometer needle as the condensers were charged and discharged.[433] William Thomson referred to de Sauty's "beautiful method" as being "nearly free" from a number of problems associated with the older non-bridge methods except that of retardation in cables of greater length than 200 miles.[434] However John Gott's bridge method of measuring capacitance became the commonest test for the measurement of capacity (see Figure 7.21).[435] Gott eventually became the chief engineer of the Commercial Cable Company.

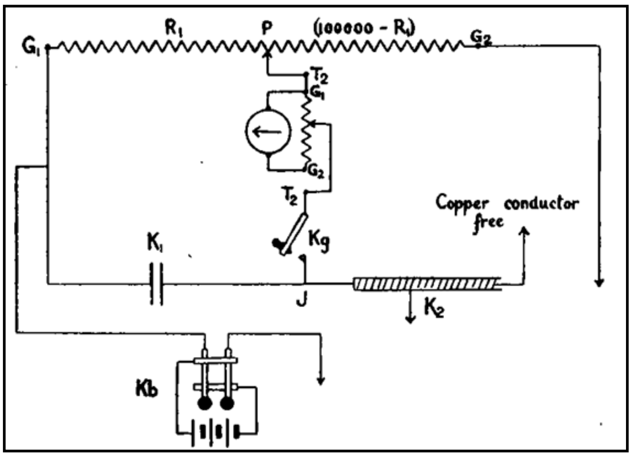

Fig 7.21 Gott's Test. Depression of the battery key charged both the standard condenser K_1 and the cable K_2. The slider was adjusted for balance during the charging period. K_2 was then K_1 times R_1/R_2

On cables of greater than 20 – 50nm it was necessary to compensate for dielectric resistance by first measuring the dielectric resistance and then shunting the standard condenser with a resistance of equal value.

Capacity measurements for the location of breaks were never as accurate as resistive measurements due to a number of factors. The most important factors were the difference between the rates of "absorption" of the cable under test and the balancing or comparison condensers; variation of this rate of absorption with temperature and most importantly the error due to resistive dielectric leakage. Leakage error could be significant on long submarine cables and so affected measurements more than any other cause.[436] The dielectric resistance of the earliest submarine cable was particularly poor.[437]

In the spring of 1873 Fleeming Jenkin, an academic electrician, published a very simple method of measuring dielectric resistance of short lengths of cable using a four-quadrant electrometer. [438] Jenkin had developed this method with William Thomson and he had used it

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[433] L. Clark L, *op cit*,
[434] W. Thomson, On the measurement of electrical capacity, *JSTE*, vol 1, 1873, p. 394-398.
[435] The ability of a condenser (capacitor) to store an electrical charge is often termed its "capacity" whereas the measure of this capacity is "capacitance"
[436] J. E. Young, Capacity measurements of long submarine cables. *Proc IEE*, April 27th, 1899, pp. 475-508.
[437] F. C.Webb. On the insulation of an early cable. *The Electrician*. 13 Nov 1885, p. 13.
[438] F. Jenkin, On a method of testing short lengths of highly insulated wire in submarine cables. *JSTE*, vol 2, 1873, p. 169-180.

on the cables of the Great Western Telegraph Company and the Platino-Braziliera Company. The electrometer is an electrostatic device that indicates a potential difference or voltage whilst drawing no current. Put simply, the electrometer was connected between earth and the copper core which had previously been charged. Thus the electrometer indicated the self-discharge of the dielectric. If the value of the capacitance of the cable was known it was then possible to calculate the dielectric resistance. In the discussion following Jenkin's paper, Cromwell Varley pointed out that he had sold himself short in that this method worked equally well on long lengths of cable. He also pointed out that the electrometer was not so likely to be damaged than the galvanometer by condenser discharges through it. However Latimer Clark pointed out that this method did not become popular because "an electrometer was [very delicate and therefore] not a nice instrument to carry about for use, but the luxury of using it when at hand was very great."[439] Later in the year John Munro described in detail the quadrant electrometer and elucidated further uses of the electrometer in cable telegraphy including continuous assessment of dielectric resistance during manufacture and laying, measurement of the internal resistance of a battery and the measurement of condenser capacitance.[440]

Sir Henry Christopher Mance (1840-1926) spent a lifetime in telegraphy. Although his first contribution to submarine cable telegraphy was in 1871 when he developed "Mance's method" of measuring the internal resistance of batteries- he was already well known as the inventor of the heliograph in 1869.[441] In 1871 he also published a theoretical method of measuring the resistance of a conductor of a telegraph cable when troubled with earth currents[442] – this was seen by the electricians of the time as the Holy Grail. But it was not until 1884 that he published what then became known as "Mance's Method of eliminating the effects of polarization and earth currents from fault tests"[443] – the practical application of his earlier theory. Tests before this time had been able to minimise the effects of polarization and earth currents but, although accurate, were time consuming. Time was not a luxury available on board ship when a bite of cable had been raised and cut in search of the location of a fault in rough seas. As Mance explained:

> To test quietly on shore, where you may be able to 'bide your time and take advantage of any favourable opportunity when the cable happens to be free from earth currents, to try the different methods provided by the text-books, is comparatively a simple matter; but to cut in on a cable, say, between two faults - to be testing with the knowledge that the cable is old and incapable of standing a strain, the ship possibly rolling and the cable staff waiting for orders - is quite another thing. This is the trying time for an electrician. At such times the questions present themselves for immediate answer: Shall I splice up again? Pick up to the east or west? Is the cable broken close to the ship or half a mile distant?

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439 *Ibid* p. 169-180.

440 J. Munro, On the quadrant electrometer, *JSTE,* , vol 2, 1873, pp. 339-367.

441 A. W. Smith, Battery Resistance by Mance's Method. *Science*, New Series, 1905, Oct 6th vol 22, No 562, pp434-439.

442 H. C. Mance, Method of measuring the Resistance of a Conductor or of a Battery, or of a Telegraph-Line influenced by unknown Earth currents, from a single deflection of a galvanometer of unknown resistance. *Proceedings of the Royal Society of London,* Vol. 19 (1870 - 1871), pp. 248-252.

443 H. C. Mance, On a method of measuring the Resistance of a Conductor or of a Battery, or of a Telegraph-Line influenced by unknown Earth currents, from a single deflection of a galvanometer of unknown resistance. *JSTE*, 1884, pp. 329-358.

Must I buoy one side, or can I hold on while I wind in the intermediate bit? As a general rule, the electrician has only the tests from his own side to rely on, and under these circumstances any formula which will strip the tests of the increment due to polarisation current, leaving bare only the actual resistance in the circuit tested, is certain to be found of the greatest service.[444]

The advantage of Mance's method was that it required only two measurements, both with the same polarity but with different values of the proportional (fixed) resistances in the bridge, usually 100 : 100 ohms or 1,000 : 1,000 ohms. The two observations had to be taken as rapidly as possible after one another to eliminate any change in earth current. The test was usually performed when the estimated location of the fault was within 50 nautical miles.

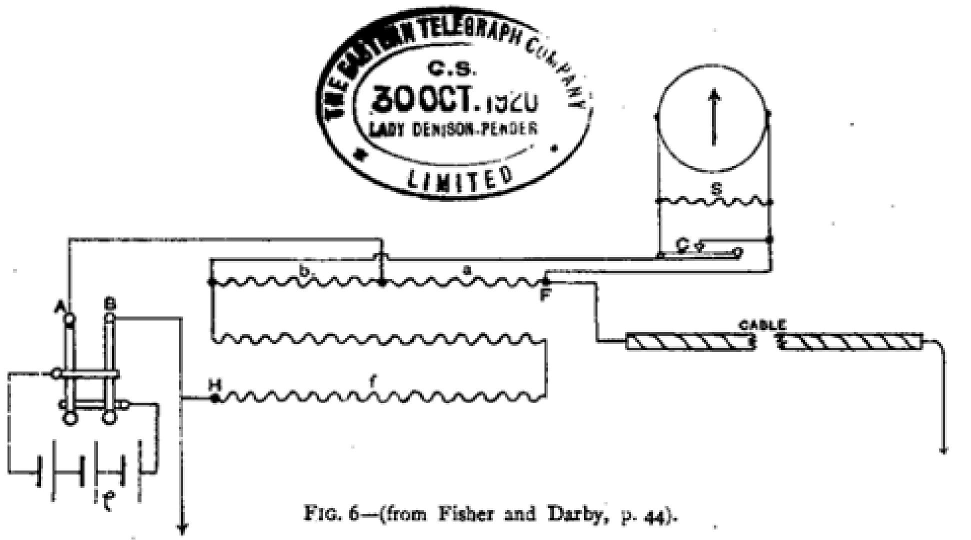

FIG. 6—(from Fisher and Darby, p. 44).

Figure 7.22 The circuit for Mance's test was the same bridge circuit as for Lumsden's test. However Mance found that the effects of earth current were greatly reduced by bringing the bridge to balance firstly with resistances 'a' and 'b' being 100 ohms and then rapidly re-balancing with 'a' and 'b' being 1000 ohms (rapidly to eliminate the effects of earth current changing between readings).

Professor Ayrton commenting on Mance's test stated that…

I certainly had not seen this method of eliminating the effect of an earth current, and must confess my ignorance in that respect. The moment the method is suggested one wonders why one did not see it before, and one is only too glad, for the reputation of telegraph-engineers, to hear that it has been known to Mr. Mance for four years. Hitherto the ordinary way of eliminating the effect of an earth current, or polarisation current, in a submarine cable has been by reversing the testing battery. [445]

Andrew Jamieson, whilst working as an electrician on CS *Norseman* in 1886, found more accuracy of localization using the loop test by exchanging the positions of the galvanometer

[444] *Ibid*, p. 330.

[445] H. C Mance. , Method of measuring the Resistance of a Conductor or of a Battery, or of a Telegraph-Line influenced by unknown Earth currents, from a single deflection of a galvanometer of unknown resistance. *JSTE,* May 1884, p. 354.

and the battery.[446] He stated the great advantage of this method was that the same current passed through the galvanometer as out at the fault. Accuracy was further increased by taking the mean of readings with quick reversals of the battery polarity.

7.8.9 Introduction of the *Calibrated* Milliammeter

One of the biggest problems in acquiring an accurate geographic location of a fault was the necessity of knowing the area of copper exposed to the sea at the site of the fault or break. This of course could not be known until the fault was brought to the surface. Arthur E Kennelly (1861-1939), an Irish American educated in India and London, developed a law which solved this problem, taking advantage of the newly developed *calibrated* milliammeter. During his long and distinguished career in electrical engineering, he worked for ETC as an electrician. Between 1876 and 1887 he developed a number of cable tests, the most important of which were the *Kennelly Two & Three Current tests* aimed to eliminate the resistance of the exposure of the copper to the sea water by the application of Kennelly's Law to the results of bridge balances with two different strengths of current.

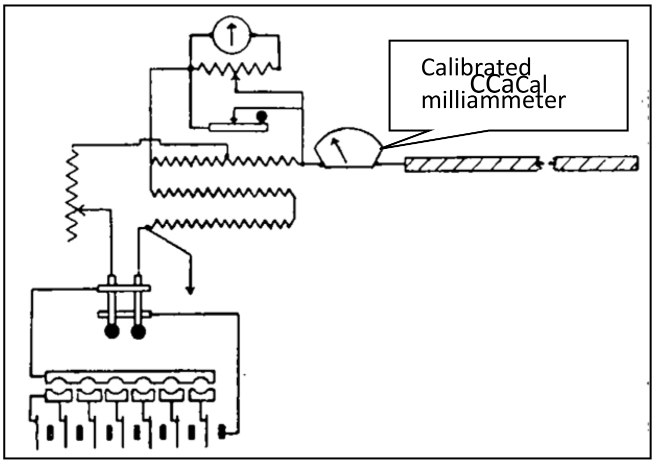

Fig 7.23 The Circuit used by Arthur Kennelly for his 2 and 3 Current tests (from Stephens JH: *Telegraph Cable Engineering,* Eastern & Associated Telegraph Companies, vol 1, 1925, p. 566.

Kennelly's Law stated that *with a constant area of exposure of the copper to the sea water, the resistance of the interface between the copper and the brine varied inversely as the square of the current passing through it.* As can be seen from the circuit diagram in Figure 7.23 a conventional Wheatstone bridge circuit was used but with the possibility of measuring the current in the cable during the test with a calibrated ammeter and a variable source of electromotive force. The calculation of the resistance to the fault was complicated but fortunately the measured values were easily applied to a nomogram which quickly indicated the required value.

Schaefer's Test (1897) was similar to Kennelly's but he positioned the ammeter to indicate battery current rather than the cable current and invoked "Schaefer's Law" which stated that

> when the exposed copper is of constant area the resistance of the end [between the copper and the sea water] varied inversely as the 1.3rd root of the strength of the current through it.[447]

.[446] Jamieson A, A new method of taking the loop test. *JSTE*, 1876, Vol 5, pp252-255.

Why were so many tests developed? Why didn't the development of a new test render previous tests obsolete? The answer lay in the number of variables that occurred which reduced the accuracy of each of the tests, such as: the variable temperature along the length of the cable affecting the resistivity of the copper, the area of the copper exposed to the sea at the site of the break or the depth of the break in sea-bed ooze partially insulating the copper at the break and fault from the sea water. Only the huge experience of the cable electricians gave them a "feel" for the behaviour of a break or fault from the results of three or four different tests, correcting for temperature differences along the length of the submerged cable and the application of sometimes empirical correction formulae (e.g. "Murphy's Correction"[448]) and "laws" (e.g. Schaefer's Law). Accuracy and rapidity of location was always easier when there were no earth currents. Earth currents required the application of false zero balances of bridges and the problems increased with increasing length of cable. Reduced-current zero balances were always easier to carry out than false-zero balances.

All of these tests were carried out on a test bench typical of that shown in Figure 7.24. Careful records of all results were kept on the cable sea-chart and on *splice lists* which were tables relating distances (geographical and cable length), type of cable and electrical properties measured in each direction along the cable. Only the results were recorded but unfortunately for the historian the electrician's calculations and even notes of which particular tests were used were not recorded until the 1890s. However it is apparent that several tests were applied to confirm the location. Updated copies of the charts and splice lists were kept at the stations at the end of each cable and cable section for comparison should further faults occur.

[447] C. W. Schaefer. A new method of localising total breaks in submarine cables. *The Electrician*, 1897, 15th October, pp811-818.
[448] Murphy's Theorem provided a mathematical correction for the error in the measurement of the copper core resistance caused by the shunting effect of the dielectric resistance.

Fig 7.24 These photographs show the test bench at Porthcurno Station. The majority of the parts are from around the 1870s and 1880s but with a Sullivan galvanometer dated 1880 and a 20th century Wheatstone bridge potentiometer in the foreground which replaces the original in the 1950s. Essentially this test board is as it was in the 1880s and was still in use in 1960. (Photograph by the author)

7.9. Other skills of the cable electricians

Although the most important skill of the station cable electrician was to maintain the operation of the cables, he had other specialist functions at the stations. He had to maintain the terminal hardware (the keys, mirror galvanometers and siphon recorders) and the electrical power sources, which were mostly batteries of primary cells or on the largest stations, secondary cells charged from dynamos. He also had to “rebalance” the “artificial cables”. It also fell to his lot, especially on the smaller stations, to maintain other electrical apparatus such as - from around 1900 - electric light.

7.9.1 Terminal equipment

Although the keys used for transmission of messages were very straight forward and usually robust, great manual dexterity and a very steady hand was required to maintain speaking mirror galvanometers and siphon recorders. Damage to these devices by electrical overload usually required a painstaking rebuild. The most likely cause of overload damage was a lightning strike at a cable station or at a cable hut. This was because once a new cable had been installed, electrical shunts connected across galvanometer coils were of fixed values as the current expected along the cable would always have been within a narrow range during operation. Lightning strikes would have sent very high pulses of current through the devices. More often frequent use would wear the support or suspension of the moving parts. Re-suspension required the electricians to have the fine manual dexterity of a watchmaker. The photograph (Figure 7.25) shows a beautifully boxed kit for the repair of galvanometer suspensions.

Fig 7.25 Set of tools and spare parts for the maintenance of galvanometers and siphon recorders. Photo by the author at The Telegraph Museum, Porthcurno

7.9.2 Maintenance of power sources

In the main, the source of electricity for submarine cable telegraphy was batteries of primary cells as previously explained. The care and maintenance of each battery of cells was essential for uninterrupted communication. The electricians had to ensure that the batteries of cells were kept in a cool, well ventilated environment that was easy to keep clean; dirt attracted dampness which made cells discharge more quickly. A constant temperature lessened the risk of contact contamination and corrosion.[449] The biggest maintenance problem with the often open cells was evaporation of the electrolyte and crystallization on the walls of the container. Periodically the electrician had to change the electrolyte as it became exhausted and similarly electrodes were replaced as they were consumed. Regular inspections were carried out daily. In the larger stations towards the turn of the century secondary cells were installed but always with the back-up of banks of primary cells. The electricians daily checked the specific gravity of the electrolyte and topped it up as necessary. It was also the duty of the electrician to maintain the dynamo.

7.9.3 Balancing the artificial cables[450]

As described earlier the artificial cable was composed of a set of resistors and condensers connected in such a way that they exactly corresponded to the electrical properties of the submarine cable they were associated with. There was an artificial cable at each end of each section of every cable. Only if the artificial cable was exactly equivalent to its submarine cable

[449] A. M. Codd, *Practical Primary Cells*, Isaac Pitman, London. 1929, p. 105.

[450] In 1863 Mr Cromwell Varley first suggested what he termed a “test circuit” formed from resistance coils and “inductance plates” to simulate a submarine cable for training purposes. The “inductive plates” were his description of capacitors (condensers). Varley’s “test circuit” soon became known as an “artificial cable”. It was not only used to demonstrate the electrical properties of cable and cable faults but more importantly it became an essential component of duplex telegraphy – the simultaneous transmission of messages in each direction. Anonymous, Test Circuits, *The Electrician,* vol 4, (first series) October 23, 1863, pp289-9.

was it possible to maintain duplex telegraphy (messages in both directions *simultaneously*). It was very difficult to maintain this equality especially at tropical stations. The artificial cables were kept in the most environmentally stable conditions possible given the available technology.[451] It was the electrician's responsibility to check and if necessary adjust the balance of the artificial cables at regular intervals. In temperate climates this was often once or twice a week; at tropical stations rebalancing might be necessary every few hours.

7.10 Conclusions

The development of the tests to locate faults and breaks in submarine telegraph cables was driven by the need for quicker repair of cables to reduce loss of income during episodes of malfunction and also to maintain the reputation of cable telegraphy as a reliable means of rapid communication. This was clearly summarized by J.H. Stephens, the editor of *the* textbook on the subject in 1925 when he worked for the Eastern Telegraph Company:

> It is a matter of the utmost importance that the time during which any cable is interrupted, or impaired in efficiency by a fault, should be reduced to a minimum. A high degree of accuracy is, therefore, required in localisations, and the utmost despatch is called for in effecting repairs. The position of the fault or break is determined as nearly as possible by tests from the shore stations, and further tests are carried out from the ship after the cable has been cut at the estimated position.[452]

New tests were developed as the understanding of the interfering resistances and electric currents improved.[453] However, the development of new tests also depended upon improvements in measurement technology in three main stages: comparatively crude galvanometers as a means of indicating current qualitatively; Wheatstone's bridge and ever increasing quality and ingenuity in the design of galvanometers; the development of *calibrated* milliammeters and volt meters. By 1925 when Stephens' *Textbook* was published, the list of tests shows that the only tests which had failed the test of time since 1850 were those which were not adaptable to the increased precision provided by the use of the Wheatstone bridge.[454]

The only bridge-type tests available in 1883 suitable for the location of the break on the St Vincent – Pernambuco cable were Blavier's test and Lumsden's test. The Varley loop test could not have been used as it required an identical parallel cable; such a cable was laid within a decade. With only Blavier's and Lumsden's tests available and applied from both the St Vincent cable station and the station at Pernambuco the accuracy of location was surprisingly accurate - to within 4 nautical miles. The discrepancy noted in Chapter 6 was due to there being *two* breaks due to a huge volcanic eruption on the sea bed.

Very few new tests were developed between 1900 and 1925. "Correction" formulae were the main additions to the armoury of fault localization tests. I surmise that this technical "stagnation" was due either to a certain lackadaisical state of mind brought on by Eastern Telegraph's near monopoly or due to the technology having reached the limit of its

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[451] The first air conditioning plants became available in the early 1900s.
[452] Stephens *op cit*.
[453] See Appendix 1
[454] Stephens *op cit*, p. 526.

possibilities. The next generation of fault localization had to await the invention of pulse reflection technology.[455]

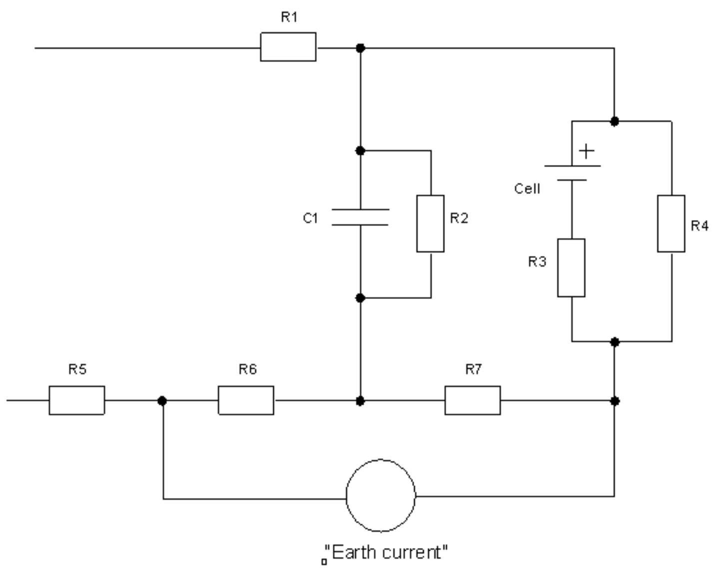
Although the cable charts and splice lists note the electrical resistance of each section of a cable and the resistance value to a fault or break, the engineer's final reports at the end of each laying or repair voyage did not state which tests were used although the fact that several tests were used in a confirmatory manner was stated. The resistance values to the fault/break was what was needed by the marine staff (the captain, navigator and cable engineer) as it was proportional to the length of the cable to the fault/break but which tests were used were kept confidential by the cable electricians, possibly as a commercial secret.

I also conclude that through the period of study (1850-1914) the electricians suffered a progressive loss of professional autonomy. During the “experimental era” (1850-1860) there were far fewer practising submarine telegraph electricians and they had the need to invent and pioneer new techniques in fault location but, as submarine cable telegraphy became a world-wide institution, the number of electricians involved increased dramatically and therefore some standardization in training and management became necessary. This is discussed in Chapter 8.

[455] Localization by pulse reflection technology relied upon the finite velocity of the conduction of electricity in a particular medium. In the case of submarine telegraph cables, a pulse of electricity was transmitted from one end or the other. This pulse was reflected at the break in the cable and detected at the same end as its source. The delay in the returned pulse was proportional to twice the distance to the break.

Appendix

Twenty first century equivalent circuit of a cable break as "seen" from one side of the break.



R1	Resistance of cable core to the break – the resistance required to calculate the location.
R2	Dielectric resistance to the break
R3	"internal" resistance of cell formed by copper/brine/iron
R4	Resistance between the break and Earth return
R5	Resistance of earth return connection
R6&R7	Resistance of Earth return
C1	Capacitance up to the break
Cell	Galvanic cell formed by copper/brine/iron (about 0.3 volts)

8. Maintaining the Maintainers – Recruitment, Training and Health

8.1 Introduction

Over the 54 years following the Inquiry, it became ever more clear that, in addition to the "health" of the cables, the health and preparedness of the cable staff was of equal importance. This was especially the case as the telegraph system became increasingly critical to communication in the growing British Empire. This is in contrast to Hughes' theories about Large Technological Systems (LTS) which major on technology and organization, whereas the *people* involved submarine cable telegraphy were of equal importance. In this chapter, I discuss the selection, training and health of the maintenance electricians, their lives in the UK and as expatriates in far flung cable stations around the globe. Many cable stations were in tropical areas with increased risk of contracting diseases that were uncommon in Western Europe. Like submarine telegraphy, these advances were related to the expanding British Empire and had a great bearing on lives of the operators and electricians. The training and organization of the maintenance staff also fits into my categories; my categorization of the periods of growth in submarine cable telegraphy has already been alluded to earlier in this thesis into the "experimental decade" from 1850 to 1860, the "developmental period" 1860 to the early 1870s and the "reliable communication era" from the early 1870s onwards. The period covered by this thesis was paralleled by enormous advances in the understanding of tropical medicine and health, greater than any period in history.

8.2 The "experimental period"

There is a great deal of information available in the Eastern Telegraph Company's (ETC) archives about the selection and training of the telegraph operating staff but little about that of the cable electricians. The reason for this is that there were many more operators than engineers and electricians. At the beginning of the submarine telegraph era, many of the telegraphers, engineers and electricians came from employment in land-line telegraphy. In the 1850s, the "experimental" period, some famous names were the pioneer electricians and engineers. All were leaders in their fields, pushing technical boundaries beyond comparatively crude land line technology. The list includes Sir Samuel Canning (1823-1908), Sir Charles Tilston Bright (1832–88), William Thomson (later Lord Kelvin) (1824-1907), Josiah Latimer Clark (1822-1899) and Charles Wheatstone (1802-1875).

Formal training, as such, in the skills required for the laying and maintenance of submarine cable systems was just not available to these men and they had to develop the necessary skills from scratch. This was a brand new technology; they learnt as they gained practical experience and developed techniques which would then be used in the future. Many of them have already been mentioned in this thesis. (Biographical details of these pioneers and others important to this thesis are included in Appendix A at the end of this chapter).

There were many possible reasons for such high quality engineers wanting to change from land-line telegraphy to the new and possibly risky submarine technology. They may have been attracted by the prestige of the submarine cable technology as being new and in its early years experimental, offering a new challenge to senior land-line telegraph engineers. The science and instrumentation of inland telegraphs were comparatively crude compared with what was required to receive minute signals which were grossly distorted in submarine cable telegraphy. The submarine telegraph companies competed for the best engineers available; increased salaries were also an attraction. There may also have been a sense that the UK government was considering nationalization of the inland network; this eventually came to fruition with the 1868 Telegraph Act.

With the exponential growth and success in submarine cable technology after the *Joint Committee to Inquire into the Construction of Submarine Telegraph Cables* (discussed in chapter 4) some sort of formalised training for engineers and electricians became necessary so that new and experimental techniques could be adapted for use by the increasing number of electricians with no background in telegraphy.

8.3 After the Committee of Inquiry – The "Developmental Period"

The decade following the Inquiry I term the "Developmental Period". With the growth of the industry following the Inquiry, the exponential increase in submarine cables and the increase in the popularity of this almost instantaneous means of international communication, there was a similar increase in the requirement for operating and maintenance staff. They needed to be trained as soon as possible to an extent that they could carry out their respective professions in cable stations all over the world, some in inhospitable places. The customers of the telegraph operating companies also demanded a high degree of reliability in the cable system. The operators were needed in sufficient numbers to maintain a 24-hour watch system for each cable at the station, with extras to cover contingencies including sickness. As the numbers of staff in tropical stations increased so the companies were forced to provided appropriate healthy working conditions if they were not to suffer from attrition due to diseases not encountered in the UK. This staff requirement continued to increase as the total mileage of submarine cable increased only levelling out as some degree of automation in transmission and reception by the early 1900s.[456]

8.3.1 Recruitment by the printed media

Staff were recruited by advertisements in newspapers and by word of mouth. The educational requirements for operators and electricians were good English and good spelling and an aptitude for the work. No more could be asked for without grossly limiting applications as so few actually knew what an electrician was.[457] Munro's book *The Wire and the Wave* was probably published to encourage more youngsters to consider service in the cable industry.[458] He wrote it in the form of a novel following the life of Charlie Seaforth who was excited by tales he had heard, to become a trainee electrician. The book includes the excitement of the wrecking of a cable ship in a storm and rioting in the West Indies but mentions nothing about the endemic tropical and often untreatable diseases which might worry him (or his parents!). John Munro had a long and distinguished career in submarine cable telegraphy and then in electrical engineering. The first chapters of his book were written to encourage young men to apply whilst not being embarrassed by not even knowing what an electrician was.[459] *The Wire and the Wave* was one of a number of books that he wrote for general readership that were published by the Religious Tract Society.[460] This publishing house was formed in 1799 to promote evangelical Christianity by the production of tracts for free distribution. However they later took on the role of publishing books which were not specifically religious to counterbalance what was seen to be the threat of irreligious "popular science".[461] Although for the first 40 years of its existence all its publications were "theology simply explained" in pamphlet or booklet form the RTS increasingly published scientific books with two objects in mind: to show that there was no conflict between Christianity and Science but also to encourage young men towards good, honest professions. To this end the RTS made use of professing Christian scientists and engineers…

> It is also believed by many that the study of natural science tends to produce an active antagonism, or, at least, a cold indifference towards Christianity. But the

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456 There was however a large reduction in operating staff from the 1920s as full automation in the form of automatic "regeneration" meant the need for operators was drastically reduced but the number of skilled electricians had to increase to maintain the delicate electromagnetic equipment.
457 J. Munro. *The Wire and the Wave.* 1895 The Religious Tract Society, London. Pp15-17.
458 There has been confusion in the past between two "John Munro's" who were both electrical engineers, forthright evangelical Christians and published much. The distinction between JOHN MUNRO and JOHN MACINTOSH MACKAY MUNRO is demonstrated in Appendix B at the end of this chapter.
459 Munro *op cit,* p. 17.
460 *Uses of Electricity* (1889) , *Pioneers of Electricity* (1890), *The Heroes of the Telegraph* (1891) , *The Romance of Electricity* (1893) , *The Wire and the Wave* (1895) .
461 A. Fyfe. *Science and Salvation – Evangelical popular science publishing in Victorian Britain*. University of Chicago Press, 2004, pp.16-59.

> reader will find that these masterminds in one of the most profound lines of research have seen no reason to give up their faith. Faraday and Maxwell, who lived in our own day, were as remarkable for their Christian piety as for a rational insight into the nature of things surpassing that of their contemporaries.[462]

In the middle of the 19th century there was a sudden increase in of publication of books and especially magazines. This was due to several factors including an increase in literacy, a steady increase in leisure time to read, technological developments in printing and the abolition of taxes on paper and rags. The rapid expansion of the railway system also meant that more timely delivery of periodicals was possible.[463] Unfortunately these very reasons also led to the circulation in large numbers of the so-called "penny dreadful" magazines of dubious morality for teenagers. In an attempt to counteract this several publishers were set up to raise the moral tone and to be more attractive to this young audience. The **Society for the Diffusion of Useful Knowledge** (**SDUK**), founded in 1826, and wound up in 1848, was set-up at the instigation of Lord Broughham to counteract the many falsehoods about the sciences in the "penny dreadfulls". The SDUK's most successful series of publications was undoubtedly "The Bridgewater Treatises" and the "Library of Useful Knowledge" on subjects of natural theology and science written by eminent academics of the time.[464] Unlike the RTS and the SPCK, the SDUK was not specifically a Christian publisher. The **Society for Promoting Christian Knowledge** (**SPCK**) is the oldest specifically Anglican missionary organization. It was founded in 1698 the Rev Thomas Bray and a small group of friends. The SPCK was very firmly linked to the Church of England, whereas the RTS was evangelical and interdenominational and all its publications both religious and natural history were aimed at the members of the Anglican Church.[465]

Another popular author, R. M. Ballantyne (1825-1894), but who had no scientific background, wrote in a similar vein to entertain and encourage boys to honourable employment. He wrote over 100 fictional books for youngsters. Of importance to this thesis is his *The Battery and the Boiler* which was published in 1883 which as with Munro's *Wire and the Wave* depicts the story of a young apprentice on the first Great Eastern attempt to lay a transatlantic cable, with remarkable technical accuracy. Ballantyne usually took great pains to research his subject by actually involving himself with the trades of his fictional characters such as deep sea fishing,

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[462] J. Munro. *Pioneers of Electricity – or short lives of the great electricians.* The Religious Tract Society, London. 1890. P. 6.

[463] J. R. Topham, R. Noakes *et al*. *Science in the Nineteenth Century Periodical.* Cambridge University Press, 2004, p.16.

[464] J. R. Topham. Science and popular education in the 1830s: the role of the *Bridgewater Treatises. BJHS,* vol 25**,** 1992, pp.397-430.

[465] Fyfe. *op cit*, p. 29.

life boats, light houses and the fire brigade but this is not noted in the case of submarine telegraphy in his autobiography or biography.[466] Nor did Ballantyne use Munro's *Wire and the Wave* as his author's "research" as that was published a year after Ballentyne's death. According to Quayle, *The Battery and the Boiler* was "churned-out" during a period of personal upheaval.[467] His books were usually published by the family company owned by his uncle.

It is not possible to know the proportion of new trainees or "probationers" were attracted to submarine cable telegraphy by these authors. Also, judging by 20th century practices in the company, word-of-mouth contributed for many applications.

8.4 Training

Some trainees had been land line Morse operators although submarine cable code, which was based on the Morse code, which was very different from that used on land-lines. Training of operators was based in London. With the opening of the Cable Station at Porthcurno in 1870 the trainees spent twelve months at the London headquarters of the operating company followed by six to twelve months at Porthcurno gaining experience until they were deemed good enough to be appointed to the Staff and sent on "Foreign Service".

8.4.1 The Porthcurno Cable Station

John Pender, a Lancashire cotton magnate had formed the Falmouth Gibraltar Malta Telegraph Company, which eventually made connection with India and Australasia, in 1870. He chose Falmouth on the south Cornish coast for his main cable station because it was a major port with good land-line telegraph circuits to London.[468] However, before the first section of cable was laid it was realised that the use of a very busy harbour would have led to regular damage of the submarine cables by ships anchors being dragged in foul weather. He therefore chose to use the quiet Porthcurno cove a few miles west of Falmouth with its gently sloping sandy beach and no shipping activity. Porthcurno station rapidly grew and became the largest cable station in the world and the centre for training of operators and electricians.[469] New probationers arriving at Porthcurno (PK) were encouraged in their quest for excellence by

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[466] R. M. Ballantyne. *Personal Reminiscences in Book Making*. 1893; Quayle E. *Ballantyne the Brave – A Victorian writer and his family*, Rupert Hart-Davis, London, 1967.

[467] Quayle *op cit,* pp. 275-276.

[468] J. E. Packer. Gateway to Empire – Porthcurno Cable Station 1870-1970. in *Semaphores to Shortwaves* edited by J. Fall. 1998, RSA and C&W, London.

[469] At its peak, in the 1940s & 1950s, Porthcurno cable station (PK) had fourteen operating cables. PK finally closed as a telegraph station in 1970 but continued as the main Cable & Wireless training school until 1990. It is now the Porthcurno Telegraph Museum.

the fact that as unskilled beginners they paid for their own keep and earned no wages until their appointment to the Staff.[470]

> Human wastage was rather high and many failed to satisfy or find satisfaction. Early failures [in the 1870s] included a youth with an awful stammer who wished to be a [speaking] “mirror [galvanometer] reader”, several with a propensity to drink, some who could not write decently and one or two who, according to reports, required more earnest energy devoted to a thorough desire to make progress. Others just came, saw and departed.[471]

“A probationer’s experience” was described in detail by one of the same who called himself “Quondam Probationer” in 6th and 13th of March 1880 editions of *The Electrician.*[472] His articles present a picture of the life and the syllabus of training at Porthcurno. The articles were written following a letter from “WHA” in the same journal two weeks before.[473] This letter described the syllabus and the academic background expected of applicants. The anonymity used leads me to consider whether they were probationers or actually members of the ETC staff there.

The training of the operators also included basic maintenance of keys, batteries, speaking mirror galvanometer and the siphon recorder. However, every station also needed skilled electricians to maintain not only the telegraph equipment and lines/cables but also the electric lighting (where available), the generating equipment and batteries. In tropical countries the electricians were also often required to maintain the station food refrigerators. Large and busy stations had at least two electricians one of which would be an apprentice. However, smaller stations often had only one electrician who had to be self-sufficient in maintenance skills of everything electrical, not just the telegraphic equipment. A routine task for station electricians was keeping the “balance” of the artificial cables. As described earlier (chapter 5), to use a telegraph cable in both directions simultaneously required extra circuitry which included a network of resistors and condensers arranged so that they exactly simulated the electrical properties of the cable that was being “duplexed”. The properties of a cable varied with the temperature of the surrounding seawater which may change with time of day and season, more markedly in tropical waters.[474] The frequency of rebalancing depended upon the

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[470] D. Cleaver, *History of Porthcurno* 1953, (re-edited by J. E. Packer 1988) Porthcurno Telegraph Museum p. 7.
[471] ibid
[472] “Quondam Probationer”, A Probationer’s Experience. *The Electrician,* March 6th 1880, pp. 187-8 and March 13th pp203-4
[473] “WHA”. The school of telegraphy at the Eastern Telegraph Company’s station, Porthcurnow, Penzance. *The Electrician.* February 14th 1880*.*
[474] L. Clark. *An Elementary Treatise on Electrical Measurement: for the use of telegraph inspectors and operators.* E&FN Spon, London, 1868, pp67-69.

length of the cable to which matched the artificial cable (the longer, the more frequent) and the climate and weather at the station. The electricians only needed to rebalance short cables on a weekly basis whereas an artificial cable at a station in a hot and humid climate often had to be rebalanced several times per day. Electricians were also needed in the cable factories and on cable laying and repair ships. In the cable factories, at each stage of the manufacturing process, which was continuous, they monitored the electrical properties of the core and insulation. This was to save the expense of trying to locate manufacturing faults in lengths of finished cable which might be many miles long. Similarly the electricians on board the ships laying cables maintained a continuous testing regime to detect immediately a fault occurred during the storage or laying process.

A summary of what was basically an apprenticeship scheme in the mid Victorian era is found in Munro's novel *"The Wire and the Wave"* already mentioned. This book is the only reliable source about the training of the telegraph electricians and may be assumed to be accurate despite being fictional, as it was written in the main to promote an increase in applicants for training as electricians. Although applicants were attracted by newspaper adverts, those who were successful were expected to have an aptitude for mathematics and an interest in things scientific. In the 1870s and 1880s advertisements placed for trainee cable telegraph operators were fruitful as land-line telegraphy was well known by the educated populous. But it was more of a problem when advertising for trainee cable electricians as very few suitable applicants knew what an *electrician* was. Especially with regard to the electricians, The Eastern Telegraph Company had a policy of preferentially employing family members of their existing staff.[475] As the telegraph system expanded worldwide and became more complex technically, more formalised training especially as regards to electrical theory became necessary. The training in the 1870s for electricians in the Eastern Telegraph Group was mainly in-house and this was becoming inadequate.

8.4.2 More formalized training

The *Journal of the Society of Telegraph Engineers* published a paper in 1872 which William Preece had given as a lecture to "the Telegraphic Staff", trying to encourage attention to a

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[475] This continued well into the 20th century and the Cable & Wireless era. Personal communication with John Nash, 85, a retired telegraph electrician as was his father. ETC often had more knowledge about employees families because so many of their staff were sent abroad than other employers.

scientific education for those involved in the telegraph.[476] Who these "telegraphic staff" were is not stated but most likely to be engineering staff of the Post Office. He pointed out the advantages of understanding the theoretical background as being "a pleasure…..which sharpens the mind……Knowledge is power" and that it would increase an individual's professional standing and earning power. He also said that the basis of the technical education should be "investigation by lectures and reading followed by practical testing of newfound knowledge in a laboratory". This was just after the end of the first Industrial Revolution (1780-1850). There also seemed to be an avoidance of the warnings given by a succession of royal commissions, reports and influential individuals.[477] Preece was obviously trying to re-vitalize technical education in Great Britain as it had had fallen behind that of other parts of Europe 1840s and 1850s as was reported by Fleeming Jenkin and other worthies at the Paris Exposition of 1867.[478] However, Gooday points out that that not only were there vested interests in publicising this point of view but the French made sure that they had much larger exhibits than the British just as the reverse had occurred at the Great Exhibition of 1851 in London.[479]

There was unanimity amongst Commissions of the Society of Arts, Royal Commissions, House of Commons Inquires, Chambers of Commerce Commissions and trades unions inquiries that something had to be done but there was much argument as to whether apprenticeships alone were suitable or whether practical "craft" training should be supplemented with college-based theoretical education. Balanced against the college based training it was pointed out that advances in submarine cable telegraphy had been made in the testing rooms of the cable companies as well as in the ivory towers of universities. Theory was initially taught at the London headquarters of the ETC and from 1880 by day-release and evening classes at Finsbury Technical College where William Ayrton was made Professor of Physics and later Professor of Electrical Engineering.[480] Ayrton was just the man to argue for the correct balance between an

[476] W. H. Preece, On the advantages of a scientific education – a lecture addressed to the telegraphic staff. *JSTE* Vol 1, 1872-1873, pp.266-276.
[477] Evans R. *Technical Education Matters*
www.technicaleducationmatters.org/publications/shorthistory/chapter1 last accessed 10.12.2013
[478] F. Jenkin. Pamphlet published in 1868 (JSTOR 60246172)
[479] J. G. N. Gooday. 'Lies, Damned Lies and Declinism: Lyon Playfair, the Paris 1867 Exhibition and the Contested Rhetorics of Scientific Education and Industrial Performance', *in The Golden Age: Essays in British Social and Economic History, 1850-70,* ed. by I. Inkster,: Ashgate, Aldershot, 2000, pp.105-120.
[480] Finsbury Technical College was set up by The City & Guilds of London Institute. The City of London Livery Companies were the original trade and craft associations which were common all over Europe but the City of London had a high concentration of them. They made themselves responsible for standards and organizing apprenticeships in their own disciplines. In 1878 seeing the mess that technical education was in, the Livery Companies together formed the City & Guilds of London Institute. The City Livery Companies still exist today though almost exclusively a purely ceremonial but also carry out

old fashioned apprenticeship and the learning of the theoretical basis behind the technology. He had originally trained at University College, London and then after post-graduate training with the Telegraph Construction & Maintenance Company had gone to India to work on the Imperial telegraph organization and developed fault location methods under C. L. Schwendler, the most senior telegraph electrician in India. He returned to England in 1872 and worked with William Thomson and Fleeming Jenkin. In 1873 he took a chair of Natural Philosophy & Telegraphy in Japan. There he had to create from scratch training methods both theoretical and practical. He returned to the UK in 1879. Thus he was the perfect candidate to lead training of telegraph electricians in Britain. His arguments not only persuaded the telegraph companies of the need for training in theory but also in practice in the teaching laboratory he set up to supplement the practical training provided by apprenticeships.[481]

Because of the newness of the technology involved much of the learning was acquiring tacit knowledge, not just from book-learning.[482] Ayrton & Perry pointed out the absolute necessity for theory *and practical experimentation,* both at school and during apprenticeship.[483] This tacit knowledge, rather than just studying books, was no more important than when testing for cable faults and interruptions. As related in the previous chapter no single test was available for their location as all tests included unknown disturbing factors. It was only by acquiring the tacit knowledge by working with an experienced electrician that these skills of combining results of a number of tests to increase the accuracy of location could be acquired.

Students who progressed successfully, spent time as apprentices in the test rooms at the Telegraph Construction and Maintenance Company factory. They were then attached to cable ships and the larger stations around the globe to continue their training under the company's most experienced electricians. These were exciting times for new young electricians in training as the technology which was new and experimental in the 1850s and 1860s was growing in complexity very rapidly not only for the trainees but also for their mentors. This can be seen not only from the progression in editions of textbooks but also in electrical periodicals. A table

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charitable works and provide those electable for the Court of Common Council of the Lord Mayor of London. The author is a Liveryman of the Worshipful Company of Loriners, by patrimony.
The City & Guilds of London Institute is still a leader in technical education today.

[481] G. J. N. Gooday, Teaching Telegraphy and Electrotechnics in the Physics Laboratory – Willian Aryton and the Creation of an Academic Space for Electrical Engineering in Britain 1873-1884. *History of Technology.* vol 13, 1991, pp. 73-111.

[482] *Tacit Knowledge* is knowledge or skills collected mainly from experience which could not be acquired from books and not captured by language or mathematics, for example, riding a bicycle . Originally defined by Michael Polyani. See Polyani M. *Personal Knowledge: Towards a Post-Critical Philosophy.* Routledge, London, 1958.

[483] W. E. Ayrton, J. Perry, Some Remarks on the Technical Education of an Electrical Engineer. *JSTE*, vol 11, 1883, p. 389.

of textbooks available during the period of this thesis is shown in chapter 7. Of these, only two were directly targeted for trainees with Kempe kept for reference (Table 8.1).

Authors/Editions		**1e**	**2e**	**3e**	**4e**	**5e**	**6e**	**7e**
H. R. Kempe	*Handbook of Electrical Testing*	1876	1881	1884	1887	1892	1900	1907
H. K. C. Fisher, J. C. H. Darby	*Student's Guide to Submarine Cable Testing*	??	??	1903	1908	1920		
G. M. Baines	*Beginner's Manual of Submarine Cable Testing and Working*	??	1904	??	1921			

Table 8.1 Textbooks for student cable electricians

There was no specific publication on the work of the Cable Testing Rooms at the cable factories until 1882-1883 when a series of 23 weekly articles by F S Beechey, entitled “A Guide to Practice in the Submarine Cable Testing Room” appeared in the *Electrician* the first printed in the edition of September 23rd 1882 and the last on May 12th 1883. Another serialized course aimed at trainees at cable stations was published in a short running periodical *Monthly Correspondent* which was originally published by the Brazillian Submarine Telegraph Company for its staff at Madeira, St Vincent and Pernambuco. However, its circulation soon became worldwide but closed after 49 editions at the end of 1887. The series of articles began in its second edition in January 1884, entitled “Technical (Dialogue)” and was in the main a dialogue between an apprentice and his trainer at a far-flung cable station. In 1895, *The Telegraphists' Guide to the New Examinations* by James Bell AIEE, “Certificated teacher, City & Guilds of London Institute” was published and ran to 5 editions. It was a 100-page book of worked examples from exam papers as a revision tool, a new concept in electrical publications.[484]

As the requirement for staff continued to increase so the size of the Porthcurno school followed suit with increasing number of fit young men passing through. There was little for these probationers to do when not studying in such an out of the way part of Cornwall and there were problems with their behaviour with “crude horse-play and ragging” which soon affected relationships with the local villagers especially when one night the head-stones in the local grave yard were interchanged![485] Mr W H Ash was appointed Superintendent at PK in 1877 to improve the situation, with some success. Cleaver states that “in the eyes of the

[484] The preface states that it is a “reprint of a series of articles which appeared in the columns of “ELECTRICITY”. It was published by “ELECTRICITY”, 29 Ludgate Hill, London EC.
[485] Cleaver, *op cit,* p. 10.

youngsters the “old man” was powerful and generally believed to be merciless towards wrong doers”. He created new laws and even insisted upon church attendance on Sundays. Church attendance and also individual beer consumption were reported to Head Office on a monthly basis. On completion of their training, the electricians were a very valuable commodity to the company.

Once fully trained and indoctrinated into the company’s policies, operators were then dispersed around the world to the company’s cable stations. The electricians who would have spent a variable amount of time at PK were then allotted to gain further practical knowledge on cable ships at foreign stations and in the cable factories. For most newly qualified probationers, these foreign placements were the first time that they had left the UK. Although many of their first postings were to temperate climates such as Carcavellos (near Lisbon), Vigo (Spain), Gibraltar and Malta, it was not long before they were sent to warmer less well developed climbs.

According to Munro there was always excitement at the end of the probationary period – the excitement of qualifying and the preparation for a whole new life style at work and ‘play’ in strange new surroundings and climate. Although the electricians were paid throughout their apprenticeship, the new operator also had the excitement of at last receiving a salary.
Company policy was always to use expatriate “company men” wherever possible. The main reason for this was that there were far fewer errors made in transcription as English was the *lingua franca* of the majority of the telegrams conveyed by the Eastern Telegraph Group. Further, expatriates were more likely to perform with loyalty and due discretion to their country and to prioritize British communications. The high tariffs charged by the operating companies lead to more and more use of codes, for economy rather than secrecy (books of the codes were published). The codes used a combination of letters as a single “word” to replace phrases of up to 5 words. The operating companies would have liked every message to be in plain language to keep the charges high but had to give in to mounting complaints from users. The operating companies especially liked the verbosity of the diplomats. The operators were extremely skilful in transmitting and receiving coded messages which were of course much more difficult than dealing with messages *en clair.* To keep the operators on their toes they were fined per error. However, to keep the operators and electricians working efficiently it was necessary to maintain their health and well-being wherever they were working.

8.5 Health & Hygiene

Before considering the effects of living and working abroad one must consider the state of health, hygiene and medicine in Britain during the period under consideration. Infectious diseases were the greatest killer of the time. Outbreaks of infectious diseases were frequent and spread rapidly due to the increasing number of the population moving from the countryside to overcrowded towns and cities. Infectious diseases increased due to the poor hygiene and increasing pollution as industrialization drew the population from the countryside to densely overcrowded conurbations. Drugs and treatments in the early Victorian era were often ineffective or even dangerous with little scientific evidence of their efficacy. The risks of infectious disease were certainly less in Cornwall but when the probationers were sent abroad to tropical areas they met with diseases for which they had little or no immunity and about which there was poor understanding in the earlier years of submarine cable telegraphy,.

8.5.1 Morbidity & mortality caused by infection

Although the range of ailments was of course similar to today, the greatest killer was infection. The mortality due to infectious disease in England and Wales from the Annual Reports of the Office of National Statistics for 1840 – 1910 are shown in the Table 8.2.[486]

Adult Deaths attributable to Infectious Diseases in England & Wales								
	1840	***1850***	***1860***	***1870***	***1880***	***1890***	***1900***	***1910***
Smallpox	**10,786**	**4,753**	**2,882**	**2,857**	**651**	**16**	**85**	**19**
Typhus				**3,520**	**611**	**151**	**29**	**5**
Typhoid	**19,040**	**15,435**	**14,084**	**9,185**	**7,160**	**5,146**	**5,591**	**1,889**
Scarlet fever	**21,377**	**14,756**	**10,578**	**34,628**	**18,703**	**6,974**	**3,844**	**2,370**
Whooping cough	**6,352**	**8,285**	**8,956**	**12,528**	**14,103**	**13,756**	**11,467**	**8,797**
Measles	**9,566**	**7,332**	**9,805**	**7,986**	**13,690**	**12,614**	**12,710**	**8,302**
Pneumonia	**19,083**	**21,138**	**26,586**	**25,147**	**27,099**	**40,373**	**44,300**	**39,760**
Tuberculosis	**63,870**	**50,202**	**55,345**	**57,973**	**51,711**	**48,366**	**42,987**	**36,334**

Table 8.2 Deaths due to infectious diseases in England and Wales

The data shows a steady decline in most infectious disease mortality during the Victorian period in the England and Wales, except that of pneumonia and tuberculosis (TB) which increased; TB increased with overcrowding and chest diseases because of industrial pollution.

The infrastructure in terms of water supply, sewerage and housing, of the new large conurbations, was not able to support the move of the population, from countryside, to large

[486] S. Halliday. *The Great Filth – The War against Disease in Victorian England*, Sutton Publishing, Stroud, UK, 2007, p. 58.

towns and cities because of industrialization. The stimuli towards rapid progress in public health in the latter part of the 19th century were the rapid growth of conurbations which increased the risk of infectious disease transfer and advances in scientific methodology. The figures in the table above do not include other serious killer infections of the time, namely diphtheria, and the enteric diseases dysentery and cholera, as although they were devastating and dramatic they occurred as short epidemics in geographically limited locations. It is not common knowledge that Malaria was also endemic in certain specific geographical locations in the UK (see figure 8.1).

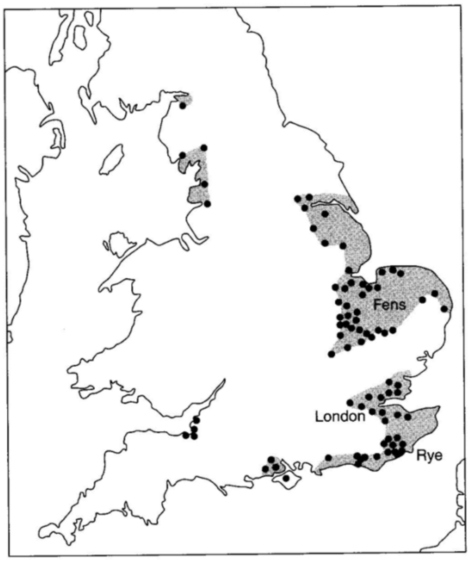

Fig 8.1 Geographical distribution of Malaria in England and Wales in the 1860s. M. J. From Dobson, *Contours of Death and Disease in early modern England*, Cambridge University Press, 1977 p. 348.

Even before there was an understanding of the mechanism of these infectious diseases, it was apparent that there must be rapid improvements in the water supply and in sewerage to stem the enteric diseases especially.[487] During the early 19th century, the River Thames was no more than an open sewer with all waste, liquid or semi-liquid draining or discharged into it. Unfortunately the main source of water for drinking and cooking in conurbations was the Thames or other similar river. The Great Stink of London during a particularly hot summer in 1858 concentrated minds in government especially as the Houses of Parliament adjoined the River Thames at Westminster.[488] The Metropolitan Board of Works which had been set up in 1855 proposed a new sewer system designed by its chief engineer, Joseph Bazalgette, in 1859. Bazalgette's plan was to enclose all sewerage channels in underground, brick built, "pipes" finally discharging the raw sewerage into the Thames again but much further downstream. Fortunately he had the foresight to design these "sewers" to cope with an annually increasing volume sufficient to cope with London to the late 20th century. An unforeseen consequence of

[487] Enteric diseases are often referred to as "oro/faecal" as they are transmitted via sewerage to the next recipient by the mouth.
[488] S. Halliday. *The Great Stink of London – Sir Joseph Bazalgette and the Cleansing of the Victorian Metrololis.* The History Press, Stroud, Glos, UK 2009.

Bazalgette's sewer system was less pollution of ground water from which London obtained much of its "fresh" water supply. Bazalgette's ideas were rapidly taken up by other towns and cities in Britain. The Metropolis Water Act of 1852 already insisted that water supplied by Water Companies had to supply "pure and wholesome water" in that it forbad the extraction of water from the tidal reaches of the Thames and by 1855 all such water had to be "effectually filtered". Filtration of water for domestic use had been taking place either industrially or domestically since the early 19th century (see figure 8.2).

Victorian filter jars with brass and 'stone' taps. Top: Inscribed '3' to denote a capacity of 3 gallons (13.6 litres). Middle left: 'Lipscombe and Co. Patentees, 233, The Strand, Temple Bar, London'. This jar shows grape vines to signify purity and the Royal Arms, suggesting patronage. Middle right: 'Black and Brownlow, Canning Court, Manchester, Established 1830'. Bottom: Inscribed 'Etherium Drinking Water' with '2' impressed denoting a capacity of 2 gallons (9.1 litres). Regardless of the inscriptions for London or Manchester, most of the jars were custom-made in Chesterfield, Derbyshire.

Fig 8.2 Domestic water filter jars. From P. Naylor, *Water Supply*. Shire Publications, Buckinghamshire, 2005, p. 25.

The Eastern Telegraph Company was attentive to what was going on in London to the extent that the principles were used on a small scale at its cable stations at home and abroad which were of course all in coastal situations. A cynical view is that it was necessary to maintain the health of its staff at home and abroad in order to get the best out of them - in other words it was profit driven.

The health of the young probationer operators and electricians was likely to be have been better than the national average because, they were selected as young and fit and after their initial training in the metropolis they were dispatched to Cornwall for further training at

Porthcurno and then to often far-flung places abroad at cable stations which were near the coast rather than deep in overcrowded cities. However, when these expatriates lived in tropical regions they also became at risk of ailments specific the environment they then found themselves in as well as those found in the UK.

8.5.2 Living and working in the Tropics

> Although Sierra Leone is called the White Man's Grave there is not much difference between that place and nearly all the others down to a long way south of the Equator as regards fever dysentery, heat, insects and black men.
>
> Anon[489]

> It is a general opinion among philosophers that the constitution of man is better adapted to bear those changes of temperature and other circumstances experienced in migrating from a northern to a tropical region and vice versa than that of any other animal.
>
> James Ranald Martin (1856)[490]

There was little preparation for the newly qualified probationers living abroad except by word of mouth from returning expatriates in the first few decades. However, by the time the training had become more formalized at PK in the late 1800s, so was the preparation of the probationers. This was helped by such publications as *West African Hygiene or Hints on the preservation of Health and the Treatment of Tropical Diseases* which was written for the layman in 1882 and ran to three editions.[491]

Newly trained operators and apprentice electricians were dispatched abroad to cable stations as soon as it was considered that they be able to make a useful contribution to the company's service. In almost all cases this would have been their first ever trip abroad. They not only had to be professionally adept but also had to cope with a new way of life, often with a limited circle of compatriots who would have been mainly those with whom they worked at that particular cable station. Those who were sent to hotter climates than the UK also had to cope with a radically new environment of higher temperatures, higher humidity, local diets and tropical diseases to which they were not immune. There were also the added temptations of

[489] Anonymous. The White man's grave – Scenes on the West coast of Africa. *The New Penny Magazine*. 28th Jan 1899. Source: Foreign & Commonwealth Office Collection (1899) held at The John Rylands University Library, Manchester. [JSTOR Stable 60232436] I doubt that the F&CO would approve of such words today.

[490] J. R. Martin, *The Influence of Tropical Climates on European Constitutions.* 1856, John Churchill, London, p86

[491] C. S. Grant . *West African Hygiene or Hints on the preservation of Health and the Treatment of Tropical Diseases*. Edward Standford, London. 1882, 1884, 1887. Chapter 1 of each edition concerns "general health" contains a paragraph entitles "Morals": "Great *moderation* in the indulgence of sexual passion is advisable"!

the looser regimes away from the training school at PK: alcohol, tobacco and the local "flesh pots". An interesting feature during this period, 1850-1914, was that it was also an era of great advances in tropical medicine and the understanding of infection in general.[492]

By 1850, the morbidity and mortality of white Caucasians had already been improved by the physicians of the Army and the Colonial Service. Martin describes how in the decades before 1850, physicians described the effects of hot climates on the human frame through: Perspiration, Sympathy of the skin with internal organs, Influence of tropical heat on the biliary function and *Lichen tropicus* or "prickly heat".[493]

The factors that lead to what John Farley has termed a "declaration of war on tropical diseases" after 1850 were the emergence of the *germ theory* of disease (see below) and British expansion into new tropical territories.[494] Farley also coined the term Imperial Tropical Medicine (ITM). This British attack against tropical diseases was largely motivated by the desire to protect the health of British colonial officials and British military personnel working in tropical climates.[495] Farley characterized ITM as a "triad of definition, imposition and non-involvement" where problems and solutions were "defined and imposed by practitioners of Western style medicine without involving the indigenous populations".[496] There is no doubt that ITM was one of the most powerful "tools of empire" in the battle for colonial rule.[497] Headrick in his book *The Tools of Empire* also notes the importance of ITM in British Imperialism.[498] ITM was not only of great benefit to military personnel, expatriate governors and administrators of the empire but vital to those maintaining communications with Great Britain. However, as Stacy May, an economist, pointed out it must be remembered that many of the so-called tropical diseases were not inherently confined to the tropics but had by then been banished from more temperate regions of the world.[499]

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[492] D. Arnold, *Warm Climates and Western Medicine – The emergence of Tropical Medicine 1500-1900.* The Welcome History of medicine Series, Rodopi, Amsterdam, 1996. Worboys M, 2000, *Spreading Germs – Disease Theories and Medical Practice in Britain 1865-1900*. Cambridge History of Medicine Series, Cambridge University Press, 2000.

[493] J. R. Martin, *The Influence of Tropical Climates on European Constitutions.* John Churchill, London, 1856, pp. 88-98.

[494] J. Farley. *Bilharzia – a history of Imperial Tropical Medicine*, Cambridge University Press, p. 13.

[495] *Ibid* p. 17.

[496] *Ibid* p. 293.

[497] M. Warboys. The Colonial World as Mission and Mandate: Leprosy and Empire 1900-1940. *Osiris,* 2nd series, vol 15, 'Nature and Empire: Science and the Colonial Enterprise', 2000, pp. 207-218.

[498] D. R. Headrick, *The Tools of Empire – Technology and European Imperialism in the Nineteenth Century*, Oxford University Press, 1981, pp. 58-79.

[499] S. May, Economic interest in tropical medicine. *American Journal of Tropical Medicine and Hygiene,* vol 3, 1954, pp. 412-421.

Although the aetiology and mechanisms of disease were not understood initially, increased clean water intake and protection from the sun had been shown to be very beneficial. Also improvements in the poor sanitation had led to a marked reduction in incapacitating diarrhoea. The corpus of knowledge had been slowly growing from earlier in the 19th century as evidenced by the publications (Table 8.3).

Year first published	**Author(s)**	**Title**	**Further editions**
1813	James Johnson	*Influences of Tropical Climates on European Constitutions*	
	James Johnson & James Ranald Martin	*Ditto*	1841
	James Ranald Martin	*Ditto*	1859, 1862
1861	William James Moore	*Manual of diseases in India*	
	New authors & co-authors	*Ditto*	1886,1889, 1893,1903
1875	Henry King	*The Madras Manual of Hygiene*	
	William Ewing Grant	became *The Indian Manual of Hygiene*	Multiple editions, the last being in 1894
1908	W. J. R. Simpson	*Principles of Hygiene as applied to Tropical and Sub-Tropical Climates*	

Table 8.3 Victorian publications on tropical health

Beginning in 1861, EA Parkes a former medical officer in India became professor of hygiene at the Army Medical School and began a long running series of articles entitled “Review of the Progress of Hygiene” as a feature of the Army’s annual statistical review. This series appeared in almost every edition until 1907 and continued thereafter in *the Journal of the Royal Army Medical Corps.*[500] All of the listed publications were to do with hygiene, epidemiology and prevention and avoidance of what were, in the main, incurable tropical infections and form the basis of “Public Health” for expatriates in hot climates. Patrick Manson’s *Tropical Diseases: A Manual of the Diseases of Warm Climates* was first published in 1898 and had reached five

[500] P. D. Curtin, *Death by Migration – Europe’s encounter with the Tropical World in the Nineteenth Century.* Cambridge University Press. 1989, pp. 104-106.

editions by 1914.[501] This was the first book in the English language which dealt with the *management* (treatment) of tropical disease in individual patients which was in the main due to a better understanding of microbiology.[502]

8.5.3 Germ Theory

The great advances in the understanding of infection and infectious diseases accelerated because of the replacement of the *contagion* and *miasma* theories of the transmission of disease by the "*germ* theory". The miasmatists believed that many diseases were contracted by inhaling air or even being in the presence of "miasmas" or smelly, unpleasant vapours emanating from rotting matter in stagnant water. Diseases caused by miasmas disappeared when the source was removed. Contagionists, on the other hand believed that diseases were transmitted by contact with other humans, flora or fauna or even contaminated water.

William Farr (1807-1883) classified disease causation in 1854[503]…

- ***Miasmatic*** – diffusible through air or water and producing fevers of two main types: those derived from the human body or animal matter and those derived from earth or plant matter, such as ague (malaria).
- ***Contagious*** – Enthetic (introduced from without), communicated from person-to-person by contact, puncture or inoculation, such as syphilis or glanders.
- ***Dietetic*** – arising in the blood from poor diet or bad food eg scurvy.
- ***Parasitic*** – animal and plant organisms infesting the skin, intestines and other structures of the body.

It was not until the latter part of the century that micro-organisms or "germs", too small to be seen with the naked eye, were determined to be the cause of infectious diseases. The acceptance the new germ theory was not over-night but gradually over the course of three decades.[504] Key researchers contributing to germ theory included Louis Pasteur, (1822-1895) in Paris, Joseph Lister (1827-1912) in London and Robert Koch (1843- 1910) in Germany, the latter defining Koch's Postulates in 1884 (Table 8.4).[505]

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[501] Patrick Manson (1844-1922) is considered to be the "father" of tropical medicine, mainly because he saw the necessity to open the first academic institution specifically to further treatment and research in the specialty: the London School of Tropical Medicine.

[502] It is now in its 22nd edition as *Manson's Tropical Diseases* edited by Gordon C. Cook, Alimuddin Zumla 2008 and remains the world's leading text on Tropical Medicine.

[503] W. Farr, *Sixteenth Report of the Registrar General for 1854*, BPP, 1855, vol 15, p. 1.

[504] Warboys *op cit.*

[505] T. D. Brock *Robert Koch: a life in medicine and bacteriology*. Washington DC: American Society of Microbiology Press. 1999.

1. The microorganism must be found in abundance in all organisms suffering from the disease, but should not be found in healthy organisms.
2. The microorganism must be isolated from a diseased organism and grown in pure culture.
3. The cultured microorganism should cause disease when introduced into a healthy organism.
4. The microorganism must be re-isolated from the inoculated, diseased experimental host and identified as being identical to the original specific causative agent.

Table 8.4 Koch's postulates

For more than a century, physicians involved in public health and military medicine had successfully improved the health of those under their care by removing them from miasmas but it was not until the germ theory and improvements in microscopy lead to the elucidation of infectious disease mechanisms that there were rapid advances in prevention.[506] In parallel with the new theory of aetiology of infectious disease, the *symptomatic* descriptions continued to be used.[507] They were roughly grouped into "fevers", "dysentery", "rashes" (or examthemata) and "the Pox". *Fevers* included any disease which produced a pyrexia (raised body temperature) such as malaria (ague); indeed with the introduction of clinical thermometry, more accurate diagnosis became possible by the classification of temperature patterns (Table 8.5).[508]

Fevers of short duration	*Fevers of long duration*
Kala-Azar	Malarial fevers
Sleeping sickness	Dengue
Relapsing fever & African Tick fever	Plague
Malta/Undulant fever	Yellow fever
Pre-suppurative stage of amoebic hepatitis	Heat/Sun-stroke
Epidemic Dropsy	Typhus
	Influenza
	Examthematous (spotty) diseases

Table 8.5 Classification of Fevers

The term *dysentery* included many diseases that caused diarrhoea such as cholera and food poisoning but with little differentiation before the germ theory. Small pox was the classic *examthematous* disease with a very high mortality although "the pox" was often a collective term for sexually transmitted diseases (see below).

506 Curtin *op cit.*
507 And are still today.
508 L. Rogers. *Fevers in the Tropics, their clinical and microscopical differentiation including the Milroy Lecture.* 2e OUP, Oxford, 1910, pp1-14 "Historical introduction".

Malaria was an important example of a fever at tropical cable stations. It had been considered for decades that malaria was due to the miasma from stagnant marshland. It was one of a group of tropical infections known collectively as *tropical fevers.* An association between tropical fevers and tropical swamps had been noted for many decades but the connection was attributed to the miasmas from rotting vegetation. In 1878, Edwin Klebs (1834-1913), a Swiss-German pathologist, possibly excited by the new germ theory, found a bacterium in swamp land which he called *Bacillus malariae.* It was not until 1880, with the improvements in microscopy, that Charles Louis Alphonse Laveran (1845–1922) a French physician, identified a protozoan plasmodium in the blood of soldiers with malaria in Algeria.[509] Camillo Golgi (1844-1925), an Italian physician, pathologist, and Nobel laureate, noted in 1886 the tertian and quartian nature of the fever in malaria and related them to Lavaran's cycles of parasite concentrations in the blood.[510] Patrick (later Sir Patrick) Manson, from his previous observations with tropical diseases, suggested in 1894 to a colleague who he mentored, Ronald Ross (1857-1932), that the malaria parasite may be transmitted by the mosquito. Ross (later Sir Ronald Ross), an irascible army surgeon working in Secunderabad India, proved in 1897 that malaria is transmitted by mosquitoes.[511] Before this cycle had been elucidated, tropical fever, ague or malaria had been tamed to a certain extent by public health and military physicians by the removal of personnel from areas of tropical swamp but with the new understanding of the disease the protection of humans from the ravages of the anopheles mosquito by the use of mosquito netting at night, swamp clearance where possible and mosquito eradication became the norm. A similar pattern of discovery for other, so-called, vector-born tropical infectious diseases occurred during the late Victorian era. Although the greatest reduction in malaria in the early Victorian period was caused by reduction in the areas of stagnant miasma-generating water, a treatment which alleviated the symptoms of malaria and many other fevers of the time had been found empirically in the 17th century, namely quinine which was made from the ground-up bark of the cinchona tree.

All the submarine cable telegraph companies realised right from the start of their operations that cable stations and staff accommodation needed to be of a high standard to maintain the health and morale of the expatriate staff and therefore get the best service out of them. The buildings were always substantial, light and airy.

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[509] For this and other research he received a Nobel Prize in 1907

[510] C. Golgi. "On the cycle of development of malarial parasites in tertian fever: differential diagnosis between the intracellular parasites of tertian and quartant fever." Archivio per le Scienza Mediche. Vol 13,1889. [Italian]

[511] an event now commemorated as World Mosquito Day annually on the 20th August.

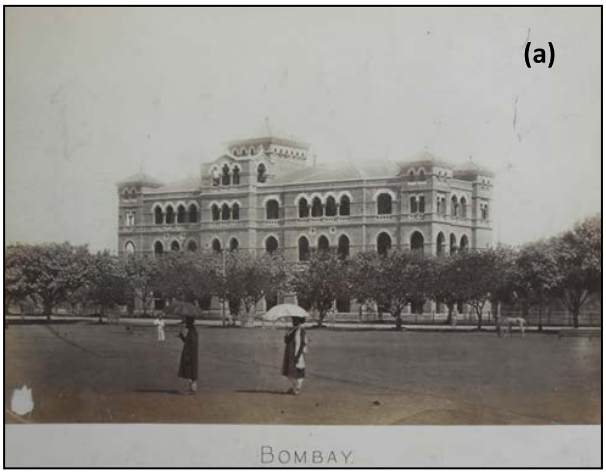
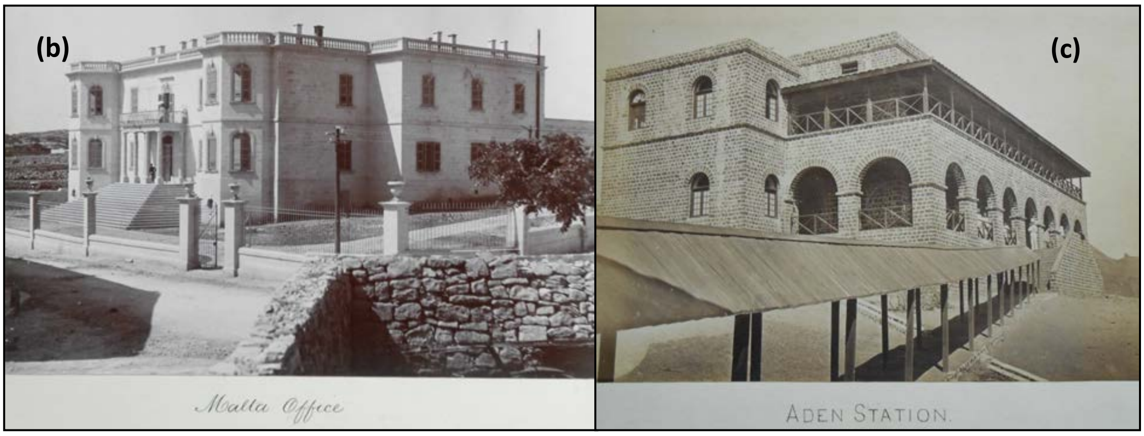


Fig 8.3a-c ETC Cable Stations in Bombay, Malta and Aden from the photo-archives at the Telegraph Museum, Porthcurno



If fresh clean water was not available then filtration equipment was installed. The most up-to-date methods of sewerage disposal were likewise applied. By 1860 reliable refrigeration equipment was also available which improved the food hygiene, thus reducing the incidence of enteric disease such as dysentery. To maintain physical and mental fitness, cable stations also had tennis courts, a library and billiards room for their use during off duty periods. Staff at the larger stations set up amateur dramatic societies and sports clubs. Exercise and cleanliness were encouraged.

Despite all the most modern building construction and appliances for health, cleanliness and efficiency, these fit young adults were still at risk of contracting ailments that they would have been afflicted by in the UK and by diseases specific to the geographical location of the cable station. The ailments most commonly acquired by expatriates at the cable stations were infections, heat stroke and poisoning by local fauna. Although no evidence has been found in the ETC archives there is a great deal of evidence of venereal disease amongst expatriate men in the military and colonial services. It is therefore highly likely that the young men in telegraphic service abroad should suffer similarly.[512] The venereal diseases were collectively known In the Victorian era as "infectious malady", pox, Venus illness, lecherous sickness, morbus gallicus, luis and syphilis.[513]

8.5.4 Health and Disease in the ETC archives

It has been difficult to assess the actual incidence of disease in the ETC expatriate staff in the Victorian period as few records survive apart from occasional paragraphs in the ETC Board meeting minute books and occasional comments in *Zodiac* (the in-house periodical which was first published in 1906). Occasional remarks also occur in Spratt's Diaries.[514] Excerpts from these documents relating to health and disease are shown in Appendix C of this chapter. It is possible that these matters were only discussed at board level when they affected the running of the service and its profitability. An especially obvious example occurred in the months of April to July 1880 (see Appendix C) where cable operations at the Delagoa Bay cable station were severely disrupted by a "fever" to the extent that the station was closed for operation for several weeks. This was the only recorded time during the period of this thesis that a station had to completely shut down due to sickness.

Knowledge is available of endemic disease during the period studied in this thesis. For example, public health data of each geographical area which was the location for a cable station on the route from the UK to our largest colony, India is shown below. The public health data was found in Andrew Davidson's *Geographical Pathology: An inquiry into the Geographical Distribution of Infective and Climatic Diseases* published in 1892, Martin's *The Influence of tropical Climates on European Constitutions* and Clemow's *The Geography of Disease* published in 1903.[515]

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[512] P. Levine. *Prostitution Race and Politics: Policing Venereal Disease in the British Empire.*, Routledge, London, 2003; P. D. Curtin, *Death by Migration*. Cambridge University Press, 1989, pp. 156-7.

[513] J. Forai. History of Different Therapeutics of VD before the discovery of Penicillin. www.itechopen.com/download/pdf/23785. Last accessed 18/04/2013.

[514] George Spratt was Assistant Superintendent at Porthcurno cable station from 1871 and then Superintendent at the Gibraltar station. There is an entry in the minutes of the ETC Board dated 6/1/1909 to say that he was invalided home and died in 1909 (see appendix C). He left a fascinating diary which has been transcribed and is available to view at www.porthcurno.org.uk

[515] A. Davidson. *Geographical Pathology: An inquiry into the Geographical Distribution of Infective and Climatic Diseases*, vols 1 & 2, Young J Pentland, London & Edinburgh. 1892. J. R. Martin. *The Influence of tropical Climates on European Constitutions*, John Churchill, London, 1856. F. G. Clemow. *The Geography of Disease*. Cambridge University Press, 1903.

Figure 8.4 The Cable routes to India in 1874. From J. Goldsmid, *Telegraph and Travel,* Macmillan, London, 1874, Frontispiece.

The map in Figure 8.4 traces the routes of telegraph cables from the UK to India. I now describe the health situation at the stations between the UK and Bombay during the relevant period.

Porthcurno (England)

During the Victorian era, malaria (also known as *ague*) was still common in England with a death rate of 3.2 per million in 1885; Malaria outbreaks also occurred mainly East Anglia, Kent, Essex, along the south coast around the Romney and Pevensey Marshes, Bridgewater in Somerset and in London (see figure 8.1). The diagnosis of malaria was often used interchangeably with "remittent fever". Other common infectious ailments were *enteric fever, typhoid, relapsing fever, diphtheria, erysipelas, diarrhoea/dysentery, cholera, typhus, scarlet fever*, *whooping cough, smallpox, influenza*, *phthisis* (tuberculosis) and *measles*, all of which had significant mortality. *Pneumonia* and *bronchitis* also took their toll. Diabetes caused 50 deaths per million and cancer more than 500 similar to the rest of Europe. Even venereal disease lead to premature death of approximately 100 per million population in 1885.

Vigo (Spain) and **Carcavelos** (Lisbon, Portugal)

Malaria was epidemic in Spain and Portugal between 1849 and 1860 but controlled thereafter. *Febris complicata* (see below) was common around the coast. The Iberian Peninsula was the only part of Europe to suffer Yellow fever during the 19th century. Dysentry and cholera were endemic, the latter having been introduced to Portugal by persons on a British ship in 1833. There was smallpox in Spain but concentrated inland especially around Madrid. The Mediterranean coast of Spain also had endemic leprosy. Venereal diseases were as common as in England and then rest of Europe. Bronchitis, pneumonia and Whooping cough, although common inland, had a low prevalence at the coast.

Gibraltar

Although Gibraltar was free of malaria, it had its own special form of swinging fever spoken of as *Gibraltar fever, Rock fever,* or *Febris complicata.* It had a low mortality but could incapacitate intermittently by causing extreme malaise, headaches, rigors and back pain. Also venereal diseases caused much fewer hospital admissions than further north.

Malta

Throughout the Colonial period, Malta has always been an important staging post; none less than during the period of this thesis as far as communications between the UK and India and then on as far as Australia. A medical problem specific to Malta was *Malta fever*, which was very debilitating. Major David Bruce (1855-1931) discovered the cause to be a bacterium transmitted in goats milk.[516] The name of the disease became *Brucillosis* in his honour.

Alexandria, Port Said and Suez (Egypt)

Malaria was endemic in Egypt with a much higher prevalence in Lower Egypt (the north) than Upper Egypt, by a factor of two. The highest prevalence was in Suez, Port Said and Alexandria. The prevalence around the Suez Canal was so high in 1880 as to demoralize the population; maxima occurring when the water level was low exposing marshes and also when winds blew from over the lakes towards the conurbations.[517] Other endemic diseases included relapsing fever, plague, dysentery, tuberculosis, hepatitis and cholera which was especially prevalent in 1850, 1855, 1868, and 1883-1884.

Aden (Arabia)

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[516] G. C. Cook. *Tropical Medicine – An illustrated history of pioneers.* Academic Press, London, pp. 145-152.
[517] Davidson *op cit.* p. 603

Aden was a "domain of burning rock and sand" with high temperature, high humidity and a high hospital admission rate with fever.[518] Other prevalent health problems were ulcers, rheumatism, diarrhoea and dysentery. Malaria was non-existent in Aden but endemic immediately north of the protectorate.

Bombay (India)

More medical data of the Victorian era is available concerning India than any other part of the world (excluding the UK) as it was the "jewel in the crown" of the British Empire. James Bird who had been a surgeon of the European General Hospital in Bombay and a physician to the "Bombay Army" summarized the state of health amongst expatriates at the beginning of the period.[519] By then the main problems in tropical medicine were the "tropical fevers" which were classified as intermittent, remittent and continuous.[520] Although Bird classified various diseases in this way, the exact aetiology of disease was unknown until the late 19th and early 20th centuries. During the period covered by this thesis, tropical fever was endemic in the Bombay area but with a very severe outbreak in 1852. The commonest cause of tropical fever in Bombay was malaria closely followed by enteric fever, relapsing fever, influenza, dengue fever, plague, dysentery, yellow fever, leprosy and cholera.[521] There was a higher incidence of venereal diseases, especially syphilis, amongst the British expatriates; this incidence became even higher during episodes of famine owing to hunger which compelled many more of the indigenous population to resort to prostitution.[522]

Cable stations were always on the coast and not far from major ports where medical attention could usually be found provided by expatriate doctors at embassies or consulates or by British military doctors. These government doctors were often more focused upon public health issues than on the management of individual patients.[523]

The table in Appendix C also shows some other interesting features. "Fever" was a common source of morbidity and mortality and was reported in a very matter-of-fact manner as though it was the norm for the era in which indeed it was. Smallpox was only partially under control by vaccination. Edward Jenner (1749-1823) had found in 1796 that protection against

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[518] *Ibid* p. 287.

[519] J. Bird, Contributions to the Pathology and Treatment of Tropical Fevers*. London Journal of Medicine*., 3rd January, 1849, pp, 43-50 and 3rd February, 1849, pp. 152-171. (the *LJM* became the *British Medical Journal*, the main publication of the British Medical Association, in 1885).

[520] *Ibid.* p. 44.

[521] Davidson *op cit,* vol 1, pp311-465

[522] *Ibid,* vol 1, p460

[523] Warboys *op.cit.* p2. 10.

smallpox was afforded by inoculation with a very small amount of sera from a cow suffering cowpox. He published his findings in 1798 and vaccination soon became very popular. Smallpox was a highly contagious disease with a very high mortality. The first entry in Appendix C comes from Spratt's diaries, noting almost in-passing that there was an epidemic of smallpox in London and in Malta. By 1895 there is an entry which says that there was another epidemic of smallpox in Cairo – "vaccine to be sent". By the turn of the century it is apparent that of ETC's foreign staff had been vaccinated as on the 12th of July 1905. CS Britannia was "quarantined for 5 days at Loanda due to smallpox amongst the *native* crew" [italics mine].

Entries in March 1892 claim an epidemic of bilharzia at Suez station due to "drinking from the river Nile". Bilharzia was not contagious as such but due to a parasite in "fresh" river water more often caused by swimming or paddling in contaminated rivers. The ETC board minute stated that those who had tried to gain relief from the heat by so doing had been reprimanded for "disobeying the company rulebook" although I can find no entry about this in remaining rule books in the archives.

Despite the paucity of information in the ETC minute books it is clear that the expatriate staff remained healthier that the indigenous populations throughout the period of this study. This was due to the careful selection of trainee staff for health and fitness, their generally younger age and their exceptionally good working and living conditions.

8.6 Conclusions

In this chapter I have shown that the operating companies, in this case the ETC, did all they could possibly do to select the best and healthiest staff and trainees and train them in the most up-to-date methods using apprenticeship schemes. During the period under study, great advances in health care were made especially in tropical medicine. Although not spelt out in the archives it is clear that the operating companies kept pace with every advance in health and hygiene. The ETC realized that the "maintenance" of their operating, engineering and electrical engineering staff was absolutely vital to the well-being of the whole system and their profits. This aspect was something that Thomas Hughes did not wholly take into account in his Large Technical Systems theory. The submarine telegraph cable system bore similarity to the "electrical power delivery system" of Hughes' theory of large systems or networks.[524] A *Large Technical System* as defined by Thomas Hughes described a system or network of enormous

[524] T. P. Hughes, *Networks of Power – Electrification in Western Society 1880-1930*. Johns Hopkins University Press, Baltimore, USA, 1983.

proportions or complexity.[525] He expounded his theories in two large books: *Networks of Power* (1983) which he based upon electrification of the United States.[526] His second tome on LTS was entitled *Rescuing Prometheus* (2000) in which he applied his theories to other LTSs.[527] The most useful function of Hughes' theories is probably what he termed the *reverse salient.* A "reverse salient" is a military term and refers to a backward bulge in the advancing line of a military front which although appearing to be a small problem, has negative effects of much greater proportions. It is a shame that Hughes did not study The Victorian Submarine Cable System which was of equal if not greater complexity than those that he did study as shown in the chart below (Figure 8.5).

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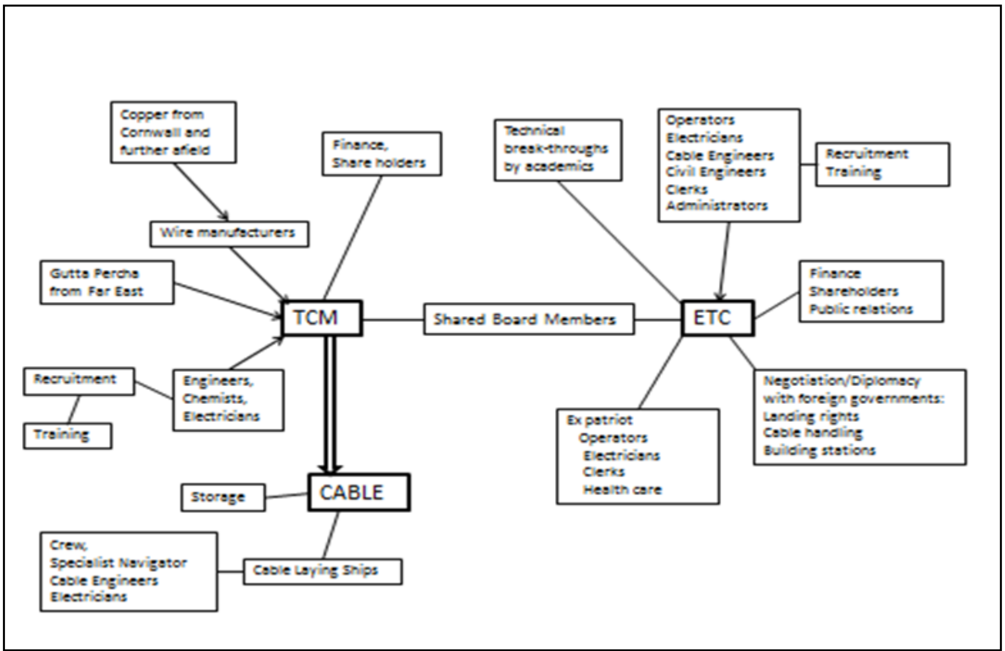

Figure 8.5 Diagram showing the great complexity of the submarine telegraph cable system

There were plenty of opportunities for reverse salients to have major detrimental effects on the system. For example, (1) cable incorrectly stored on land (dry or at high ambient temperature) could cause problems after it was laid which would cause failure of communication and subsequent necessity for relaying replacement cable; (2) local infectious

[525] T. P. Hughes, *Rescuing Prometheus: Four Monumental Projects That Changed the Modern World*, 2000.
[526] T. P. Hughes, *Networks of Power – Electrification in Western Society 1880-1930.* The Johns Hopkins University Press, Baltimore, 1983.
[527] (1) Semi Automatic Ground Environment (SAGE), which was a computer- and radar-based air-defense system (2) the Atlas project, which produced America's first intercontinental ballistic missile (3) Boston's Central Artery/Tunnel Project, a traffic-unclogging system of highways, tunnels and bridges originally scheduled for completion in 2004 and finally (4) ARPANET, an interactive computer-based information network that paved the way for the Internet

disease affecting more than one operator at a far-flung cable station caused complete closure of Delagoa station for more than a week. However, Hughes does not take into account the health and "efficiency" of the individual human resource. Another outstanding difference between Hughes' LTSs and submarine cable telegraphy are that his *Large* was comparatively parochial compared with the world-wide cable telegraphy system.

Appendices

Appendix A – Biographical notes of the early pioneers of cable telegraphy

John Watkins Brett (1805-1863) is often referred to as the founder of submarine telegraphy as he laid the first submarine cables between England and France. His first attempt in 1849 was unsuccessful for a number of reasons not the least of which was the apocryphal recovery of a portion of the cable by a French fisherman who announced that he had captured a sea-snake with a core of gold. With his younger brother **Jacob Brett,** John Brett had success in 1850.[528]

Sir Samuel Canning (1823-1908) was one of the pioneers of submarine cable telegraphy and his name will always be associated with those of Professor William Thomson (later Lord Kelvin) and Sir Charles Bright. Sir Samuel Canning worked with the Great Western Railway from 1846 until 1852 when he turned his attention to telegraphy. He worked with William Thomson and Charles Bright on the first unsuccessful Atlantic cables (1865,1866). He then worked for Messrs Glass, Elliot & Company. He was appointed Chief Engineer when Glass, Elliot was amalgamated with the Gutta Percha Company to form the Telegraph Maintenance and Construction Company. He continued as a consulting engineer in retirement.[529]

Sir Charles Tilston Bright (1832–88) became a clerk for the Electric Telegraph Company but showed an aptitude for electrical engineering. Transferring to the Magnetic Telegraph Company in 1852 he supervised the laying of many inland telegraph lines and then the first cable between Scotland and Ireland at the age of 21. He was Chief Engineer for the early attempts at the Atlantic cables and many cables all over the world thereafter. He even found time to become a Liberal MP (1865-1868). Over-work lead to his early demise at the age of 55.[530]

[528] J. W. Brett. *On the Origin and Progress of the Oceanic Telegraph with a few brief facts and opinions of the press*, London, 1858.
[529] Obituary. *Minutes of the Proc Inst Civil Engineers.* vol 175, 1909, pp. 316-7.
[530] C. Bright. *The Life Story of Charles Tilston Bright*, Archbold Constable, London, 1908.

William Thomson (later Lord Kelvin) (1824-1907) was another pioneer engineer of the submarine telegraph but came from a very academic background - Cambridge University, eventually he became Professor of Physics at Glasgow University. Although a very broadly based physicist he became an expert in this new field and was made a director of the Electric Telegraph Company in 1856. He was involved with all of the early attempts, unsuccessful and successful at laying the first Atlantic Cables. As mentioned earlier in this thesis, he invented both the speaking mirror galvanometer and the siphon recorder.[531]

Latimer Clark (1822-1899) had originally intended to be a chemist but was attracted to the burgeoning railway industry by his brother who was in the habit of firing a time gun by electricity at 2000hrs every day. This led him to become interested in telegraphy and he eventually became assistant (to his brother) chief engineer of the Electric Telegraph Company in 1850. In 1861 he became a consulting engineer to the rapidly expanding submarine telegraph industry with many patents to his name.[532] He set up a firm of consulting electrical engineers with a Messrs Forde and Taylor and sub-contacted their services to many of the cable-laying projects of the ETC and the Telegraph Construction & maintenance Company.

E. O. Wildman Whitehouse (1816-1890) began is working life as a successful surgeon in Brighton, Sussex but “retired” early because of an increasing interest in all things electric. He had no formal training in electrical engineering but, such was the state of the discipline, with the little knowledge he acquired as an amateur, he convinced the Atlantic Telegraph Company to employ him as the chief electrician on the 1855 and 1856 cables. He did not get on with William Thomson who realised that Whitehouse did not understand the theoretical principles. They argued in public in the press. He was eventually made the scape-goat for the demise of the 1856 cable after he applied 2kV to the failing cable in an attempt to rectify the problem.[533]

[531] S. P. Thompson, *The Life of William Thomson, Baron Kelvin of Largs*, Chelsea Publishing Company, New York , 1910.
[532] Obituary. *Journal IEE* v28 1899
[533] http://atlantic-cable.com/Books/Whitehouse/eoww.htm - a biography by Bill Burns, the founder of atlantic-cable.com. Last accessed 23.3.2015

Charles Wheatstone (1802-1875), later Sir Charles Wheatstone, like William Thomson, was an expert in many fields. He invented the English concertina, the stereoscope, and the Playfair cypher but was best known for the Wheatstone bridge which he developed from the ideas of Samuel Hunter Christie (1784-1865). The Wheatstone bridge became the most important method of measurement of electrical resistance by *null detection.* With William Cooke (1806-1879) he invented the first practical electric telegraph in the UK. Wheatstone went on to invent the "Wheatstone ABC Telegraph" and important devices to send submarine telegraph signals at higher speeds than those achievable by manual methods.[534]

James Graves (1833 - 1911) was the superintendent at the Valentia Cable station and had a long and distinguished career as a cable electrician (see biographical details in Chapter 5).

F C Webb (1828-1899) spent a life time in submarine telegraphy and was also a prolific technical writer on the subject. He was author of a series of articles in the *Electrician* entitled "Old Cable Stories Retold". A more complete biography may be found in Chapter 3 footnote number 36.

Willoughby Smith (1828-1891) was an electrical engineer joining the Gutta Percha company in 1848. He designed and supplied the cable for the first (1849, unsuccessful) and second (1850, successful) cables between Dover and France, supervising their laying.[535] In 1873 he developed a system for the continuous electrical monitoring of submarine cable whilst it was being laid. One of his requirements for this was a series of resistors of very high value. Experimenting for this he discovered the photoconductivity of selenium which was probably his most important contribution to electrical engineering.[536]

[534] B. Bowers. *Sir Charles Wheatstone FRS 1802-1875.* IEE/Science Museum, London, 2001.
[535] Obituary. *The Electrical Engineer*, July 24, 1891, p. 85.
[536]W. Smith. Effect of Light on Selenium During the Passage of An Electric Current.
Nature vol 7, 20 February 1873, p. 303

Cromwell F Varley (1828-1883) came from a family of prominent engineers, artists and spiritualists. He joined the Electric Telegraph Company in 1846 becoming the chief engineer by 1861. He first became involved with submarine cable telegraphy when he was appointed to the Inquiry into the failure of the 1858 Atlantic cable. He replaced Wildman Whitehouse as chief electrician for the Atlantic Telegraph Company. He was one of the founder members of the Society of Telegraph Engineers which eventually became the Institution of Electrical Engineers.[537] Like most of his family, he was deeply involved in the occult arts.[538]

[537] John Varley Jeffery The Varley Family: Engineers and Artists. *Notes Rec. R Soc London*, , vol 51, 1997,pp263-279

[538]R. J. Noakes. Telegraphy is an occult art: Cromwell Fleetwood Varley and the diffusion of electricity to the other world. *BJHS,* vol 32, 1999, 421-459.

Appendix B – The two John Munros

<table>
<tr><th>JOHN MUNRO</th><th>JOHN MACINTOSH MACKAY MUNRO</th></tr>
<tr><td>1849 – 1930 Died in Bristol

“UK Engineer & Professor of Mechanical Engineering at Bristol University”

Career began with telegraph work on the GWR

Member of the Institute of Civil Engineers

Munro & Jamieson’s Pocket-book of Electrical Rules & Tables (5e = 1888)
Uses of Electricity (1889) - RTS
Pioneers of Electricity (1890) - RTS
The Heroes of the Telegraph (1891) - RTS
The Romance of Electricity (1893) - RTS
The Wire and the Wave (1895) –RTS

Frequent contributor to The Electrician

On the Quadrant Galvanometer – JSTE 1873

A Message from Mars (1894) - Cassel’s Magazine
Sunrise in the Moon (1894) - Cassel’s Magazine
A Trip to Venus (1897) – Cassel’s Magazine

Evangelical Christian</td><td>1853 – 1925 Died in Edinburgh

Never referred to as “Professor”

MIEE (1890); FRSE (1894)

Worked/published on…
Electric lighting
Dynamos
Fire alarm systems
Hydroelectricity
Seaplanes during Great War in RFC

Founder of Glasgow section of the IEE (1890) and became Chairman (1905)

Interested in the reconciliation of theology and science
Spiritual Dynamics (1886)
The Divine Mechanism (1926)</td></tr>
</table>

I am much indebted to Jon Cable, Assistant Archivist at the IET for putting me on track to finding information to solve this riddle.

The most conclusive evidence for their separate identities is their separate entries in *The Electrical Trades Directory* page LX 1898 published *The Electrician,* London

Appendix C – Health and Sickness as found in the ETC Archives at Porthurno

Source	Vol	Date of Report	Page	Min No.	Station	
Spratt diary		03/03/1871			London	Smallpox in London. Black flags flying in some streets.
Spratt diary		25/03/1871			Malta	Smallpox among staff. Brayshore & Gillespie reported as dying
Spratt diary		27/01/1872			Gibraltar?	"Frank Grey dead - drink"
ETC Min Book	1	??			Marseilles	Clerk died in service
Spratt diary		11/5/1872				Mr Adams very ill
ETC Min Book	2	13/05/1873			Suez	Ill health of Doctor - resigned
ETC Min Book	2	10/06/1873			Cairo	Continued illness of Supt Mr Cross. Given passage home
Spratt diary		26/2/1877			PK	Mr Uren ill
Spratt diary		5/3/1877			PK	Uren still absent on sick leave
Spratt diary		13/3/1877			PK	Absent from work as large boil on leg; unable to walk
Spratt diary		10/4/1877			PK	Still troubled by boil - sent to Dr in St Just
Spratt diary		12/4/1877			PK	Resumed duty but still unwell
Spratt diary		10/8/1877			PK	Larkia & Toynbee away ill
Spratt diary		27/9/1877			PK	Mr Hamilton died
The Electrician		21/9/1878			New Orleans	Yellow fever at New Orleans Station reported in the *Electrician*
ETC Min Book	3	19/12/1878			Candia/Carerra	On the 14th inst Mr William Anderson (Superintendent) and a clerk were murdered
ETC Min Book	3	27/01/1879			Marseilles	Sudden death of French clerk Angles by scarlet fever
ETC Min Book	4	11/03/1880			Delagoa Bay	Telegram to Head Office - Many staff down with Fever. "Durban put through to Mozambique"
ETC Min Book	4	22/04/1880			Delagoa Bay	Improvement in health
ETC Min Book	4	06/05/1880			Delagoa Bay	Cassidy and Clark down with fever
ETC Min Book	4	03/06/1880			Delagoa Bay	Cables test & work well. Health: Cassidy & Davies improving. Millard ill
ETC Min Book	4	17/07/1880			Delagoa Bay	Cables OK. Davies & Robinson ill.
ETC Min Book	4	29/07/1880			Zanzibar	Cables working well but Culliford down with fever - improving.

ETC Min Book	4	02/12/1880			Delagoa Bay	Cables working well. Sickness resolved
ETC Min Book	4	05/10/1880			CS Retriever	Capt Dunn #leg falling on to pontoon
ETC Min Book	4	09/03/1882		429	Suez	Several members of Suez staff have contracted Bilharzia (a very insidious disease) from drinking Nile water. Dr Cobbold "eminent physician" sent from London
ETC Min Book	4	23/03/1882			Suez	"Infectious malady" - "avoidable if rules had been obeyed". - Dr Cobbold
ETC Min Book	5	11/01/1883			Egypt	Murder of Mr George de Ternant
ETC Min Book	5	26/07/1883			Suez	Suez staff ask for more pay because of increase prevelance of cholera in Egypt
ETC Min Book	5	06/09/1883		311	Alexandria	Death of clerk Poulton from cholera on 19th August. Mr Tuch ordered home on sick leave (Bilharzia)
ETC Min Book	5	10/07/1884		511	Marseilles	Cholera. ETC rents house out of town for staff
ETC Min Book	5	24/07/1884			Marseilles	Extra payments approved for staff during epidemic.
ETC Min Book	5	03/01/1884	156	422	Gibraltar	Mr George Tilly, clerk in charge, died after a short illness from congestion of the liver & dysentery
ETC Min Book	5	08/02/1885			Marseilles	Mr A L Tennant, manager at Marseilles, died 27/1/1885
ETC Min Book	5	01/10/1885			Marseilles	Cholera at Marseilles but no one at the cable station affected
ETC Min Book	6	31/03/1887			CS Volta	Capt Anderson injured 18th October 1886
ETC Min Book	6	12/05/1887			CS Volta	Wrecked
ETC Min Book	6	22/12/1887		480	Levant	Mr Binner, Divisional Manager at Levant given 3/12 sick leave "ill health"
ETC Min Book	6	19/01/1888		490	CS Mirror	Mr J Calton, 2nd Engineer on CS Mirror died from Typhoid contracted in Gibraltar
ETC Min Book	6	01/03/1888			Levant	Mr Binney "seriously ill"
ETC Min Book	6	15/03/1888		539	Levant	Mr Binney died 12 March 1888
ETC Min Book	7	15/01/1891		271	Tripoli	Supt Mr Crabtree died. ?cause
ETC Min Book	7	29/01/1891		284	Gibraltar	Telegram from Mr de Sauty (Supt): Death of Arthur Drake and sickness of 2 others - "Fever". Sanitation to be reported on.

ETC Min Book	7	12/02/1891		Gibraltar	Sanitation report - all ok
ETC Min Book	7	12/02/1891	291	Liverpool	Sudden death of Supt Mr Moore
ETC Min Book	7	26/02/1891	300	???	Clerk Elliott died 16th Feb. "Staff withdrawn"
ETC Min Book	7	12/03/1891	322	???	Staff returned to full working 6th March
ETC Min Book	7	04/06/1891	376	Suez	Santiary work completed
ETC Min Book	7	16/07/1891	413	Suez	Clerk Newberry died 15th July from Typhoid fever
ETC Min Book	7	30/07/1891		Suez	Clerk Johnson died 25th July from Typhoid. Others are sick with it.
ETC Min Book	7	24/09/1891	440	Suez	Contamination of slaughter house next door to cable house confirmed
ETC Min Book	7	08/10/1891	464	Suez	Contamination of slaughter house next door to cable house confirmed
ETC Min Book	7	03/12/1891	539	Gibraltar	Mr de Sauty ill but out of danger.
ETC Min Book	7		664	Gibraltar	Mr de Sauty to return to the UK
ETC Min Book	7	17/11/1892	749	Odessa	Death of Supt John Meyl. "Inflammation of the brain"
ETC Min Book	8	20/04/1893	93	Cyprus	Supt Mr Brayshaw died
ETC Min Book	8	20/04/1893	93	Gibraltar	Mr de Sauty died 11th April
ETC Min Book	8	13/07/1893		Marseilles	Sickness at Marseilles
ETC Min Book	8	14/12/1893	255	Lisbon	Mr RW Inch died
ETC Min Book	8	20/09/1894		Porthcurno	Clerk in charge Mr Maunsell died
ETC Min Book	8	20/09/1894		Marseilles	Mr Gilchrist died
ETC Min Book	8	15/11/1894	475	Manchester	Supt Mr E McGrath died
ETC Min Book	8	04/04/1895	568	CS John Pender	Capt Perkins injured in rough seas.
ETC Min Book	8	16/05/1895	593	Cairo	Smallpox in Cairo. Vaccine to be sent
ETC Min Book	9	14/12/1896	192	Bombay	Plague in Bombay
ETC Min Book	9	22/01/1897	224	Bombay	Plague & Fever in Bombay
ETC Min Book	9	30/09/1897		CS Electra	Sickness +++
ETC Min Book	9	20/01/1898	55	CS Electra	Mr WE Pender - Chief Electrician invalided out Sept 1897
ETC Min Book	9	17/03/1898	505	CS Electra	Chief Officer off duty 1/12 with rheumatism & neuritis
ETC Min Book	9	17/03/1898	506	CS John Pender	Chief Officer - failing eyesight. "To be dispensed with"

ETC Min Book	9	31/03/1898		CS John Pender	Capt Perkins ill. Ordered home by mail steamer
ETC Min Book	10	13/04/1899	8	Malta	Asssistant Supt Mr Warwick sent home to London sick
ETC Min Book	10	13/04/1899	21	Bombay	Plague in Bombay. Staff want more pay
ETC Min Book	10	28/09/1899		Malta	Mr Warwick from Malta died in Glasgow
ETC Min Book	10	23/11/1899	183	Bombay	Board declines pay rise related to plague in Bombay
ETC Min Book	10	21/12/1899	218	Suez	Fever amongst staff
ETC Min Book	10	15/02/1900	253	Gibraltar	"Sickness in Gibraltar
ETC Min Book	10	01/03/1900	266	Gibraltar	Sickness in Gibraltar improving.
ETC Min Book	10	29/03/1900	299	Bombay	Board agrees to pay rise related to plague in Bombay
ETC Min Book	10	29/03/1900	297	CS Mirror	Mr J Pollock, Carpenter invalided home
ETC Min Book	10	29/03/1900	302	CS Gt Northern	Chief Officer to return home to see occulist due to poor eyesight
ETC Min Book	10	11/05/1900		CS Duplex	Capt Benito ill in Sierra Leone for 41 days
ETC Min Book	10	24/05/1900	341	CS Gt Northern	Chief Officer to be paid until he can find suitable employment.
ETC Min Book	10	08/11/1900	450	Gibraltar	Mr Robbins - expensive surgery
ETC Min Book	10	04/12/1901	821	CS John Pender	Capt Starkey dies on board ship. ?cause.
ETC Min Book	11	04/06/1902	90	SS Grappler	Death of Mr WJ Murphy on board SS Grappler on the destruction of that ship at St Pierre, Martinique
ETC Min Book	11	23/07/1902	157		Mr JW Mackay died 20/07/1902
ETC Min Book	11	03/12/1902	248	CS Electra	Illness of Capt Gibson reported. Left in hospital in Malta. Mr Sparks, chief officer left ion charge
ETC Min Book	11	14/01/1903	295	Trieste	Death of Mr Frank Bolton, Superintendent of the Company's station in Trieste
ETC Min Book	11	25/01/1903	308	CS Electra	Death of Capt Gibson late of the CS Electra on 17th inst
ETC Min Book	11	11/03/1903	377	CS John Pender	Accident to Mr Power, assistant deck engine driver on the CS John Pender. Referred to the Managing Director as to supplying an artificial arm and some employment.
ETC Min Book	11	06/05/1903	439	Head Office	Death of Mr GW Talley after 18 years service

ETC Min Book	11	01/07/1903	511	Gt Eastern Rly	Fatal railway accident killed Clerk John Venndh
ETC Min Book	11	15/07/1903	536	Malta	Death of Mr Horsfall on 19th April
ETC Min Book	11	16/12/1903	706	Malta	Mr Stark, electrician at Malta, died. ETC to pay for the education of his 2 children.
ETC Min Book	11	13/01/1904	739	Malta	Mr Warwick, Assistant Superintendent, died
	12	19/10/1904	76	Cape Town	Death of Mr GB Stacey, late Supt at Cape Town died at Bath 5th inst
ETC Min Book	12	16/11/1904	114	Malta	Mr DePiro, clerk at Malta station trys to claim expenxes for Thermal Bath treatment in Sicily under doctor's orders for rhrumatism. Refused!
ETC Min Book	12	16/11/1904	115	Aden	Aden staff try to get ETC board to pay for a dentist from Cairo to "overhaul" their teeth. Told that they should have had them sorted our before foreign service!
ETC Min Book	12	16/11/1904	118		Mr HP Fisher, instrument clerk - breakdown in health
ETC Min Book	12	16/11/1904	119	Liverpool	Mr WA Lewis - early retirement due to ill health
ETC Min Book	12	11`/01/1905	188	Aden	Request for subscription towards segregation camps during the plague epidemic
ETC Min Book	12	03/05/1905	338	Head Office	Mr T Rose, 3rd Class Clerk in the Transfer Dept to be sent to Sanatorium for 6 months on half pay
ETC Min Book	12	28/06/1905	394	CS Sherrard Osborne	3 cases of beri-beri amongst European crew
ETC Min Book	12	12/07/1905	422	CS Britannia	Quarantined for 5 days at Loanda due to small pox anong native crew
ETC Min Book	12	26/07/1905	443	CS Britannia	Now also "slight" cases amongst white crew.
ETC Min Book	12	20/09/1905	467	CS Britannia	All sick men came out of [Cape Town] hospital and rejoined to the ship
ETC Min Book	12	21/04/1906	722	CS Britannia	Quarentined 14/7 because of Scarletina amongst the crew at Dakar
ETC Min Book	12	16/05/1906	784	CS Duplex	Lascar stoker scalded when combustion chamber blew
ETC Min Book	12	16/05/1906	791	Seychelles	Death of Mr Maxwell, Superentendent
ETC Min Book		30/05/1906	806	CS John Pender	Captain Halpin has "blood poisoning in hand"; to see a surgeon
ETC Min Book	12	01/06/1906	834	CS John Pender	Capt Halpin died on 1st of June

ETC Min Book	12	11/07/1906		854	Athens	Mr A Esperon to be retired because of bad health
ETC Min Book	12	25/07/1906		876		Discussions at Board meeting about employment of married men at unhealthy stations where their wives cannot reside.
ETC Min Book	12	31/10/1906		960	Malta	Report on the sick list Malta submitted to the Board
ETC Min Book	12	31/10/1906		961	Aden	Outbreak of Typhoid fever at Aden. Sanitary conditions to be reported upon
ETC Min Book	12	28/11/1906		994	Bombay	Mr RH Bell, Supervisor, resigned due to poor health
ETC Min Book	13	09/01/1907		48	St Helena	Mr HS Prowse, ill, summoned to see doctor in London but died in London.
Zodiac	1	?/01/1907	164		London	Mr PR Ranger, Assistant Accountant, suddenly died aged 43
Zodiac	1	?/01/1907	174		London	Mr HS Pickworth, counter clerk, died aged 29 from pneumonia
ETC Min Book	13	20/03/1907		144	CS Sentenil	CS Sentenil reports that on the 8th March 1907, the doctor, Chief & 3rd Engineering Officers, the 2nd Officer and the cable jointer have fever. Further, on the 10th March Mr Witt, the cable jointer died; the others are improving
Zodiac	2	April-May 1907	23		Head Office	Mr WM Hugh Boeck Chief Clerk, Transfers Office. Died suddenly aged 33
Zodiac	2	April-May 1907	77		Fayal	Mr EF Swords died a few weeks after he was married
ETC Min Book	13	12/06/1907		235	Syra	James Anderson recomends retirement of Mr Maroulianos, abstract clerk at Syra Stn due to mental trouble, age 53
ETC Min Book	13	12/06/1907		236	Alexandria	Mr Degaetano, clerk at Alex "no longer fit for work" age 50
ETC Min Book	13	27/11/1907		391	CS Electra	At Aden, landed several cases of beri beri amongst crew.
Zodiac	2	01/01/1908	227		CS Britannia	Charles Johnson, 2nd Officer of CS Britannia, died of fever in hospital in Loanda
ETC Min Book	13	08/01/1908		432	CS Colonia	The loss was reported of Mr London, Cable Engineer of CS Colonia, while on a shooting expedition on the 20th ulto near Mombassa
ETC Min Book	13	08/01/1908		437	Head Office	Mr GH Fischer, 3rd class clerk in the Engineer's department,

						away sick
ETC Min Book	13	05/02/1908		476	Bombay	Mr H Nicholson, operator, to retire due to ill health and seek employment in the UK
ETC Min Book	13	19/02/1908		491	Porthcurno	Death by drowning whilst bathing off the beach of Probationer Reece-Heal. Premium to be repaid to his father. Also noted in Zodiac vol 2 p234
ETC Min Book	13	27/05/1908		630	Head Office	Pobationers must take out life insurance
ETC Min Book	13	06/01/1909		792	Gibraltar	Mr GO Spratt, superintendent invalided home and died from insomnia and neuralgia
Zodiac	3	??/2/1909	151		Tangier	Mr HR Harvey, Superintendent, died suddenly on the 4th Jan. "martyr to dyspepsia"
ETC Min Book	13	06/01/1909		793	Vigo	Typhoid fever amongst staff
ETC Min Book	13	03/02/1909		826	Marseilles	Mr GF Lawton, late Supt, retired due to ill health
ETC Min Book	13	17/02/1909		845	Tangier	Mr RH Harvey, Officer in Charge died suddenly last month. ETC to pay for young son's education.
ETC Min Book	13	17/03/1909		878	Vigo	End of typhoid fever outbreaK
ETC Min Book	14	21/07/1909		18	Malta	Mr WL Hendrie, a clerk at Malta Station, came home on furlough in October 1908 but suffering from phthisis. But not fit to return to work
ETC Min Book	14	16/02/1910		209		Mr CW Harding, 31, Phthisis. Unfit for further work. To be retired with a pension.
ETC Min Book	14	08/06/1910		310	Aden	Staff to be inoculated against enteric fever
Zodiac	4	?/4/1910	7		Teheran	Mr HC Darvell of the Indo-European Teleg Co died from Typhoid fever & pneumonia at the4 age of 29 on the 29th of Nov 1909
Zodiac	4	?/8/1910	140		P&O SS Borneo	Mr RBJ Grey, Supt at Broome, Western Australia, on his way home on furlough, washed overboard in high seas.
ETC Min Book	14	26/10/1910		402	CS Britannia	Capt Macarthur invalided home on the 17th leaving Chief Officer Pattison in command
ETC Min Book	14	07/12/1910		465	Zanzibar	ETC Board consider purchasing the hospital at Zanzibar which will other wise be closed.

ETC Min Book	14	05/04/1911		515	Rodriguez; CS Duplex	6 men from Rodriguez were lost at sea from pilot boat when bringing CS Duplex in in a hurricane
Zodiac	6	17/06/1912	35		Carcavellos	Mr EV Wyse, Supt, dies after brief and painful illness aged 64
ETC Min Book	14	28/06/1911		557		Mr RN Johnson retired early as suffering from phthisis aged 30
ETC Min Book	14	07/02/1911		688		Mr FJ Finlay, first officer. Not to sail any more due to poor eyesight.
ETC Min Book	14	07/02/1911		689	Vigo	Mr JP Mulholland, electrician at Vigo died 27th December 1910
ETC Min Book	15	25/09/1912		4	CS John Pender	"Epidemic" on the John Pender with 16 of the creww ill
ETC Min Book	15	25/09/1912		15	Porthcurno	Measles outbreak among the staff
ETC Min Book	15	25/09/1912		16	Vigo	Mr J Mckean, Supt, failing health. To be retired
ETC Min Book	15	05/07/1912		113	Athens	Turco - Balkan War: ETC staff injured on Gk Aux cruiser by shell from Turkish warship.
Zodiac	6	01/12/1912	189		Alexandria	Mr JE Cook died from Typhoid fever aged 27
Zodiac	6	13/12/1912	189		Shanghai	Mr FW Edwards died of acute peritonitis
Zodiac	6	??/03/1913	242		CS Amber	Death of Mr J Tannahill
ETC Min Book	15	16/04/1913		154	Porthcurno	Mr C Davey, 37, clerk at PK to be retired due to ill health
ETC Min Book	15	11/04/1913		189	LSTM	Donation of £250 to The London School of Tropical Medicine.
Zodiac	6	??/05/1913	298		CS Britannia	death of Mr JB Nichols
Zodiac	7	12/06/1913	10		Head Office	Ethel Plank, traffic department, dies of appendicitis & peritonitis
Zodiac	7	20/07/1913	57		Bombay	Mr Claude Haines, Supt, Bombay, washed overboard whilst on way home on furlough
ETC Min Book	15	12/11/1913		267	Bonny	Mr WA Duncombe died from hydrophobia [rabies] in August 1912
Zodiac	7	13/12.1913	155		Pera	Mr CH Weale, Supt at Pera Stn died
ETC Min Book	15	01/04/1914		357	Ascension	Mr Allan, clerk, 41, retired due to ill health
ETC Min Book	15	10/06/1914		404	Athens	Mr Bonatti, Div. Manager at Athens to be retired at 55 due to bad health.
ETC Min Book	15	10/06/1914		404	London	Mr HS Barber to be retired due to bad health at 41

ETC Min Book	15	24/06/1914	425	Alexandria	Sudden death of Mr TA Kime Superintendent on the 7th inst. Also mentioned in Zodiac vol 8 p16
ETC Min Book	15	14/10/1914	477	Cardiff	Mr AF Creighton retired because of ill health aged 29

9. Conclusions

9.1 Introduction

In this thesis I have shown that historians of submarine cable telegraphy have overlooked, deliberately or otherwise, issues of reliability and maintenance. I have attempted to show that this vast network of submarine cables was technically far from the picture of technical reliability assumed by cable historians. This is demonstrated in my **Time Line of Faults, Breaks, Interruptions & Repairs** (Appendix B of Chapter 2 on the attached CDROM). In this chapter, I will describe my conclusions about the reliability, maintenance and repair of the system and how the operating companies made the system as a whole appear reliable. Then I relate possible research which would elaborate further upon what I have found and on the subjects which I will be continuing my research.

9.2 Findings of the research

My first finding is that previous historians of submarine cable telegraphy have somewhat naively believed exactly what the Eastern Telegraph Company (ETC) and the Telegraph Construction and Maintenance Company (TCM) wanted them to believe – that submarine cable telegraphy was inherently technically reliable. The evidence for the actual situation was not easy to un-earth probably because cable operating companies as a whole and the ETC in particular, did not want the true situation to become public knowledge which would have had a deleterious effect on their dependability.

In Chapter 2, I described my methodology for interrogating the records that I have managed to unearth. Analysis of these records showed that, for the largest operating company, submarine telegraph cables appeared to commerce, governments and the general public to have a trouble free life of 50 – 70 years. However the truth was that the individual cables ended up as a patch-work of repairs and replaced sections of various lengths. The graph in Figure 9.1 shows that cables of the ETC which was inaugurated in 1873 required voyages by cable-ships at a rate of approximately one repair voyage for every 500 nautical miles of cable per annum and this figure remained constant from around 1875 to the Great War.

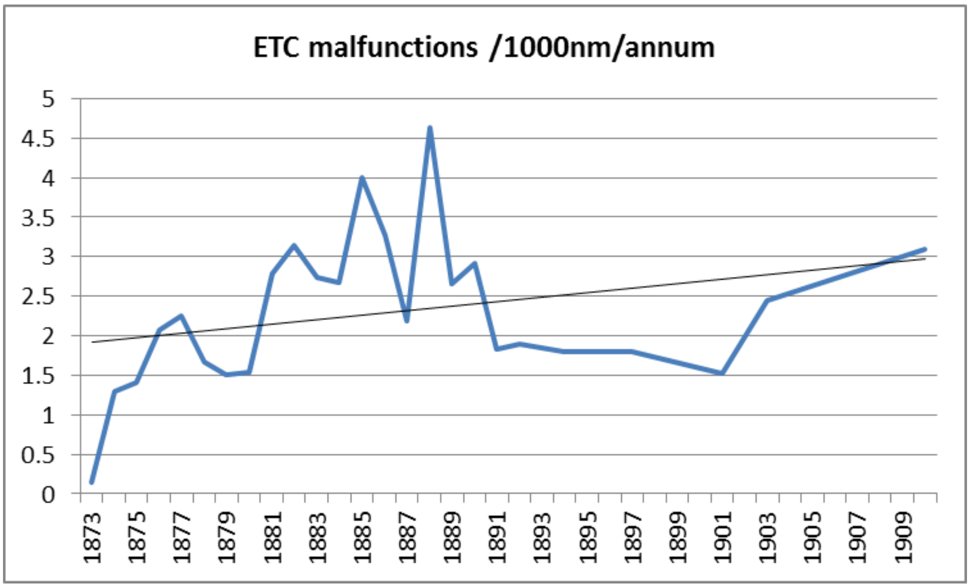

Figure 9.1 ETC malfunctions requiring repair voyages per 1000 nautical miles per annum with a linear trend line (black) showing an average of approximately one repair for every 500 nautical miles per year

In Chapter 3, I have laid out the early history of submarine cable technology during the *experimental period* which I have redefined as 1850 - 1860.[539] Towards the end of this period there was much concern in Government circles about the reliability of this new technology especially the reliability of long-distance deep-sea cables. This concern led to the Government of the day setting up a *Joint Committee Appointed by the Lords of the Committee of the Privy Council for Trade and the Atlantic Telegraph Company to Inquire into the Construction of Submarine Telegraph Cables* which began its investigations in 1859 (see Chapter 4).

The opinion of the *Committee of Inquiry* adduced that past cable failures were due, in the main, to causes which could have been avoided had the conditions been sufficiently understood beforehand. They also:

> expressed the conviction that submarine telegraphy might be as sure and remunerative in the future as it had been speculative in the past, provided that the specification, laying and maintenance of the cable were proceeded with on the lines laid down in their report.[540]

The Committee, which sat for more than a year, also stipulated that certain relevant investigations should be carried out by other learned institutions. The most important of these investigations was British Association for the Advancement of Science Standards

[539] Rather than Hugill's 1857-1858. (Hugill PJ. Global Communications since 1844, Geopolitics and Technology, Johns Hopkins University Press, Maryland, USA. 1999. P. 29.)
[540] Bright C, *Submarine Telegraphs, op cit,* p. 60.

Committee to investigate a universal unit of electrical resistance, an extremely important unit of measurement in all electrical technology. The measurement of resistance was the most important test for the location of faults in submarine cables.

In Chapter 5, I have described both the modifications in cable manufacture and laying which were the results of the *Committee of Inquiry* and the developments in complexity over the next 50 years which progressively led to a faster and more efficient submarine cable telegraph system. As more cable was laid, awareness of different causes of cable malfunction increased beyond the volcanoes and anchors originally suggested. The two most important advances were cable *duplexing* and cable *duplication*. Cable duplexing made use of more complex instrumentation at the cable stations which allowed telegrams to be sent and received in both directions along existing cables simultaneously. This immediately doubled the amount of traffic which could be communicated per unit time. Duplexing technology put increased responsibilities on the cable electricians due to its complexity. The increase in demand for international communication by cable also induced the operating companies to lay duplicate cables. This was beneficial both in managing the increasing traffic and had the probably initially unforeseen benefit of making the system as a whole appear more reliable in that when a cable failed the traffic load could be maintained using either the duplicate cables or by rerouting over entirely different circuits. This particular use of duplicate cables is now referred to as *engineering redundancy*, a very different use of the word used in common parlance.

Any complacency by the cable operating companies about improving the efficiency of cable telegraphy was dispelled in the late 1890s by wireless telegraphy (W/T) which as its name implies, did not require expensive capital outlay on the manufacture, laying and maintenance of undersea cables. Malfunction of a cable required organization of a repair voyage required not only serviceable cable ships and their crews to be available but also a great amount of planning: the ships had to be ready but also required time for the loading spare cable of various types in to their tanks, bunkering, taking on of fresh water and victuals, sailing to the area of cable malfunction and actually finding the exact location for the repair. The operating companies struggled to hide the reasons for the high tariffs which were in large part due to maintaining a fleet of these repair ships around the world each with a crew of between 30 and 50 highly skilled men and also very expensive spare cable on board. By the end of the Victorian era, ETC alone had more than 10 repair ships at sea. Regular visits to dry docks for cleaning and repairs, boiler cleaning as they were all fuelled by coal, occupied their time whilst not on repair voyages. There were also many costly delays due to bad weather.

There was great concern that W/T might have presaged the end of cable telegraphy but this proved not to be the case for several decades as early wireless could only maintain communication between two stations when atmospheric propagation and solar weather permitted, only one channel of communication existed per station and there was a major disadvantage in the lack of secrecy. W/T proved of greatest benefit when one or both stations were mobile for example ship-to-shore and ship-to-ship. It had very little effect upon the market share of cable telegraphy but did induce the cable operating companies to reduce their tariffs markedly which suggests that the cable operating companies were taking excessive profits.[541]

In Chapter 6, I have compared two repair expeditions from the 1880s as examples of complexity and expense of repairing submarine telegraph cables. The examples I have chosen were typical of such expeditions in any part of the period under consideration, after the *Committee of Inquiry*. The specific choice of the failure of the St Vincent to Pernambuco section of the cable from Portugal to Brazil on the 21st Sept 1883 was because most of the documents related this particular repair were available in the archives. This repair was typical as I have examined documents from many other repairs but none were so complete. At the time of this repair the operating company, the Brazilian Submarine Telegraph Company (BSTC) had not been absorbed into the mighty Eastern Telegraph group. Therefore the BSTC, a single cable concern, had to subcontract the repair to the Telegraph Construction and Maintenance Company (TCM) with all the legal complications involved. Also I was able to demonstrate the effect of the cable failure upon the BSTC income and share price. I have compared this repair expedition with the 1888 repair expedition to repair the Porthcurno – Lisbon – Vigo cable. Very much less detail is available in the archives as this cable was owned by the ETC and repaired by the ETC's own staff and ship. An advantage to the ETC was that of commercial secrecy: the malfunction of the cable was not apparent to those outside the company because traffic was re-routed through one of several duplicate cables and there were no lawyers or other parties involved.

It is obvious that for the duration of failure of a particular cable or section of cable, that cable was not capable of carrying telegrams and therefore produced no revenue. Thus the quicker and more accurately the malfunction was located and repaired the better. Before repair, the geographical location of the problem was ascertained by the station electricians. In Chapter 7,

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[541] F. J. Brown, *Cable and Wireless Communications of the World.* Sir Isaac Pitman & Sons, London , 1927, pp. 89-100.

I describe the history of the tests used to estimate the location. This history parallels the development of tests for the measurement of electrical resistance in general and in many cases cable telegraphy was the reason for their development. There were three main stages: (1) comparatively crude comparison tests adopted from land-line telegraphy were superseded by (2) bridge tests with the adoption of the Wheatstone bridge and latterly (3) combination of bridge tests by calibrated milliammeters.[542] Very few new tests were developed between 1900 and 1925; “correction” formulae were the main additions to the armoury of fault localization tests. I surmise that this technical “plateau” was due either to a lackadaisical state of mind brought on by Eastern Telegraph’s near monopoly or due to the technology having reached the limit of its possibilities. The next generation of fault localization had to await the invention of pulse reflection technology.[543]

The reliability of communication by submarine cable was also dependent upon the skilled work force both in the UK and at the cable stations around the world. In Chapter 8, I have described how they were selected and trained and “maintained”. It is clear that although apprenticeships had for centuries been the basis of training in almost all disciplines, no other discipline had developed so rapidly in the past. This lead to apprenticeships which had to be based as much on the tacit theoretical background of the subject as well as the explicit practical experience whereas in the past skills were learnt entirely on-the-job. Further, never before had there been such rapid advancement and increase in complexity over such a short period of time. Thus it was also necessary to maintain continuous professional development of especially the electricians which often proved difficult when they were at geographically distant cable stations.

I then discussed the operating company’s concerns about maintaining the health and well-being of its ex-patriate staff. Many of the cable stations were in inhospitable parts of the world. Much knowledge had been acquired about tropical medicine and health from diplomatic and military experience in the Victorian era which was rapidly applied to the rapidly expanding submarine cable industry. The ETC applied all the new techniques of health and sanitation to its cable stations, no doubt because it saw its employees as being its greatest asset.

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[542] Many of the tests were still in use in the 1920s. (see J. H. Stephens, *Telegraph Cable Engineering,* Vols 1-3, The Eastern Associated Telegraph Companies. 1923, “Private internal circulation only”).

[543] Localization by pulse reflection technology relied upon the finite velocity of the conduction of electricity in a particular medium. In the case of submarine telegraph cables, a pulse of electricity was transmitted from one end or the other. This pulse was reflected at the break in the cable and detected at the same end as its source. The delay in the returned pulse was proportional to twice the distance to the break.

9.3 Sociological theories of technology

It is hard to apply Hughes' theories about large technological systems (LTS).[544] Although there are many possible "reverse salients" in the submarine cable telegraph system, Hughes' theories which major on technology and organization, whereas the individual *users* (operators and maintenance staff) involved were of equal importance. Hughes' work was based on the electricity supply industry in the USA which appears far less complex than the older, world-wide cable telegraph network. Hughes studied LTSs which although large were comparatively parochial as the electricity supply industry he studies was not part of an integrated nationa or international network. Similarly, Bijker & Pinch's theories on the social construction of technology are not applicable to the study of the *maintenance* of a system but only to its development in the first place.[545] All of these theories are biased towards the early history and further development of LTS. I see no benefit in trying to force the reliability and maintenance of submarine cable telegraphy to any of the current sociological theories of technology which are concerned with design and development of systems and not their maintenance.

Surprisingly, there is little in the general academic literature about engineering maintenance and reliability until the 1950s with the rebuilding of industry after the *Second* World War. From the evidence I have found theories about *reliability, (engineering) "redundancy"* and *maintenance* could have been promulgated decades before if more attention had been paid to the evidence of the Victorian era by *engineers.*

Modern theories of engineering reliability and maintenance are summarised by the bathtub curve (Figure 9.1).[546] The same curve could be applied to Victorian submarine cable telegraphy. The bathtub curve originates from studies of human longevity, hence the term "infant mortality". It is not clear from the available evidence what were the causes of the final "wear out phase" except in very few cases.

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[544] T. P. Hughes, *Networks of Power – Electrification in Western Society 1880-1930.* The Johns Hopkins University Press, Baltimore. 1983.

[545] T. Pinch, W. E. Bijke. The social construction of facts and artefacts: or how the sociology of science and the sociology of technology might benefit each other". *Social Studies of Science*., vol 14**,** 1984, pp.388–441.

[546] Modified from *Asset Maintenance Management – The path toward defect elimination*. www.lifetime-reliability.com Last accessed 20.5.2014

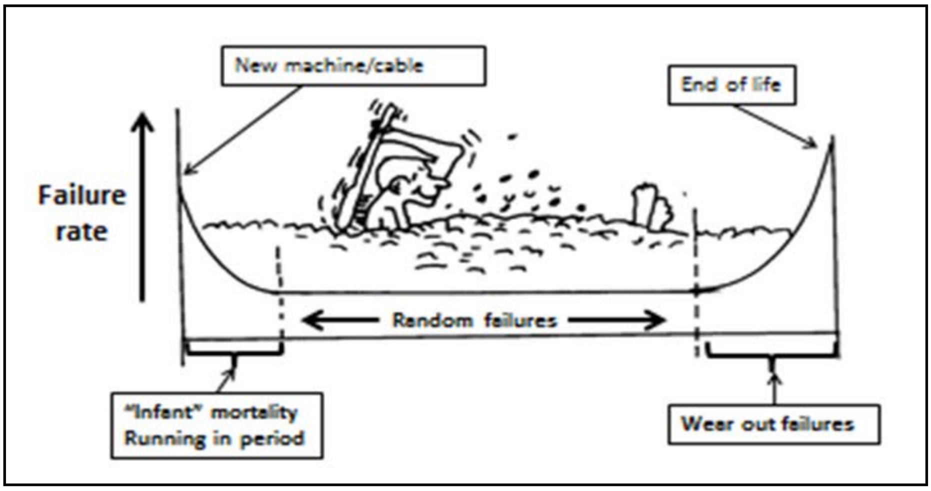

Fig 9.2 The "Bath Tub" Curve modified from *Asset Maintenance Management – The path toward defect elimination*. www.lifetime-reliability.com

9.4 "Reliability Engineering"

To those outside the world of science and engineering the word *reliable* means "able to be trusted, trustworthy, safe, sure, dependable and consistently good in quality" and was used as an adjective referring to people[547] From the scientist's and engineer's point of view it has much more exact meanings. To the scientist *reliability* refers to accuracy, repeatability and precision of measurement as ably discussed in Gooday's *Morals of Measurement*.[548] However, to the engineer *reliability* has yet a further additional definition:

> Reliability – the characteristic of an item expressed by the probability that it will perform a required function under stated conditions for a stated period of time.[549]

Or

> The capability of an equipment not to breakdown.[550]

I postulate that the historiography I have related very much correlates with what is now termed *Reliability Engineering* which is said to have originated during the late 1940s and 1950s but which is now a very important engineering specialty especially related to safety critical systems and also to mass production. Although cable telegraphy could not really be termed "safety critical" (ie "lives depend upon it"), the manufacture of submarine cable was definitely "mass production".

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[547] *Oxford English Dictionary,* entry No 161905 last accessed 23.10.2012. The word *reliability* was coined by Samuel T. Coleridge in 1816 in praise of his friend the poet Robert Southey

[548] G. J. N. Gooday. *Morals and Measurement – Accuracy, irony, and trust in late Victorian electrical practice.* Cambridge University Press, 2004, pp. 40-81.

[549] G. W. A. Dummer, M. H. Tooley, R. C. Winton, *An Elementary Guide to Reliability,* Butterworth Heinemann, Oxford, 1997, p. 6, quoting both the British Standards Institute and the International Electrotechnical Commission.

[550] I. Bazovsky, *Reliability theory and Practice.* Prentice-Hall Inc, New Jersey, 1961, p. 3.

The history of engineering reliability began with Pierre Fermat and Blaise Pascal developing theories of probability in 1654 and William Hooper's first use of the word "statistics" in 1771.[551] *Reliability Engineering* considers mathematically predicting the causes of equipment failure and looks for ways of reducing or eliminating the causes.

Although qualitative attempts at improving quality of products were the main aim of apprenticeships as far back as the middle ages, the catalyst to the development of *Reliability Engineering* as a new discipline was mass production, especially Ford cars, Springfield rifles and, in World War 2, thermionic valves. The coming-of-age of reliability engineering was the establishment of the *Ad Hoc Group on Reliability of Military Electronic Equipment* (AGREE) 1950-1957.[552] The group recommendations included better keeping of records of equipment or component failure; development of better quality components; establishment of quantitative specifications including reliability requirements; newly developed equipment should be tested in simulated situations before full-scale production.

There is a similarity here with the catastrophic expensive failure of intercontinental deep-water submarine telegraph cables being the "catalyst" which lead to the *House of Lords Committee of Privy Council for Trade and The Atlantic Telegraph Company to Enquire into the Construction of Submarine Telegraph Cables* whose recommendation were very similar to those of AGREE. However the concern for secrecy by the major cable companies did not allow the specialty of reliability engineering *per se,* to grow until the next major reliability crisis 90 years later.

Recently (2014), Anique Hommels and colleagues have published a book entitled *Vulnerability in Technological Cultures: New Directions in Research and Governance.*[553] I found that this tome is not particularly relevant to this thesis: it is based on 20th century experience, mainly in India and the Netherlands and strangely does not mention reliability engineering which grew as an important discipline especially during World War 2 and thereafter.

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[551] J. H. Selah, Marais K, Highlights from the early (and pre-) history of reliability engineering. *ReliabilityEngineering & System Safety*, vol 91, 2006, p. 250.

[552] A. Coppola. Reliability Engineering of Electronic Equipment – A historical perspective. *IEEE Trans on Reliability,* vol R-33, 1984, pp. 29-35.

[553] A. Hommels, J. Mesman, W.E. Bijker, *Vulnerability in Technological Cultures: New Directions in Research and Governance.* M. I. T. Press, Cambridge, Massachusetts, 2014.

9.5 Summary of Key Findings

Overall I conclude that the operating companies did conceal the unreliability and the maintenance costs which were much greater than those of *wireless* telegraphy. After a faltering start, the worldwide submarine cable telegraph system over the period under study, began with a technically experimental and somewhat unreliable period (1850-1860). This lead to the setting up of the *House of Lords Committee of Privy Council for Trade and The Atlantic Telegraph Company to Enquire into the Construction of Submarine Telegraph Cables* by HM Government in 1859. The outcome foresaw a good future for this new technology if standards in all aspects of the technology were improved and lead to an exponential growth in the industry. This in turn lead to advances in equipment especially in precision instruments which were also robust enough to operate in the marine environment and in a large range of climatic conditions. This all required better training and research at academic institutions which benefitted other precision electrical technologies. The most startling finding of my research was the lack of historical awareness of the actual unreliability of the cable system which was carefully concealed deliberately or otherwise by the cable operating companies.

9.6 Future Research

Future research that leads directly from my thesis should include:

- Investigation of the costs and profits related to maintenance of the cables. It would be of benefit to the corpus of knowledge on Victorian submarine cable telegraphy for an economic historian to investigate the financial history of the Eastern Telegraph Group especially looking at the cost of maintenance and repair and also the financial effects of the threats from wireless telegraphy..
- Formation of a database of all submarine telegraph cables. A problem that has dogged the research for this thesis and for further in-depth technical studies, is the lack of a comprehensive database of all submarine telegraph cables laid since 1850. There is a basic list of cables on the Atlantic Cable website www.atlantic-cable.com maintained independently by Bill Burns in New York. It is my intention together with Bill Burns, Dr Nicole Starosielski of New York University and The Telegraph Museum, Porthcurno to set up a definitive database of cables which will be available to other researchers on-line. Entries will include detail, technical and otherwise, available in the archives.

10. Epilogue – The "Reverse Maintenance" of the Great War

10.1 The early months of the Great War

The beginning of the Great War heralded a new field of application for the skills of cable electricians and engineers. Their skills were applied on deliberately cutting or re-routing some strategic cables that they so assiduously laid and maintained.

Although the Eastern Telegraph Company had coped with the experiences of conflict in the past, for example in July 1882, when the Alexandria cable station had to be moved out to sea in CS Chiltern whilst the city was bombarded, the experiences of the Great War far eclipsed anything the company had had to cope with in the past.[554] At the commencement of the Great War (1914-1918) there were 18 working cables spanning the Atlantic Ocean (Table 10.1)

Table 10.1 Working Cables at the commencement of the Gt War

Route	Year laid
Valentia – Heart's Content	1873, 1874, 1880, 1894
Sennen Cove – Bay Roberts	1881,1882, 1910
Waterville – St Johns	1884, 1884, 1894, 1905
Waterville – Azores – Canso*	1901
Brest – Cape Cod*	1898
Brest – Azores - New York*	1900-1903
Porthcurno – Harbour Grace	1874
Porthcurno – Halifax	1900-1904
Porthcurno – Horta (Azores)	1906

*Cable routes used by the German government

The British Government's ultimatum to the German Government concerning Belgian neutrality expired at 2300GMT on the 3rd of August 1914. Within two hours the General Post Office Cable Ship *Alert* sailed from Dover harbor on a pre-planned mission.[555] Before dawn but under the light of a full moon she had grappled and cut all of Germany's trans-Atlantic cable routes

[554] James SH, Reminiscences of the Bombardment of Alexandria in 1882. *Zodiac* vol 3, pp106107

[555] Most historians base their narratives upon Barbara Tuchmann's *The Zimmermann Telegram* where she states that the Telegraph Construction and Maintenance Company's *CS Telconia* carried out this daring mission. But see Bordeaux J, Submarine Superintendent, Dover, to Secretary, GPO, 7th August, 1914, POST 56/55, Post Office Archives, London.

and their cables from Borkum to Brest, Vigo and Tenerife. The cables that were cut were all the property of Britain or Germany. The strategic importance of the cables chosen was that Germany could still contact the USA but only via neutral Scandinavia or eastwards overland through non-friendly territory, either Russia or India. Ironically The Western Union Company of America had been trying to negotiate the laying of an American owned cable from New York direct to Germany but it was thwarted by the owners of the one existing German-owned company which feared losing it income. Fierce anger erupted in the upper echelons of the Teuton government when negotiation broke down just prior to the declaration of war because such an American owned cable could not have been cut by the UK and would have been a valuable link to German sympathisers in the USA.[556] The Germans seemed to have missed the fact that the Scandinavian cables to North America passed through relay stations in the British Isles. Any telegrams sent to the USA from Germany were read by "Room 40", the decryption centre at the Admiralty in London. At later stages in the War some of the cut cables were re-routed so that they *started* in England rather than Germany.

The Germans forces also had an important communications hub on Yap Island in the Pacific Ocean (Figure 10.1 and 10.2). At the outbreak of the Great War Yap Island and its telecommunications came under the mandate of Japan. On the 12th of August British cruisers destroyed the wireless station and the Japanese closed the cable station for the duration of the war.[557]

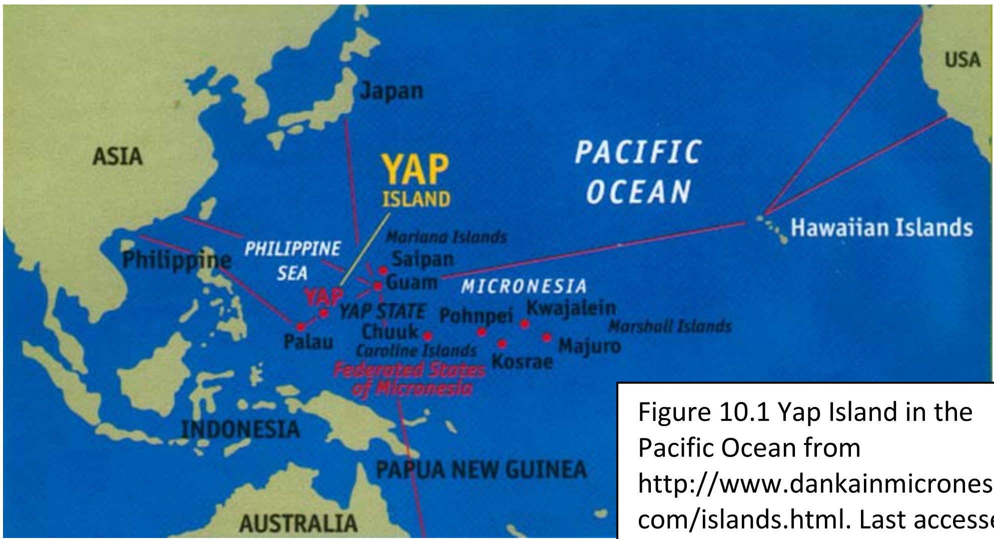

Figure 10.1 Yap Island in the Pacific Ocean from http://www.dankainmicronesia.com/islands.html. Last accessed 6.2.2015

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[556] Anon. The Romance of the British Cable Service in War. *The Great War – The Standard History of World Wide Conflict.*, Part 195 May 11th 1919, The Amalgamated Press Ltd, London, pp213-4. Porthcurno Telegraph Museum DOC//12/314.

[557] Bruton E, 2014, http://blogs.mhs.ox.ac.uk/innovatingincombat/yap-island-german-cable-telegraphy-world-war-one/ Last viewed 15/4/2014

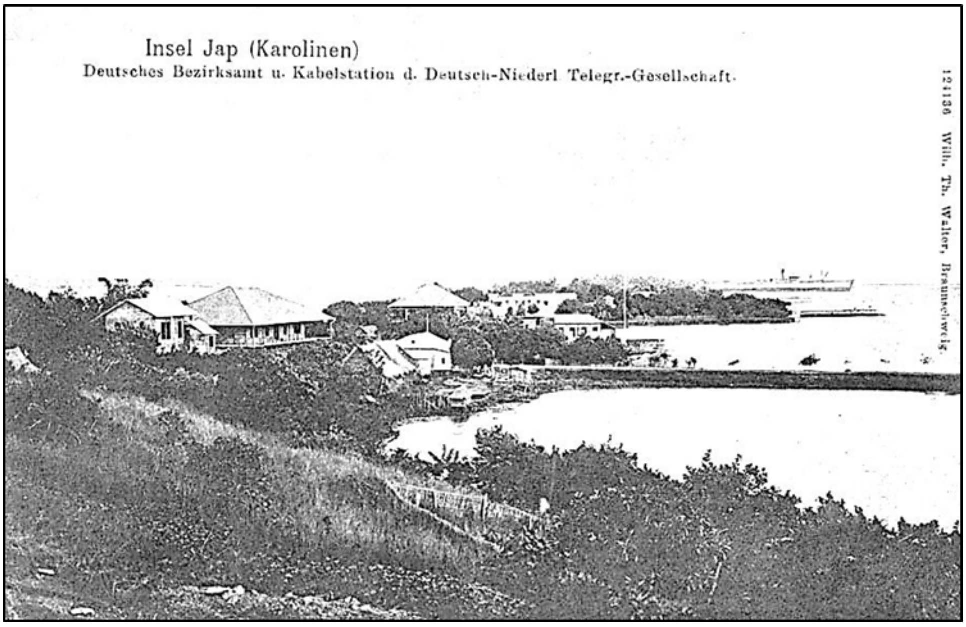
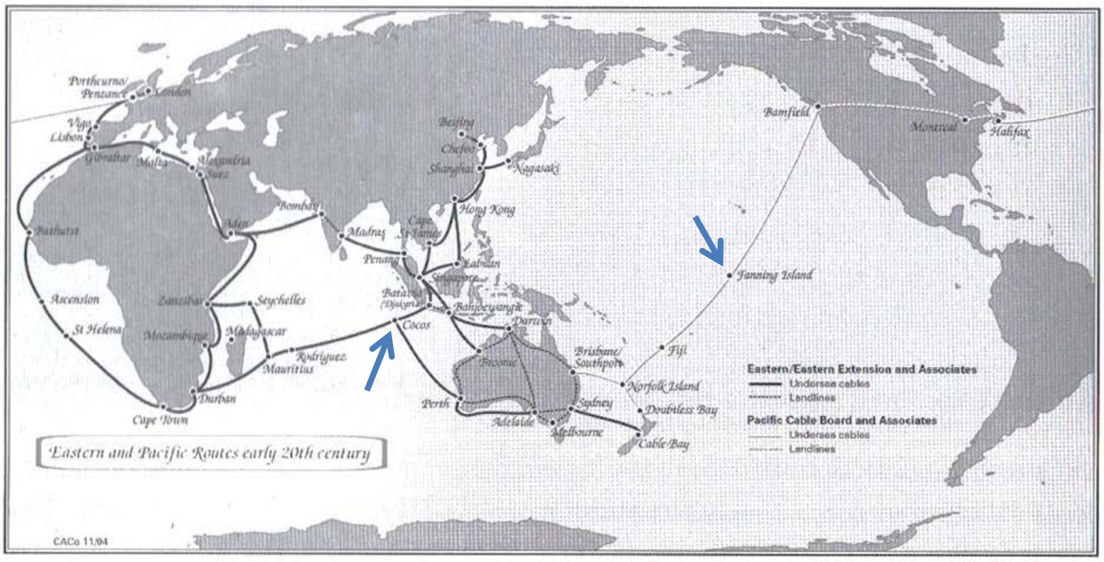


Figure 10.2 German-Netherlands Telegraph Company District Office and Cable Station, Yap. **CS Stephan** is at centre right. Dated 2 July 1908, the card was sent to a member of the staff of the German Atlantic Telegraph Company Cable Station at Vigo, Spain. Image available in the public domain via Atlantic-Cable.com. Last accessed 6.2.2015

Within a few days of the outbreak of the Great War, the four British cable men who worked at a small outpost station at Swakopmund in South-West Africa, a small Germany colony, were arrested and accused of having communicated with military forces in Cape Town where ETC had a large cable station. The charges were completely false but they were treated very badly as base-criminals. Only after eleven harsh months were they released by General Botha the Boer General.[558]

The UK still had cable routes around the globe including to Australasia as shown in the map below. It was not lost on the Germans that communication to and from Australasia was vulnerable at two easily assaulted points Fanning Island and the Cocos Islands.

[558] The Romance of the British Cable Service in War. P215



Cartographic Art Co, Greytown

Figure 10.3 Cocos and Fanning Islands. From Elisabeth Airey, *The Taming of Distance*, 2005, Dunmore Publishing, New Zealand,

Fanning Island is one of a group of lonely coral islets in the Pacific Ocean not far south of the equator (see Figure 10.3). However it was a very important cable relay station between Banfield 3600nm to the north and Fiji (and thence Norfolk Island and Australasia). Early on the 7th of September 1914, The German light cruiser Nürnberg with an accompanying collier arrived off Fanning Island. The telegraph station superintendent surrendered the un-armed and un-protected station to a landing party. The landing party end set about destroying the equipment but a remarkable amount was left undamaged as none of the Germans had any understanding of the technology. They did however raid the station's safe and stole a considerable amount of money and a map showing where spare equipment was buried. This equipment was blown up. They also destroyed the refrigeration plant as they thought it was something to do with wireless telegraphy.[559] The damage would have been much worse if a German telegrapher or electrician had been in the raiding party. They did however destroy the station's refrigerator mistaking it for a wireless transmitter. This was not too surprising as there was some external similarity in their components. (Figure 10.4)

[559] Anon, The Romance of the British Cable Service in War, *The Great War, (*a monthly periodical published in London in 1918) chapter 37, p216ff

Fig 10.4 Aerial tuning inductor of 1914 vintage and a refrigerator of the same era (from the archives, Telegraph Museum, Porthcurno

The Germans were very courteous and no one was injured. They left after 12 hours. The Admiralty had predicted two weeks before the landing that it was a possibility and as soon as communication was cut, SS *Kestrel* was commissioned from London to re-supply the station and repair the damage. Meanwhile the station electricians manage to jury-rig the remaining equipment and weak signals were received and sent within three days.[560]

In an attempt to completely cut communications between the UK and Australasia, The German commerce raider *Emden* was sent to the Cocos-Keeling Islands (see Figure 10.4) in the Indian Ocean.[561] The *Emden* was accompanied by the British collier *SS Buresk* which the Emden had captured with a full load of high grade Welsh steam coal. As at Fanning Island a landing party was sent to destroy communications equipment and cables. Arriving on 9th November 1914, they did not achieve the surprise that they had at Fanning and before they laid foot on Direction Island which was the home of the cable station, the station staff had sent distress messages via each of its three cables. The wireless station signals were also picked up by several Australian warships which were in the vicinity. The landing party were received cordially and set about damaging the cable equipment, wireless station and some of the cable shore-ends. However they were prematurely recalled by the *Emden* when her crew saw smoke on the horizon. Before the landing party could get back to their mother ship, she had

[560] The *Nürnberg* was eventually sunk by *HMS Kent* of the Falkland Islands.
[561] Lockner RK, *The Last Gentleman of War – The raider exploits of the Cruiser Emden.* 1988, Century-Hutchinson, London, ISBN 0-09-173782-6.

to rapidly set sail abandoning them. The *Emden* was destroyed by *HMAS Sydney* and her captain beached the sinking *Emden* so that what was left of her crew might survive. The landing party, left to their own devices, stole the Governor's schooner, *Ayesha*, and eventually made their way through many exciting adventures by to the Fatherland.[562] The station staff made valiant and successful efforts to get the cable station back to temporary working order using secretly buried spares. Again lack of knowledge by the Germans left important equipment spared and some of the cables as the staff had laid several dummy shore-ends of cables.

During the first few months of the war there was a shortage of submarine telegraph cable so the GPO chartered the CS *John Pender* from the Eastern Telegraph Company to pick up the 247nm section of the Borkum – Fayal (1903) cable between Folkestone and Lands' End as it was in extremely good condition.[563] Several of the cut German owned cables to the UK were redirected to increase cable capacity to France and the Channel Islands. Other cable ships including CS *Telconia* of the telegraph Construction & Maintenance Company and CS *Dacia* from the India Rubber & Gutta Perch Company were also chartered for this work.[564]

10.2 The Eastern Telegraph Company's attitude to the war

Initially ETC's management saw a financial oppurtunity in the War because of increased telecommunications especially by verbose diplomats but they were soon on the horns of a dilemma: many of the staff wanted to sign up to Kitchener's call to arms.[565]

When the first member of the operating/engineering staff, a Mr FW Clinton, resigned to become a Royal Naval Telegrapher, he was told that he would only be re-employed at a reduced salary and level of seniority.[566] The flow of specialized staff from the company to the armed forces was staunched to some extent by making it clear to them that operating and maintaining the cable network was "necessary war work".

> The skilled operating staffs of the Eastern and Associated Telegraph Companies are now on War Duty, keeping the wires at work in every part of the world, and

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[562] Mücke H. *The Emden-Ayesha Adventure: German Raiders in the South Seas and Beyond,* 1914 (Classics of Naval Literature Series)

[563] De Cogan D, The Great War of 1914-8 http://dandadec.files.wordpress.com/2013/07/8-the-great-war-of-1914-18.pdf (last accessed 22/11/2113) page 1

[564] De Cogan D, The Great War of 1914-8 http://dandadec.files.wordpress.com/2013/07/8-the-great-war-of-1914-18.pdf (last accessed 22/11/2113) page 2

[565] Gagen W: *"Not Another Hero: The Eastern Telegraph Company's Creation of the Soldier Hero and Company Man"*. PDF article at the Porthcurno Telegraph Museum website, retrieved 5 December 2013.

[566] Minutes of ETC Board Meeting. 9 December 1914, vol 14, p281, minute number 521

> being indispensable to the country, they cannot leave their instruments for the more adventurous career of a soldier, as many would wish to do.[567]

Head Office staff who were not operators or electricians were soon allowed freedom to volunteer; ETC had little choice especially when Mr Henry Denison-Pender, son of one of the Board members volunteered and was commissioned, and was soon involved in front line fighting.[568] Also Captain Lord Arthur Vincent Hay of the Irish Guards who was the son of the late Lord Tweedsdale, another Board member, was killed in action in 1914.[569] "Letters from the Front" immediately became an important section in each war-time edition of *Zodiac.*

The next problem for the Board of ETC was with the skilled staff who "stayed behind" either at UK cable stations or who were expatriate. They were the butt of the white feather brigade and branded as cowards. Eventually the War Office allowed the ETC to mint a medal (Figure 10.5) to be worn by these specialist staff to make it clear to the public that they were on important essential war work.

> It was reported that in reply to our further application the Army Council now state that they have no objection to the use of private badges provided that the design does not include any part of the Royal Insignia, or the words 'On his Majesty's Service'. Approved. The following words are to be embodied on the badge – 'Telegraph Cable Service'.[570]

Figure 10.5 ETC War medal. Photograph by the author at The Telegraph Museum, Porthcurno

[567] Editorial *The Zodiac*, September 1914 Vol.3 No.86 p.31
[568] Editorial *The Zodiac*, September 1914 Vol.3 No.86 p.31
[569] Editorial *The Zodiac*, September 1914 Vol.3 No.86 p42.
[570] Porthcurno Telegraph Museum. DOC/CW/1/25 Minute Book No.15 p.329; Minute number 605: Issue of Private Badges to our Staff

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	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2	08/01/1857	"Ostend Cable" (Sub Tel Co)	Damaged by dragged anchor in gale on the 5th Jan.					Damaged by dragged anchor in gale on the 5th Jan.
3	08/01/1857	"Calais Cable" (Sub Tel Co)	Damaged by dragged anchor in gale on the 5th Jan.					Damaged by dragged anchor in gale on the 5th Jan.
4	03/01/1859	Malta - Sardinia	Cable broken since the 20th December			SS Caradoc		Cable broken since the 20th December
5	04/02/1859	Malta - Cagliari	"up to the 24th damage still not found"					"up to the 24th damage still not found"
6	12/02/1859	Malta - Cagliari	"still interrupted after 45/7. Still trying to locate fault"					"still interrupted after 45/7. Still trying to locate fault"
7	02/03/1859	Malta - Cagliari	"…has been repaired"					"…has been repaired"
8	25/07/1859	Aden - Suez	"…confidant that cable will be repaired by the end of the month…"					"…confidant thet cable will be repaired by the end of the month…"
9	02/08/1859	Aden - Suez	Comms re-established			SS Cyclops		Comms re-established
10	21/09/1859	Isle of Man cable	interrupted for some days					Interrupted for some days

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
11	13/01/1860	Liverpool - Birkenhead	Repeatedly damaged by ship's anchors. Possibly to be abandoned in favour of land-line.					Repeatedly damaged by ship's anchors. Possibly to be abandoned in favour of land-line.
12	16/01/1860	Singpore - Batavia	Damaged by ship's anchor a few days after it was laid. Repaired immediately.					Damaged by ship's anchor a few days after it was laid. Repaired immediately.
13	08/02/1860	UK - Holland	"the original cable…a complete loss and to be abandoned…"					"the original cable…a complete loss and to be abandoned…"
14	08/02/1860	Malta - Cagliari	"…has a fault which will be repaired when the weather improves…"					"…has a fault which will be repaired when the weather improves…"
15	07/05/1860	Aden - Suez	Remains interrupted					Remains interrupted
16	06/12/1860	Channel Islands	EIGHT fractures since 1858 due to the rough sea bed					EIGHT fractures since 1858 due to the rough sea bed
17	22/01/1861	Sweden - Denmark	Interrupted					Interrupted

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
18	24/03/1861	Red Sea Cable	"Cable badly corroded in many places"					"Cable badly corroded in many places"
19	28/08/1863	Bengaze - Alexandria	Repaired 18th inst					Repaired 18th inst
20	07/09/1863	Malta - Alexandria	Damage in 10 places caused by the anchors of 150 sponge boats - repaired					Damage in 10 places caused by the anchors of 150 sponge boats - repaired
21	14/04/1864	Lowestoft - Amsterdam (Elec & Int Teleg Co	Repaired "earlier this month"			CS Monarch		Repaired "earlier this month"
22	01/07/1864	Spessia - Sardinia - Cape Corso, Corsica (1854)	Interrupted by sharp rocks					Interrupted by sharp rocks
23	11/10/1864	Bussora - Kurrachee	Restored					Restored
24	25/05/1865	Alexandria - ?Malta	6 fractures caused by rocks repaired					6 fractures caused by rocks repaired
25	29/11/1865	Corfu - Oranto (1861)	Repaired			CS Hawk		Repaired
26	27/12/1865	Malta - Sicily	Interrupted yesterday					Interrupted yesterday

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
27	21/08/1866	Atlantic	Land-line interrupted between Bay du Nord and Grandy's Brook, 300 miles from Heart's Content.					Land-line interrupted between Bay du Nord and Grandy's Brook, 300 miles from Heart's Content.
28	15/10/1866	Malta - Alexandria	Repaired			CS Hawk		Repaired
29	12/12/1866	Malta - Alexandria	Again ruptured 230 miles from Alexandria			CS Hawk		Again ruptured 230 miles from Alexandria
30	17/12/1866	Malta - Alexandria	Repaired					Repaired
31	20/05/1867	Atlantic (1866)	Fault a mile and a half from Heart's Content - Repaired in one day					Fault a mile and a half from Heart's Content - Repaired in one day
32	23/09/1867	Atlantic (1866)	Repaired 88miles from Heart's Content					Repaired 88miles from Heart's Content
33	24/09/1867	Atlantic (1866)	Complaints of delays by Reuters					Complaints of delays by Reuters
34	22/11/1867	Malta - Alexandria	Repaired			CS Hawk		Repaired
35	02/12/1867	Persian Gulf Cable	Interrupted					Interrupted

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
36	02/03/1868							2nd March and days folowing to about the 28th May: Correspondence about the unreliability of the Telegraph to India.
37	24/07/1868	Malta - Alexandria	Broken					Broken
38	04/12/1868							More about unreliable Comms with India
39	21/03/1870	Wexford - Haverford-West	Broken					Broken. Repairs may be delayed
40	23/03/1870	Wexford - Haverford-West	Still broken					Still broken
41	26/03/1870	Wexford - Haverford-West	Still broken					Still broken
42	20/03/1870	Atlantic (1866)	Repaired					Repaired
43	26/09/1870	Suez - Aden	Interrupted					Interrupted
44	18.10/1870	Cuba - USA	interrupted for some days					Interruptrd for some days
45	28/11/1870	Channel Islands	All comms to UK cut by gale					All comms to UK cut by gale
46	28/11/1870	Jersey - France	Cut by gale					Cut by gale
47	09/01/1871	Falmouth - Gibraltar - Malta	Being repaired			CS Chiltern		Being repaired
48	16/01/1871	Falmouth - Gibraltar - Malta	Being repaired. Bad weather			CS Chiltern		Being repaired. Bad weather

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
49	28/02/1871	Porto Rico	Interrupted			CS Dacia		Interrupted. CS Dacia sent to repair
50	15/07/1872	Malta - Alexandria	Repairs		TCM/8/6 CABLE ENGINEERS' LOGBOOKS. WILLIAM CORY, 26 April - 15 July 1872	CS William Cory		
51	01/08/1872	"British Australian"	British Australian repairs		NMM TCM/8/4 CABLE ENGINEERS' LOGBOOKS. British Australian repairs, INVESTIGATOR, 30 June - 1 August 1872	CS Investigator		
52	06/09/1872	Kingston - Apinwall (W Indies)	Being repaired					Being repaired
53	22/05/1873	French Atlantic	Repairs		NMM TCM/9/1 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. French Atlantic (1869), HIBERNIA, 3 - 22 May1873	CS Hibernia		
54	20/09/1873	Hong Kong- Amoy	Interupted for one day	Interupted for one day				
55	08/10/1873	West Indies	Repairs		NMM TCM/8/7 ABLE ENGINEERS' LOGBOOKS. - West Indies, INVESTIGATOR~ 4 June - 8 October 1873	CS Investigator		

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
56	30/04/1874	Porthcurno-Carcavelos	Break/fault Lat 43.25N Long 9.30W ?@Finisterre	Break/fault Lat 43.25N Long 9.30W ?@Finisterre				
57	06/05/1874	Carcavellos - Vigo	Under repair	Under repair		CS Chiltern		
58	11/06/1874	Malta-Alexandria Duplicate	Repaired by CS La Plata. 3 and a half inch linear split between 2 strands of armour wire. ?Malicious. ?Knife during manufacture or laying	Repaired by CS La Plata. 3 and a half inch linear split between 2 strands of armour wire. ?Malicious. ?Knife during manufacture or laying		CS La Plata		
59	17/06/1874	Lisbon-Madiera (BSTC) .	Repaired	Repaired				
60	18/06/1874	Lisbon - Madiera	Repairs		NMM TCM/9/2 ROUGH DRAFTS OF CABLE-ENGINEERS' LOGBOOKS. Brazilian Cable (Lisbon and Madeira), CS AFRICA 16 April -18 June 1874	CS Africa		
61	21/06/1874	Vigo-Lisbon "section".	During morning cable broken by anchor chain of Pacific Mail Co's SS Chimborarzo near to Lisbon	During morning cable broken by anchor chain of Pacific Mail Co's SS Chimborarzo near to Lisbon in 16 fathoms. Repair affected by Mr De Sauty in a tugboat				
62	25/06/1874	Malta-Alexandria Duplicate	Under repair	Under repair		CS La Plata		
63	09/07/1874	Porthcurno-Carcarvelos	Under repair	CS Chiltern: Cut Porthcurno to Lisbon cable 150nm from Porthcurno then going to pick up Lisbon end. (??Why??)		CS Chiltern		

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
64	21/07/1874	Vigo-Lisbon.	Under repair	**CS Chiltern**: 21st to 27th Repairs to Vigo - Lisbon near Lisbon. **CS Hawk:** 21st to 27th, assisting CS Chiltern		CS Chiltern		
65	22/07/1874	Vigo-Lisbon	Under repair	CS Chiltern: Cable grappled Lat 43.17N Long 9.35W on 18th and 21st but parted on both occaisions due to rough bottom. Proceeded to N of fault on Porthcurno end Lat 43.30N Long 9.26W. To be Joined by CS Hawk.		CS Chiltern		
66	27/07/1874	Porthcurno-Carcavelos	Repaired	Cable repaired by CS Chiltern		CS Chiltern		
67	06/08/1874	Vigo-Lisbon:	Permanent repair	Permanent repair by CS Chiltern		CS Chiltern		
68	17/09/1874	Singapore- Batavia	Repaired	Repaired		CS Chiltern		
69	24/09/1874	Hong Kong-Amoy	Broken	Broken				
70	25/09/1874	Saigon-Hong Kong	Interrupted	Interrupted "NO China traffic"				

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
71	06/10/1874	Syra - Thermia: Syra - Chios: Syra - Tenos: Andros - Tenos: Andros - Negraport: Morea - Hydra: Morea - Spetizia: Morea - Paros cable which was laid by Telcon in 1873 and operated by Greek Government & Eastern Telegraph Co:	50 fathoms of cable cut & stolen between Andros and Tenos (ETC Min Bk vol 2 p52)	50 fathoms of cable cut & stolen between Andros and Tenos (ETC Min Bk vol 2 p52)				
72	25/11/1874	Porthcurno-Carcavelos .	Interruption 38nm from Gib	Interruption 38nm from Gib to be repaired by CS Hawk		CS Hawk		
73	13/12/1874	Gibraltar-Lisbon	Repaired	Repaired		CS Hawk		
74	09/01/1875	Lisbon Duplicate	Lisbon Duplicate Fault 60nm from Lisbon	Lisbon Duplicate Fault 60nm from Lisbon				
75	21/01/1875	Lisbon Duplicate	To be repaired	To be repaired by CS Hawk		CS Hawk		
76	15/02/1875	Belen cable across the Tagus river	Repaired by CS Hawk	Repaired by CS Hawk		CS Hawk		
77	05/03/1875	Vigo-Lisbon section	Fault. CS Hawk to repair	Fault. CS Hawk to repair		CS Hawk		
78	19/03/1875	Tagus river	Repaired	Repaired		CS Hawk		
79	10/04/1875	Chio-Chesme	Maliciously cut	Maliciously cut, same place as before				
80	13/05/1875	Chio-Chesme	Reward of £50 offered for apprehension of those who damaged the Chio-Chesme cable	Reward of £50 offered for apprehension of those who damaged the Chio-Chesme cable				
81	15/06/1875	Lisbon-Vigo	"Signals small". Repaired	"Signals small" Shore end repaired by CS Chiltern		CS Chiltern		

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
82	02/07/1875	Lisbon Duplicate	Fault in Duplicate cable off Peniche, N of Lisbon	Fault in Duplicate cable off Peniche, N of Lisbon to be repaired by CS Chiltern		CS Chiltern		
83	06/07/1875	Direct Porthcurno-Vigo	Fault	Fault. Tests by CS Chiltern		CS Chiltern		
84	06/07/1875	Shetland-Orkney	Repair of fault Shetland-Orkney by SS Lightning	Repair of fault Shetland-Orkney by SS Lightning				
85	05/08/1875	Hong Kong - Shanghai	Restored					Restored
86	05/08/1875	Lisbon Direct	Direct Lisbon cable "fair range of signals but only at slow speed"	Direct Lisbon cable "fair range of signals but only at slow speed". CS Chiltern: Will be ready for sea again on Saturday 7th		CS Chiltern		
87	20/08/1875	Syra-Chio	Syra-Chio cable broken on 19th by SS Eliza Hunting. Repaired on the 30th August	Syra-Chio cable broken on 19th by SS Eliza Hunting. Repaired on the 30th August				
88	05/08/1875	French Atlantic	Repaired					Repaired
89	17/09/1875	Singapore - Batavia	Repaired					Cable repaired this morning restoring comms with Java & Australia
90	26/09/1875	Aden-Bombay.	Aden-Bombay interrupted by ship's anchor. Repaired	Aden-Bombay interrupted by ship's anchor. Repaired by local station using 2 barges but delayed by 24 hours by strike by Coolies.				

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
91	14/10/1875	Lisbon Direct	Still faulty	CS Chiltern: Continuous bad weather and heavy seas at this season. Considered hopeless to try repairs to Lisbon Direct. Therefore ordered to return home on the 12th		CS Chiltern		
92	11/11/1875	Vigo-Lisbon	Fault on the Vigo-Lisbon Cable about 60nm from Lisbon.	Fault on the Vigo-Lisbon Cable about 60nm from Lisbon. SS Hawk sent immediately to repair.		CS Hawk		
93	16/11/1875	Madras - Penang (Indo-European Teleg Co)	Interrupted					Interrupted
94	25/11/1875	Suez-Aden	Sudden interruption Suez-Aden cable on the 15th.	Sudden interruption Suez-Aden cable on the 15th. Working well until 1813hrs. Fault appears to be 110nmfrom Aden in shallow water				Interruption "near Aden caused by violent storms near Kertch". Other 2 routes to India working.
95	09/12/1875	Vigo-Lisbon section	Under repair	Under repair		CS Hawk		
96	23/12/1875	Vigo-Lisbon section	Repaired 10th inst	CS Hawk: affected repairs to Vigo-Lisbon on the 10th. Awaiting orders at Lisbon.		CS Hawk		
97	13/01/1876	Lisbon - Madiera	Fault at shore end repaired 11th inst	Fault at shore end on the 5th inst. Repaired by CS Hawk on the 11th inst		CS Hawk		
98	13/10/1876	Suez - Aden	Repair in progress	CS Chiltern repairing		CS Chiltern		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
99	03/02/1876	Suez - Aden	Repair in progress	CS Chiltern repairing. The fault of the 15/11/1875 near Aden was repaired on 16/01/1876. On the 15/01/1876 a second fault opened out in the same cable near Suez. on 20/01/1876 and completed repairs on the 02/02/1876.		CS Chiltern.		
100	03/02/1876	Indo - European line	Interrupted	Interrupted				
101	03/02/1876	Porthcurno - Lisbon	Unreadable signals	Reported as "unreadable"				
102	17/02/1876	Porthcurno - Lisbon	Unreadable signals	Fault 62 miles from Lisbon. CS Hawk sails tomorrow to repair		CS Hawk		
103	08/03/1876	Direct United States						Recent breakages were due to wilfull damage. Discussion about legal protection of submarine cables
104	16/03/1876	Syra - Sunium	Intermittent fault	Telegram from Mr Binney: interrupted since Sunday; intending to repair on Wednesday				
105	16/03/1876	Vigo-Lisbon section	Being repaired	Being repaired by CS Hawk		CS Hawk		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
106	16/03/1876	Porthcurno - Lisbon	Broken	CS Chiltern has returned to London. She is to be got ready to repair the Direct Lisbon cable which is broken off Finesterre. CS Hawk to be available to give assistance if necessary.		CS Chiltern; CS Hawk		
107	30/03/1876	Vigo-Lisbon section	Repaired on 18th inst	Repaired on 18th inst		CS Hawk		
108	30/03/1876	Madras - Penang (Extension Company)	Interrupted	Interrupted				
109	30/03/1876	Syra - Sunium	Repaired on 29th inst	Repaired on 29th inst				
110	11/05/1876	Direct Falmouth - Lisbon	Repair in progress	CS Hawk on site awaiting CS Chiltern off Finesterre		CS Hawk; CS Chiltern		
111	27/05/1876	Gibraltar - Villa Real	Failed	Failed (reported in Minutes 22/6/1876				
112	22/06/1876	Direct Falmouth - Lisbon	Repair in progress	CS Hawk & CS Chiltern engaged in repairing		CS Hawk; CS Chiltern		
113	22/06/1876	Alexandria - Sitia	Insulation deteriorating	Insulation deteriorating past few days but fault found in land line section at Alexandria.				
114	27/06/1876	UK - Channel Islands	Comms restored					Comms restored more quickly than expected
115	06/07/1876	Direct Falmouth - Lisbon	Repairs in progress	Repairs in progress		CS Chiltern; CS Hawk		
116	18/07/1876	Pernambuco - Bahia	Repaired 15th inst					Restored on 15th
117	20/07/1876	Direct Falmouth - Lisbon	Repairs in progress	MD reported on the work done to 19th July				

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
118	03/08/1876	Bona - Malta	Interrupted 31st July by coral fishermen	Interrupted 31st July by coral fishermen. CS Hawk sent to repair on the 1st inst		CS Hawk		
119	03/08/1876		CS Hawk wrecked	CS Hawk reported wrecked at 0700 this morning 5 miles from Terife on the Cabezoes rocks		CS Hawk		
120	03/08/1876	Direct Falmouth - Lisbon	Fault off Finisterre repaired	Fault off Finisterre repaired by CS Chiltern. Then to repair fault off Vigo - completed 21st July. Then sailed for Lisbon on the 24th July as another fault had occurred 60 miles from Lisbon		CS Chiltern		
121	02/09/1876	Penang - Madras	Interrupted					"During the interruption of this cable a special service of steamers….."
122	14/09/1876	Direct Falmouth - Lisbon	Report on problems	Report on problems with this cable. Fault at 100 miles from Lisbon repaired. Then another fault 20 miles north. MD wanted cable spliced to Vigo - Lisbon Duplicate but insufficient cable of correct type on board. CS Chiltern therefore to return home. Arrived 1st Sept		CS Chiltern		
123	28/09/1976	Sitia - Rhodes	Repaired	Two separate faults repaired				

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
124	28/09/1976	Direct Falmouth - Lisbon		CS Chiltern in Victoria Docks awaiting cable for repairs and alterations to Direct Lisbon cable. Report to the MD about the condition of this cable. Report from Capt Brisco of CS Hawk.		CS Chiltern		
125	26/10/1876	Direct Falmouth - Lisbon	Repair in progress	CS Chiltern leaves London with cable for repairs		CS Chiltern		
126	26/10/1876	Santiago - Jamaica	"Being repaired"					"being repaired & works to be completed in a couple of days"
127	23/11/1876	Direct Falmouth - Lisbon	Repairs in progress	Repairs in progress		CS Chiltern		
128	23/11/1876	Lisbon - Madiera	Interrupted a mile from Lisbon	Interrupted a mile from Lisbon. CS Chiltern left Vigo on 16th to repair. Comms restorred 22nd Nov		CS Chiltern		
129	01/12/1876	Singapore - Java	Restored					Restored - restablishing direct telegraphic comms with Java, Australia and NZ via Teheran.
130	07/12/1876	Direct Falmouth - Lisbon	Repairs and alterations completed 29th Nov; 5th Dec - interrupted again 50 miles from Lisbon	Repairs and alterations completed 29th Nov; 5th Dec - interrupted again 50 miles from Lisbon		CS Chiltern		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
131	21/12/1876	Direct Falmouth - Lisbon	Repairing	Grappled on the 14th but weather deteriorated so returned to Vigo		CS Chiltern		
132	21/12/1876	Australia - UK	Frequent interruptions					"Frequent interruptions have rendered the cable uselss"
133	04/01/1877	Vigo - Lisbon	Interrupted on the 23rd December	Interruption on the 23rd December. Repairs delayed by bad weather. Still strong SW gale		CS Chiltern		
134	18/01/1877	Direct Falmouth - Lisbon	Repaired 16th Jan	Repaired 16th Jan (interrupted 3rd December)		CS Chiltern		Now repaired
135	18/01/1877	Vigo - Caminha section	Interrupted	Interrupted. CS Chiltern leaves to repair		CS Chiltern		
136	31/01/1877	Bahia - Rio section of the Brazil cable repaired	Repaired					Repaired. Teleg comms from England to Rio, Buenos Ayres & Co restored
137	01/02/1877	Vigo - Caminha section	Repairs delayed by bad weather off Vigo but completed on the 15th Jan	Repairs delayed by bad weather off Vigo but completed on the 15th Jan		CS Chiltern		
138	01/02/1877	Villa Real - Gibraltar	Repairs to this cable interrupted since 27th May 1876.	Repairs to this cable interrupted since 27th May 1876.		CS Chiltern		
139	15/02/1877	Lisbon Direct	Interrupted on 2nd Feb	Interrupted on 2nd Feb, 169miles South of Porthcurno & 5 miles south of last splice made by Chiltern		CS Chiltern		
140	15/02/1877	Vigo - Caminha section	Repaired 8th inst	Repaired 8th inst		CS Chiltern		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
141	15/02/1877	Villa Real - Gibraltar	Faults 9 and 18 miles from Gib.	Faults 9 and 18 miles from Gib. CS Chiltern sent		CS Chiltern		
142	01/03/1877	Villa Real - Gibraltar	Under repair. One fault was a cut with an axe - sabotage	Under repair. One fault was a cut with an axe - sabotage		CS Chiltern		
143	13/03/1877	Villa Real - Gibraltar	Repaired on the 1st March. Other fault was caused by strain and "bad bottom"	Repaired on the 1st March. Other fault was caused by strain and "bad bottom"		CS Chiltern		
144	26/04/1877	("Old")Aden - Bombay	Fault 135 miles from Bombay	Fault 135 miles from Bombay. CS Chiltern will leave Malta on 2nd May		CS Chiltern		
145	10/05/1877	Old Aden - Bombay	Fault	CS Chiltern left Malta on the 5th inst for Bombay. The cable still working fairly but at half speed		CS Chiltern		
146	10/05/1877	Lisbon Direct	Faults	CS John Pender left Gravesend on the 2nd inst		CS John Pender		
147	10/05/1877	Sunium - Syra	Interrupted 27th April, repaired 30th April	Interrupted 27th April, repaired by Mr Binney 30th April				
148	07/06/1877	Old Aden - Bombay	Repaired 4th June	Repaired 4th June		CS Chiltern		
149	21/06/1877	Direct Lisbon	Under repair	Under repair by CS John Pender		CS John Pender		
150	21/06/1877	Old Aden - Bombay	New fault 30 miles south of Aden	New fault 30 miles south of Aden				
151	19/07/1877	Old Aden - Bombay	Faults due to terado	CS Chiltern left Port Said for Syra on the 17th inst. Faults due to terado. Samples sent to London		CS Chiltern		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
152	23/07/1877	Atlantic (1865,1866)	Repairs		NMM TCM/8/8 CABLE ENGINEERS' LOGBOOKS. Atlantic (1865,1866), SEINE, HIBERNIA, 3 May - 23 July 1877	CS Seine; CS Hibernia		
153	02/08/1877	Direct Lisbon	Under repair	Under repair by CS John Pender		CS John Pender		
154	02/08/1877	Gibraltar Lisbon section	Interrupted 12th June 25 miles from Gib.	Interrupted 12th June 25 miles from Gib. CS Calabria to repair		CS Calabria		
155	17/08/1877	Atlantic (1865,1866),	Repairs		NMM TCM/9/5 ROUGH DRAFTS OF CABLE ENGINEERS LOGBOOKS. Atlantic (1865,1866), SEINE, 20 June - 17 August 1877; TCM/9/6 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Atlantic (1865,1866), SEINE, 20 June -17 August 1877	CS Seine		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
156	20/08/1877	Atlantic (1865,1866)	Repairs		NMM TCM/8/9 CABLE ENGINEERS' LOGBOOKS. Atlantic(1865,1866) , SEINE, HIBERNIA, 3 May - 20 August 1877	CS Seine; CS Hibernia		
157	20/08/1877	Atlantic (1865,1866)	Repairs		NMM TCM/8/10 CABLE ENGINEERS' LOGBOOKS. Atlantic (1865,1866), SEINE, HIBERNIA, 14 June - 20 August 1877	CS Seine; CS Hibernia		
158	?? Sep 1877	Porthcurno-Carcarvelos	Porthcurno-Carcarvelos repaired (broken since February 1877) Sample returned to London for examination.	Porthcurno-Carcarvelos repaired (broken since February 1877) Sample returned to London for examination.		CS Calabria: Returns to London with sample of Porthcurno-Carcavelos fault for examination		
159	11/09/1877		Captain Brisco found drunk and sacked!	CS Chiltern & CS John Pender off Portland on 26 August. CS Chiltern arrived London 31st Aug for refit. Capt Briscoe found drunk and sacked!		CS Chiltern; CS John Pender		
160	11/09/1877	Direct Lisbon Cable	Under repair restored 4th inst)	CS Calabria en route to repair (broken since February) Restored 4th inst		CS Calabria		
161	25/09/1877	Direct Lisbon	Sample in London	Sample of cable submitted to Board		CS Calabria		
162	25/09/1877	Direct Lisbon	Failed to recover portion after repair	Failed to recover portion after repair. Back at Falmouth on the 6th inst. CS Chiltern now refitting		CS Chiltern; CS John Pender		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
163	25/09/1877	Aden - Bombay	Interrupted	Interrupted one mile from Aden by ship's anchor. Mr Stacey hopes to repair by tomorrow but the coolies have gone on strike				
164	22/10/1877	Atlantic (1865, 1866)	Repairs		NMM TCM/9/3 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Atlantic (1865, 1866) SEINE, 3 May- 22 -October 1877	CS Seine		
165	26/10/1877	Singapore - Penang	Interrupted all week	Interrupted all week				
166	28/10/1877	Atlantic (1865, 1866)	Repairs		NMM TCM/9/4 ROUGH DRAFTS- OF CABLE ENGINEERS' LOGBOOKS. Atlantic (1865, 1866), SEINE, 5 May - 28 October 1877; TCM/8/11 CABLE ENGINEERS' LOGBOOKS. Atlantic (1865,1866), SEINE, HIBERNIA, 29 August - 28 October 1877	CS Seine; CS Hibernia		
167	08/11/1877	Batavia-Australia cable	Reported as interrupted	Reported as interrupted				

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
168	13/11/1877	Porthcurno-Carcavelos	Porthcurno-Carcavelos: sudden fault off Burlings, 50nm from Lisbon	Porthcurno-Carcavelos: sudden fault off Burlings, 50nm from Lisbon				
169	22/11/1877	Porthcurno-Carcavelos	Repair to sudden fault Porthcurno-Carcacvelos 50nm from Lisbon	Repair to sudden fault Porthcurno-Carcacvelos 50nm from Lisbon. CS Chiltern to repair		CS Chiltern		
170	06/12/1877	Lisbon	Fault 54 miles from Lisbon	Fault 54 miles from Lisbon. CS Chiltern attending. Bad weather. (Board Minutes of 13th Dec.		CS Chiltern		
171	08/12/1877	Lisbon		CS Chiltern: Lisbon, 8 days out from Gravesend "and now proceeds to cable repairs"		CS Chiltern: Lisbon, 8 days out from Gravesend "and now proceeds to cable repairs"		
172	19/12/1877	Direct Lisbon	Repaired off Burlings	Repaired off Burlings		CS Chiltern		
173	31/12/1877	Cables to India						".....Through the ineffective working of the cable the rest of our Indian letter has been delayed"
174	31/01/1878	Canea - Zante	Interrupted on 29th inst	Interrupted on 29th inst. CS John Pender leaves Malta to repair		CS John Pender		
175	04/02/1978	Singapore - Batavia (Estern Ext Teleg Co)						Repaired restoring direct communication with Java, Australia & NZ

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
176	14/02/1878	Canea - Zante	Being repaired	Being repaired by CS John Pender		CS John Pender		
177	28/02/1878	Candia - Zante	Being repaired	Being repaired by CS John Pender		CS John Pender		
178	14/03/1878	Bisica Bay	Being repaired	CS John Pender to malta to collect more cable. Sailed on 13th inst for Syra		CS John Pender		
179	11/04/1878	Canea - Zante	Repaires continue	Repairs continue		CS John Pender		
180	16/04/1878	Canea - Zante	Repaired	Repaired		CS John Pender		
181	21/04/1878	Ithica - Santa Maura	Repaired	Repaired		CS John Pender		
182	26/04/1878	Syra - Tenos	Repaired	Repaired		CS Chiltern		
183	06/06/1878	Aden - Suez	Repaired 29 May	Repaired 29 May		CS Chiltern		
184	09/05/1878	Malta - Alga Grande (Medit Ext Teleg Co)	Interrupted	Interrupted. ETC asked to repair about 40 miles from Malta. CS John Pender sent and found cable in very poor condition. Repair deferred		CS John Pender		
185	09/05/1878	Oranto - Vellona	"in a bad condition"	"in a bad condition"				
186	23/06/1878	Old Aden - Suez	Broken 102 miles from Aden	Broken 102 miles from Aden as already reported. CS Chiltern sent to repair.		CS Chiltern		
187	20/06/1878	Aden - Suez	Faulty	CS Chiltern testing at Aden		CS Chiltern		
188	11/07/1878	Red Sea Cables	Repaired fault that occurred 5th July	Repaired fault that occurred 5th July. CS Chiltern now on her way to Suez		CS Chiltern		
189	13/07/1878	Atlantic (1866)	Interrupted				Interrupted	
190	13/07/1878	Amoy-Shanghai	Reported as repaired				Reported as repaired	
191	18/07/1878	Suez - Aden	Aden end faulty	Repairs in progress		CS Chiltern		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
192	23/07/1878	Atlantic (1866)	Repairs		NMM TCM/8/12 - 13 CABLE ENGEERS LOGBOOKS. Atlantic (1866), SEINE, 25 May - 23 July 1878; TCM/8/14 CABLE ENGINEERS' LOGBOOKS. Atlantic (1866), CALABRIA, 2 June - 23 July 1878	CS Seine; CS Calabria		
193	01/08/1878	Suez - Aden	Repaired 26 July	Repaired 26 July fault 303 miles from Suez		CS Chiltern		
194	03/08/1878	Havana-Key West (Cuba Sub Co)	Repaired			CS Prof Morse	Reported as repaired by CS Prof Morse	
195	29/08/1878	Suez - Aden	Repaired fault 97 miles from Aden	Repaired fault 97 miles from Aden		CS Chiltern		
196	29/08/1878	Lisbon Direct	Broken	Broken of Cape Finisterre. CS John Pender to repair but damaged in a collision with an Italian caique and a leaking boiler		CS John Pender		
197	10/10/1878	Lisbon Direct	Repaired 30th Sept	Repaired. 30th Sept		CS John Pender		
198	10/10/1878	Bombay	Fault near Aden	CS Chiltern to repair and stay in area "due to the disturbed state of Indian affairs…"		CS Chiltern		
199	10/10/1878	Malta - Gibraltar	Interrupted on the 3rd October	Interrupted on the 3rd October				

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
200	12/10/1878	Firth of Forth	Damage by some boys lighting a fire on the beach immediately above the cable				Damage by some boys lighting a fire on the beach immediately above the cable	Reported in *Nature* and in *The Times*
201	12/10/1878	Cable across Forth Estuary	Repaired April 1875 has now been broken again				Repaired April 1875 has now been broken again	
202	21/11/1878	Direct Lisbon	Interrupted on the 12th Nov	Interrupted on the 12th Nov. 483 miles from Porthcurno and 333 miles from Lisbon. CS Gt Northern on Charter to repair		CS Gt Northern		
203	21/11/1878	Oranto - Vallona	Repaired	Temporary repair by French Steamer SS Charente		SS Charente		
204	23/11/1878	Cienfuegos-Santiago (Cuba Sub Tel Co)	Reported as repaired				Reported as repaired	
205	05/12/1878	Lisbon Direct	Being repaired	Being repaired		SS Gt Northern		
206	07/12/1878	Nagasaki-Shanghai (GNT)	Reported as interrupted				Reported as interupted	
207	19/12/1878	Direct Lisbon	Repaired on 6th December	Repaired on 6th December		SS Gt Northern		
208	21/12/1878	Jersey-England	Reported as repaired				Reported as repaired	
209	04/01/1879	Jersey-England	Reported as repaired				Reported as repaired	
210	11/01/1879	Pernambuco-Bahia	Reported as now in working order				Reported as now in working order	
211	11/01/1879	Batavian section	Defect reported near Torbay				Defect reported near Torbay	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
212	16/01/1879	Direct Lisbon	Interrupted 31 Dec 1878	Interrupted 31 Dec 1878. CS John Pender to repair. Charter of SS Gt Northern terminated. CS Chiltern still in Suez		CS John Pender; CS Chiltern; CS Gt Northern		
213	27/01/1879	United States Direct	Interrupted 27/1/79. Repaired 20/7/79 (J Telegraphique)					
214	30/01/1879	Lisbon Direct	Repaired 25th inst	Repaired 25th inst		CS John Pender		
215	30/01/1879	Chanak	Interruption	Interruption. CS John Pender sent		CS John Pender		
216	23/02/1879	Neuwerk-Heligoland	Interrupted 23/2/79. Repaired 10/8/79 (J Telegraphique)					
217	27/02/1879	Caminha cable	Interrupted 14th inst	Interrupted 14th inst near cable house				
218	05/03/1879	Dardanelles Cable	Repaired	Repaired by James Anderson before CS John Pender arrived		CS John Pender		
219	05/04/1879	Brest-St Pierre	Reported as repaired				Reported as repaired	
220	05/04/1879	Bahai-Rio Janeiro (W&BTCo)	Reported as repaired				Reported as repaired	
221	24/04/1879	Vigo - Lisbon	Recovery of 200 miles of cable and connect Vigo to Lisbon to form Duplicate	Recovery of 200 miles of cable and connect Vigo to Lisbon to form Duplicate		CS John Pender		
222	26/04/1879	India - Ceylon	Reported as repaired				Reported as repaired	
223	08/05/1879	Caminha cable	CS John Pender to repair	CS John Pender to repair		CS John Pender		
224	10/05/1879	India-Ceylon 1867 canle	Reported as interrupted				Reported as interrupted	
225	10/05/1879	Bahia-Rio de Janiero	Reported as repaired				Reported as repaired	
226	20/05/1879	Caminha cable	Repaired	Repaired		CS John Pender		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
227	19/06/1879	Suez - Aden	Fault under repair	Fault under repair but delayed by very bad weather		CS Chiltern		
228	28/06/1879	Para-Maranham (W&BTC)	Interrupted 28/6/79. Repaired 27/7/79 (J Telegraphique)					
229	29/06/1879	Suez - Aden	Repaired	Repaired		CS Chiltern		
230	08/07/1879	Rio Grande do Sol - Montivideo	Interrupted 8/7/79. Repaired 27/7/79 (J Telegraphique)					
231	08/07/1879	Pernambuco-Bahia	Interrupted 8/7/79. Repaired 30/7/79 (J Telegraphique)					
232	11/07/1879	St Vincent-Barbados	Interrupted 11/7/79 Repaired 30/7/79 (J Telegraphique)					
233	30/07/1879	Antibes - St Florent of Corsica	Interrupted 30/7/79 Repaired 23/8/79 (J Telegraphique)					
234	31/07/1879	Antibes - St Florent of Corsica	Repairs to this cable effected 27th July. Fault caused by a stone crushing the cable	Repairs to this cable effected 27th July. Fault caused by a stone crushing the cable		CS Chiltern		
235	06/08/1879	Caminha section of ? cable	To be repaired by CS Retriever	To be repaired by CS Retriever		CS Retriever		
236	11/08/1879	Trinidad-Demerara	Interrupted 11/8/79 Repaired 23/8/79 (J Telegraphique					
237	11/08/1879	Grenada-Trinidad	Iinterrupted 11/8/79. Repaired 16/8/79 (J Telegraphique)					
238	12/08/1879	Shanghai-Nagasaki	Interrupted 12/8/79 Repaired 15/8/79 (J Telegraphic)					

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
239	12/08/1879	Amoor line near Blagowestschensk	Broken in Feb 1879 now repaired restoring comms between US and France					Broken in Feb 1879 now repaired restoring comms between US and France
240	14/08/1879	Brest-St Pierre - Duxburd	Interrupted 14/8/79 Still interrupted 13th Sept 79					
241	16/08/1879	Dominique-Martinique	Interrupted 8/7/79 Repaired 30/7/79 (J Telegraphique)				Reported as repaired 16 Aug	
242	16/08/1879	St Vincent-Barbados	Reported as repaired				Reported as repaired	
243	18/08/1879	France-Corsica	Interrupted 18 Aug. Still interrupted 13th Sept 79					
244	01/09/1879	Siberian line near Stretinsk	CS John Pender left Sylt for London					
245	11/09/1879	French Corsica Cable	Repairs completed 26 July	Repairs completed 26 July		CS Chiltern		
246	11/09/1879	Caminha cable	Repairs completed 23 August	Repairs completed 23 August		CS Retriever		
247	04/10/1879	Singapore - Batavia	Reported as repaired				Reported as repaired	
248	15/11/1879	Singapore-Batavia	Fault reported as fully restored				Fault reported as fully restored	
249	13/11/1879	Gibraltar - Lisbon	Fault 20-30 miles from Gib	Fault 20-30 miles from Gib. CS Retriever sent to repair from Syra		CS Retriever		
250	15/11/1879	Suez - Aden	Fault 120 miles from Aden	Fault 120 miles from Aden. CS John pender ordered from London to Aden to effect repairs		CS John Pender		
251	03/12/1879	Caminha - Vigo and Vigo - Porthcurno cables	Interrupted	Interrupted				

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
252	04/12/1879	Lisbon - Gibraltar	Under repair	Under repair		CS Retriever		
253	15/12/1879	Gibraltar - Lisbon	Repaired	Repaired. CS Retriever proceded to Vigo to permanently repair Vigo - Porthcurno cable		CS Retriever		
254	18/12/1879	Suez - Aden	Under repair	CS John Pender arrived in Suez on the 14th		CS John Pender		
255	18/12/1879	Dardanelles - Perim	Interrupted this morning	Interrupted this morning. CS Retriever to repair.		CS Retriever		
256	10/01/1880	Direct Spanish via Bilbao	Interrupted					
257	10/01/1880	Santa Cruze - Trinidad	Interrupted				Interrupted	Interrupted (from the *Electrician)*
258	13/01/1880	Dardanelles - Pera	Repaired	Repaired		CS Retriever		
259	13/01/1880	Suez - Aden	Repaired on 25/12/1879	Repaired on 25/12/1879		CS John Pender		
260	17/01/1880	St Thomas - St Kitts (1875)	Interrupted				Interrupted	Interrupted (from the *Electrician)*
261	29/01/1880	Gibraltar - Lisbon	Insulation "going down"	Insulation "going down" over last few days. CS Retriever to Malta in case of need.		CS Retriever		
262	11/02/1880	Gibraltar - Lisbon	Cable still working well	Cable still working well. CS Retriever arrived Malta 05/02/1880		CS Retriever		
263	09/03/1880	Dardanelles - Pera	Interrupted	Interrupted. CS Retriever sent to repair		CS Retriever		
264	11/03/1880	Direct Lisbon	Being repaired	Being repaired by CS Gt Northern		CS Gt Northern		
265	13/03/1880	Mozambique	Fault off Mozambique repaired				Fault off Mozambique repaired	

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
266	24/03/1880	Cable "off Mozambique" ETC	Defect discovered in Oct 1879 to be repaired.					Defect discovered in Oct 1879 to be repaired. (Reference made to this in half-yearly report)
267	08/04/1880	Chios - Tenedos and Dardenelles - Pera	Repaired on 18th March by CS Retriever	Repaired on 18th March. Both had been broken by ship's anchors.		CS Retriever		
268	08/04/1880	Sitia - Alexandria	Repaired by CS Retriever	Repaired by CS Retriever		CS Retriever		
269	08/04/1880	Vigo - Lisbon	Damage by the rocky bottom "The Burlings"	Discussed replacement to section due to many faults and great depth. Considered important as this cable has been very unrelaible. To be laid outside the Burlings. Normally 600 messages per day over that section.				
270	10/04/1880	"Bilbao Cable" (Direct Spanish Teleg Co)	Repaired	Repaired				
271	22/04/1880	Ithica cable	Repaired 19th April	Repaired 19th April		CS Retriever		
272	27/04/1880	Atlantic (1866)	Repairs	NMM TCM/8/15 ENGINEERS' LOGBOOKS. Atlantic (1866), SCOTIA, 10 - 27 April, 1880 .		CS Scotia		
273	06/05/1880	Spezzia and Hydra cables	Repaired	Repaired		CS Retriever		
274	03/06/1880	Lisbon - Vigo	Under repair	CS Chiltern loading cable fromTCM to repalace 239 miles. Sailed on 29th May. Arrived at Lisbon 3rd June		CS Chiltern		

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
275	12/06/1880	Atlantic (1866)	Injury by large rocks brought down by icebergs				Injury by large rocks brought down by icebergs	
276	01/07/1880	Lisbon - Vigo	Under repair. Weather improved, ship leaving port	Weather improved, ship leaving port		CS Chiltern		
277	01/07/1880	Draconisi - Chio	Under repair	Under repair		CS Retriever		
278	15/07/1880	Lisbon - Vigo	Relaying in progress	Relaying in progress		CS Chiltern		
279	17/07/1880	Lisbon - Vigo	Unfavourable weather for laying bypass connection	Unfavourable weather for laying bypass connection		CS Chiltern		
280	17/07/1880	Doro Channel	3.5 nm cable picked up in poor condition	3.5 nm cable picked up in poor condition		CS Retriever		
281	29/07/1880	Lisbon - Vigo	Trying to grapple old cable	Trying to grapple old cable		CS Chiltern		
282	07/08/1880	"New French Cable"	First cable to be raised from >2000 fathoms by CS Chiltern			CS Chiltern: First cable to be raised from >2000 fathoms by CS Chiltern	First cable to be raised from >2000 fathoms by CS Chiltern	
283	12/08/1880	Lisbon - Vigo	Work completed	Work completed		CS Chiltern		
284	14/08/1880	"ETC Cable off Portugal laid in 1870"	Interrupted				Interrupted	
285	28/08/1880	Heligoland cable	Reported repaired				Now repaired	
286	28/08/1880	Pernambuco-Bahia	Cable grappled and ? Section into Lisbon moved?					
287	23/09/1880	Lisbon Direct	Restoration complete 21st August	Restoration complete 21st August. - Outside the Burlings. 195 nm cable used. CS Chiltern congratulated		CS Chiltern		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
288	14/10/1880	Porthcurno - Lisbon Direct 1870	Cable dispatched for repair. It had been deliberately cut to free a ship's anchor			CS Grappler		Cable dispatched for repair. It had been deliberately cut to free a ship's anchor. The Peterhead - Denmark cable laid 17 years ago has also recently been cut to free an anchor.
289	12/11/1880	West Indian - Panama	Interrupted				Interrupted	
290	20/11/1880	French Atlantic (1869)	Reported repaired				Now repaired	
291	20/11/1880	Monte Video - Rio do Sul	Reported interrupted				Interrupted	
292	25/11/1880	Suez - Aden	Fault occurred 24th November, 3 miles from Aden	Fault occurred 24th November, 3 miles from Aden due to ship's anchor. CS John Pender to investigate		CS John Pender		
293								
294	04/12/1880	Isle of Wight cable	Reported repaired				Now repaired	
295	11/12/1880	IoW cable Ryde - Portsmouth	Reported repaired				Repaired	
296	11/12/1880	St Thomas - Porto Rico	Reported Still interrupted				Still interrupted	
297	11/12/1880	St Croix - Porto Rico & St Thomas	Reported Still interrupted				Still interrupted	

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
298	11/12/1880	Guadeloupe - Antigua	CS Scotia of TCM has bouyed the Brest end of the faulty cable and will continue repair when weather favourable				CS Scotia of TCM has bouyed the Brest end of the faulty cable and will continue repair when weather favourable	
299	16/12/1880	Isle of Wight cable	Interrupted - Letter in the *Times*					Reported as interrupted 16th December 1880. Writer suggests 2nd cable
300	16/12/1880	Suez - Aden	Repaired	Repaired		CS John Pender		
301	18/12/1880	Anglo American Cable (1869)	Reported repaired				Repaired	
302	19/12/1880	French Atlantic (1869)	Repairs		NMM TCM/9/10 ROUGH DRAFTS OF ENGINEERS' LOGBOOKS. French Atlantic (1869), SCOTIA, 15 November - 19 December 1880	CS Scotia		
303	25/12/1880	French Atlantic (1869)	Weather still too rough for CS Scotia to repair according to The Electrician				Weather still too rough for CS Scotia to repair	
304	25/12/1880	Anglo American	SS Charente chartered by French Govt still trying to repair			SS Charente	SS Charente chartered by French Govt still trying to repair	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
305	08/01/1881	French Atlantic (Brest - St Pierre)	Interrupted				Interrupted	
306	08/01/1881	UK to Transvaal	Interrupted				Interrupted	
307	16/01/1881	Suez - Aden	Broken off Perim Island 30th Dec Repaired 16th Jan. But 2nd fault 100nm from Aden occurred	Broken off Perim Island 30th Dec Repaired 16th Jan. But 2nd fault 100nm from Aden occurred		CS John Pender		
308	22/01/1881	Rio de Janeiro - Bahia	Reported repaired (40 miles from Brest)				Repaired (40 miles from Brest)	
309	29/01/1881	Brest - St Pierre	Reported restored				Restored	
310	29/01/1881	Rio de Janeiro - Bahia	Reported repaired				Repaired	
311	05/02/1881	Cable to Hebrides	Reported Interrupted				Interrupted	
312	12/02/1881	Rio Grande do Sul - Montevideo	Reported Interrupted				Interrupted	
313	12/02/1881	Porto Rico - St Thomas	Reported Interrupted				Interrupted	
314	19/02/1881	Porto Rico - St Croix	Reported restored				Restored	
315	19/02/1881	Communications with West Indies	Reported repaired				Repaired	
316	19/02/1881	St Lucia - St Vincent	Reported repaired				Repaired	
317	19/02/1881	Falmouth - Vigo	Reported repaired				Repaired	
318	10/03/1881	Bona - Malta No 1	Repairs completed on 6th March	Repairs completed on 6th March		CS Retriever		
319	10/03/1881	Black Sea Cable	Interrupted on the 6th March	Interrupted 6th March. CS Retriever sent to repair fault about 7 nm from Odessa		CS Retriever		
320	10/03/1881	Direct Lisbon	Broken September 1880	Broken September 1880. Following repairs and sea trials, CS Chiltern sent to Malta		CS Chiltern		
321	19/03/1881	Madras - Penang	Reported Interrupted				Interrupted	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
322	24/03/1881	Black Sea Cable	Under repair	Under repair. Repairs should be complete by 23rd March		CS Retriever		
323	25/03/1881	Odessa cable	Repaired	Repaired		CS Retriever		
324	03/04/1881	Colon - Panama	Repaired				Repaired	
325	16/04/1881	Brest - St Pierre	Reported Interrupted				Interrupted	
326	20/04/1881	Marseilles - Algiers	Reported restored					Restored
327	23/04/1881	Pernambuco - Para	Reported repaired				Repaired	Reported repaired on 20/4/1881
328	30/04/1881	Brest - St Pierre (French Atlantic)	Reported repaired after 8 months				Repaired after 8 months	
329	19/05/1881	Direct Lisbon	Repaired	Repaired by CS Chiltern		CS Chiltern		
330	19/05/1881	Aden - Bombay No 2	Repaired 14th May	Repaired 14th May		CS John Pender		
331	07/05/1881	Jamaica - Colon	Reported repaired				Repaired	
332	07/05/1881	Jamaica - Colon	Reported Interrupted				Interrupted	
333	07/05/1881	Orkney - Shetlands	Reported interrupted and repaired within a few days				Interrupted and repaired within a few days	
334	14/05/1881	Comms with Tunis	Reported interrupted				Interrupted	
335	21/05/1881	Amoy - Shanghai	Interrupted				Interrupted	
336	21/05/1881	Key West (Florida) - Havana	Interrupted				Interrupted	
337	21/05/1881	Orkney - Shetlands	Repaired			CS Chiltern	Reported as repaired	
338	28/05/1881	Porthcurno - Lisbon	Completely repaired				Completely repaired	
339	04/06/1881	Panama Cable System	Repaired; comms restored with British Guiana				Repaired; comms restored with British Guiana	
340	04/06/1881	Trinidad - Demerara	Repaired				Repaired	

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
341	07/06/1881	Stornoway - mainland	Repaired					
342	16/06/1881	Direct Lisbon	Repaired on 20 June	Repaired on 20 June		CS Chiltern		
343	16/06/1881	Gibraltar - Malta	Repaired on 26 June	Repaired on 26 June		CS Chiltern		
344	25/06/1881	Atlantic (Anglo-American)	Interrupted				Interrupted	
345	06/07/1881	Brest - St Pierre (1869)	Repairs		NMM TCM/8/16 ,CABLE ENGINEERS' LOGBOOKS. Brest - St Pierre 11869), SCOTIA, 7 June - 6 July 1881	CS Scotia	Interrupted (reported 09/07/1881)	
346	09/07/1881	St Thomas - St Kitts	Still interrupted				Still interrupted	
347	09/07/1881	Pernambuco - Maranham	Still interrupted				Still interrupted	
348	09/07/1881	Antigua - Guadeloupe	Still interrupted				Still interrupted	
349	09/07/1881	St Lucia - St Vincent	Still interrupted				Still interrupted	
350	09/07/1881	Orkney - Shetlands	Repaired by Telcon				Repaired by Telcon	
351	16/07/1881	Suez - Aden (No 1)	Fault 3rd July 144nm from Aden. Good signals but complete interruption 12th July	Fault 3rd July 144nm from Aden. Good signals but complete interruption on the 12th July				
352	16/07/1881	Greek Archipelago; Doro Channel;	Under repair	CS Retriever affecting repairs		CS Retriever		
353	16/07/1881	St Lucia - St Vincent and Antigua - Guadeloupe	Broken12th Nov 1880 now restored			CS Scotia	Broken12th Nov 1880 now restored	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
354	23/07/1881	Atlantic (Anglo-American) - the Brest - St Pierre cable (1869)	Repaired. Comms restored between Guadeloupe,Dominica, Martinique & St Lucia				Repaired. Comms restored between Guadeloupe,Dominica, Martinique & St Lucia	
355	28/07/1881	Bombay - Aden	Interrupted	CS Chiltern leaves TCM wharf for Bombay. Gt Northern also to help at Bombay		CS Chiltern; CS Gt Northern		
356	30/07/1881	St Lucia - St Vincent	Restored				Restored	
357	30/07/1881	Isle of Islay - mainland	"Communication very uncertain"				"Communication very uncertain"	
358	06/08/1881	India	"All comms restored"				"All comms restored"	
359	11/08/1881	Vigo - Lisbon	Prophylactic repairs before winter	Prophylactic repairs before winter		CS Retriever		
360	13/08/1881	West Indies	"now in good working order"				"now in good working order"	
361	20/08/1881	Aden - Bombay (ETC)	Interrupted				Interrupted	
362	03/09/1881	St Vincent - Barbados	Restored				Restored	
363	03/09/1881	St Vincent - Barbados	Interrupted by typhoon				Interrupted by typhoon	
364	10/09/1881	Shanghai cables of GNT	Restored				Restored	
365	24/09/1881	Shanghai - Gutzlaff - Amoy (GNT)	Interrupted				Interrupted	
366	24/09/1881	Colon - Jamaica	"Difficult repair proceeding"			CS Dacia	"Difficult repair proceeding"	
367	29/09/1881	Bombay No 2	Repaired 10th August	Repaired 10th August.		CS Timsah		
368	29/09/1881	Bombay No1	Repaired 25th of August by CS Gt Northern	Repaired 25th of August by CS Gt Northern		CS Gt Northern		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
369	29/09/1881	Porthcurno - Lisbon Direct	Faulty since the 6th September	Faulty since the 6th September. CS Retriever leaves London on the 1st inst to repair fault 50nm from Lisbon. CS John Pender to join CS Retriever		CS Retriever; CS John Pender		
370	29/09/1881	No 1 Suez - Aden	Fault near Aden and 2 other faults near Suez	Fault near Aden and 2 other faults near Suez. CS Chiltern left Malta on 20th Aug to repair		CS Chiltern		
371	01/10/1881	Orkney - Shetlands	Interrupted "again"				"interrupted again"	
372	08/10/1881	Rio Grande do Sul - Monte Video	Interrupted for last 3 months				Interrupted for the last 3 months	
373	20/10/1881	Porthcurno - Lisbon Direct	Repaired 30th Sept	Repaired 30th Sept		CS Retriever		
374	20/10/1881	Lisbon - Gibraltar	Fault 97 nm from Lisbon on 4th Oct, repaired 16th Oct	Fault 97 nm from Lisbon on 4th Oct, repaired 16th Oct		CS Retriever		
375	20/10/1881	Vigo - Lisbon	Fault 19th Oct.	Fault 19th Oct. CS Retriever to repair		CS Retriever		
376	20/10/1881	No 1 Suez - Aden	Repaired 4th October	Repaired 4th October		CS Chiltern		
377	20/10/1881	Aden - Bombay (ETC)	Terado fault repaired	Terado fault repaired		CS Chiltern		
378	22/10/1881	"The Gould Cable"	Restored				Restored	
379	28/10/1881	Jamaica - Colon	Interrupted and still reported as broken 7/10/1881					Still reported as broken (*Times* 7/12/81)
380	29/10/1881	Lowestoft "to the Continent" (owned by Post Office)	Interrupted				Interrupted	
381	03/11/1881	No 1 Suez - Aden	Repaired 29th Oct	Repaired 29th Oct		CS Chiltern		
382	03/11/1881	Vigo - Lisbon	Being repaired	Being repaired		CS John Pender		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
383	03/11/1881	Direct Lisbon	Interrupted 22nd Oct.	Interrupted 22nd Oct. CS Retriever to repair		CS Retriever		
384	03/11/1881	Vigo - Lisbon and Caminha Cables	Under repair	Under repair		CS John Pender; CS Retriever		
385	05/11/1881	"Four of ETC's cables"	Damaged in gales repaired			CS Retriever; CS John Pender	Damaged in gales repaired	
386	17/11/1881	Suez - Aden No 2	Fault near Aden but working ok so repair defferred	CS Chiltern arrived Bombay 14th inst. Working OK so repair deferred		CS Chiltern		
387	17/11/1881	Vigo - Lisbon	Repaired 12th inst	Repaired 12th inst		CS John Pender		
388	17/11/1881	Villa Real - Gibraltar	Repair in progress	Repair in Progress		CS Gt Northern		
389	17/11/1881	Lisbon - Gibraltar	Repaired 16th inst	Repaired 16th inst. Ship then ordered to Salonica		CS Retriever		
390	19/11/1881	IoW Hurst cable						Letter about multiple cable failures, duplicates etc. Also see letter 21st Nov 1881ff
391	19/11/1881	"4 ETC Cables"	Damaged in gales repaired			CS Retriever; CS John Pender	Damaged in gales repaired	
392	25/11/1881	"4 ETC Cables"	Both cables "broken " on the 25th November. Repaired by the 4th December			CS Patrick Stewart		Both cables "broken " on the 25th November. Rpaired by the 4th December *(Times* 7/12/81)
393	01/12/1881	Bombay	Repaired small fault due to terado	Repaired small fault due to terado		CS Chiltern		
394	01/12/1881	Suez - Aden No2	Small fault repaired	Small fault repaired		CS Gt Northern		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
395	01/12/1881	Salonica cable	Broken by Greek barque Sotir	Broken by Greek barque Sotir. CS Retriever proceding to repair		CS Retriever		
396	01/12/1881	Atlantic cables	Repaired by CS Retriever	Repaired by CS Retriever. "...great credit to all concerned"		CS Retriever		
397	01/12/1881	Villa Real - Gibraltar	Repaired 23rd November	Repaired 23rd November		CS John Pender		
398	01/12/1881	Vigo - Camhina	Under repair	Under repair		CS John Pender		
399	01/12/1881	"German Union Company's cable"	Under repair	Under repair by CS Kangaroo		CS Kangaroo		
400	03/12/1881	Bushire - Kurrachee	Interrupted near the Spanish Coast				Interrupted near the Spanish Coast	
401	03/12/1881	Falmouth - Bilbao	Interrupted			CS HC Oersted	Interrupted	
402	06/12/1881	Isles of Scilly	Letter of complaint in the *Times*					"sometime back Shetlands cut off for many months……this unpardonable negligence is now being repeated on the Scilly Isles…"
403	10/12/1881	Shetlands; Isles of Scilly	Repaired				Repaired	
404	10/12/1881	Wladiwostock - Nagasaki (GNT)	Interrupted				Interrupted	
405	17/12/1881	Ardbeg Point, Rothesay - Ardyne Point, Mainland	Repaired				Repaired	
406	17/12/1881	Bushire - Jask	Repaired				Repaired	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
407	17/12/1881	Salonica - Tenedos	Repaired				Repaired	
408	17/12/1881	Aden - Suez	Small fault but ship standing by in harbour in case it becomes interrupted	Small fault but ship standing by in harbour in case it becomes interrupted. Report for CS Chiltern that these cable are often being damaged as they were laid on the Malabar reef.		CS Chiltern		
409	17/12/1881	Salonica cable	Repaired on 6th inst	Repaired on 6th inst		CS Retriever		
410	24/12/1881	Pernambuco - Bahia	Both interrupted				Both interrupted	
411	24/12/1881	Amoy - Shanghai; Amoy - Hong Kong	Will be repaired today or tomorrow after FIVE months			SS Morna	Will be repaired today or tomorrow after FIVE months	
412	24/12/1881	Scilly cable	Repaired 14th			SS Oersted	Repaired 14th Dec	
413	31/12/1881	Susa - Tunis	Interrupted				Interrupted	
414	04/01/1882	Antigua - Guadeloupe	Repaired				Repaired	
415	04/01/1882	Nagasaki - Shanghai (GtNT)	Repaired				Repaired	
416	07/01/1882	Tinidad - Demerara	Repaired				Repaired	
417	07/01/1882	Hong Kong - Amoy (ETC)	Interrupted				Interrupted	
418	07/01/1882	Wladiwostock - Nagasaki (GNT)	Repaired Saturday 31/12/1881 after >2 months			CS Lady Carmichael	Repaired Saturday 31/12/1881 after >2 months	
419	12/01/1882	Aden - Suez No 2	Repaired on the 8th inst	Repaired on the 8th inst. Damage due to terado		CS Chiltern		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
420	12/01/1882	Bombay No 1	"Defective or some time" Slow and requiring constant negative current to protect.	"Defective or some time" Slow and requiring constant negative current to protect. Worst 25 miles out of Bombay. To be physically inspected by CS Chiltern		CS Chiltern		
421	12/01/1882	Bombay No 2	Also has a fault but is x10 better than No 1	Also has a fault but is x10 better than No 1				
422	12/01/1882	Direct Lisbon	Interrupted 9th inst 50 miles from Corunna	Interrupted 9th inst 50 miles from Corunna. CS John Pender immediately sent to repair		CS John Pender		
423	12/01/1882	Marsailles - Malta	Interrupted by anchor of P&O SS Ravenna on the 28th December. Repaired the following day.	Interrupted by anchor of P&O SS Ravenna on the 28th December. Repaired the following day by the staff at Malta				
424	14/01/1882	Lowestoft - Emden (Reuters)	Interrupted				Interrupted	
425	26/01/1882	Aden - Bombay	Repair deferred until repair of the Indo-European line	Repair deferred until repair of the Indo-European line. CS Chiltern waiting at Aden.		CS Chiltern		
426	28/01/1882	Brest - St Pierre (1869)	Repaired				Repaired	
427	04/02/1882	Lowestoft - Germany (Indo-European Teleg Co)	Repaired				Repaired	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
428	06/02/1882	Valentla - Greetsiel	Repairs		NMM TCM/8/17 CABLE ENGINEERS' LOGBOOKS. Atlantic (1874), Valentia - Greetsiel, GAMECOCK, KANGAROO, 24 December 1881 - 6 February 1882	CS Gamecock; CS Kangroo		
429	09/02/1882	Direct Lisbon	Still under repair	Still under repair.		CS John Pender		
430	09/02/1882	Aden - Bombay No1	Still under repair	Still under repair. Tests show fault 700nm from Bombay		CS Chiltern		
431	09/02/1882	Zanzibar cable	Grappled in error, repaired 29th Jan	Grappled in error, repaired 29th Jan		CS Chiltern		
432	09/02/1882	Kartal - Dardanelles	Interrupted 2nd inst	Interrupted 2nd inst				
433	09/02/1882	Bona - Marseilles No1	Faulty 20nm from Marseilles 3rd inst	Faulty 20nm from Marseilles. 3rd inst. CS Retriever left on the 5th for the locality of the fault		CS Retriever		
434	18/02/1882	British Guiana	CS Duchess of Marlborough arrives in Georgetown (Brit Guiana) to repair cables there			CS Duchess of Marlborough	CS Duchess of Marlborough arrives in Georgetown (Brit Guiana) to repair cables there	

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
435	20/02/1882	Panama - Colon	"Broken during the autumn gales"			CS Lady Carmichael	CS Lady Carmichael returns from repairing Gale damage to cables	CS Lady Carmichael returned from 2 month voyage repairing 4 cables damaged in last autumn's gales. Delay caused by large fishing fleet at this time of year"
436	20/02/1882	"4 cables in the N Sea"	"Still broken"				"broken again"	CS Lady Carmichael returned from 2 month voyage repairing 4 cables damaged in last autumn's gales. "N German cable still broken)
437	23/02/1882	Aden - Bombay No1	Under repair	Under repair		CS Chiltern		
438	23/02/1882	Marseilles - BonaNo 1	Repaired 19th	Repaired on 19th but several other cables grappled in error and restored.		CS Retriever		

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
439	23/02/1882	Lisbon - Gibraltar	Interrupted 9th inst off Cabezos 30nm from Gibraltar	Interrupted 9th inst off Cabezos 30nm from Gibraltar. CS Retriever to repair		CS Retriever		
440	25/02/1882	Shanghai - Hong kong cable and Hong Kong - Amoy cable	Repaired				Repaired	
441	25/02/1882	Nagasaki - Shanghai (GtNT)	Interrupted				Interrupted	
442	04/03/1882	Fao - Bushire	Interrupted				Interrupted	
443	09/03/1882	Aden - Bombay No1	Long section replaced. Now working 9th inst	Long section replaced. (in detail) No working 9th inst		CS Chiltern		
444	09/03/1882	Lisbon - Gibraltar	Now repaired 2nd inst	Now repaired 2nd inst		CS Retriever		
445	09/03/1882	Direct Lisbon	Still under repair	Still under repair		CS John Pender		
446	23/03/1882	No 2 Bombay	Faulty 11th inst. Repaired 22nd inst	Faulty 11th inst. CS Chiltern repaired 22nd inst		CS Chiltern		
447	23/03/1882	Lisbon Direct	Still under repair	Still under repair. CS John Pender looses grappling gear. More to be sent		CS John Pender		
448	23/03/1882	Dardanelles	Repaired	Repaired		CS Retriever		
449	14/03/1882	No 1 Bombay	Repairing fault 530 miles from Aden	Repairing fault 530 miles from Aden		CS Chiltern		
450	14/03/1882	Direct Lisbon	Still under repair	CS Retriever to be in readines at Malta to repair Direct Lisbon cable as CS John Pender had failed to repair.		CS Retriever; CS John Pender		
451	14/03/1882	Zanzibar - Mozambique	Interrupted on 7th inst (Good Friday), 323 nm from Zanzibar.	Interrupted on 7th inst (Good Friday), 323 nm from Zanzibar. CS Gt Northern left Zanzibar on the 11th to repair		CS Gt Northern		

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
452	10/04/1882	St Vincent - Pernambuco (1874)	Interrupted					Reported interrupted; repair ship sent from Zanzibar
453	15/04/1882	Zanzibar - Mozambique (Eastern Tel Co)	Interruption				Interrupted - notified by Eastern Tel Co	
454	22/04/1882	Bahia - Rio de Janeiro	Interrupted				Interupted - notified by the Post Office	
455	06/05/1882	Falmouth - Bilbao (Direct Spanish Teleg Co)	Interrupted				Interrupted	
456	04/05/1882	No 1 Bombay	Interruption under repair	Under repair. CS Chiltern left Bombay 25th April to repair interruption 325nm from Aden. Samples of this cable submitted to Board. Report from Mr Forde: "animal damage"		CS Chiltern		
457	04/05/1882	Villa Real cable	Repaired 30th April	Repaired 30th April. Damage possible caused by divers tools whilst working on a wreck		CS Retriever		
458	04/05/1882	Zanzibar - Mozambique	Repaired by CS Gt Northern on 25th April.	Repaired by CS Gt Northern. Reported fault damage as caused by strain and chafing on rocks		CS Gt Northern		
459	13/05/1882	Northern section of Brazil cables (Western & Brazilian Teleg Co)	Repaired				Repaired	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
460	18/05/1882	Corunna	CS Retriever & CS John Pender leave Corunna to repair fault	CS Retriever & CS John Pender leave Corunna to repair fault. Bad weather, rocky bottom. CS Retriever fined £80 at Corunna for having too much tobacco on board!		CS Retriever; CS John Pender		
461	18/05/1882	Aden - Bombay No1	Under repair	Under repair. Reports very rough bottom. Difficult to grapple		CS Chiltern		
462	25/07/1882	Zanzibar - Mozambique (Esatern Tel Co)	Repaired	Repaired				
463	27/05/1882	Spain via Bilbao (Direct Spanish Teleg Co)	Repaired				Repaired 19th inst	
464	03/06/1882	Amoy - Shanghai (GNT)	Interrupted				Interrupted	
465	03/06/1882	St Vincent - Pernambuco (1874) (Brazilian Subm Teleg Co)	Restored				Restored	
466	03/06/1882	Bahia - Rio de Janeiro (Western Braz Teleg Co	Repaired				Repaired	
467	08/06/1882	Aden - Bombay No1	Under repair	Under repair but strong currents broke all centipedes (of the grapnel)		CS Chiltern		
468	08/06/1882		EGYPTIAN CRISIS	Off shore gunboat to act as floating cable station. CS Chiltern to wait at Aden in case repairs required				
469	08/06/1882	Direct Lisbon	Still under repair	Still under repair		CS Retriever; CS John Pender		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
470	10/06/1882	Amoy - Shanghai (GNT)	Restored				Restored	
471	10/06/1882	St Vincent - Pernambuco	Restored				Restored	
472	16/06/1882		EGYPTIAN CRISIS	Further reports of Egyptian Crisis from Mr Gibbs at . Worries about safety of staff				
473	17/06/1882	List of cables interrupted: St Thomas - St Kitts; St Vincent - Grenada; Guadeloupe - Dominuca; Paris & New YorkTeleg Co's cable to South America; Rio Grande do Sul Monte Vid;eo					List of cables interrupted: St Thomas - St Kitts; St Vincent - Grenada; Guadeloupe - Dominuca; Paris & New YorkTeleg Co's cable to South America; Rio Grande do Sul Monte Vid;eo	
474	29/06/1882	Suez	EGYPTIAN CRISIS	CS Chiltern arrived Alexandria 15th June. Reported damage to cable in Suez canal and that cable should be moved to opposite bank where ships seldom moor. CS Gt Northern to join CS Chiltern at Suez in case of need. Small steamer to be chartered in London to take out supplies to them		CS Chiltern; CS Gt Northern		
475	29/06/1882	Direct Lisbon	Under repair	Under repair		CS John Pender; CS Retriever		
476	04/07/1882	Falmouth - Lisbon	Repaired	Repaired				

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
477	13/07/1882		EGYPTIAN CRISIS	CS Chiltern 5nm off Alexandria acting as cable station between Cyprus and Alexandria. Alexandria telegraph office destroyed and clerk Fernant murdered				
478	22/07/1882	Trinidad - Grenada	Interrupted (St Thomas - St Kitts not yet repaired)				Interrupted (St Thomas - St Kitts not yet repaired)	
479	22/07/1883	Mull (Scotland) cable	Repaired				Repaired by CS Morna. Cable had been broken by an anchor	
480	27/07/1882		EGYPTIAN CRISIS	CS Chiltern still off Alexandria. Telegram: "all cables working…..Malta No 2 and Cyprus through boat bypass…." Admiral orders not to return to cable station at present due to no water supply. Cyprus cable faulty close to Alexandria. HMG lends CS Amberwich to ETC to help with crisis. CS John Pender also sent to area to help if necessary		CS Chiltern, CS Amberwich; CS John Pender		
481	27/07/1882	Lisbon Direct	Under repair	CS Seine sent to help CS Retriever in repalcement for CS John Pender		CS Seine; CS John Pender		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
482	31/07/1882	St-Vincent - Pernambuco (1874)	Repairs		NMM TCM/8/19 CABLE ENGINEERS' LOGBOOKS. St Vincent - Pernambuco (1874), KANGAR0O 25 February - 31 July 1882	CS Kangaroo		
483	05/08/1882	Trinidad - Grenada	Repaired				Repaired	
484	10/08/1882	Lisbon Direct	Under repair/ "restoration"	Under repair/ "restoration"		CS Seine; CS John Pender		
485	10/08/1882	Alexandria - Port Said	Ordered to lay connection by HMG	Ordered to lay connection by HMG		CS Chiltern; CS John Pender		
486	12/08/1882	Rio Grande do Sul - Monte Video	Restored				Restored	
487	13/08/1882	Falmouth - Lisbon	Repairs		NMM TCM/8/20 CABLE ENGINEERS' LOGBOOKS. Falmouth - Lisbon, SEINE, 25 July - 13 August 1882	CS Seine		
488	19/08/1882	Atlantic (Paris & New York Teleg Co)	Repaired				Repaired	
489	02/09/1882	French Atlantic	Difficulties in repairing. Broken by chafing in several places				Difficulties in repairing. Broken by chafing in several places	
490	09/09/1882	Shanghai - Nagasaki	Interrupted				Interrupted	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
491	09/09/1882	French Atlantic	Further interruption 20 miles away from last				Further interruption 20 miles away from last	
492	11/09/1882	Lowestoft - Greetsiel	Repairs		NMM TCM/8/18 CABLE ENGINEERS' LOGBOOKS. Lowestoft - Greetsiel, STORMCOCK, GAMECOCK, 24 December 1881 - 11 September 1882	CS Gamecock; CS Stormcock		
493	16/09/1882	Jamaca - Colon	Interrupted				Interrupted	
494	21/09/1882	Direct Lisbon	Repairs completed 12th August	Repairs completed 12th August		CS Seine; CS Retriever		
495	21/09/1882	Aden - Suez	Interrupted 12th August	Interrupted 12th August				
496	23/09/1882	Atlantic (1869) (Anglo-American Co)	Fault between Brest and St Pierre		NMM TCM/8/21 CABLE ENGINEERS' LOGBOOKS. Brest - St Pierre (1869), SCOTIA, 4 August - 28 September 1882	CS Scotia	Fault between Brest and St Pierre repaired by CS Scotia of TCM	
497	29/09/1882	Vladiwostock - Nagasaki (GNT)	Still working on repairs to this cable			CS Scotia		CS Scotia back in Plymouth again; still repairing multiple problems with French Atlantic

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
498	30/09/1882	St Vincent - Grenada	Interrupted				Interrupted	
499	05/10/1882	Suez	Adjustment of shore ends	CS Caroline to Alexandria on 4th inst to adjust shore ends		CS Caroline		
500	05/10/1882	Alexandria		Readjustment of shore ends at Alexandria completed 26th September		CS John Pender		
501	05/10/1882	Bona - Marseilles No1	Repaired 22nd Sept	Repaired 22nd September		CS Retriever		
502	05/10/1882	Alexandria - Cairo	Comms re-established	Comms re-established				
503	07/10/1882	Shanghai - Amoy	Interrupted				Interrupted	
504	07/10/1882	Amoy - Hong Kong	Interrupted				Interrupted	
505	07/10/1882	Fao - Bushire	Interrupted				Interrupted	
506	07/10/1882	Martinique - St Lucia	Interrupted				Interrupted	
507	07/10/1882	St Thomas - St Kitts	Repaired				Repaired	
508	14/10/1882	Amoy - Hong Kong	Repaired				Repaired	
509	14/10/1882	Guadaloupe - Dominica	Interrupted				Interrupted	
510	19/10/1882	Suez - Aden No2	Fault 140nm fromAden	Fault 140nm fromAden		CS Chiltern		
511	19/10/1882		EGYPTIAN CRISIS	All cables back to normal positions		CS Caroline		
512	21/10/1882	Hong Kong - Shanghai (ETC)	Repaired				Repaired	
513	28/10/1882	Fao - Bushire	Repaired				Repaired	
514	28/10/1882	All West Indian cables	Now repaired				Now repaired	
515	02/11/1882	Bombay - Aden No 1	Faulty	CS Chiltern to repair fault which had occurred in May but unable to at the time because of Monsoon		CS Chiltern		

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
516	02/11/1882	Suez - Aden No2	Another fault on 25th Oct. Repaired 27th Oct. Terado.	Another fault on 25th Oct. Repaired 27th Oct. Terado.		CS Chiltern		
517	02/11/1882	Lisbon - Gibraltar	Fault inside Cabezos	Fault inside Cabezos. CS John Pender to repair and then return home		CS John Pender		
518	04/11/1882	Trinidad - Demerara	Interrupted				Interrupted	
519	04/11/1882	Lima - Mollendo (W Coast of America Teleg Co)	Repaired on 30th October				Repaired on 30th Oct	
520	06/11/1882	Duplicate Lisbon - Madeira	Repairs		NMM TCM/8/22 CABLE ENGINEERS'·LOGBOOKS. Duplicate Lisbon - Madeira, SEINE, 2 October - 6 November 1882	CS Seine		
521	16/11/1882	Aden - Bombay No 1	CS Chiltern leaves Aden to repair	CS Chiltern leaves Aden to repair		CS Chiltern		
522	16/11/1882	Lisbon - Gibraltar	Repaired	Repaired		CS John Pender		
523	16/11/1882	Suez - Aden Nos 1 & 2	Shore ends adjusted	Shore ends adjusted		CS Caroline		
524	18/11/1882	Guernsey - Alderney	Interrupted				Interrupted	
525	25/11/1882	St Vincent - St Lucia	Repaired				Repaired	
526	25/11/1882	St Croix - Trinidad	Interrupted				Interrupted	
527	30/11/1882	Aden - Bombay No 1	Repairs continue, interrupted by bad weather	Repairs continue, interrupted by bad weather		CS Chiltern		
528	30/11/1882	Santa Maura cable	Repaired fault in shore end	Repaired fault in shore end		CS Retriever		
529	02/12/1882	Jamaca - Porto Rico W India & Panama Co)	Interrupted				Interrupted	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
530	09/12/1882	Jamaca - Porto Rico W India & Panama Co)	Repaired on the 1st Dec.				Repaired on the 1st Dec	
531	09/12/1882	St Croix - Trinidad	Repaired				Repaired	
532	14/11/1882	Aden - Bombay No 1	Still working on repairs to this cable	Still working on repairs to this cable. CS Gt Norther is sent to assist		CS Chiltern; CS Gt Northern		
533	14/11/1882	Vigo - Lisbon	Fault 50 miles from Lisbon	Fault 50 miles from Lisbon. CS Retriever sent to repair		CS Retriever		
534	16/12/1882	Marseilles - Barcelona	Interrupted				Interrupted	
535	16/12/1882	Fortazella - Maranham	Interrupted				Interrupted	
536	23/12/1882	Jamaca - Colon	Repaired				Repaired	
537	30/12/1882	Antigua - Guadeloupe	Interrupted				Interrupted	
538	03/01/1883	UK - Spain via Bilbao	Now fully restored				Now fully restored	
539	06/01/1883	Para - Maranham	Repaired				Repaired	
540	06/01/1883	Marseilles - Barcelona	Repaired				Repaired	
541	11/01/1883	Vigo - Lisbon	Repaired on 25 December	Repaired on 25 December		CS Retriever		
542	11/01/1883	Direct Lisbon	New fault	New fault. CS Retriever engaged in repair		CS Retriever		
543	11/01/1883	Aden - Bombay No 1	Repaired 28th December	Repaired 28th December		CS Chiltern; CS Gt Northern		
544	20/01/1883	Falmouth - Bilboa	Interrupted				Interrupted	
545	25/01/1883	Suez - Aden No2	Faulty 13th Jan	Faulty 13th Jan. Cs Chiltern to repair		CS Chiltern		
546	25/01/1883	Vigo - Porthcurno	Faulty 13th Jan	Faulty 13th Jan.				
547	25/01/1883	Vigo - Carminha	Faulty 13th Jan	Faulty 13th Jan				
548	27/01/1883	England - Guernsey	Interrupted				Interrupted	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
549	27/01/1883	Porthcurno - Vigo (ETC)	Interrupted Last week is now repaired				Interrupted Last week is now repaired	
550	01/02/1883	St Vincent - Pernambuco (1874)	Damaged by Earthquakes					Damage by earthquakes reported on 14/3/83
551	08/02/1883	Constantinople - Odessa	Broken 29th ulto, 90nm from Odessa	Broken 29th ulto, 90nm from Odessa. CS Retriever left vigo 30th ulto to repair		CS Retriever		
552	08/02/1883	Vigo - Caminha and Lisbon - Vigo	To be repaired by CS Volta	To be repaired by CS Volta		CS Volta		
553	22/02/1883	Constantinople - Odessa	Repairs delayed by weather	Repairs delayed by weather		CS Retriever		
554	22/02/1883	Direct Lisbon	Interrupted 15th inst. Repaired on the 17th	Interrupted 15th inst about 20 miles from Lisbon. CS Volta to repaired on the 17th inst. A fault persists near the Burlings.		CS Volta		
555	03/03/1883	Callao - Mollende	Interrupted				Interrupted	
556	03/03/1883	England - Guernsey	Restored				Restored	
557	08/03/1883	Direct Lisbon	Repaired	Repaired. CS Volta on passage to repair Vigo - Caminha cable		CS Volta		
558	10/03/1883	Para - Maranham	Restored				Restored	
559	10/03/1883	Guernsey - Alderny	Restored				Restored	
560	10/03/1883	Port Darwin Australia	Both cables interrupted but repaired the next day				Both cables interrupted but repaired the next day	
561	17/03/1883	Falmouth - Bilbao	Interrupted				Interrupted	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
562	17/03/1883	All W Indies cables	Restored				Restored	
563	24/03/1883	Odessa - Constantinople	Restored				Restored	
564	24/03/1883	All Australian Cables	Restored				Restored	
565	05/04/1883	Odessa - Constantinople	Repaired 18th March	Repaired 18th March		CS Retriever		
566	05/04/1883	Kartel cable	Repaired 29th March	Repaired 29th March		CS Retriever		
567	05/04/1883	Vellona cable	Repairs expected	Repairs expected		CS Retriever		
568	05/04/1883	Gibraltar - Villa Real	2 Faults found and repaired 3rd inst	2 Faults found and repaired 3rd inst		CS Volta		
569	05/04/1883	Persian Gulf Cables	Interrupted 26th ulto and restored on the 2nd inst	Interrupted 26th ulto and restored on the 2nd inst				
570	05/04/1883	Direct Spanish	Interrupted 10th ulto and repaired on the 2nd inst	Interrupted 10th ulto and repaired on the 2nd inst				
571	07/04/1883	UK - Spain via Bilbao (Direct Spanish Cable Co)	Restored				Restored	
572	10/04/1883	Pedro Gonzales Is - San Juan del Sur (Central & S American Cable Co's cables)	Interrupted for last 2 months					Interrupted for last 2 months (*Times* 23/4/83)
573	14/04/1883	Zanzibar - Mozambique (ETC)	Interruption				Interruption	
574	19/04/1883	Gibraltar - Villa Real	Restored 15th inst	Restored 15th inst (2 faults)		CS Volta		
575	19/04/1883	Oranto - Vellona	Restored 12th inst	Restored 12th inst		CS Retriever		
576	19/04/1883	Zanzibar - Mozambique	Interrupted 6th inst . Restored 9th inst	Interrupted 6th inst 300nm from Zanzibar. Restored by CS Gt Northern 9th inst		CS Gt Northern		"Broken"
577	24/04/1883	Para - Maranham	Interrupted again				Interrupted again	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
578	28/04/1883	Zanzibar - Mozambique (ETC)	Repaired				Repaired	
579	03/05/1883	Suez - Aden	Under repair completed on the 29th ulto. Worked well for 1 day then fault near Suez which first showed 9 months ago became much worse	Under repair completed on the 29th ulto. Worked well for 1 day then fault near Suez which first showed 9 months ago became much worse		CS Chiltern		
580	03/05/1883	Tranto - Vellona	Repairs of Trampani - Favignana section for Itallian Govt by CS Retriever	Repairs of Trampani - Favignana section for Itallian Govt by CS Retriever		CS Retriever		
581	03/05/1883	Zanzibar - Mozambique	2nd interruption on 27 April. Previous break repaired 24th April	2nd interruption on 27 April. Previous break repaired 24th April.		CS Gt Northern		
582	03/05/1883	Bombay No 1	"loss of insulation" - cause not yet ascertained	"loss of insulation" - cause not yet ascertained				
583	05/05/1883	Zanzibar - Mozambique (ETC)	Interrupted again				Interrupted again	
584	12/05/1883	England - Ireland	One of the cables to be replaced.				One of the cables to be replaced. (reported in the Daily Telegraph)	
585	12/05/1883	Mozambique - Zanzibar	Repeated breaks (x3) because of rough ground. CS Gt Norther to re-route				Repeated breaks (x3) because of rough ground. CS Gt Norther to re-route	
586	19/05/1883	Zanzibar - Mozambique	Restored by ETC				Restored by ETC for Eastern& S African Teleg Co	
587	31/05/1883	Direct Lisbon	Under repair	Under repair		CS Volta		
588	31/05/1883	Mozambique - Zanzibar	Repaired 13th inst	Repaired 13th inst		CS Gt Northern		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
589	02/06/1883	St Helena - Payta	Interrupted				Interrupted	
590	09/06/1883	St Helena - Payta	Repaired				Repaired	
591	14/06/1883	No 1 Suez - Aden	Fault then interruption 9th inst.	Fault then interruption 9th inst. 610nm from Suez. CS Chiltern to proceed to repair		CS Chiltern		
592	14/06/1883	Direct Lisbon	Repaired 3rd inst	Repaired by CS Volta on 3rd inst. To proceed home from Portugal, taking soundings through the Bay of Biscay		CS Volta		
593	28/06/1883	No 1 Suez - Aden	Repaired 26th inst	Repaired 26th inst		CS Chiltern		
594	28/06/1883	Mozambique - Zanzibar	Interruption again 23rd inst, about 7nm from last repair	Interruption again 23rd inst, about 7nm from last repair. CS Gt Norther to repair		CS Gt Northern	Interrupted Saturday afternoon	
595	07/-7/1883	Maldouado - Monte Video (W Brz Teg Co)	Repaired				Repaired as notified by the W Braz Teleg Co	
596	12/07/1883	No 2 Suez - Aden	Fault repaired 7th inst	Fault repaired 7th inst repaired by CS Chiltern		CS Chiltern		
597	12/07/1883	Mozambique - Zanzibar	Repaired 10th inst	Repaired 10th inst		CS Gt Northern		
598	14/07/1883	Madras - Penang (EETC)	Repaired				Repaired. Notified by EETC	
599	21/07/1883	Zanzibar - Mozambique	Repaired				Repaired	
600	10/08/1883	Woosung and Gutzlaff River	Interruption					Interruption
601	11/08/1883	Demerara - Trinidad	Interrupted				Interrupted	
602	11/08/1883	Foochow - Shanghai (ETC)	Interruption ? How long					Interrupted
603	18/08/1883	Falmouth - Bilbao (Direct Spanish Teleg Co)	Interrupted				Interrupted	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
604	25/08/1883	Foochow - Shanghai (ETC)	Repaired				Repaired	
605	01/09/1883	Trinidad - Demerara	Repaired				Repaired	
606	06/09/1883	Direct Spanish	Interrupted 6th August. Repaired 27th August	Interrupted 6th August. Repaired 27th August by CS Retriever		CS Retriever		
607	06/09/1883	"Black Sea Company's Cable"	Interrupted 3rd Sept	Interrupted 3rd Sept about 5nm from Constantinople				
608	08/09/1883	Amoy - Hong Kong (GNT)	Destroyed by Volcanic erruption in Java					Destroyed by Volcanic erruption in Java
609	15/09/1883	Chorillos - Mollendo	Interrupted				Interrupted	
610	22/09/1883	Amoy - Shanghai (ETC)	Repaired				Repaired	
611	29/09/1883	British Collumbia - Vancouver Island	Restored				Restored	
612	29/09/1883	??? - Brownsville, Texas	"still interrupted"				"still interrupted"	
613	29/09/1883	Chorillos - Arica	Repaired				Repaired	
614	29/09/1883	St Vincent - Pernambuco (Braz Sub Tel Co)	Interrupted				Interrupted	
615	04/10/1883	Direct Spanish	Repaired	Repaired		CS Retriever		
616	04/10/1883	Bona - Malta No 2	Interrupted 10th September. Repaired 20th Sept. 45nm from Bona	Interrupted 10th September. Repaired 20th Sept. 45nm from Bona		CS Retriever		
617	04/10/1883	"Black Sea Company's Cable"	Repaired between shore end and cable house	Repaired between shore end and cable house				

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
618	26/10/1883	Woosung- and Gutzlaff River	Repairs		NMM TCM/9/12 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS Woosung-and Gutzlaff River, SEINE, 4 September - 26 October 1883	CS Seine		
619	27/10/1883	Java - Australia	Interrupted				Interrupted	
620	01/11/1883	Porthcurno - Vigo	Fault 150nm from Porthcurno on 14th Oct	Fault 150nm from Porthcurno on 14th Oct. CS John Pender sent		CS John Pender		
621	01/11/1883	Gibraltar - Lisbon	Repaired fault 13th October	Repaired fault 13th October by CS Retriever		CS Retriever		
622	01/11/1883	Villa Real	Repaired fault 28th October	Repaired fault 28th October by CS Retriever		CS Retriever		
623	15/11/1883	Porthcurno - Vigo	Under repair	Under repair		CS John Pender		
624	24/11/1883	Persian Gulf Cable (Indo-European Teleg Co)	Repaired				Repaired	
625	29/11/1883	Vigo - Lisbon	Faulty	Fault 45nm from Lisbon. CS Volta sent to repair		CS Volta		
626	29/11/1883	Direct Spanish	Interrupted	Interrupted 120nm from Bilbao. CS Volta to repair after Vigo - Lisbon repair		CS Volta		
627	01/12/1883	Falmouth - Bilbao (Direct Spanish Teleg Co)	Interrupted				Interrupted	
628	08/12/1883	St Vincent - Pernambuco (Braz Sub Tel Co)	Repaired				Repaired	
629	13/12/1883	Porthcurno - Vigo	Still under repair	Still under repair		CS John Pender		

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
630	13/12/1883	Valetta - Masascorocco (1861)	Cable being retrieved	Cable being retrieved by CS Retriever		CS Retriever		
631	13/12/1883	Direct Spanish	Under repair	Under repair		CS Volta		
632	13/12/1883	Vigo - Lisbon	Restored	Restored by CS Volta		CS Volta		
633	16/12/1883	St Vincent - Pernambuco (1874)	Repairs		NMM TCM/8/23 CABLE ENGINEERS' LOGBOOKS. St Vincent - Pernambuco (1874), SCOTIA, 1 November -16 December 1883	CS Scotia		
634	19/12/1883	Batavia - Telok Betong	Interrupted					Interrupted (*Times* 25th)
635	22/12/1883	West India - Panama (Jamaca - Colon)	Interrupted. CS Duchess of Marlborough proceeding to repair.			CS Duchess of Marlborough		Interrupted. CS Duchess of Marlborough proceeding to repair.
636	28/12/1883	St Vincent - Granada (W India & Panama Teleg Co)	Interrupted 19th. CS Grappler proceeding to repair			CS Grappler		Interrupted 19th. CS Grappler proceeding to repair
637	29/12/1883	Jamacia - Colon (of W India - Panama)	Broken				Broken	
638	05/01/1884	Jamacia - Colon (of W India - Panama)	Under repair			CS Grappler	CS Grappler en route to repair	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
639	05/01/1884	St Vincent - Granada cable	Interrupted 22nd ulto. CS Duchess of Marlborough to repair.				Interrupted 22nd ulto. CS Duchess of Marlborough to repair.	
640	10/01/1884	Porthcurno - Vigo	Repaired 26th ulto	Repaired 26th ulto		John Pender		
641	10/01/1884	Kartel - Chanak	Interrupted 27th ulto	Interrupted 27th ulto. CS Chiltern to reapir		CS Chiltern		
642	12/01/1884	Falmouth - Bilbao (Direct Spanish Teleg Co)	Repaired 3rd inst	Repaired 3rd inst. CS Volta now taking soundings on the way home		CS Volta	Now repaired	
643	02/02/1884	Pernambuco - Fortazela	Interrupted				Interrupted	
644	07/02/1884	Kartel - Chanak	Repaired 27th January	Repaired 27th January		CS Retriever		
645	09/02/1884	England - Holland	Interrupted				Interrupted	
646	09/02/1884	England - Ostend	Interrupted				Interrupted	
647	16/02/1884	Island of Islay - Mainland	Interrupted				Interrupted	
648	16/02/1884	England - Ostend	Repaired				Repaired	
649	16/02/1884	Cadiz - Canary Is	Repaired				Repaired	
650	16/02/1884	Falmouth - Bilbao (Direct Spanish Teleg Co)	Interrupted				Interrupted	
651	21/02/1884	Malta - Alexandria No 2	"Fall in insulation"	"Fall in insulation". CS John Pender to wait at Malta in case repair necessary		CS John Pender		
652	21/02/1884	Direct Spanish	Interrupted 10th inst	Interrupted 10th inst. 2 faults: one 5nm from Lizard, the other 70 miles further out to sea				
653	23/02/1884	Trinidad - Demerara	Interrupted				Interrupted	
654	23/02/1884	Maranham - Para	Interrupted				Interrupted	
655	23/02/1884	England - Jersey	Interrupted				Interrupted	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
656	01/03/1884	St Vincent - Barbados	Repaired				Repaired	
657	01/03/1884	Lima - Mollendo	Interrupted				Interrupted	
658	06/03/1884	Direct Spanish	CS Volta to repair	CS Volta to repair		CS Volta		
659	08/03/1884	Jersey - France	Repaired				Repaired	
660	08/03/1884	Antigua - Guadeloupe	Interrupted and Repaired				Interrupted and repaired	
661	15/03/1884	St Vincent - Pernambuco	Interrupted				Interrupted	
662	15/03/1884	Cadiz - Canary Is	Interrupted				Interrupted	
663	15/03/1884	Lima - Mollendo	Repaired				Repaired	
664	15/03/1884	Grenada - Trinidad	Repaired				Repaired	
665	20/03/1884	Messina Straits cable	CS Retriever taking on cable to effect repair	CS Retriever taking on cable to effect repair		CS Retriever		
666	20/03/1884	Direct Spanish	Repaired by CS Volta but there are 2 further faults on the line : 9 nm and 40nm from Falmouth	Repaired by CS Volta but there are 2 further faults on the line : 9 nm and 40nm from Falmouth		CS Volta		
667	20/03/1884	S African cable	Fault 50nm from Delagoa.	Fault 50nm from Delagoa. CS Gt Northern proceeding to repair		CS Gt Northern		
668	22/03/1884	England - Holland	Repaired				Repaired	
669	22/03/1884	Antigua - Guadeloupe	Repaired				Repaired	
670	22/03/1884	Maranham - Para	Repaired				Repaired	
671	02/04/1884	Lisbon - Vigo	Under repair by CS Chiltern	Under repair by CS Chiltern		CS Chiltern		
672	02/04/1884	Direct Spanish	Under repair by CS Volta	Under repair by CS Volta. She has already takenout FOUR faults and is now about to repair another 80nm from the Lizard		CS Volta		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
673	02/04/1884	Messina Straits cable	Repaired	Repaired		CS Retriever		
674	02/04/1884	Mozambique - Delagoa (S African cable)	Repaired on the 30th ulto	Repaired on the 30th ulto		CS Gt Northern		
675	12/04/1884	Trinidad - Demerara	Repaired				Repaired	
676	18/04/1884	West India - Panama (Jamaca - Colon)	Reports of serious interruptions in 1884 denied by operating company					Reports of serious interruptions in 1884 denied by operating company
677	19/04/1884	Rio Grand do Sul - Montevideo	Interrupted				Interrupted	
678	19/04/1884	Trinidad - Demerara	Interrupted				Interrupted	
679	19/04/1884	Orkney - Shetland	Repaired				Repaired	
680	19/04/1884	Falmouth - Bilbao (Direct Spanish Teleg Co)	Repaired				Repaired	
681	19/04/1884	Mollendo - Chorillos	Repaired				Repaired	
682	19/04/1884	Island of Islay - Mainland	Repaired				Repaired	
683	24/04/1884	Vigo - Lisbon	2 faults repaired	2 faults repaired by CS Chiltern on her way home		CS Chiltern		
684	24/04/1884	Direct Spanish	Repaired 9th inst	CS Volta repaired 2 faults on her way home as well as taking soundings		CS Volta		
685	26/04/1883	Trinidad - Demerara	Interrupted				Interrupted	
686	26/04/1883	Lima - Mollendo	Repaired				Repaired	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
687	03/05/1884	Fortazela - Maranham	Repaired				Repaired	
688	10/05/1884	Ceylon - India cable	"Repeatedly damaged"				"Repeatedly damaged"	
689	15/05/1884	Suez - Suakim	Interrupted 11th inst	Interrupted 11th inst. CS John Pender to repair		CS John Pender		
690	15/05/1884	Aden - Suakim	Faulty but still working	Faulty but still working				
691	15/05/1884	Vigo - Lisbon	Repaired	Repaired. CS Volta now proceeding to repair fault in Direct Lisbon - Porthcurno		CS Volta		
692	17/05/1884	Key West - Havana	Interrupted				Interrupted	
693	21/05/1884	Trinidad - Demerara	Repaired				Repaired	
694	29/05/1884	Suez - Suakim	Repaired	Repaired		CS John Pender		
695	29/05/1884	Suakim - Aden section of the Red Sea No 2	Faulty but under repair	Faulty but under repair		CS John Pender		
696	29/05/1884	Direct Lisbon	Faults to be repaired by CS Chiltern	Faults to be repaired by CS Chiltern now that her refit has been completed		CS Chiltern		
697	07/06/1884	Maranham - Para	Interrupted				Interrupted	
698	07/06/1884	Key West - Havana	Restored				Restored	
699	12/06/1884	Aden - Suakim	Restored	Restored. Cs John Pender now working on the Aden - Suakim section.		CS John Pender		
700	14/06/1884	Maranham - Para	Repaired				Repaired	
701	26/06/1884	Direct Lisbon	Repaired 17th inst	Repaired 17th inst		CS Chiltern		
702	26/06/1884	Bona - Malta	Interrupted 12th inst	Interrupted 12th inst. CS Chiltern to repair		CS Chiltern		
703	26/06/1884	Malta - Alexandria No 2 (1870)	Fault	Fault		CS Chiltern		
704	26/06/1884	Aden - Suakim	Repaired	Repaired		CS John Pender		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
705	28/06/1884	Chorillos - Mollendo	Repaired				Repaired	
706	28/06/1884	Pernambuco - Ceara	Repaired				Repaired	
707	28/06/1884	The Forth Cable	Damaged by anchor				Damaged by anchor	
708	10/07/1884	Malta - Alexandria	Repaired 9th inst	Repaired 9th inst		CS Chiltern		
709	26/07/1884	The Forth Cable	Repaired by CS Monarch			CS Monarch	Repaired by CS Monarch	
710	26/07/1884	Shetland cables	Repaired by CS Monarch			CS Monarch	Repaired by CS Monarch	
711	05/08/1884	Madeira St - Vincent (1874)	Repairs		NMM TCM/8/24 CABLE ENGINEERS' LOGBOOKS. Madeira - St Vincent (1874), SCOTIA, 16 July - 5 August 1884	CS Scotia		
712	30/08/1884	Amoy (GNT)	Comms restored				Comms Restored	
713	09/09/1884	Vigo - Lisbon and Giraltar - Lisbon	Renewal of shore ends	Renewal of shore ends		CS Chiltern		
714	09/09/1884	Malta - Gibraltar	Interrupted 3rd inst and repaired by Malta Staff 6th inst (interrupted by SS Rembrance)	Interrupted 3rd inst and repaired by Malta Staff 6th inst (interrupted by SS Rembrance)				
715	09/09/1884	Malta - Sicily	Interrupted on the 3rd inst and repaired by Malta Staff 7th inst (interrupted by SS Rembrance)	Interrupted on the 3rd inst and repaired by Malta Staff 7th inst (interrupted by SS Rembrance)				
716	04/10/1884	Saigon - Hong Kong (ETC)	Interrupted				Interrupted	
717	11/10/1884	Australia - Tasmania	Repaired				Repaired	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
718		Haiphong - Hong Kong	Also interrupted				Also interrupted	
719	11/10/1884	Both of Western Union's Atlantic cables	Interrupted				Interrupted	
720	16/10/1884	Gibraltar - Lisbon	Unable to locate fault but as cable working satisfactorily - leave alone	Unable to locate fault but as cable working satisfactorily - leave alone		CS Chiltern		
721	16/10/1884	Belem cable across River Tagus	Repairing faults in "6-wire"	Repairing faults in "6-wire"		CS Chiltern		
722	16/10/1884	Rhoded - Scarpanto & Cania	Repair of shore ends off Scarpanto	Repair of shore ends off Scarpanto		CS Volta		
723	16/10/1884	Haiphong - Hong Kong	Repaired				Repaired	
724	30/10/1884	Belem cable across River Tagus	Temporary repair	Temporary repair		CS Chiltern		
725	30/10/1884	Rhoded - Scarpanto & Cania	Repaired 29th ulto	Repaired 29th ulto		CS Volta		
726	30/10/1884	Suez - Aden No 2	Repaired	Repaired		CS John Pender		
727	13/11/1884	Marseilles - Bona No 2	Repaired shore end at Marseilles 9th inst damaged by SS Burgundia	Repaired shore end at Marseilles 9th inst damaged by SS Burgundia		CS Volta		
728	13/11/1884	Gibraltar - Lisbon	Fault to be repaired by CS Volta	Fault to be repaired by CS Volta		CS Volta		
729	13/11/1884	Syra - Chios	Interrupted on 9th inst by sailing ship's anchor	Interrupted on 9th inst by sailing ship's anchor. To be repaired by Station staff when weather moderates				
730	27/11/1884	Red Sea No 1	Fault 280nm from Suakim. CS John Pender to repair			CS John Pender		
731	27/11/1884	Syra - Chios	Repaired	Repaired by Mr Cardona the Supt at Chios				
732	29/11/1884	Fao - Bushire	Interrupted				Interrupted	
733	11/12/1884	Suakim - Suez	Repaired	Repaired		CS John Pender		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
734	11/12/1884	Syra - Chios	Interruption on the 9th ulto was caused by a lighter sinking on the cable	Interruption on the 9th ulto was caused by a lighter sinking on the cable				
735	11/12/1884	No 1 Malta - Alexandria	Fault 5nm from Alexandria on 7th inst	Fault 5nm from Alexandria on 7th inst. CS Volta to reapir		CS Volta		
736	20/12/1884	Bennet - Mackay	Now in working order				Now in working order	
737	20/12/1884	Trinidad - Demerara	Interrupted				Interrupted	
738	27/12/1884	"Brazillian Submarine Cable"	Interrupted half nm from shore by ship anchor and repaired				Interrupted half nm from shore by ship anchor and repaired	
739	03/01/1885	St Vincent - Madiera	Interrupted 28th ulto near Madiera			CS Kangaroo	Interrupted near Madiera. CS Kangaroo to repair. From the *Monthly Correspondent* , Madiera	
740	08/01/1885	Both Bombay cables	Small faults near Bombay	Small faults near Bombay		CS John Pender		
741	08/01/1885	Lisbon - Gibraltar	Interrupted 4th inst	Interrupted 4th inst VC Volta to repair		CS Volta		
742	08/01/1885	Bona - Malta	Interrupted 8nm from Malta 20th ulto. Repaired by CS Volta 23rd ulto. Damaged by HMS Agamemnon	Interrupted 8nm from Malta 20th ulto. Repaired by CS Volta 23rd ulto. Damaged by HMS Agamemnon		CS Volta		
743	08/01/1885	Vigo - Caminha	Interrupted 7th inst	Interrupted 7th inst				
744	08/01/1885	Persian Gulf cables	Interrupted 3rd inst	Interrupted 3rd inst				
745	17/01/1885	India - Ceylon	Interrupted 10th inst				Interrupted 10th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
746	22/01/1885	Belem cable across River Tagus	Broken by SS Geronde	Broken by SS Geronde				
747	22/01/1885	Persian Gulf cables	Repaired 9th inst	Repaired 9th inst				
748	22/01/1885	Messina Straits 3-Core (1881)	Interrupted	Interrupted				
749	24/01/1885	Neuwerk - Heligoland	Interrupted				Interrupted	
750	29/01/1885	Alexandria - Port Said	Interrupted 23rd inst	Interrupted 23rd inst. CS John Pender to repair		CS John Pender		
751	29/01/1885	Malta - Alexandriaandia No 1	Failed 23rd inst. CS John Pender to repair	Failed 23rd inst. CS John Pender to repair		CS John Pender		
752	29/01/1885	Suakim - Perim	Interrupted 28th inst 272 nm from Suakim	Interrupted 28th inst 272 nm from Suakim				
753	29/01/1885	Villa Real - Gibraltar	Interrupted 24th inst CS Volta repairing	Interrupted 24th inst CS Volta repairing		CS Volta		
754	31/01/1885	Paris - New York	Still interrupted				Still interrupted	
755	05/02/1885	Belem cable across River Tagus	Interrupted by the Chesepeake on 31st ulto. To be repaird by CS Chiltern	Interrupted by the Chesepeake on 31st ulto. To be repaird by CS Chiltern		CS Chiltern		
756	05/02/1885	Direct Spanish Co's original cable	Interrupted 31st ulto 2.5nm from Bilbao	Interrupted 31st ulto 2.5nm from Bilbao				
757	05/02/1885	Zanzibar - Mozambique	Interrupted 100nm from Mozambique	Interrupted 100nm from Mozambique. CS Gt Northern to repair		CS Gt Northern		
758	07/02/1885	Direct United States	Interrupted				Interrupted	
759	07/02/1885	Zanzibar - Mozambique	Interrupted				Interrupted	
760	14/02/1885	Lundy Island	Interrupted				Interrupted	
761	19/02/1885	Belem cable across River Tagus	Being replaced by CS CS Chilterm	Being replaced by CS CS Chilterm		CS Chiltern		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
762	19/02/1885	Malta - Alexandriaandia No 1	Repaired 6th inst	Repaired 6th inst		CS John Pender		
763	19/02/1885	Alexandria - Port Said	Repaired on the 11th	Repaired 11th inst		CS John Pender		
764	19/02/1885	Suez - Suakin	To be repaired	To be repaired by CS John Pender		CS John Pender		
765	19/02/1885	Suakin - Perim	To be repaired	To be repaired by CS John Pender		CS John Pender		
766	19/02/1885	Villa Real - Gibraltar	Repaired 12th inst	Repaired 12th inst		CS Volta		
767		Gibraltar - Lisbon	Being repaired; Bad weather	Being repaired; Bad weather		CS Volta		
768	21/02/1885	Direct United States	Repaired				Repaired	
769	28/02/1885	West India Cable	Repaired except for St Vincent - Granada				Repaired except for St Vincent - Granada	
770	05'03/1885	Suez - Suakin	Repaired 20th ulto	Repaired 20th ulto		CS John Pender		
771	05/03/1885	Gibraltar - Lisbon	Faulty	Faulty. CS Volta to repair		CS Volta		
772	05/03/1885	Zanzibar - Mozambique (ETC)	Repaired 24th ulto	Repaired 24th ulto by CS Gt Northern		CS Gt Northern		
773	07/03/1885	Paris - New York Compagnir Francaise)	Repaired				Repaired	
774	14/03/1885	Lundy Island	Repaired				Repaired	
775	19/03/1885	Perim - Suakin	Repairing multiple faults	CS John Pender repairing multiple faults		CS John Pender		
776	19/03/1885	Gibraltar - Lisbon	Repaired 15th inst	Repaired		CS Volta		
777	21/03/1885	Maranham - Para	Interrupted				Interrupted	
778	21/03/1885	India - Ceylon	Repaired				Repaired	
779	21/03/1885	Trinidad - Demerara	Repaired				Repaired	
780	04/04/1885	Maranham - Para	Repaired				Repaired	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
781	16/04/1885	Zanzibar-Mozambique	Interrupted 2nd inst	Interrupted 2nd inst. To be repaired by CS Chiltern		CS Chiltern		
782	16/04/1885	Zante - Canea	Interrupted 29th ulto	Interrupted 29th ulto. CS Volta to reapir		CS Volta		
783	16/04/1885	Aden - Bombay duplicate (ETC)	2 faults	2 faults to be repaired by CS John Pender		CS John Pender		
784	30/04/1885	Suez - Suakin	Interrupted 28th inst	Interrupted 28th inst. CS Electra to repair		CS Electra		
785	02/05/1885	Cable in the Caspian Sea	"Cable in the Caspian Sea has been cut by some fishermen"				"Cable in the Caspian Sea has been cut by some fishermen"	
786	05/05/1885	Brest - St Pierre (1869)	Repairs		NMM TCM/8/25 CABLE ENGINEERS' LOGBOOKS. Brest - St Pierre (1869), MINIA, 18 March - 5 May 1885	CS Minia		
787	09/05/1885	Paris - New York	Interrupted				Interrupted	
788	14/05/1885	Bombay - Aden No 1	Repaired	Repaired 40nm from Bombay		CS John Pender		
789	14/05/1885	Suez - Suakin	Repaired 5th inst	Repaired 5th inst		CS Electra		
790	15/05/1885	Maranham - Para	Interrupted again				Interrupted	
791	22/05/1885	Zanzibar - Mozambique (ETC)	Repaired	Repaired			Repaired	
792	29/05/1885	Maranham - Para	Repaired				Repaired	
793	05/06/1885	Aden - Bombay duplicate (ETC)	Interrupted					
794	11/06/1885	Zanzibar - Mozambique (ETC)	Repaired 16th May	Repaired 16th May		CS Chiltern		
795	11/06/1885	Zante - Canea	Repaired 4th May	Repaired 4th May		CS Volta		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
796	11/06/1885	Zante - Cephalonia	Repaired 6th May	Repaired 6th May		CS Volta		
797	11/06/1885	Vigo - Caminha	Repaired 8th inst	Repaired 8th inst		CS Electra		
798	11/06/1885	Both Aden - Bombay cables	Interrupted on 3rd inst	Interrupted 140nm from Aden 3rd inst		John Pender		
799	11/06/1885	Suakin - Perim	Interrupted on 3rd inst	Interrupted 140nm from Aden 3rd inst				
800	12/06/1885	Both Aden - Bombay cables	Interrupted but repair expected in hours				Interrupted but repair expected in hours	
801	25/06/1885	Porthcurno - Vigo	Repaired 21st inst	Repaired 21st inst		CS Electra		
802	25/06/1885	Direct Lisbon cable	Fault 143nm from Porthcurno	Fault 143nm from Porthcurno. CS Electra repairing		CS Electra		
803	03/07/1885	Both Aden - Bombay cables	Repaired				Repaired	
804	09/07/1885	No 2 Bombay - Aden	Repaired 27th ultimo	Repaired 27th ultimo		CS John Pender		
805	09/07/1885	Direct Lisbon cable	Repaired 2nd inst	Repaired 2nd inst		CS Electra		
806	16/07/1885	Bombay - Aden No 1	Unable to repair because of current along cable	Unable to repair because of current along cable		CS John Pender		
807	16/07/1885	Perim - Suakim	Interrupted	Interrupted CS John Pender to repair 44 nm from Suakim		CS John Pender		
808	16/07/1885	Suakim - Suez	Interrupted	Interrupted CS John Pender to repair break in harbour caused by a ship		CS John Pender		
809	16/07/1885	Gibraltar - Lisbon	Interrupted 45nm from Gibraltar	Interrupted 45nm from Gibraltar. CS Volta to repair		CS Volta		
810	16/07/1885	Direct Lisbon cable	Interrupted 12th inst	Interrupted 12th inst				
811	24/07/1885	"Western Union Cables" ??Atlantic??	Repaired				Repaired	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
812	31/07/1885	Suakin	Comms re-established				Comms re-established	
813	06/08/1885		SUBMARINE TELEGRAPH ACT 1885					
814	21/8/1885	Old cable across Cook's Straight is broken (NZ) (1866) (3-core)	Broken				Broken	
815	28/8/1885	Fao - Bushire	Interrupted				Interrupted	
816	04/09/1885	Fao - Bushire	Repaired				Repaired	
817	11/09/1885	Paris - New York	Repaired				Repaired	
818	18/09/1885	Dominica - Martinique	Interrupted				Interrupted	
819	18/09/1885	St Vincent - Grenada	Interrupted				Interrupted	
820	18/09/1885	Fao - Bushire	Interrupted				Interrupted	
821	01/10/1885	Bombay - Aden No 2	Fault occurred 14th August	Fault occurred 14th August. Finally repaired by CS Chiltern 26th September		CS Chiltern		
822	01/10/1885	Suakim - Suez	Repaired 31st July	Repaired 31st July		CS John Pender		
823	01/10/1885	No 1 Bombay	Under repair	Under repair by CS John Pender		CS John Pender		
824	01/10/1885	Perim - Suakim	Under repair	Under repair by CS John Pender		CS John Pender		
825	01/10/1885	Direct Lisbon	Repaired 4th August	Repaired 4th August		CS Electra		
826	01/10/1885	Trieste - Corfu	Repaired 6th September	Repaired 6th September		CS Electra		
827	01/10/1885	Gibraltar - Lisbon	Repaired 20th August	Repaired 20th August		CS Volta		
828	01/10/1885	Malta - Alexandria No 2	Fault under repair	Fault under repair		CS Volta		
829	16/10/1885	Direct Spanish Co's original cable	Interrupted				Interrupted	
830	23/10/1885	Mackay Bennet cable	Will be repaired within a few days			CS Faraday	Will be repaired within a few days	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
831	29/10/1885	Suakim - Perim	Repaired 7th inst	Repaired 7th inst		CS John Pender		
832	29/10/1885	No 1 Aden - Bombay	Repaired 26th inst	Repaired 26th inst		CS John Pender		
833	29/10/1885	Oranto - Corfu	Repaired 24th inst	Repaired 24th inst		CS Electra		
834	29/10/1885	Gibraltar - Malta	Interrupted 11th inst; repaired 25th inst	Interrupted 11th inst; repaired 25th inst		CS Electra		
835	29/10/1885	Direct Spanish	Interrupted 11th inst; repaired 25th inst	Interrupted 11th inst; repaired 25th inst		CS Electra		
836	29/10/1885	Malta - Alexandria No 2	Repaired 8th inst	Repaired 8th inst		CS Volta		
837	29/10/1885	No 2 Bombay	Repaired 4th inst	Repaired 4th inst		CS Chiltern		
838	13/11/1885	Brest - St Pierre (1869)	Repaired			CS Electra	Operator reported to *The Electrician* that it was repaired	
839	20/11/1885	UK - Bilbao - "Spain" (Direct Spanish Teleg Co)	26 year old cable repaired			CS Volta	26 year old cable repaired - the oldest cable repaired so far. "life nrmally 10 years"	
840	25/11/1885	?Cable (Direct Spanish Teleg Co)	Interrupted				Interrupted	
841	10/12/1885	Suez - Aden No 2	Repaired 20th November	Repaired 20th November		CS John Pender		
842	10/12/1885	Suez - Suakim	Fault repaired 29th	Fault repaired 29th		CS John Pender		
843	10/12/1885	Oranto - Corfu	Repaired 12th Nov	Repaired 12th Nov		CS Volta		
844	10/12/1885	Bona - Malta No 1	Repaired 27th November	Repaired 27th November		CS Volta		
845	10/12/1885	Direct Spanish	Repaired 9th Nov	Repaired 9th Nov		CS Electra		
846	10/12/1885	Lisbon - Vigo	Repaired 5th inst	Repaired 5th inst		CS Electra		
847	07/01/1886	Salonica cable	Under repair	Under repair		CS Volta		
848	15/01.1886	Trinidad - Demerara	Repaired				Repaired	
849	21/01/1886	Salonica cable	Repaired 8th inst	Repaired 8th inst		CS Volta		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
850	21/01/1886	Zante - Corfu	Repaired 19th inst	Repaired 19th inst		CS Volta		
851	04/02/1886	Messina cables	Under repair	Under repair		CS Volta		
852	04/02/1886	Doro Channel cable	Interrupted	Interrupted' to be repaired by CS Volta		CS Volta		
853	04/02/1886	Vigo - Lisbon	Fault 31st ulto	Fault 31st ulto. To be repaired by CS Electra		CS Electra		
854	03/03/1886	Zanzibar - Mozambique No 1	Interrupted 23rd Feb	Interrupted 23rd Feb to be repaired by CS Chiltern		CS Chiltern		
855	03/03/1886	Alexandria - Sitia	Interrupted	Interrupted near Alexandria. To be repaired by CS Electra but bad weather.		CS Electra		
856	03/03/1886	Messina cables	Interrupted again	Interrupted again. To be repaired by CS Volta		CS Volta		
857	18/03/1886	Zanzibar - Mozambique No 1	Under repair	Under repair		CS Chiltern		
858	18/03/1886	Alexandria - Sitia	Repaired 5th inst	Repaired 5th inst		CS Electra		
859	18/03/1886	Malta -Alexandria No 1	Interrupted	Interrupted 10nm from Malta		CS Volta		
860	19/03/1886	Trinidad - Demerara	Interrupted				Reported by the Times; picked up by the Electrician	Reported by the Times; picked up by the Electrician
861	01/04/1886	Zanzibar - Mozambique No 1	Repaired 19th March	Repaired 19th March		CS Chiltern		
862	01/04/1886	Malta -Alexandria No 1	Repaired 17th March	Repaired 17th March		VS Volta		
863	01/04/1886	Ava - Myingyan	Interrupted				Interrupted	
864	09/04/1886	Trinidad - Demerara	Interrupted				Interrupted	
865	09/04/1886	St Lucia - St Vincent	Interrupted				Interrupted	
866	15/04/1886	Direct Spanish (1872)	Examination	Cable under examination by CS John Pender & CS Volta		CS John Pender; CS Volta		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
867	15/04/1886	Villa Real - Gibraltar	Repaired 6th inst	Repaired 6th inst by CS Electra		CS Electra		
868	15/04/1886	Vigo - Lisbon	Interrupted 2nd inst	Interrupted 2nd inst. CS Electra to repair		CS Electra		
869	16/04/1886	Dominica - Guadaloupe	Repaired				Repaired	
870	23/04/1886	St Lucia - St Vincent	Interrupted				Interrupted	
871	23/04/1886	Fao - Bushire	Repaired				Repaired	
872	07/05/1886	Maranham - Para	Repaired				Repaired	
873	13/05/1886	Suez - Suakin and Suakim - Perim	Faults	Faults to be removed by CS Chiltern		CS Chiltern		
874	13/05/1886	Bona - Malta No 1	Broken by ship's anchor off Bona. Repaired 8th inst	Broken by ship's anchor off Bona. Repaired 8th inst		CS Electra		
875	13/05/1886	Chios - Tenedos	Interrupted	Interrupted. CS Electra to repair		CS Electra		
876	13/05/1886	Direct Spanish (1872)	Under examination	Under examination. Shore end bouyed		CS John Pender; CS Volta		
877	14/05/1886	Paris - New York	Faulty			CS Lady Carmichael	Faulty; CS Lady Carmichael to repair	
878	27/05/1886	Perim - Suakim and Suakim - Suez	Repaired 12th inst	Repaired 12th inst but now repairing further fault in Suez - Suakim, 80nm from Suakim		CS Chiltern		
879	27/05/1886	Chios - Tenedos and Lemnos cables	Repaired	Repaired		CS Electra		
880	27/05/1886	Direct Spanish (1872)	Unrepairable; to be abandoned	Unrepairable; to be abandoned		CS John Pender; CS Volta		
881	24/06/1886	Suez - Suakim	Repaired fault 7th inst	Repaired fault 7th inst		CS Chiltern		
882	24/06/1886	Gibraltar - Lisbon	Being repaired	Being repaired by CS Electra		CS Electra		
883	24/06/1886	Direct Spanish (1872)	198nm recovered	198nm recovered by CS John Pender		CS John Pender		
884	25/06/1886	Paris - New York	Repaired			CS Lady Carmichael	Repaired	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
885	08/07/1886	Direct Porthcurno - Lisbon	Under repair	Under repair		CS Electra		
886	08/07/1886	Malta - Gibraltar	Interrupted 6th inst	Interrupted 6th inst, 6nm from Gibraltar. CS Mirror to repair		CS Mirror		
887	16/07/1886	Autofagusta - Caldera	Interrupted				Interrupted	
888	22/07/1886	Direct Porthcurno - Lisbon	Still under repair	Still under repair		CS Electra		
889	22/07/1886	Gibraltar - Malta	Interrupted	Interrupted. To be repaired by CS Mirror		CS Mirror		
890	05/08/1886	Direct Porthcurno - Lisbon	Still under repair	Still under repair. Cable repeatedly breaks on grappling		CS Electra		
891	05/08/1886	Gibraltar - Malta	Repaired 28th ulto	Repaired 28th ulto		CS Mirror		
892	05/08/1886	Villa Real - Gibraltar	Repaired 25th ulto	Repaired 25th ulto		CS Mirror		
893	06/08/1886	"Persia Cable" between Fao and Bushire	Interrupted for 3 months				Interrupted for 3 months	
894	03/09/1886	Scilly Isles cable	Interrupted				Interrupted	
895	10/09/1886	Madras - Penang	Interrupted				Interrupted	
896	10/09/1886	Rangoon - Penang	Interrupted				Interrupted	
897	10/09/1886	Isle of Mull	Interrupted				Interrupted	
898	24/9/1886	Madras - Penang	Repaired				Repaired	
899	24/9/1886	Rangoon - Penang	Repaired				Repaired	
900	24/9/1886	Jamaica - Colon	Interrupted				Interrupted	
901	24/9/1886	Libertad - San Juan de Sur	Interrupted				Interrupted	
902	24/9/1886	Submarine Teleg Act 1885 Ammendment passed					Submarine Teleg Act 1885 Ammendment passed	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
903	27/09/1886	Trinidad - Demerara	Cable interrupted for 2 weeks repaired yesterday					Cable interrupted for 2 weeks repaired yesterday
904	30/09/1886	Direct Porthcurno - Lisbon	Interrupted since 11th June; still under repair	Still unter repair. 195nm cable already relaid but now another break off Cape Finisterre		CS Electra		
905	30/09/1886	Gibraltar - Lisbon	Repaired 28th July	Repaired 28th July		CS Mirror		
906	30/09/1886	Villa Real - Gibraltar	Fault repaired 10th Aug	Fault repaired 10th Aug by CS Mirror		CS Mirror		
907	30/09/1886	Lisbon - Vigo	Repaired 6th inst	Repaired 6th inst		CS Mirror		
908	30/09/1886	Zante - Candia	Interrupted by earthquake 27th August; Repaired on the 28th	Interrupted by earthquake 27th August; Repaired on the 28th by CS Mirror		CS Mirror		
909	08/10/1886	St Vincent - Barbados	Interrupted				Interrupted	
910		Havana - Key West	Repaired 4th inst				Repaired 4th inst	
911	14/10/1886	Lisbon - Gibraltar	Faulty again	Faulty again. To be repaired by CS Volta		CS Volta		
912	14/10/1886	Direct Lisbon	Bad weather delaying repair	Bad weather delaying repair		CS Electra		
913	14/10/1886	Malta - Alexandria No 2	Fault and Break	Fault and Break. CS Mirror repairing		CS Mirror		
914	14/10/1886	Candia - Rettino	Faulty	Faulty. To be repaired by CS Mirror after Malta - Alexandria No 2		CS Mirror		
915	14/10/1886	Malta Shore Ends	Maltese Govt warn ETC that the shore ends may be destroyed by newly laid submarine mines laid for defense of Malta	Maltese Govt warn ETC that the shore ends may be destroyed by newly laid submarine mines laid for defense of Malta				
916	22/10/1886	St Vincent - Barbados	Repaired				Repaired	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
917	28/10/1886	Malta - Alexandria No 2	Repaired 19th inst	Repaired 19th inst		CS Mirror		
918	28/10/1886	Direct Porthcurno - Lisbon	Under repair	Under repair by CS Electra		CS Electra		
919	28/10/1886	Chios - Tenedos	Interrupted 26th inst.	Interrupted 26th inst. CS Volta to repair		CS Volta		
920	28/10/1886	Vigo - Caminha	Un reliable	Because of unreliability it was suggested that a land line was laid between these two stations if the Spanish Govt agrees				
921	29/10/1886	Scilly Isles cable	Now repaired				Now repaired	
922	05/11/1886	St Vincent - Granada	Interrupted				Interrupted	
923	05/11/1886	Dominica - Martinique	Interrupted				Interrupted	
924	11/11/1886	Direct Porthcurno - Lisbon	Repairs delayed by strong winds	Repairs delayed by strong winds		CS Electra		
925	11/11/1886	Malta - Bona No 1	Interrupted 1st inst	Interrupted 1st inst. CS Volta to repair		CS Volta		
926	19/11/1886	West Indies & British Guiana	Repaired - All W Indian Islands in communication again				Repaired - All W Indian Islands in communication again	
927	19/11/1886	Lundy Island	Repaired				Repaired	
928	23/11/1886	Suez - Suakim	Faulty 20th inst	Faulty 20th inst. CS Chiltern to repair		CS Chiltern		
929	23/11/1886	Direct Porthcurno - Lisbon	Still under repair	Still under repair		CS Electra		
930	23/11/1886	Cephalonia - Zante	Repaired 23rd inst	Repaired 23rd inst		CS Electra		
931	23/11/1886	Malta Shore Ends	Referred to War Office	Referred to War Office				
932	26/11/1886	Dominica - Martinique	Repaired				Repaired	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
933	03/12/1886	San Juan del Sur - Panama	Interrupted				Interrupted	
934	03/12/1886	Trinidad - Demerara	Storm damage repaired on 24th ultimo				Storm damage repaired on 24th ult	
935	09/12/1886	Suez - Suakim	Fault repaired on 1st inst 200nm from Suez; 2nd fault 250nm from Suakim repaired.	Fault repaired on 1st inst 200nm from Suez; 2nd fault 250nm from Suakim repaired. CS Chiltern		CS Chiltern		
936	09/12/1886	Direct Porthcurno - Lisbon	Repaired 3rd inst	Repaired 3rd inst				
937	09/12/1886	Rettino - Canea	Repaired 6th inst	Repaired 6th inst		CS Volta		
938	09/12/1886	Sita	Repaired shore ends	Repaired shore ends		CS Volta		
939	09/12/1886	Oranto - Corfu	Faulty	Faulty. CS Volta to repair		CS Volta		
940	10/12/1886	Isle of Man	Restored				Restored	
941	17/12/1886	China - Hong Kong - Manila (GNT)	Repaired				Repaired	
942	17/12/1886	Trinidad - Demerara	Interrupted				Interrupted	
943	31/12/1886	Atlantic	An Atlantic cable which had been broken off Land's End for 6 weeks now working				An Atlantic cable which had been broken for 6 weeks now working	
944	06/01/1887	Suakim - Suez	Repaired	Repaired		CS Chiltern		
945	06/01/1887	Vigo - Camhina	Repaired 1st inst	Repaired 1st inst		CS Electra		
946	06/01/1887	Lipari - Messina	To be repaired	To be repaired by CS Volta		CS Volta		
947	06/01/1887	Corfu - Oranto	To be repaired	To be repaired by CS Volta		CS Volta		
948	20/01/1887	Lipari - Messina	Repaired	Repaired		CS Volta		
949	20/01/1887	Oranto - Corfu	Repaired	Repaired		CS Volta		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
950	03/02/1887	Suez - Aden (No 3)	Interrupted 25th ultimo. Damaged caused by SS Pelican. Repaired 26th ultimo	Interrupted 25th ultimo. Damage caused by SS Pelican. Repaired 26th ultimo by stem launch Teazer				
951	03/02/1887	Corfu - Oranto	Repaired 26th ultimo	Repaired 26th ultimo		CS Volta		
952	03/02/1887	Lisbon - Gibraltar	Broken 22nd ulto	Broken 22nd ultimo. To be repaired by CS Electra		CS Electra		
953	03/02/1887	Villa Real	Fault 30th ulto	Faulty 30th ulto. To be repaired by CS Electra		CS Electra		
954	04/02/1887	Atlantic (French?)	Interrupted				Interrupted	
955	17/02/1887	Paros - Naxos (Levant cables)	Interrupted	Interrupted				
956	17/02/1887	Gibraltar - Lisbon	Repaired	Repaired		CS Electra		
957	17/02/1887	Villa Real	Repaired	Repaired		CS Electra		
958	03/03/1887	Suakim - Suez	Faulty	Faulty 20nm from Suez. Cs Chiltern to repair		CS Chiltern		
959	03/03/1887	Marsailles shore ends	Adjusted	Adjusted 25th ulto		CS Volta		
960	03/03/1887	Paros - Naxos (Levant cables)	Under repair	Under repair by CS Volta		CS Volta		
961	04/03/1887	????	Broken down off the Congo River			CS Bucaneer	Broken down off the Congo River	
962	17/03/1887	Suakim - Suez	Repaired 15th inst. Broken by anchor chain of a dhow	Broben by the anchor chain of a dhow. Repaired by CS Chiltern		CS Chiltern		
963	17/03/1887	Alexandria - Port Said	Repaired 11th inst	Repaired 11th inst by CS Volta		CS Volta		
964	17/03/1887	Tangiers cable	Cut maliciously on 3 occaisions	Cut maliciously on 3 occaisions				
965	25/03/1887	Loanda Sao Thome section of W Africa Tele Co cable	Interrupted				Interrupted	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
966	01/04/1887	Trinidad - Demerara	Repaired				Repaired	
967	01/04/1887	French Atlantic	Interrupted				Interrupted	
968	08/04/1887	Chorillos - Molendo section of Chili, Argentine, Uroguay	Restored				Restored	
969	15/04/1887	Chorillos - Molendo section of Chili, Argentine, Uroguay	Restored				Restored	
970	28/04/1887	Villa Real	Repaired 21st inst	Repaired 21st inst		CS Electra		
971	28/04/1887	Lisbon - Gibraltar	Faults repaired	Faul;ts repaired off Cape St Vincent and from 60nm neared to Gibraltar		CS Electra		
972	29/04/1887	Loanda Sao Thome section of W Africa Tele Co cable	All restored				All Restored	
973	12/05/1887	Lisbon - Gibraltar	3 faults removed 7th inst	3 faults removed 7th inst		CS Electra		
974	12/05/1887	Malta - Alexandria No 1	Break 20nm from Malta on 5th inst	Break 20nm from Malta on 5th inst				
975	20/05/1887	Porto Rico - Antilles	Interrupted				Interrupted	
976	26/05/1887	Lisbon - Gibraltar	Repaired	Repaired		CS Electra		
977	26/05/1887	Malta - Alexandria No 1	Repaired	Repaired		CS Electra		
978	26/05/1887	Perim - Suakim	Repaired	Repaired		CS Chiltern		
979	03/06/1887	Howth - Holyhead	Defective				Defective - unfavourable bottom	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
980	09/06/1887	No 2 Aden - Suez	Faulty	Faulty; to be repaired by CS Chiltern				
981	10/06/1887	Paris - New York	Repaired				Repaired	
982	03/07/1887	Lowestoft - Greetsiel	Repairs		NMM TCM/8/26 CABLE ENGINEERS' LOGBOOKS. Lowestoft - Greetsiel, BRITANNIA, 22 June - 3 July 1887	CS Britannia		
983	14/07/1887	Perim - Suakim	Fault	Fault. CS Chiltern to repair		CS Chiltern		
984	02/09/1887	Chorillos - Mollendo	Broken 2 weeks ago. Now repaired				Broken 2/52 ago; now repaired	
985	15/09/1887	Bombay - Aden No 2	Fault removed 8th inst 17nm from Bombay	Fault removed 8th inst 17nm from Bombay				
986	15/09/1887	Valentia (1873, 1874,1880)	Repairs		NMM TCM/9/13 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Valentia (1873,1874,1880), BRITANNIA, 6 August - 15 September 1887	CS Britannia		
987	30/09/1887	Trinidad - Demerara	Interrupted early September. Now repaired				Interrupted early September. Now repaired	
988	15/10/1887	Gibraltar - Lisbon	Repaired	Repaired "very expeditiously at night"		CS Mirror		
989	15/10/1887	Torbay - Ballinskellig; Torbay - Rye Beach	Interrupted					

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
990	27/10/1887	Salonica cable	Interrupted 23rd inst	Interrupted 23rd inst off Tenedos Island by an Egyptian vessel trying to tow a stranded vessel				
991	10/11/1887	Salonica cable	Repaired 5th inst	Repaired 5th inst		CS Mirror		
992	24/11/1887	Para - Chanack	Repaired 20th inst	Repaired 20th inst		CS Mirror		
993	24/11/1887	New Gibraltar Direct	Broken 1.75nm from Gibraltar on the 20th inst	Broken 1.75nm from Gibraltar on the 20th inst. To be repaired by CS Mirror		CS Mirror		
994	08/12/1887	New Gibraltar Direct	Repaired 30th ulto	Repaired 30th ulto				
995	08/12/1887	Chios - Chesme	Broken by ship's anchor; repaired by local Staff	Broken by ship's anchor; repaired by local Staff				
996	11/12/1887	Ballinskellig - Halifax - Rye Beech	Repairs		NMM TCM/8/27 CABLE ENGINEERS' LOGBOOKS. Ballinskellig - Halifax - Rye Beech, BRITANNIA, 2 October - 11 December1887	CS Britannia		
997	20/12/1887	Valentia - Greetsiel	Interrupted for few days					Interrupted for last few days
998	20/12/1887	Germany - Valentia (Anglo American)	Interrupted but no attempt being made to repair					Interrupted but no attempt being made to repair. An unfortunate cable which has had many faults

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
999	22/12/1887	Suez - Aden No 2	Interrupted 14th inst; repaired 20th inst.	Intweerupted 14th inst; repaired 20th inst by CS John Pender		CS John Pender		
1000		Bona - Malta No 1 (1870)	Interrupted 18th inst	Interrupted 18th inst. Being repaired by CS Mirror but grappled No 2 (1877) by mistake initially		CS Mirror		
1001	24/12/1887	Valentia - Greetsiel	Repairs		NMM TCM/8/28 . CABLE ENGINEERS' LOGBOOKS. Valentia - Greetsiel, BRITANNIA, 15 - 24 December 1887	CS Britannia		
1002	30/12/1887	Trinidad - Demerara	Repaired				Repaired	
1003	19/01/1888	St Vincent - St Jago (African Direct Teleg Co)	Interrupted 30th ulto	Interrupted 30th ulto. CS Electra chartered to repair		CS Electra		
1004	19/01/1888	Dardanelles Cable	Interrupted 28th ulto; repaired 3rd inst by CS mirror	Interrupted 28th ulto; repaired 3rd inst		CS Mirror		
1005	19/01/1888	Doro Channel cable	Interrupted 3rd inst and rfepaired	Interrupted and repaired 3rd inst by CS Mirror		CS Mirror		
1006	19/01/1888	Syra - Port Said	Interrupted 23rd ulto and repaired 3rd inst by CS Mirror	Interrupted 23rd ulto and repaired 3rd inst		CS Mirror		
1007	19/01/1888	Zante - Corfu	Broken 28th ulto	Broken 28th ulto. CS Mirror to repair		CS Mirror		
1008	19/01/1888	Suez - Aden No 2	Interrupted 15th inst; repaired 19th inst	Interrupted 15th inst; repaired 19th inst. CS John Pender		CS John Pender		
1009	19/01/1888	Suakim - Suez	Interrupted 14th inst 20nm from Suakim	Interrupted 14th inst 20nm from Suakim				
1010	02/02/1888	Zante - Corfu	Repaired 18th ulto	Repaired 18th ulto		CS Mirror		
1011	02/02/1888	Villa Real cable	Under repair	Under repair		CS Mirror		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1012	02/02/1888	Corfu cable	"Bad fault again" 23rd ulto; repaired 28th ulto	"Bad fault again". 23rd ulto; repaired 28th ulto.		CS Mirror		
1013	02/02/1888	Bona No 1	Broken 50 nm from Bona. Under repair	Broken 50 nm from Bona. Under repair		CS Mirror		
1014	02/02/1888	St Vincent - St Jago (African Direct Teleg Co)	Under repair	Under repair		CS Electra		
1015	02/02/1888	Suakim - Perim	Repaired 25th ulto	Repaired 25th ulto by CS John Pender		CS John Pender		
1016	02/02/1888	Suez - Suakim	Under repair	Under repair		CS John Pender		
1017	16/02/1888	Bona Malta No 1	Repaired 2nd inst	Repaired 2nd inst		CS Mirror		
1018	16/02/1888	Villa Real cable	Repaired 10th inst	Repaired 10th inst		CS Mirror		
1019	16/02/1888	St Vincent - St Jago (African Direct Teleg Co)	Restored 13th inst	Restored 13th inst		CS Electra		
1020	16/02/1888	Sierra Leone - Bathurst (African Direct Teleg Co)	Fault 100 nm fromBathurst	Fault 100nm from Bathurst		CS Electra		
1021	16/02/1888	Suez - Suakim	Under repair	Under repair		CS John Pender		
1022	19/02/1888	Lisbon - Madeira (No2)	Repairs		NMM TCM/8/29 CABLE ENGINEERS' LOGBOOKS. Lisbon - Madeira (No2) - RNF, BRITANNIA, 9 January - 9 February 1888	CS Britannia		
1023	01/03/1888	Vigo - Lisbon	Repaired 23rd ulto	Repaired 23rd ulto		CS Mirror		
1024	01/03/1888	Caminha - Vigo	Break repaired 29th ulto	Break repaired 29th ulto		CS Mirror		
1025	01/03/1888	Suez - Suakim	Under repair	Under repair		CS John Pender		
1026	01/03/1888	Sierra Leone - Bathurst (African Direct Teleg Co)	Under repair	Under repair		CS Electra		
1027	01/03/1888	Dardanelles Cable	Cut by anchor of Steamer	Cut by anchor of Steamer				

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1028	01/03/1888	Odessa Cable	Cut by anchor of Steamer	Cut by anchor of Steamer				
1029	02/03/1888	St Vincent - Barbados	Repaired				Repaired	
1030	07/03/1888	Lowestoft - Greetsiel, Cuxhaven - Heligoland	Interrupted			CS John Pender		?Insurrection at Suakim. Cable cut
1031	13/03/1888	Suakin	Suakin BURNING. Cables interrupted					Suakin BURNING. Cables interrupted
1032	14/03/1888	Suakim - Perim	Cable repaired (Suez line of cable still interrupted)					Cable repaired. Suez line of cable still interrupted
1033	15/03/1888	Suez - Suakim	Still under repair	Difficulty in repairing due to rocky bottom. Repaired but broke again 200nm from Suakim		CS John Pender		
1034	15/03/1888	Bombay No 2	Fault	Fault CS Mirror to repair		CS Mirror		
1035	15/03/1888	Black Sea cable	Interrupted	Interrupted near Odessa. Station Staf attempting repair				
1036	15/03/1888	African Direct Teleg Co's Bathurst - Sierra Leone	Repaired 5th ulto	Repaired 5th ulto		CS Electra		
1037	16/03/1888	Suakim cable	Interrupted 100nm from Suakim			CS John Pender; CS Mirror	Interrupted 100nm from Suakim. CS John Pender; CS Mirror to repair	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1038	19/03/1888	Suakin Cables	Still interrupted					Still interrupted
1039	23/03/1888	Suakim - Perim	Repaired				Repaired	
1040	27/03/1888	Suakin	Suakin - all quiet					All quiet
1041	27/03/1888	Suakim - Perim	Repaired	Repaired				
1042	27/03/1888	Suez cable	Still interrupted					Still interrupted
1043	28/03/1888	Suakin - Perim	Repaired 24th inst	Repaired 24th inst.		CS John Pender		
1044	28/03/1888	Bombay - Aden No 2	Fault 10th inst	Fault 10th inst. Cs Mirror to repair		CS Mirror		
1045	28/03/1888	Dardanelles Cable	Broken by anchor 18th inst	Broken by anchor of CS Violet 18th inst off Channack				
1046	06/04/1888	Lowestoft - Emden; Heligoland	Repairs		NMM TCM/9/19 . ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Lowestoft - Emden; Heligoland, BRITANNIA, 7 March - 6 April 1888; TCM/8/30 CABLE ENGINEERS' LOGBOOKS. Lowestoft - Greetsiel, Cuxhaven - Heligoland, BRITANNIA, 7 March - 16 April 1888	CS Britannia		
1047	07/04/1888	Suez - Suakin	Repaired					Repaired

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1048	13/06/1888	Ballinskellig - Halifax	Cable still broken					Cable still broken
1049	26/04/1888	Suez- Suakim	Repaired 4th inst	Repaired 4th inst		CS John Pender		
1050	26/04/1888	Suez - Suakim	Another fault 200nm from Suakim	Another fault 200nm from Suakim. CS John Pender to repair		CS John Pender		
1051	26/04/1888	Bombay - Aden No 2	Repaired 7th inst	Repaired 7th inst		CS Mirror		
1052	26/04/1888	Tenedos cable	Repaired 30th ulto	Repaired 30th ulto		CS Electra		
1053	26/04/1888	Odessa Cable	Repaired 4th inst	Repaired 4th inst		CS Electra		
1054	26/04/1888	Bona - Malta	Interrupted 2nd April; repaired 23rd inst	Interrupted 2nd April; repaired 23rd inst		CS Electra		
1055	26/04/1888	Bona - Malta	Another fault	Another fault a few days later		CS Electra		
1056	27/04/1888	St Vincent - Barbados	Repaired				Repaired	
1057	10/05/1888	Bona - Malta	2nd fault repaired 26th ulto	2nd fault repaired 26th ulto		CS Electra		
1058	10/05/1888	Suez - Suakim	Repaired 30th ulto	Repaired 30th ulto		CS John Pender		
1059	10/05/1888	Alexandria - Port Said	To be repaired	To be repaired by CS Mirror		CS Mirror		
1060	10/05/1888	Vigo - Lisbon	Broken 26th ulto by anchor of SS Cabo Palos and repaired by Superentendant of cable station	Broken 26th ulto by anchor of SS Cabo Palos and repaired by Superentendant of cable station				
1061	18/05/1888	St Vincent - Barbados	Interrupted				Interrupted	
1062	01/06/1888	St Vincent - Barbados	Repaired				Repaired	
1063	07/06/1888	Alexandria - Port Said	Repaired 20th May	Repaired 20th may		CS Mirror		
1064	07/06/1888	Katacolo cable	Repaired 4th inst	Repaired 4th inst		CS Amber		
1065	07/06/1888	Zea - Kathnos	Under repair	Under repair		CS Amber		
1066	07/06/1888	Mykonos - Delos	To be repaired	To be repaired by CS Amber		CS Amber		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1067	13/07/1888	Ballinskellig - Halifax (1875)	Repairs		NMM TCM/8/31 CABLE ENGINEERS' LOGBOOKS. Ballinskellig - Halifax, SCOTIA, 15 May - 13 June 1888	CS Scotia		
1068	21/06/1888	Zea - Kathnos	Repaired 9th inst	Repaired 9th inst		CS Amber		
1069	21/06/1888	Rhodes	2 faults at shore ends removed 14th inst	2 faults at shore ends removed 14th inst		CS Amber		
1070	21/06/1888	Bombay No 2	Fault	Fault CS John Pender to repair		CS John Pender		
1071	05/07/1888	Aden - Bombay No 2	Failed 29th ulto.	Failed 29th ulto. CS John Pender to repair		CS John Pender		
1072	06/07/1888	Both Java - Australia	Interrupted			CS Scotia; CS Minia	Interrupted	
1073	13/07/1888	Both Java - Australia	Bad weather delaying repair			CS Scotia; CS Minia	Bad weather delaying repair	
1074	20/07/1888	Both Java - Australia	Repaired				Repaired	
1075	20/07/1888	Brest - St Pierre (Anglo American) (1868)	3 faults under repair				3 faults under repair	
1076	31/07/1888	Africa Direct Teleg Co's Accra - Lagos	Interrupted	Interrupted. CS John Pender to repair		CS John Pender		
1077	31/07/1888	Bombay	Renewal of shore ends	Renewal of shore ends		CS John Pender		
1078	08/08/1888	Ballinskellig - Halifax	Repairs		NMM TCM/8/33 CABLE ENGINEERS' LOGBOOKS. Ballinskellig - Halifax, SCOTIA, 2 July - 8 August 1888	CS Scotia		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1079	10/08/1888	Ireland - Halifax	Now working again				Now working again	
1080	13/08/1888	Ballinskellig - Halifax (1875)	Repairs		NMM TCM/9/15 CABLE ENGINEERS' LOGBOOKS. Ballinskellig - Halifax (1875), SCOTIA, 2 July - 13 August 1888	CS Scotia		
1081	16/08/1888	Lisbon - Madiera (No 1)	Repaired					Repaired
1082	17/08/1888	Aden - Bombay Cables (ETC)	Interrupted			CS Patrick Stewart	Interrupted. CS Patrick Stewart to repair	
1083	06/09/1888	Lisbon - Madeira (No 1)	Repairs		NMM TCM/8/34 ENGINEERS' LOGBOOKS. Lisbon - Madeira (No 1), Britannia, 16 August - 6 September 1888	CS Britannia		
1084	07/09/1888	Bushire - Jask (Indian Govt)	Interrupted 13th ulto; repaired 1st inst				Interrupted 13th ulto; repaired 1st inst	
1085	12/09/1888	Aden - Bombay	Repaired					Repaired
1086	14/09/1888	" ETC's Cables to the East"	Now repaired				No w repaired	
1087	27/09/1888	Suakim - Perim	Repaired 26th August	Repaired 26th August		CS John Pender		
1088	27/09/1888	Aden - Bombay No 1	Interrupted 11th August; repaired 11th Sept	Interrupted 11th August; repaired 11th Sept. 340 nm from Aden		CS John Pender		
1089	27/09/1888	Suez - Aden No 2	Interrupted 10th inst; repaired 19th inst	Interrupted 10th inst; repaired 19th inst		CS John Pender		
1090	27/09/1888	Bombay cables	Interrupted 18nm from shore	Interrupted 18nm from shore		CS Electra		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1091	27/09/1888	Patras - Corinth	Interrupted by earthquake; repaired 25th inst	Interrupted by earthquake; repaired 25th inst		CS Mirror		
1092	27/09/1888	Bolamo Cable (West African Telegraph Co)	Repaired 28th August	Repaired 28th August		CS Amber		
1093	27/09/1888	Accra - Lagos and Lagos - Brass (Africa Direct)	Repaired 7th and 12th inst respectively	Repaired 7th and 12th inst respectively		CS Amber		
1094	28/09/1888	Brest - St Pierre (Anglo American) (1868)	Broken again				Broken again	
1095	11/10/1888	Suakim	Repairs to electric lighting and "condensing" machines ? At the Govenors residence	Repairs to electric lighting and "condensing" machines ? At the Govenors residence		CS John Pender		
1096	11/10/1888	Bombay	Replacement of shore ends	Replacement of shore ends		CS Electra		
1097	11/10/1888	Corfu - Zante	Repaired 3rd inst	Repaired 3rd inst		CS Mirror		
1098	11/10/1888	Rhodes cable	Repaired 9th inst	Repaired 9th inst		CS Mirror		
1099	11/10/1888	Accra - Lagos and Lagos - Brass (Africa Direct)	Broken	Broken				
1100	12/10/1888	Nordeny - Lowestoft (Sub Teleg Co)	Repaired			CS Lady Carmichael	Repaired	
1101	12/10/1888	Port Darwin Cable (EETC & China Teleg Co)	Interrupted by CS Sherard Osborn whilst repairing other cable			CS Sherard Osborn	Interrupted by CS Sherard Osborn whilst repairing other cable	
1102	19/10/1888	Port Darwin Cable (EETC & China Teleg Co)	Repaired				Repaired	
1103	25/10/1888	Aden - Bombay No 2	Repaired 17th inst	Repaired 17th inst		CS Electra		

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1		Cable	Event	ETC Board Minute Books	Engineer's Reports (and other sources)	Ship	The Electrician	The Times
1104	25/10/1888	Accra - Lagos and Lagos - Brass (Africa Direct)	Temporarily repaired according to Africa Direct Teleg Co. Proper repair requested of CS Amber	Temporarily repaired according to Africa Direct Teleg Co. Proper repair requested of CS Amber		CS Amber		
1105	25/10/1888	Alexandriaandri - Bombay	Fault found insufficient to warrant repair at present	Fault found insufficient to warrant repair at present		CS Mirror		
1106	26/10/1888	Suakin	Suakin under seige			CS John Pender standing by		Suakin under seige
1107	26/10/1888	Port Darwin Cable (EETC & China Teleg Co)	Interrupted again				Interrupted again	
1108	02/11/1888	Port Darwin Cable (EETC & China Teleg Co)	Repaired			CS Sherard Osborn; CS Recorder	Repaired	
1109	08/11/1888	Suakim - Perim	Broken 5th inst	Broken 5th inst CS John Pender to land 20 cavalry men and a bag of letters from Suez(!)		CS John Pender		
1110	08/11/1888	Suez		CS Electra arrived Suez 3rd inst with 40 wounded men on board from Suakim		CS Electra		
1111	08/11/1888	Odessa cable	"Fall of insulation" reported by MD	Fault to be repaired by CS Mirror before winter sets in.		CS Mirror		
1112	08/11/1888	Sierra Leone (Africa Direct)	To be repaired	CS Amber to repair		CS Amber		
1113	09/11/1888	Trinidad - Demerera	Interrupted				Interrupted again	
1114	15/11/1888	Lowestoft - Emden	Interrupted			CS John Pender		
1115	16/11/1888	Trinidad - Demerara	Repaired				Repaired	
1116	21/11/1888		BATTLE OF SUAKIM					
1117	22/11/1888	Porthcurno - Lisbon	Interrupted 11th inst	Interrupted 11th inst. The be repaired by CS Electra		CS Electra		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1118	22/11/1888	Vigo - Lisbon	Interrupted 11th inst	Interrupted 11th inst. The be repaired by CS Electra		CS Electra		
1119	22/11/1888	Lisbon Direct	Repaired on 21st	Repaired on 21st by CS Electra		CS Electra		
1120	22/11/1888	No 1 Porthcurno Direct		"Working well on Duplex"				
1121	22/11/1888	Chios - Tenedos	Broken by Anchors on 11th inst. Repaired 19th inst	Broken by Anchors on 11th inst. Repaired 19th inst		CS Mirror		
1122	22/11/1888	Alexandria - Malta No 1	Broken shore end 13th inst	Broken shore end 13th inst CS Mirror to reapir		CS Mirror		
1123	22/11/1888	Suez - Suakim	Interrupted 21st inst 175 miles from Suez	Interrupted 21st inst 175 nm from Suez. CS Mirror to repair.		CS Mirror		
1124	22/11/1888	Suakim - Perim	Interrupted 5th inst. Under repair	Interrupted 5th inst. Under repair		CS John Pender		
1125	22/11/1888	Aden - Bombay No 1	Interrupted	Interrupted 700 miles from Bombay				
1126	22/11/1888	Sierra Leone (Africa Direct)	Repaired	Repaired		CS Amber		
1127	23/11/1888	Suakim "both cables"	Suez -Suakim repaired; Suez - Perin still down					Suez -Suakim repaired; Suez - Perin still down
1128	29/11/1888	Suez - Suakim; Suez - Perin	Repaired			CS Mackay Bennett		Repaired
1129	06/12/1888	Milazzo - Lipari	Interrupted 29th ulto	Interrupted 29th ulto. To be repaired by CS Amber		CS Amber		
1130	06/12/1888	Suakim - Perim	Repairs delayed by bad weather	Repairs delayed by bad weather		CS John Pender		
1131	06/12/1888	Malta - Alexandria	Repaired 25th ulto	Repaired 25th ulto		CS Mirror		
1132	06/12/1888	Suez - Suakim	Repaired 27th ulto	Repaired 27th ulto		CS Mirror		
1133	06/12/1888	Vigo - Lisbon	Repaired 23rd ulto	Repaired 23rd ulto		CS Electra		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1134	20/12/1888			CS Mirror moving 330 troops of the Welsh Regiment to Suakim		CS Mirror		
1135	20/12/1888	Aden - Bombay No 1	To be repaired	To be repaired by CS John Pender		CS John Pender		
1136	20/12/1888	Suakim - Perim	To be repaired	To be repaired by CS Mirror		CS Mirror		
1137	20/12/1888	Milazzo - Lipari	Repaired 9th inst	Repaired 9th inst		CS Amber		
1138	20/12/1888	Port Said - Alexandria	Interrupted 15th inst	Interrupted 15th inst. To be repaired by CS Amber		CS Amber		
1139	20/12/1888	Fredericia (Denmark) - Calais (1873 GNT)	Interrupted for last 3/52				Interrupted for last 3/52	
1140	07/01/1889	Lowestoft - Greetsiel	Repairs		NMM TCM/8/35 CABLE ENGINEERS' LOGBOOKS. Lowestoft - Greetsiel, BRITANNIA, 15 November 1888 - 7 January 1889	CS Britannia		
1141	07/01/1889	Lowestoft - Emden	Repairs		NMM TCM/9/20 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Lowestoft - Emden, BRITANNIA, 15 November1888 - 7 January 1889	CS Britannia		
1142	16/01/1889	Dover - Calais	"stopped operations"					"Stopped operations"
1143	17/01/1889	Aden - Bombay No 1	Under repair	CS Mirror repairing		CS Mirror		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1144	17/01/1889	Direct Spanish	Interrupted	Interrupted near Bilbao. CS Electra to repair		CS Electra		
1145	17/01/1889	Alexandria - Port Said	Repaired 3rd inst	Repaired 3rd inst by CS Amber		CS Amber		
1146	17/01/1889	Thermia - Zia	Repaired 16th inst	Repaired 16th inst by CS Amber		CS Amber		
1147	23/01/1889	"Valparaiso Cable"	Interrupted by revolt in Chile					Interrupted by revolt in Chile
1148	31/01/1889	Aden - Bombay No 1	Repaired	Repaired by CS Mirror		CS Mirror		
1149	31/01/1889	Direct Spanish	Repaired 28th inst	Repaired 28th inst by CS Electra		CS Electra		
1150	31/01/1889	Gibraltar - Lisbon	To be repaired	To be repaired		CS Electra		
1151	01/02/1889	Falmouth - Bilbao (Direct Spanish)	Repaired				Repaired	
1152	07/02/1888	French Atlantic (English Brest section)	Broken					Broken
1153	08/02/1889	Punta Rassa - Key West	Interrupted				Interrupted	
1154	14/02/1889	Odessa cable	4 breaks repaired 9th inst, one more to repair	4 breaks repaired 9th inst, one more to repair. CS Amber		CS Amber		
1155	14/02/1889	Bombay - Aden No 1	Under repair	Under repair		CS John Pender; CS Mirror		
1156	22/02/1889	Punta Rassa - Key West	Repaired				Repaired	
1157	28/02/1889	Odessa cable	Repaired 20th inst	Repaired 20th inst		CS Amber		
1158	28/02/1889	Bona - Malta No 1	Interrupted 17th inst and a fault 152 nm from Bona	Interrupted 17th inst and a fault 152 nm from Bona		CS Amber		
1159	28/02/1889	Lisbon - Gibraltar	Repaired 21st inst	Repairfed 21st inst		CS Amber		
1160	28/02/1889	Aden - Bombay No 1	Repaired 18th inst. Further fault remains	Repaired 18th inst. Further fault remains				
1161	28/02/1889	Perim - Suakim	Under repair	Under repair		CS Mirror		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1162	14/03/1889	Lisbon - Gibraltar	Repaired	Repaired		CS Electra		
1163	14/03/1889	Bona - Malta No 1	Repaired	Repaired		CS Amber		
1164	14/03/1889	Gibraltar - Malta No 2	To be repaired	To be repaired		CS Amber		
1165	14/03/1889	Suakim - Perim	Repaired 12th inst	Repaired 12th inst		CS Mirror		
1166	15/03/1889	Burntisland - Granta, Firth of Forth	Interrupted			CS Monarch	Interrupted, CS Monarch to repair	
1167	28/03/1889	Gibraltar - Malta No 2	Repaired 20th inst	Repaired 20th inst		CS Amber		
1168	28/03/1889	Bona - Malta No2	Repaired 22nd inst	Repaired 22nd inst		CS Amber		
1169	28/03/1889	Malta - Alexandria	Interrupted 25th inst; under repair	Interrupted 25th inst; under repair		CS Amber		
1170	02/04/1889	UK - Morocco	Under repair					Under repair
1171	11/04/1889	Milazzo - Lipari	Repaired 5th inst	Repaired 5th inst		CS Amber		
1172	11/04/1889	Malta - Alexandria No 1	To be repaired	To be repaired by CS Amber		CS Amber		
1173	11/04/1889	Malta - Bona	Under repair but weather bad.	Under repair by CS Mirror but weather bad		CS Mirror		
1174	09/05/1889	Lisbon - Gibraltar	Broken 14th ulto; Repaired 18th by CS Mirror	Broken 14th ulto; Repaired 18th by CS Mirror		CS Mirror		
1175	09/05/1889	Jeddah cable	To be repaired by CS John Pender	To be repaired by CS John Pender		CS John Pender		
1176	17/05/1889	Calais cable	Interrupted for the 3rd time in 2 months				Interrupted for the third time in 2 months	
1177	23/05/1889	Jeddah cable	3 faults repaired by 18th; one more fault remains	3 faults repaired by CS John Pender by 18th. One more fault remains				

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1178	31/05/1889	Ballinskellig - Halifax	Repairs		NMM TCM/8/36 ABLE ENGINEERS' LOGBOOKS. Ballinskellig - Halifax, BRITANNIA, 27 April -31 May 1889	CS Britannia		
1179	31/05/1889	Trinidad - Demerara	Interrupted				Interrupted	
1180	06/06/1889	Cania section	Fault	Fault; CS Amber to repair		CS Amber		
1181	06/06/1889	Suez - Aden No 2	Repaired 30th ulto	Repaired 30th ulto		CS John Pender		
1182	06/06/1889	Aden - Bombay	Under repair	Under repair		CS John Pender		
1183	04/07/1989	Aden - Bombay No 1	Interrupted 26th ulto	Interrupted 26th ulto				
1184	18/07/1889	Zante - Alexandria	Interrupted	Interrupted; CS Amber to repair		CS Amber		
1185	18/07/1889	Aden - Bombay No 1	Repaired 8th inst	Repaired 8th inst		CS John Pender		
1186	31/07/1889	Porthcurno - Vigo	Fault	Fault ; CS Electra to repair		CS Electra		
1187	31/07/1889	Malta - Alexandria No 2	Repaired 28th inst	Repaired 28th inst		CS Amber		
1188	31/07/1889	Malta - Alexandria No 1	Interrupted	Interrupted; CS Amber to repair		CS Amber		
1189	31/07/1889	Perim - Suakim	Interrupted	Interrupted; CS Chiltern to repair		CS Chiltern		
1190	16/08/1889	"New Zealand cable"	Interrupted				Interrupted	
1191	28/06/1889	Dakar (Senegal) - Teneriffe	3 faults repaired by CS Silvertown			CS Silvertown	3 faults repaired by CS Silvertown	
1192	13/09/1889	Brest - St Pierre (1869)	Interrupted 17th ulto. Repaired 5th inst			CS Minia	Interrupted 17th ulto. Repaired 5th inst	
1193	20/09/1889	Tangier - Gibraltar	Interrupted				Interrupted	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1194	26/09/1889	Alexandria - Malta No 1	Repaired 9th ulto	Repaired 9th ulto		CS Amber		
1195	26/09/1889	Patras - Corinth	Repaired 2nd inst	Repaired 2nd inst				
1196	26/09/1889	Porthcurno - Vigo	Repaired 18th inst	Repaired 18th inst		CS Electra		
1197	26/09/1889	Alexandria - Malta No 1 and No 2	Repaired 11th inst	Repaired 11th inst		CS Electra		
1198	26/09/1889	Tangiers cable	Repaired 22nd inst	Repaired 22nd inst		CS Electra		
1199	26/09/1889	Perim - Suakim	Repaired 10th ulto	Repaired 10th ulto		CS Chiltern		
1200	26/09/1889	Aden - Perim	Interrupted 5th inst	Interrupted 5th inst; CS Chiltern to repair		CS Chiltern		
1201	26/09/1889	Aden - Bombay No 1	Repiared 15th and 24th inst	Repiared 15th and 24th inst		CS Chiltern		
1202	27/09/1889	Brazil coast cable (W Brazillian Teleg Co)	Repaired 17th inst. 50ft of cable embedded in whale's body				Repaired 17th inst. 50ft of cable embedded in whale's body	
1203	27/09/1889	Gibraltar - Tangiers	Restored				Restored	
1204	09/10/1889	Lisbon - Gibraltar No 1	Repaired 3rd inst	Repaired 3rd inst		CS Electra		
1205	09/10/1889	Aden - Bombay No 1	Repaired 30th ulto	Repaired 30th ulto		CS Chiltern		
1206	24/10/1889	Perim - Suakim	Interrupted 18th inst	Interrupted 18th inst; to be repaired by CS Chiltern		CS Chiltern		
1207	07/11/1889	Pozzallo cable	Interrupted & Repaired	Interrupted but fault found to be on wires leading to test table		CS Amber		
1208	07/11/1889	Perim - Suakim	Faults	Fault 200nm South of Suakim repaired on 3rd inst . 2nd fault 17nm from Suakim		CS Chiltern		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1209	13/11/1889	Halifax - Ballinskellig	Repairs		NMM TCM/8/37 CABLE ENGINEERS' LOGBOOKS. Ballinskellig - Halifax, BRITANNIA, 15 October 13 November 1889	CS Britannia		
1210	21/11/1889	Perim - Suakim	Repairs complete 9th inst	Repairs complete 9th inst		CS Chiltern		
1211	21/11/1889	Bombay - Aden No 1	Fault	Fault 70nm from Aden		CS Chiltern		
1212	05/12/1889	Bombay - Aden No 1	Under repair	Under repair		CS Chiltern		
1213	05/12/1889	Caminha cable	Fault	Fault to be repaired by CS Electra		CS Electra		
1214	06/12/1889	Calais - Fano	Interrupted				Interrupted	
1215	19/12/1889	Bombay - Aden No 1	Repaired 6th inst	Repaired 6th inst		CS Chiltern		
1216	19/12/1889	Caminha cable	Repaired 7th inst	Repaired 7th inst		CS Electra		
1217	10/01/1890	"Western Union Cable" ?Atlantic?	Repaired				Repaired	
1218	16/01/1890	Chanack - Kartal	Repaired 4th inst	Repaired 4th inst		CS Amber		
1219	16/01/1890	Pabras - Zante	Repaired 15th inst	Repaired 15th inst		CS Amber		
1220	16/01/1890	Perim - Suakim	Broken 15th ulto; Repaired 2nd inst	Broken 15th ulto; Repaired 2nd inst by CS Chiltern		CS Chiltern		
1221	16/01/1890	Jeddah cable	Interrupted & Repaired but a fault still exists	Interrupted & Repaired but a fault still exists		CS Chiltern		
1222	17/01/1890	Western Union Atlantic	Repaired 31st ulto			CS Faraday	Repaired 31st ulto	
1223	21/01/1890	Cania section	Repaired 9th inst	Repaired 9th inst				
1224	21/01/1890	Suakim - Perim	Repaired	Repaired 13th inst. Another fault still exists.				

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1225	24/01/1890	Punta Rassa - Key West	Interrupted				Interrupted	
1226	24/01/1890	Isle of Sky - Mainland	Interrupted				Interrupted	
1227	30/01/1890	Port Said - Alexandria	Interrupted 17th inst	Interrupted 17th inst; CS Amber to repair		CS Amber		
1228	30/01/1890	Suez - Suakim	Interrupted 17th inst	Interrupted 17th inst; CS Amber to repair		CS Amber		
1229	31/01/1890	Stornaway - Mainland	Interrupted			CS Monarch	Interrupted. CS Monarch to repair	
1230	07/02/1890	French Atlantic	Repaired					Repaired
1231	07.07/1890	Isle of Sky - Mainland	Restored				Restored	
1232	13/02/1890	Port Said - Alexandria	Repaired 30th ulto	Repaired 30th ulto		CS Amber		
1233	13/02/1890	Porthcurno - Vigo	Repaired 5th inst	Repaired 5th inst		CS Electra		
1234	13/02/1890	Vigo - Lisbon	Fault	Fault 7nm from Carcavellos; CS Amber to repair		CS Amber		
1235	13/02/1890	Suez - Aden No 2	Fault 4th inst	Fault 4th inst; to be repaired by CS Chiltern. Repair delayed by bad weather.		CS Chiltern		
1236	14/02/1890	French Atlantic	Repaired			CS Makay Bennett	Repaired by CS Makay Bennett	
1237	27/02/1890	Direct Porthcurno - Lisbon	To be repaired	To be repaired by CS Electra		CS Electra		
1238	27/02/1890	Suez - Aden	Fault 18th inst	Fault 18th inst; to be repaired by CS Chiltern		CS Chiltern		
1239	27/02/1890	Zebel - Zukur	Fault 24th inst	Fault 24th inst to be repaired by CS Chiltern		CS Chiltern		
1240	01/03/1890	Brest - St Pierre (1869)	Repairs		NMM TCM/8/38 Cable Engineers' Logbooks 25 January - 1 March 1890	CS Britannia		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1241	01/03/1890	Valentia - Greetsiel	Repairs		NMM TCM/8/39 CABLE ENGINEERS' LOGBOOKS. Valentia - Greetsiel, BRITANNIA 5 January -1March 1890 BRITANNIA, 25 January - 1 March 1890	CS Britannia		
1242	13/03/1890	Repalcement Red Sea Cable	Repaired 5th inst	Repaired 5th inst		CS Chiltern		
1243	13/03/1890	Vigo - Lisbon	To be repaired	To be repaired by CS Mirror		CS Mirror		
1244	13/03/1890	Suez - Suakim	Repaired 3rd inst	Repaired 3rd inst		CS Chiltern		
1245	27/03/1890	Vigo - Lisbon	Repaired 24th inst	Repaired 24th inst		CS Chiltern		
1246	27/03/1890	Suez - Aden No 2	Repaired	Repaired		CS Chiltern		
1247	27/03/1890	Vigo - Lisbon	Repaired 30th ulto	Repaired 30th ulto		CS Mirror		
1248	27/03/1890	Gibraltar - Cadiz	Repaired 21st inst	Repaired 21st inst		CS Mirror		
1249	18/04/1890	Shetland cable	Interrupted again				Interrupted again	
1250	07/05/1890	Bona - Malta No1	To be repaired	To repaired by CS Mirror		CS Mirror		
1251	07/05/1890	Vigo - Lisbon	To be repaired	To be repaired by CS Mirror		CS Mirror		
1252	07/05/1890	Suez - Suakim	Interrupted 3rd inst	Interrupted 3rd inst				
1253	23/05/1890	Cooks Straight	Repairs		NMM TCM /9/23 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Cooks Strait, SCOTIA, 9 - 23 May 1890	CS Scotia		
1254	05/06/1890	Vigo - Lisbon	Repaired 7th ulto	Repaired 7th ulto		CS Mirror		
1255	05/06/1890	Vigo - Lisbon	Further fault repaired 21st ulto	Further fault repaired 21st ulto		CS Mirror		
1256	05/06/1890	Caminha cable	Repaired 30th ulto	Repaired 30th ulto		CS Mirror		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1257	05/06/1890	Tangiers - Gibraltar	Broken 30th ulto	Broken 30th ulto. To be repaired by CS Mirror		CS Mirror		
1258	05/06/1890	Bona - Malta No1	Repaired 16th ulto	Repaired 16th ulto		CS Amber		
1259	05/06/1890	Alexandria - Malta No 1	Repaired 21st ulto	Repaired 21st ulto		CS Amber		
1260	05/06/1890	Bona - Malta No 2	Fault repaired 24th ulto	Fault repaired 24th ulto		CS Amber		
1261	05/06/1890	Suez - Suakim	2 faults, repaired 21st & 25th ulto and further repairs in progress as 2 complete breaks have occurred since.	2 faults, repaired 21st & 25th ulto and further repairs in progress as 2 complete breaks have occurred since.		CS Chiltern		
1262	03/07/1890	Tangiers - Gibraltar	Repaired 9th ulto	Repaired 9th ulto		CS Mirror		
1263	03/07/1890	Suez - Suakim	Fruther repairs. Captain reports cable in "bad condition"	Fruther repairs. Captain reports cable in "bad condition"		CS Chiltern		
1264	03/07/1890	Mossamedes - Benguela	Interrupted 13th ulto, repaired 1st inst	Interrupted 13th ulto, repaired 1st inst		CS John Pender		
1265	03/07/1890	Bolamo - Bissau	To be repaired	To be repaired by CS John Pender		CS John Pender		
1266	17/07/1890	Vigo - Lisbon	Repaired 14th inst. Last few breaks due to steam trawlers.	Repaired 14th inst. Last few breaks due to steam trawlers.		CS Mirror		
1267	17/07/1890	Perim - Suakim	Break 140nm from Perim	Break 140nm from Perim. To be repairedby CS Chiltern		CS Chiltern		
1268	17/07/1890	Suez - Perim - Aden	Replacement cable ordered from TCM	Replacement cable ordered from TCM				
1269	18/07/1890	Banjoewangie - Australia (Eastern Extension & China Teleg Co)	All 3 cables interrupted 10th inst by an earthquake				All 3 cables interrupted 10th inst by an earthquake	
1270	25/07/1890	Banjoewangie - Australia (Eastern Extension & China Teleg Co)	Repaired 20th inst				Repaired 20th inst	
1271	31/07/1890	Perim - Suakim	Repaired 29th inst	Repaired 29th inst		CS Chiltern		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1272	25/09/1890	Aden - Perim	Repaired 3rd ulto	Repaired 3rd ulto		CS Chiltern		
1273	25/09/1890	Suez - Suakim	Fault repaired 9th inst. Still another fault	Fault repaired 9th inst. Still another fault		CS Chiltern		
1274	25/09/1890	Bombay - Aden No 1	To be repaired	To be repaired by CS Chiltern		CS Chiltern		
1275	25/09/1890	Suakim - Perim	Broken 11th inst	Broken 11th inst				
1276	25/09/1890	Bona - Malta No 1	Interrupted 13th inst	Interrupted 13th inst				
1277	25/09/1890	Bolama - Bissau (W African Teleg Co)	Repaired 19th ulto	Repaired by CS John Pender 19th ulto		CS John Pender		
1278	25/09/1890	Repalcement Red Sea Cable	Ordered	Ordered from TCM				
1279	09/10/1890	Aden - Bombay No 1	Faults and Break. Under repair	Faults and break under repair by CS Chiltern. Captain reports that a further 600nm of new cable would completely renew.		CS Chiltern		
1280	17/10/1890	Guatamala cables	Restored				Restored	
1281	23/10/1890	Suez - Suakim	Fault repaired 16th inst	Fault repaired 16th inst. Reports that the cable looked in excellent condition		CS Electra		
1282	23/10/1890	Aden - Bombay No 1	Under repair	Under repair		CS Chiltern		
1283	23/10/1890	Aden - Bombay No 1	Replacement disscussed and deferred	Replacement disscussed and deferred				
1284	23/10/1890	New Red Sea Cable	Left Greenwich	Left Greenwich in CS Scotia		CS Scotia		
1285	06/11/1890	Perim - Suakim	Fault repaired 30 ulto	Fault repaired 30th ulto by CS Electra. Statement made that there had been 19 repairs to this cable so far in 1890 and 100nm of new cable had been used.		CS Electra		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1286	06/11/1890	Vigo - Porthcurno	Interrupted 26th ulto	Interrupted 26th ulto CS Mirror to repair but bad weather delaying		CS Mirror		
1287	06/11/1890	Vigo - Lisbon	Broken 1st inst	Broken 1st inst; CS Amber to repair		CS Amber		
1288	06/11/1890	Aden - Bombay No 1	Under repair	Under repair		CS Chiltern		
1289	20/11/1890	Vigo - Porthcurno	Under repair	Under repair		CS Mirror		
1290	20/11/1890	Vigo - Lisbon	Repaired 17th inst	Repaired 17th inst		CS Amber		
1291	20/11/1890	Suakim - Perim	Repaired 4th inst	Repaired 15th inst		CS Electra		
1292	20/11/1890	Aden - Bombay No 1	Under repair	Under repair		CS Chiltern		
1293	20/11/1890	New Red Sea Cable	Laid 18th inst	Laid 18th inst		CS Scotia		
1294	28/11/1890	Trinidad - Demerara	Interrupted				Interrupted	
1295	04/12/1890	St Pierre - Brest (Anglo American Teleg Co)	Repaired 26th ulto	Repaired 26th ulto		CS Mirror		
1296	04/12/1890	Suez - Suakim	3 faults	3 faults to be repaired by CS Chiltern		CS Chiltern		
1297	04/12/1890	Aden - Bombay No 1	Fault repaired 25th ulto	Fault repaired 25th ulto		CS Chiltern		
1298	05/12/1890	Trinidad - Demerara	Repaired				Repaired	
1299	18/12/1890	Accra - Lagos	Interrupted	Interrupted near Accra. CS Mirror to repair		CS Mirror		
1300	18/12/1890	Suez - Suakim	Repaired 10th inst	Repaired 10th inst		CS Electra		
1301	02/01/1891	Cables to India and Europe	4 out of 50 wires damaged by a fire in a rag warehouse at Wood bridge in Suffolk				4 out of 50 wires damaged by a fire in a rag warehouse at Wood bridge in Suffolk	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1302	09/01/1891	Lisbon - Madeira (1873)	Repairs		NMM TCM/8/42 CABLE ENGINEERS' LOGBOOKS. Lisbon - Madeira (1873), BRITANNIA, 27 December - 9 January 1891	CS Britannia		
1303	15/01/1891	Chanak Cable	Broken 30th ulto; repaired 7th inst	Broken 30th ulto; repaired 7th inst by CS Mirror		CS Mirror		
1304	15/01/1891	Odessa Cable	Broken 20th December by an anchor; repaired 11th inst	Broken 20th December by an anchor; repaired 11th inst by CS Mirror		CS Mirror		
1305	15/01/1891	Benguella - Mossamedes	Broken	Broken; CS Amber to repair		CS Amber		
1306	15/01/1891	Accra - Lagos (African Direct Teleg Co)	Interrupted	Interrupted, to be repaired by CS Amber		CS Amber		
1307	15/01/1891	Suez - Suakin	Repaired 11th inst but fault 108nm from Suakin still to tbe repaired	Repaired 11th inst but fault 108nm from Suakin still to tbe repaired by CS John Pender		CS John Pender		
1308	15/01/1891	Aden - Perim	To be repaired	To be repaired by CS Electra		CS Electra		
1309	15/01/1891	Aden - Bombay No 1	Interrupted 13th inst	Interrupted 13th inst; to be repaired by CS Electra		CS Electra		
1310	15/01/1891	Gibraltar - Malta No 1	Interrupted off Algiers	Interrupted off Algiers				
1311	17/01/1891	Dover - Calais	Interrupted					Interrupted
1312	29/01/1891	Lisbon - Gibraltar No 1	Broken 24th inst	Broken 24th inst				
1313	29/01/1891	Benguella - Mossamedes	Repaired 26th inst	Repaired 26th inst		CS Electra		
1314	29/01/1891	Suez - Suakin	Further repairs but delayed by bad weather	Further repairs but delayed by bad weather		CS John Pender		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1315	10/02/1891	Lisbon - Madeira No 1	Repairs		NMM TCM/9/24 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Lisbon - Madeira (No1), BRITANNIA, 27 December 1890 - 10 February 1891. TCM/9/25 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Lisbon - Madeira (No1), SCOTIA, 18 January - 10 February 1891	CS Britannia; CS Scotia		
1316	12/02/1891	Suez - Suakin	Repair still delayed by bad weather	Repair still delayed by bad weather		CS John Pender		
1317	12/02/1891	Accra - Lagos	Under repair	Under repair		CS Amber		
1318	20/02/1891	Trinidad - Demerara	Interrupted				Interrupted	
1319	24/01/1891	West Coast Cable (Mexico)	Interrupted south of La Serena. Fighting by insurgents					Interrupted south of La Serena. Fighting by insurgents
1320	26/02/1891	Suez - Suakin	Repaired 15th inst	Repaired 15th inst		CS John Pender		
1321	26/02/1891	Accra - Lagos	Repaired 13th inst	Repaired 13th inst		CS Amber		
1322	09/04/1891	Lisbon - Gibraltar	Repaired 8th inst	Repaired 8th inst		CS Amber		
1323	09/04/1891	Barcelona - Marsailles (Direct Spanish Teleg Co)	Fault	Fault. CS Amber to repair		CS Amber		
1324	09/04/1891	Gibraltar - Malta	Under repair	Under repair		CS Mirror		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1325	09/04/1891	Perim - Suakim	Repaired 13th inst	Repaired 13th inst		CS John Pender		
1326	23/04/1891	Barcelona - Marsailles (Direct Spanish Teleg Co)	Fault repaired 14th inst	Fault repaired 14th inst		CS Amber		
1327	23/04/1891	Vigo - Lisbon	Under repair	Under repair		CS Amber		
1328	23/04/1891	Gibraltar - Malta (1870)	Under repair. Apparently volcano damage	Under repair. Apparently volcano damage		CS Mirror		
1329	23/04/1891	Perim - Suakim	Fault 100nm from Suakin	Fault 100nm from Suakin. CS John pender to repair		CS John Pender		
1330	23/04/1891	Suez Suakin	Faults under repair	Faults under repair		CS John Pender		
1331	07/05/1891	Vigo - Lisbon	3 faults repaired 4th inst. Another fault still exists. Damage caused by steam trawlers. All repaired by 5th inst.	3 faults repaired 4th inst. Another fault still exists. Damage caused by steam trawlers. All repaired by 5th inst.				
1332	07/05/1891	Gibraltar - Malta No 1	Repaired 29th ulto	Repaired 29th ulto				
1333	07/05/1891	Direct Porthcurno - Lisbon	Interrupted 1st inst 32nm from Carcavellos. Repaired 5th inst.	Interrupted 1st inst 32nm from Carcavellos. Repaired 5th inst. Repaired by CS Mirror		CS Mirror		
1334	07/05/1891	Suez - Suakin	2 faults repaired 4th inst	2 faults repaired 4th inst		CS John Pender		
1335	07/05/1891	Suakin - Perim	Interrupted. Repaired	Interrupted. Repaired		CS John Pender		
1336	07/05/1891	Suez - Suakin	Interrupted . Repaired	Interrupted . Repaired		CS John Pender		
1337	07/05/1891	Suakin - Aden No 2	Fault 175nm from Aden	Fault 175nm from Aden; CS John Pender to repair		CS John Pender		
1338	04/06/1891	Direct Porthcurno - Lisbon	Fault 180nm from Porthcurno	Fault 180nm from Porthcurno. CS Amber to repair		CS Amber		
1339	04/06/1891	Gibraltar - Lisbon	Fault repaired 11th ulto	Fault repaired 11th ulto		CS Mirror		
1340	04/06/1891	Lisbon - Vigo	Fault repaired 24th ulto	Fault repaired 24th ulto		CS Mirror		
1341	04/06/1891	Vigo - Porthcurno	Repaired 2nd inst	Repaired 2nd inst		CS Mirror		
1342	04/06/1891	Suez - Suakin No 1	Repaired 23rd ulto	Repaired 23rd ulto		CS John Pender		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1343	04/06/1891	Aden - Zanzibar	Interrupted 10th ulto; repaired 20th ulto	Interrupted 10th ulto; repaired 20th ulto		CS Electra		
1344	04/06/1891	Aden - Suakin No 2	Fault repaired 27th ulto	Fault repaired 27th ulto		CS Electra		
1345	05/06/1891	Mollendo - Arica - Iquique	Interrupted 5th March				Interrupted 5th March	
1346	05/06/1891	Ceara - Pernambuco	Interrupted 14th March				Interrupted 14th March	
1347	05/06/1891	Assab - Massacuah	Interrupted 20th April. Repaired 4th May				Interrupted 20th April. Repaired 4th May	
1348	05/06/1891	Aden - Zanzibar	Interrupted 11th May. Repaired 20th May				Interrupted 11th May. Repaired 20th May	
1349	18/06/1891	Direct Porthcurno - Gibraltar	Fault 180nm from Porthcurno repaired 13th inst	Fault 180nm from Porthcurno repaired 13th inst		CS Amber		
1350	02/07/1891	Suez - Aden No 2	Interrupted 27th ulto by German steamer SS Banda. Repaired 28th ulto	Interrupted 27th ulto by German steamer SS Banda. Repaired 28th ulto		CS Electra		
1351	02/07/1891	Suez - Suakim	Fault	Fault. CS Electra to repair		CS Electra		
1352	16/07/1891	Accra - Lagos	Fault	Fault. CS Amber to repair		CS Amber		
1353	16/07/1891	Suez - Suakim	2 faults repaired; further fault under repair	2 faults repaired; further fault under repair		CS Electra		
1354	30/07/1891	Accra - Lagos	Under repair	Under repair		CS Amber		
1355	30/07/1891	Suez - Suakin No 1	Another fault removed; yet another remains	Another fault removed; yet another remains		CS Electra		
1356	31/07/1891	Mollendo - Arica - Iquique	Repaired 24th June				Repaired 24th June	
1357	31/07/1891	Ceara - Pernambuco	Not yet repaired				Not yet repaired	
1358	31/07/1891	Cape St Jaques - Thuan An - Haiphong	Interrupted 28th July				Interrupted 28th July	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1359	31/07/1891	Pernambuco - Bahia	Interrupted 14th July. Repaired 22nd July				Interrupted 14th July. Repaired 22nd July	
1360	13/08/1891	Trinidad - Demerara	Restored				Restored	
1361	28/08/1891	Bahia - Rio de Janiero	Interrupted 24th July. Repaired 30th July				Interrupted 24th July. Repaired 30th July	
1362	28/08/1891	Bahia - Rio de Janiero	Interrupted 31st July. Repaired 6th August				Interrupted 31st July. Repaired 6th August	
1363	28/08/1891	Suakim - Djedda	Interrupted 6th August				Interrupted 6th August	
1364	28/08/1891	Gibraltar - Tangiers	Interrupted 12th August				Interrupted 12th August	
1365	28/08/1891	Mollendo - Arica - Iquique	Interrupted 13th August. Repaired 21st August				Interrupted 13th August. Repaired 21st August	
1366	24/09/1891	Aden - Bombay No 1	Interrupted 6th inst 792nm from Aden	Interrupted 6th inst 792nm from Aden. CS Electra to repair		CS Electra		
1367	24/09/1891	Jeddah - Suakim	Interrupted	Interrupted. CS Chiltern to repair		CS Chiltern		
1368	24/09/1891	St Vincent - Pernambuco	Iinterrupted 48nm from Pernambuco. Repaired 21st inst	Iinterrupted 48nm from Pernambuco. Repaired 21st inst		CS Mirror		
1369	24/09/1891	Lisbon - Vigo	Fault repaired 10th inst	Fault repaired 10th inst		CS John Pender		
1370	24/09/1891	Patras - Corinth	Fault	Fault. CS John Pender to repair		CS John Pender		
1371	24/09/1891	Accra - Lagos (1884)	To be repaired	To be repaired by CS Amber		CS Amber		
1372	24/09/1891	Tangier cable	Interrupted 10th ulto; repaired 21st ulto	Interrupted 10th ulto; repaired 21st ulto		CS Amber		
1373	24/09/1891	Bona - Malta No 1	Repaired 13th inst	Repaired 13th inst		CS Amber		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1374	24/09/1891	Tenedos - Salonica	To be repaired	To be repaired by CS Amber		CS Amber		
1375	02/10/1891	Ceara - Pernambuco	Repaired 12th Sept				Repaired 12th Sept	
1376	02/10/1891	St Jaques - Thuan Am - Haiphong	Not yet repaired				Not yet repaired	
1377	02/10/1891	Shanghai - Amoy	Interrrupted 28th August. Repaired 3rd Sept				Interrrupted 28th August. Repaired 3rd Sept	
1378	02/10/1891	Foochow - Shanghai	Interrupted 2nd Sept				Interrupted 2nd Sept	
1379	08/10/1891	St Vincent - Pernambuco	Shore ends adjusted 3rd inst	Shore ends adjusted 3rd inst		CS Mirror		
1380	08/10/1891	Lagos - Brass	To be repaired	CS Mirror to repair		CS Mirror		
1381	08/10/1891	Patras - Corinth	Repaired 2nd inst	Repaired 2nd inst		CS John Pender		
1382	08/10/1891	Chios - Tenedos	Repaired 30th ulto	Repaired 30th ulto		CS Amber		
1383	08/10/1891	Aden - Suakin No 2	Repaired 27th ulto	Repaired 27th ulto		CS Chiltern		
1384	08/10/1891	Aden - Bombay No 1	Awaiting repair	CS Electra to repair		CS Electra		
1385	14/10/1891	Ballinskellig - Halifax	Repairs		NMM TCM/8/44 CABLE ENGINEERS' LOGBOOKS. Ballinskellig - Halifax, BRITANNIA, 26 September - 14 October 1891	CS Britannia		
1386	22/10/1891	Lagos - Brass	Under repair	Under repair		CS Mirror		
1387	22/10/1891	Patras - Corinth	Completing repair	Completing repair		CS John Pender		
1388	22/10/1891	Lisbon - Gibraltar	To be repaired	To be repaired by CS John Pender				
1389	22/10/1891	Aden - Bombay No 1	2 faults under repair	2 faults under repair		CS Electra		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1390	22/10/1891	Suez - Suakin	Further repairs	Further repairs		CS Chiltern		
1391	22/10/1891	Greek Islands	Fault repaired and then "inspections of other sections	Fault repaired and then "inspections of other sections. Faros - Nexos; Naxos - Nio; Naxos - Amorgo; Sikino - Polykandro		CS Amber		
1392	30/10/1891	Cape St Jaques - Thuan An - Haiphong	Repaired 9th Oct				Repaired 9th Oct	
1393	30/10/1891	Foochow - Shanghai	Repaired 15th Oct				Repaired 15th Oct	
1394	30/10/1891	Brest - St Pierre	Interrupted 29th Sept. Repaired 3rd Oct				Interrupted 29th Sept. Repaired 3rd Oct	
1395	30/10/1891	St Thomas - St Kitts	Interrupted 13th Oct.				Interrupted 13th Oct	
1396	30/10/1891	Grenada - St Vincent	Interrupted 13th Oct. Repaired 18th Oct				Interrupted 13th Oct. Repaired 18th Oct	
1397	30/10/1891	Para - Maranham	Interrupted 17th inst. Repaired 19th inst				Interrupted 17th inst. Repaired 19th inst	
1398	30/10/1891	Cayenne - Vizeu (Societe Francaise des Telegrahes Sous Marins	Interrupted 22nd inst				Interrupted 22nd inst	
1399	05/11/1891	Lagos - Brass	Repaired 24th ulto	Repaired 24th ulto		CS Mirror		
1400	05/11/1891	Lisbon - Gibraltar	Repaired 28th ulto	Repaired 28th ulto		CS John Pender		
1401	05/11/1891	Direct Spanish Bilbao	To be repaired	To be repaired by CS John Pender		CS John Pender		
1402	05/11/1891	Aden - Bombay No 1	Under repair	Under repair		CS Electra		
1403	05/11/1891	Suez - Suakim No 1	Repaired 26th ulto	Repaired 26th ulto		CS Chiltern		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1404	05/11/1891	Cyclades cable	Several faults repaired	Severl faults repaired. Overhauled Oropos - Eritria; Karys - Raffina - Doro Channel; Calchis - Zea - Larium; cables around Ionian Islands		CS Amber		
1405	19/11/1891	Aden - Bombay No 1	Under repair	Under repair		CS Electra		
1406	19/11/1891	Ionian Islands cables	Being overhauled	Being overhauled		CS Amber		
1407	19/11/1891	Suakim - Aden No 2	Repaired 13th inst	Repaired 13th inst		CS Chiltern		
1408	19/11/1891	Suez - Suakim No 1	Interrupted 16th inst	Interrupted 16th inst. CS Chiltern to repair		CS Chiltern		
1409	19/11/1891	Direct Spanish Bilbao	Repairs delayed by bad weather	Repairs delayed by bad weather		CS John Pender		
1410	19/11/1891	Gibraltar - Tangiers	Faulty 18th inst 12.5nm from Gibraltar	Faulty 18th inst 12.5nm from Gibraltar. CS Mirror to repair		CS Mirror		
1411	03/12/1891	Direct Spanish Bilbao	Repaired 27th ulto	Repaired 27th ulto		CS John Pender		
1412	03/12/1891	Gibraltar - Tangiers	Repaired 23rd ulto	Repaired 23rd ulto		CS Mirror		
1413	03/12/1891	Aden - Bombay No 1	Under repair	Under repair		CS Electra		
1414	03/12/1891	Suez - Suakim No 1	Repaired 26th ulto	Repaired 26th ulto		CS Chiltern		
1415	11/12/1891	Lowestoft "The Northernmost Cable" (1866) owned by Reuters	Damaged by dragged anchor			CS Monarch	Damaged by dragged anchor CS Monarch to repair	
1416	11/12/1891	Hong Kong - Manila	Broken by a Typhoon				Broken by a Typhoon	
1417	17/12/1891	Vigo - Camhina	Under repair	Under repair		CS Mirror		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1418	17/12/1891	Aden - Zanzibar	Interrupted 5th inst	Interrupted 5th inst 1200nm from Aden. CS Chiltern to repair		CS Chiltern		
1419	18/12/1891	Cayenne - Vizeu (Societe Francaise des Telegrahes Sous Marins	Interrupted 22nd October. Repaired 1st inst				Interrupted 22nd October. Repaired 1st inst	
1420	08/01/1892	St Thomas - St Kitz	Interrupted Oct 13th 1891				Interrupted 13th Oct 1891. Not yet repaired.	
1421	08/01/1892	Cayenne - Vizeu (Societe Francaise des Telegrahes Sous Marins	Interrupted 22nd October. Repaired 5th December 1891				Interrupted 22nd October. Repaired 5th December 1891	
1422	08/01/1892	Brest - St Pierre (Anglo American)	Interrupted 19th Nov 1891. Not yet repaired				Interrupted 19th Nov 1891. Not yet repaired	
1423	08/01/1892	Falmouth - Bilbao (Direct Spanish)	Interrupted 24th November. Repaired 27th Nov 1891				Interrupted 24th November. Repaired 27th Nov 1891	
1424	08/01/1892	Csera- Maranham	Interrupted 24th Nov 1891. Repaired 7th Dec 1891				Interrupted 24th Nov 1891. Repaired 7th Dec 1891	
1425	08/01/1892	Mossamedes - Port Nolloth	Interrupted 27th Nov 1891. Repaired 10th Dec 1891				Interrupted 27th Nov 1891. Repaired 10th Dec 1891	
1426	08/01/1892	Para - Maranham	Interrupted 2nd Dec 1891. Repaired 12th Dec 1891				Interrupted 2nd Dec 1891. Repaired 12th Dec 1891	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1427	08/01/1892	Rio Grande - Montevideo	Interrupted 4th Dec 1891. Not yet repaired				Interrupted 4th Dec 1891. Not yet repaired	
1428	08/01/1892	Hong Kong - Foo Chow	Interrupted 4th Dec 1891. Repaired 17th Dec 1891				Interrupted 4th Dec 1891. Repaired 17th Dec 1891	
1429	08/01/1892	Foochow - Shanghai	Interrupted 4th Dec 1891. Repaired 17th Dec 1891				Interrupted 4th Dec 1891. Repaired 17th Dec 1891	
1430	08/01/1892	Hong Kong - Cape Bolina	Interrupted 4th Dec 1891. Not yet repaired				Interrupted 4th Dec 1891. Not yet repaired	
1431	08/01/1892	Aden - Zanzibar	Interrupted 5th Dec 1891. Not yet repaired				Interrupted 5th Dec 1891. Not yet repaired	
1432	08/01/1892	Saigon - Bankok	Interrupted 16th Dec 1891. Repaired 17th Dec 1891				Interrupted 16th Dec 1891. Repaired 17th Dec 1891	
1433	14/01/1892	Vigo - Camhina	Repaired 17th ulto	Repaired 17th ulto		CS Mirror		
1434	14/01/1892	Vigo - Lisbon	Repaired 14th inst	Repaired 14th inst		CS Mirror		
1435	14/01/1892	Vigo - Camhina	Interrupted again 28th ulto. Repaired again 8th inst	Interrupted again 28th ulto. Repaired again 8th inst		CS Mirror		
1436	14/01/1892	Aden - Bombay No 1	To be repaired by CS Electra	To be repaired by CS Electra		CS Electra		
1437	14/01/1892	Salonica - Tenedos	Repaired 13th inst	Repaired 13th inst		CS Amber		
1438	14/01/1892	Aden - Zanzibar	Repaired 27th ulto	Repaired 27th ulto		CS Chiltern		
1439	28/01/1892	Vigo - Lisbon	Interrupted 19th inst	Interrupted 19th inst. CS John Pender to repair		CS John Pender		
1440	28/01/1892	Aden - Bombay No 1	Under repair	Under repair		CS Electra		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1441	28/01/1892	Suez - Suakim No 1	Interrupted 14th inst. Repaired 26th inst	Interrupted 14th inst. Repaired 26th inst		CS Chiltern		
1442	05/02/1892	St Thomas - St Kitz	Interrupted 13th Oct 1891. Not yet repaired				Interrupted 13th Oct 1891. Not yet repaired	
1443	05/02/1892	Brest - St Pierre (Anglo-American)					Brest - St Pierre (Anglo-American)	
1444	05/02/1892	Hong Kong - Bolinao	Interrupted 4th December 1891. Repaired 11th Jan 1892				Interrupted 4th December 1891. Repaired 11th Jan 1892	
1445	05/02/1892	Rio Grande - Montevideo	Interrupted 4th Dec 1891. Repaired 6th Jan 1892				Interrupted 4th Dec 1891. Repaired 6th Jan 1892	
1446	05/02/1892	Aden - Zanzibar	Interrupted 5th December 1891. Repaired 28th Dec 1891				Interrupted 5th December 1891. Repaired 28th Dec 1891	
1447	05/02/1892	Jamaica - Porto Rico Cables	Interrupted 21st Dec 1891. Repaired 21st Dec 1891				Interrupted 21st Dec 1891. Repaired 21st Dec 1891	
1448	05/02/1892	St Croix - Trinidad	Interrupted 4th Jan. Repaired 10th Jan				Interrupted 4th Jan. Repaired 10th Jan	
1449	05/02/1892	Tinidad - Granada	Interrupted 4th Jan. Repaired 23rd Jan				Interrupted 4th Jan. Repaired 23rd Jan	
1450	05/02/1892	Perim - Assab	Interrupted 5th Jan. Not yet repaired				Interrupted 5th Jan. Not yet repaired	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1451	05/02/1892	Para - Maranham	Interrupted 18th Jan. Not yet repaired.				Interrupted 18th Jan. Not yet repaired.	
1452	05/02/1892	St Thome - Loanda	Interrupted 22nd Jan. Not yet repaired				Interrupted 22nd Jan. Not yet repaired	
1453	11/02/1892	Vigo - Lisbon	Repair delayed by bad weather	Repair delayed by bad weather		CS John Pender		
1454	11/02/1892	Delos - Mykonos	CS Mirror to repair	CS Mirror to repair		CS Mirror		
1455	11/02/1892	Aden - Bombay	Repaired 31st ulto	Repaired 31st ulto		CS Electra		
1456	11/02/1892	Aden - Zanzibar	Fault	Fault. CS Electra to repair		CS Electra		
1457	11/02/1892	Loanda - San Thome	To be repaired	To be repaired by CS Amber		CS Amber		
1458	11/02/1892	Suez - Suakim No 1	2 faults repaired 6th inst	2 faults repaired 6th inst		CS Chiltern		
1459	11/02/1892	Suakim - Perim No 1	Fault repaired	Fault repaired		CS Chiltern		
1460	25/02/1892	Vigo - Lisbon	4 breaks caused by fishermen repaired	4 breaks caused by fishermen repaired		CS John Pender		
1461	25/02/1892	Lisbon - Gibraltar	Interrupted 19th inst	Interrupted 19th inst. CS John Pender to repair		CS John Pender		
1462	25/02/1892	Delos - Mykonos	Repaired 13th inst	Repaired 13th inst		CS Mirror		
1463	25/02/1892	Santa Maura - Ithica	Repaired 16th inst	Repaired 16th inst by CS Mirror		CS Mirror		
1464	25/02/1892	Zante - Cephalonia	Repaired 12th inst	Repaired 12th inst by Zante Superindendent				
1465	25/02/1892	Loanda - San Thome	Repaired 18th inst	Repaired 18th inst		CS Amber		
1466	25/02/1892	Perim - Suakim No 1	Repaired 21st inst	Repaired 21st inst		CS Chiltern		
1467	25/02/1892	Suakim - Aden Nos 1 & 2	Faults	Faults to be removed by CS Chiltern		CS Chiltern		
1468	25/02/1892	Aden - Zanzibar	Repaired by Gt Northern	Repaired by Gt Norther (E&S African Teleg Co)				

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1469	25/02/1892	Aden - Bombay No 3	Fault 30 miles from Bombay	Fault 30 miles from Bombay. CS Electra to repair		CS Electra		
1470	04/03/1892	St Thomas - St Kitz	Repaired 23rd Oct 1892				Repaired 23rd Oct 1892	
1471	04/03/1892	Brest - St Pierre	Under repair				Under repair	
1472	04/03/1892	Perim - Assab	Under repair				Under repair	
1473	04/03/1892	St Thome - Loanda	Repaired 19th Feb				Repaired 19th Feb	
1474	04/03/1892	Zanzibar - Mombassa	Under repair				Under repair	
1475	04/03/1892	Buenaventura - St Helena	Interrupted 12th Feb. Repaired 20th Feb				Interrupted 12th Feb. Repaired 20th Feb	
1476	04/03/1892	Brest - St Pierre	Interrupted 13th Feb. Repaired 1st March				Interrupted 13th Feb. Repaired 1st March	
1477	04/03/1892	Saigon - Bankok	Interrupted 17th Feb				Interrupted 17th Feb	
1478	04/03/1892	Saigon - Singapore	Interrupted 18th Feb				Interrupted 18th Feb	
1479	10/03/1892	Lisbon - Gibraltar	To be repaired	To be repaired by CS John Pender		CS John Pender		
1480	10/03/1892	Carcavelos - Vigo	Fault removed	Fault removed		CS John Pender		
1481	10/03/1892	Gibraltar - Lisbon	Fault	Fault to be removed by CS Amber		CS Amber		
1482	10/03/1892	Gibraltar - Villa Real	Fault	Fault to be removed by CS Amber		CS Amber		
1483	10/03/1892	Aden - Suakim	Repaired 2nd inst	Repaired 2nd inst		CS Chiltern		
1484	10/03/1892	Suez - Aden No 4	Fault	Fault to be removed by CS Chiltern		CS Chiltern		
1485	10/03/1892	Aden - Bombay No3	Repaired 9th inst	Repaired 9th inst				
1486	11/03/1892	Brest - St Pierre	Repaired 24th Feb				Repaired 24th Feb	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1487	11/03/1892	Zanzibar - Mombassa	Repaired 23rd Feb				Repaired 23rd Feb	
1488	11/03/1892	Siagon - Bankon	Repaired 1st March				Repaired 1st March	
1489	11/03/1892	Siagon - Singapore	Repaired Feb 23rd				Repaired 23rd Feb	
1490	24/03/1892	Lisbon - Vigo	Repaired 16th inst	Repaired 16th inst		CS John Pender		
1491	24/03/1892	Cadiz - Villa Real	Repaired 18th inst	Repaired 18th inst		CS Amber		
1492	24/03/1892	Suez - Aden No 4	Repair delayed by bad weather. Finally repaired 22nd inst	Repair delayed by bad weather. Finally repaired 22nd inst		CS Chiltern		
1493	24/03/1892	Perim - Suakim	To be repaired	To be repaired by CS Chiltern		Cs Chiltern		
1494	24/03/1892	Aden - Bombay No 3	Fault repaired	Fault repaired by CS Electra		CS Electra		
1495	24/03/1892	Aden - Bombay No 2	To be repaired	To be repaired by CS Electra		CS Electra		
1496	01/04/1892	Brest - St Pierre (Anglo-American)	Interrupted 19th Nov 1891. Not yet repaired				Interrupted 19th Nov 1891. Not yet repaired	
1497	01/04/1892	Perrim - Assab	Interrupted 5th Jan. Repaired 26th March				Interrupted 5th Jan. Repaired 26th March	
1498	01/04/1892	Para - Maranham	Interrupted 18th Jan. Repaired 19th March				Interrupted 18th Jan. Repaired 19th March	
1499	01/04/1892	Zanzibar - Mombassa	Interrupted 25th Jan; repaired 23rd Feb.				Interrupted 25th Jan; repaired 23rd Feb.	
1500	01/04/1892	Brest - St Pierre (Francaise)	Interrupted 13th Feb. Repaired 24th Feb				Interrupted 13th Feb. Repaired 24th Feb	
1501	01/04/1892	Saigon - Singapore	Interrupted 18th Feb. Repaired 23rd Feb.				Interrupted 18th Feb. Repaired 23rd Feb.	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1502	01/04/1892	Hong Kong - Macao	Ibterrupted 2th Mar. Repaired 17th Mar.				Interrupted 2th Mar. Repaired 17th Mar.	
1503	04/04/1892	Valentia - Greetsiel	Repairs		NMM TCM/8/45 CABLE ENGINEERS' LOGBOOKS. Greetsiel - Valentia, BRITANNIA, 2 - 5 April 1892	CS Brittania		
1504	07/04/1892	Gibraltar - Lisbon	Fault repaired 26th ulto; another on the 27th ulto and a third on the 6th inst	Fault repaired 26th ulto; another on the 27th ulto and a third on the 6th inst		CS Amber		
1505	07/04/1892	St Vincent - Pernambuco	Interrupted 1st April. 10 miles from SV. BSTC request repair by ETC	Interrupted 1st April. 10 miles from SV. BSTC request repair by ETC. CS Mirror sent		CS Mirror		
1506	07/04/1892	Perim - Suakim	Fault removed 28th ulto. Further fault remains	Fault removed 28th ulto. Further fault remains.		CS Chiltern		
1507	07/04/1892	Aden - Bombay No 2	Under repair	Under repair		CS Electra		
1508	05/05/1892	Gibraltar - Villa Real	Repaired 26th April	Repaired 26th April		CS Amber		
1509	05/05/1892	Villa Real - Cadiz	Repaired 30th ulto	Repaired 30th ulto		CS Amber		
1510	05/05/1892	Tangier cable	Interrupted by SS Zweena	Interrupted by SS Zweena				
1511	05/05/1892	Vigo - Lisbon	Interrupted. Repaired by the Vigo Superintendent today	Interrupted. Repaired by the Vigo Superintendent today				
1512	05/05/1892	St Vincent - Pernambuco	Repaired 9th April	Repaired 9th April		CS Mirror		
1513	05/05/1892	Madiera - Lisbon No 2	Shore ends repaired 17th inst	Shore ends repaired 17th inst		CS Mirror		
1514	05/05/1892	Malta - Alexandria No 2	Repaired 2nd inst	Repaired 2nd inst		CS Mirror		
1515	05/05/1892	Malta - Bone No 1	Faulty 26th ulto	Faulty 26th ulto				
1516	05/05/1892	Suakim - Perim	Repaired 28th April	Repaired 28th April		CS Chiltern		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1517	05/05/1892	Suez - Suakim No 1	Interrupted by SS Baghdadi and SS Naderi 26th ulto. Repaired 1st inst.	Interrupted by SS Baghdadi and SS Naderi 26th ulto. Repaired 1st inst by CS Chiltern		CS Chiltern		
1518	05/05/1892	Aden - Bombay No 2	Fault repaired 21st April	Fault repaired 21st April		CS Electra		
1519	06/05/1892	Brest - St Pierre (Anglo-American)	Repaired 22nd April				Repaired 22nd April	
1520		Perrim - Assab	Repaired 26th March				Repaired 26th March	
1521		Bolamo - Bissao	Interrupted 23rd April				Interrupted 23rd April	
1522	19/05/1892	Marsailles - Bona No 2	Repaired 17th inst	Repaired 17th inst by Cs Mirror		CS Mirror		
1523	19/05/1892	Malta - Bona No 1	Under repair - Bad weather	Under repair - Bad weather				
1524	19/05/1892	Suakim - Suez	Faults	CS Chiltern to remove faults		CS Chiltern		
1525	19/05/1892	Vigo	Shore ends to be repaired	Shore ends to be repaired by CS Amber		CS Amber		
1526	20/05/1892	Mossamedes - Benguela	Repaired 19th May				Repaired 19th May	
1527	30/05/1892	Maldonado - Chuy	Repairs		NMM TCM/8/47 Cable Edngineer's Logbooks. Maldonado - Chuy. SCOTIA, 17 30 May 1892	CS Scotia		
1528	16/06/1892	Bolamo - Bissau	Repaired	Repaired		CS John Pender		
1529	16/06/1892	Vigo	Shore ends repaired 21st ulto	Shore ends repaired 21st ulto		CS Mirror		
1530	16/06/1892	Bona - Malta No 1	Repaired 20th ulto	Repaired 20th ulto		CS Electra		
1531	16/06/1892	Suez - Suakim No 1	Faults removed on 30th ulto and 3rd inst	Faults removed on 30th ulto and 3rd inst		CS Chiltern		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1532	17/06/1892	Halifax - Rye Beach, Ballinskellig - Halifax, Brest - St Pierre,	Repairs		NMM TCM/8/46 CABLE ENGINEERS' LOGBOOKS. Halifax - Rye Beach, Ballinskellig - Halifax, Brest - St Pierre, BRITANNIA, 15 April - 17 June 1892. TCM/9/29 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Ballinskellig - Halifax, BRITANNIA, 15 April - 17 June 1892	CS Brittania		
1533	17/06/1892	Mossamedes - Benguela	Repaired 23/04/1892				Repaired 23/04/1892	
1534	23/06/1892	Peruambuco - Bakiarp	Repairs		NMM TCM/8/48 CABLE ENGINEERS' LOGBOOKS. Peruambuco - Bakiarp, SCOTIA, 7 - 23 June 1892. TCM/9/30 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Bahia - Pernambuco, SCOTIA, 7 - 23 June 1892	CS Scotia		
1535	26/06/1892	Bissau - Balloma	Repaired 21st inst				Repaired 21st inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1536	30/06/1892	Bolamo - Bissau	Repaired 21st inst	Repaired 21st inst		CS John Pender		
1537	30/06/1892	Mossamedes - Cape Town	Interrupted 26th inst	Interrupted 26th inst				
1538	30/06/1892	Perim - Suakim	Fault repaired 26th inst	Fault repaired 26th inst		CS Chiltern		
1539	30/06/1892	Suez - Suakim No 1	To be repaired	To be repaired by CS Chiltern		CS Chiltern		
1540	15/07 1892	Mossamedes - Cape Town	Interrupted 26th ulto				Interrupted 26th ulto	
1541	15/07 1892	Sierra Leone - Accra	Interrupted 14th inst				Interrupted 14th inst	
1542	22/07/1892	Suez - Suakim No 1	Repaired 6th inst	Repaired 6th inst		CSChiltern		
1543	22/07/1892	Suez - Suakim No 1	Fault on shore end repaired by Supt at Suakim 18th inst	Fault on shore end repaired by Supt at Suakim 18th inst				
1544	22/07/1892	Mossamedes - Cape Town	Under repair	Under repair		CS John Pender		
1545	28/07/1892	Tangier cable	Interrupted 26th inst	Interrupted 26th inst. CS Mirror to repair		CS Mirror		
1546	28/07/1892	Mossamedes - Cape Town	Repaired 22nd inst	Repaired 22nd inst		CS John Pender		
1547	29/07/1892	Sierra Leone - Accra	Repaired 21st inst				Repaired 21st inst	
1548	29/07/1892	Mossamedes - Cape Town	Repaired 22nd inst				Repaired 22nd inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1549	09/09/1892	Brest - St Pierre (1869)	Repairs		NMM TCM/8/49 CABLE ENGINEERS' LOGBOOKS. Brest - St Pierre, BRITANNIA, 22 July - 9 August 1892 TCM/9/31 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Brest - St Pierre (1869), BRITANNIA, 22 July - 9 August 1892	CS Brittania		
1550	22/09/1982	Cadiz - Gibraltar	Repaired 12th inst	Repaired 12th inst				
1551	22/09/1982	Bianca - Bagnara (in Messena Straits)	Interrupted 14th inst.	Interrupted 14th inst. To be repaired by CS Amber		CS Amber		
1552	22/09/1982	Suez - Suakim	Shore ends repaired.	Shore ends repaired by CS Chiltern		CS Chiltern		
1553	22/09/1982	Suez - Aden No 3	Repaired 18th inst	Repaired 18th inst				
1554	28/09/1892	Ballinskellig - Halifax	Repairs		NMM TCM/8/50 CABLE ENGINEERS' LOGBOOKS. Ballinskellig - Halifax, BRITANNIA, 29 August -28 September 1892	CS Brittania		
1555	06/10/1892	Porthcurno - Vigo	Fault	Fault to be repaired by CS Mirror		CS Mirror		
1556	06/10/1892	Messina cables	Repaired 27th ulto	Repaired 27th ulto		CS Amber		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1557	06/10/1892	Aden - Bombay No 1	To be repaired	To be repaired by CS Chiltern		CS Chiltern		
1558	06/10/1892	Suakim - Aden No 2	Fault	Fault				
1559	06/10/1892	Port Said - Alexandria	Fault	Fault				
1560	20/10/1892	Corfu - Zante	Repaired 15th inst	Repaired 15th inst		CS Amber		
1561	20/10/1892	Syra - Chio	To be repaired	To be repaired by CS Amber		CS Amber		
1562	20/10/1892	Suakim - Aden No 2	Repaired 20th inst	Repaired 20th inst		CS Chiltern		
1563	20/10/1892	Porthcurno - Vigo	Under repair	Under repair by CS Mirror		CS Mirror		
1564	22/10 1892	Greetsiel - Valentia	Repairs		NMM TCM/9/45 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Greetsiel - Valentia, BRITANNIA, 2 August - 22 October 1892	CS Britannia		
1565	28/10/1892	Bolamo - Bissau	Interrupted 9th Sept				Interrupted 9th ulto	
1566	28/10/1892	Cayenne - Vizeu	Interrupted 24th Sept				Interrupted 24th Sept	
1567	28/10/1892	Jamaica - Colon	Interrupted 13th inst				Interrupted 13th inst	
1568	28/10/1892	Hong Kong - Amoy	Interrupted 21st inst				Interrupted 21st inst	
1569	28/10/1892	Hong Kong - Foo Chow	Interrupted 21st inst				Interrupted 21st inst	
1570	03/11/1892	Porthcurno - Vigo	Under repair - Bad weather	Under repair - Bad weather		CS Mirror		
1571	03/11/1892	Chio No 1	Repaired 24th ulto	Repaired 24th ulto		CS Amber		
1572	03/11/1892	Kartel section of Dardanelles cable	Under repair	Under repair by CS Mirror		CS Mirror		

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1		Cable	Event	ETC Board Minute Books	Engineer's Reports (and other sources)	Ship	The Electrician	The Times
1573	03/11/1892	Aden - Bombay No 1	Fault near Bombay	Fault near Bombay. CS Chiltern to repair		CS Chiltern		
1574	04/11/1892	Para - Maranham	Interrupted 15th Oct				Interrupted 15th Oct	
1575	17/11/1892	Porthcurno - Vigo	Further repairs finished 9th inst	Further repairs finished 9th inst		CS Mirror		
1576	17/11/1892	Bolamo cable	Interrupted	Interrupted				
1577	17/11/1892	St Vincent - Pernambuco	Interrupted	Interrupted. Request from BSTC for ETC's help with repairs				
1578	17/11/1892	Mombassa	Repaired 11th inst	Repaired 11th inst		CS John Pender		
1579	17/11/1892	Aden - Bombay No 1	Repaired 7th inst	Repaired 7th inst		CS Chiltern		
1580	17/11/1892	Aden - Bombay No 3	Fault near Bombay	Fault near Bombay.. CS Chiltern to repair		CS Chiltern		
1581	17/11/1892	Nagaia - Karsal section	Repaired 5th inst	Repaired 5th inst by CS Amber		CS Amber		
1582	18/11/1892	Jamaica - Colon	Repaired 8th inst				Repaired 8th inst	
1583	18/11/1892	Hong Kong - Amoy	Repaired 10th inst				Repaired 10th inst	
1584	18/11/1892	Chuy - Monte Video	Interrupted 9th inst. Repaired 11th inst				Interrupted 9th inst. Repaired 11th inst	
1585	18/11/1892	Caera - Maranham	Interrupted 9th inst				Interrupted 9th inst	
1586	25/11/1892	St Thome - Loanda	Interrupted 24th inst				Interrupted 24th inst	
1587	01/12/1892	Alexandria - Malta No 1	Repaired 21st ulto	Repaired 21st ulto		CS Amber		
1588	01/12/1892	Caminha - Vigo	To be repaired	To be repaired by CS Amber		CS Amber		
1589	01/12/1892	Gibraltar - Cadiz	To be repaired	To be repaired by CS Amber		CS Amber		
1590	01/12/1892	Bolamo cable	Under repair	Under repair		CS Mirror		
1591	01/12/1892	Lagos - Brass	Interrupted	Interrupted. CS Mirror to repair		CS Mirror		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1592	01/12/1892	St Thome - Loanda	Interrupted	Interrupted. CS Mirror to repair		CS Mirror		
1593	01/12/1892	Aden - Bombay No 3	Fault removed 23rd ulto	Fault removed 23rd ulto by CS Chiltern		CS Chiltern		
1594	02/12/1892	Para - Maranham	Repaired 28th ulto				Repaired 28th ulto	
1595	02/12/1892	Fao - Bushire	Interrupted 24th ulto. Repaired 28th ulto				Interrupted 24th ulto. Repaired 28th ulto	
1596	02/12/1892	Penang - Medan	Interrupted 1st inst				Interrupted 1st inst	
1597	02/12/1892	Hong Kong - Macao	Repaired 29th ulto				Repaired 29th ulto	
1598	09/12/1892	Hong Kong - Macao	Repaired 3rd inst				Repaired 3rd inst	
1599	09/12/1892	Nagasaki - Shanghai	Interrupted 2nd inst. Repaired 8th inst				Interrupted 2nd inst. Repaired 8th inst	
1600	15/12/1892	Caminha - Vigo	Repaired 12th inst	Repaired 12th inst		CS Amber		
1601	15/12/1892	Bolama cable	Fault removed 12th inst; further fault remains	Fault removed 12th inst; further fault remains				
1602	15/12/1892	Aden - Bombay No 1	Fault near Aden	Fault near Aden CS Chiltern to repair		CS Chiltern		
1603	16/12/1892	Caera - Maranham	Repaired 9th inst				Repaired 9th inst	
1604	23/12/1892	Bolamo - Bissau	Repaired 22nd inst				Repaired 2nd inst	
1605	30/12/1892	Senegal - Pernambuco	Interrupted 27th ulto				Interrupted 27th ulto	
1606	06/01/1893	Penang - Medan	Repaired 17th ulto				Repaired 17th ulyo	
1607	06/01/1893	Mozambique - Lorenco Marques	Interrupted 5th inst				Interrupted 5th inst	
1608	12/01/1893	Porthcurno - Lisbon	Interrupted 31st ulto; Repaired 10th inst	Interrupted 31st ulto; Repaired 10th inst		CS Amber		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1609	12/01/1893	Lisbon - Vigo	Interrupted 31st ulto; Repaired 10th inst	Interrupted 31st ulto; Repaired 10th inst		CS Amber		
1610	12/01/1893	Porthcurno - Lisbon Direct	Interrupted 31st ulto; Repaired 10th inst	Interrupted 31st ulto; Repaired 10th inst		CS Amber		
1611	12/01/1893	Porthcurno - Vigo	Fault & Interruption repaired	Fault & Interruption repaired		CS Amber		
1612	12/01/1893	Lapari cable	To be repaired	To be repaired by CS Amber		CS Amber		
1613	12/01/1893	Tenedos- Chios	To be repaired	To be repaired by CS Amber		CS Amber		
1614	12/01/1893	Aden - Suakim No 1	Repaired 28th ulto	Repaired 28th ulto		CS Chiltern		
1615	12/01/1893	Suez - Suakim No 1	Repaired 9th inst	Repaired 9th inst		CS Chiltern		
1616	12/01/1893	Suez - Suakim No 1	Repaired 9th inst	Repaired 9th inst		CS Chiltern		
1617	12/01/1893	Suez - Suakim No 1	Break 500nm from Suez under repair	Break 500nm from Suez under repair		CS Chiltern		
1618	12/01/1893	Mozambique - Lorenco Marques	Interrupted 5th inst	Interrupted 5th inst. CS John Pender to repair		CS John Pender		
1619	12/01/1893	Bolamo - Conakry	Repaired 27th ulto	Repaired 27th ulto		CS Mirror		
1620	12/01/1893	St Thome - Loanda	Repaired 12th inst	Repaired 12 inst		CS Mirror		
1621	12/01/1893	Syra - Paros	Repaired by Station Superintendent	Repaired by Station Superintendent				
1622	13/01/1893	Mozambique - Lorenco Marques	Repaired 11th inst				Repaired 11th inst	
1623	13/01/1893	St Thome - Loanda	Repaired 11th inst				Repaired 11th inst	
1624	20/01/1893	Singapore - Saigon	Interrupted 17th inst. Repaired 19th inst				Interrupted 17th inst. Repaired 19th inst	
1625	26/01/1893	Alexandria - Port Said	Interrupted by fierce hurricane					Interrupted by fierce hurricane

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1626	26/01/1893	Alexandria - Malta	Interrupted by fierce hurricane					Interrupted by fierce hurricane
1627	26/01/1893	Vigo - Lisbon	Repaired 19th inst	Repaired 19th inst		CS Electra		
1628	26/01/1893	Vigo - Camhina	Under repair	Under repair		CS Electra		
1629	26/01/1893	Porthcurno - Vigo	To be repaired	To be repaired 20 nm from Porthcurno by CS Electra		CS Electra		
1630	26/01/1893	Lisbon - Gibraltar No 1	Repaired 13th inst	Repaired 13th inst		CS Amber		
1631	26/01/1893	Tenedos cable	To be repaired	To be repaired by CS Amber		CS Amber		
1632	26/01/1893	Alexandria - Malta	Interrupted 23rd inst	Interrupted 23rd inst				
1633	26/01/1893	Alexandria - Port Said	Interrupted 23rd inst	Interrupted 23rd inst				
1634	26/01/1893	Steno - Pass and Doro Channel cables	Repaired	Repaired by Station Superintendent				
1635	26/01/1893	Suez - Suakim No 1	Repaired 20th inst	Repaired 20th inst		CS Chiltern		
1636	26/01/1893	Lorenco Marques cable	Under repair	Under repair by CS John Pender		CS John Pender		
1637	26/01/1893	St Vincent - Pernambuco	To be repaired	To be repaired by CS Mirror		CS Mirror		
1638	09/02/1893	Porthcurno - Vigo No 1	Faults removed 4th inst. Further fault 120nm frm Porthcurno	Faults removed 4th inst. Further fault 120nm frm Porthcurno. CS Electra to repair		CS Electra		
1639	09/02/1893	Tenedos - Chios	Repaired 26th ulto	Repaired 26th ulto		CS Amber		
1640	09/02/1893	Alexandria - Malta No 1	Repaired 31st ulto	Repaired 31st ulto		CS Amber		
1641	09/02/1893	Lepani cable	To be repaired	To be repaired by CS Amber		CS Amber		
1642	09/02/1893	Aden - Bombay No 1	Under repair	Under repair by CS Chiltern		CS Chiltern		
1643	09/02/1893	St Vincent - Peru	Repaired 30th ulto	Repaired 30th ulto		CS Mirror		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1644	09/02/1893	St Vincent - Madiera	To be repaired	To be repaired by CS Mirror		CS Mirror		
1645	09/02/1893	Mozambique - Lorenco Marques	Repaired 27th ulto	Repaired 27th ulto		CS John Pender		
1646	10/02/1893	Senegal - Pernambuco	Repaired 9th inst				Repaired 9th inst	
1647	17/02.1893	Marseille - Berizert - Tunis	Repairs		NMM TCM/8/51 CABLE ENGINEERS' LOGBOOKS. Marseille - Berizert - Tunis, CALABRIA, 29 January - 17 February 1893	CS Calabria		
1648	23/02/1893	Porthcurno - Vigo	Under repair (bad weather)	Under repair (bad weather)		CS Electra		
1649	23/02/1893	Lipari cable	Repaired 13th inst	Repaired 13th inst		CS Amber		
1650	23/02/1893	Gib - Malta No 2	Interrupted by CS Calabria which was laying Marseilles - Bizerta for Freanch Govt	Interrupted by CS Calabria which was laying Marseilles - Bizerta for Freanch Govt. CS Amber to repair		CS Amber; CS Calabria		
1651	23/02/1893	Tangier cable	Interrupted 18th inst	Interrupted 18th inst. CS Amber to repair		CS Amber		
1652	23/02/1893	St Vincent - Madiera No 1	Under repair	Under repair		CS Mirror		
1653	23/02/1893	Aden - Bombay No 1	Repaired 19th inst	Repaired 19th inst		CS Chiltern		
1654	23/02/1893	Aden - Zanzibar	Interrupted 19th inst	Interrupted 19th inst, 450nm from Aden. CS Chiltern to repair		CS Chiltern		
1655	23/02/1893	St Thome - Loanda	Interrupted 16th inst	Interrupted 16th inst CS John Pender to repair		CS John Pender		
1656	24/02/1893	St Thome - Loanda	Interrupted 17th inst				Interrupted 17th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1657	24/02/1893	Gibraltar Tangier	Interrupted 18th inst				Interrupted 18th inst	
1658	24/02/1893	Aden - Zanzibar	Interrupted 20th inst				Interrupted 20th inst	
1659	03/03/1893	Aden - Zanzibar	Repaired 25th ulto				Repaired 25th ulto	
1660		Paramaribo - Cayenne	Interrupted 28th Jan. Repaired 27th ulto				Interrupted 28th Jan. Repaired 27th ulto	
1661	06/03/1893	Greetsiel - Valentia	Repairs		NMM TCM/8/52 CABLE ENGINEERS' LOGBOOKS. Greetsiel - Valentia, SEINE, 4 February - 6 March 1893	CS Siene		
1662	09/03/1893	Porthcurno - Vigo	One fault repaired but bad weather. Cable working well so 2nd fault left alone	One fault repaired but bad weather. Cable working well so 2nd fault left alone		CS Electra		
1663	09/03/1893	Gibralter - Malta No 2	Repaired 26th ulto	Repaired 26th ulto		CS Amber		
1664	09/03/1893	Gibraltar - Malta No1	Repaired 8th inst	Repaired 8th inst		CS Amber		
1665	09/03/1893	Aden - Zanzibar	Repaired 25th ulto	Repaired 25th ulto		CS Chiltern		
1666	09/03/1893	Perim - Suakim No 1	Interrupted 8th inst	Interrupted 8th inst. CS Chiltern to repair		CS Chiltern		
1667	09/03/1893	St Vincent - Madeira No 1	Under repair	Under repair		CS Mirror		
1668	09/03/1893	St Thome - Loanda	Under repair	Under repair		CS John Pender		
1669	09/03/1893	St Thome - Loanda	Repaired 6th inst				Repaired 6th inst	
1670	17/03/1893	Cayenne - Vizeu	Repaired 10th inst				Repaired 10th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1671	17/03/1893	Accra - Grand Bassam	Interrupted 13th inst. Repaired 15th inst				Interrupted 13th inst. Repaired 15th inst	
1672	23/03/1893	Porthcurno - Vigo	Repaired 13th inst	Repaired 13th inst		CS Electra		
1673	23/03/1893	Porthcurno - Lisbon Direct	Repaired 16th inst	Repaired 16th inst		CS Electra		
1674	23/03/1893	Lisbon - Gibraltar (Old)	Interrupted	Interrupted. CS Electra to repair		CS Electra		
1675	23/03/1893	Corfu - Orante	Under repair. Bad weather	Under repair. Bad weather		CS Amber		
1676	23/03/1893	Perim - Suakim No 1	Under repair	Under repair		CS Chiltern		
1677	23/03/1893	Suez - Suakim No 1	Interrupted	Interrupted CS Chiltern to repair		CS Chiltern		
1678	23/03/1893	St Vincent - Madeira	Repaired 19th inst	Repaired 19th inst		CS Mirror		
1679	23/03/1893	Zanzibar - Mozambique	Fault near Mozambique	Fault near Mozambique. CS John Pender to repair		CS John Pender		
1680	07/04/1893	Gibraltar - Tangiers	Interrupted 31st ulto				Interrupted 31st ulto	
1681	24/03/1893	Para - Maranham	Interrupted 20th inst				Interrupted 20th inst	
1682	20/04/1893	Gibraltar - Tangiers	Repaired 31st ulto	Repaired 31st ulto		CS Electra		
1683	20/04/1893	Gibraltar - Lisbon	Repaired 5th inst	Repaired 5th inst		CS Electra		
1684	20/04/1893	Porthcurno - Lisbon Direct	One fault repaired 10th inst. 2 more faults 2nm from Porthcurno	One fault repaired 10th inst. 2 more faults 2nm from Porthcurno		CS Electra		
1685	20/04/1893	Ithica - Cephalonia	Repaired 25th ulto	Repaired 25th ulto		CS Amber		
1686	20/04/1893	Corfu - Oranto	Repaired 25th ulto	Repaired 25th ulto		CS Amber		
1687	20/04/1893	Perim - Suakim No 1	Repaired 26th ulto	Repaired 26th ulto		CS Chiltern		
1688	20/04/1893	Suez - Suakim No 1	Repaired 26th ulto	Repaired 26th ulto		CS Chiltern		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1689	20/04/1893	Suez - Suakim No 2	Repaired 4th inst	Repaired 4th inst		CS Chiltern		
1690	20/04/1893	St Thome - Loanda	Interrupted	Interrupted. CS John Pender to repair		CS John Pender		
1691	20/04/1893	St Vincent - Pernambuco No 2	Faulty	Faulty. CS Mirror to repair		CS Mirror		
1692	21/04/1893	Gibraltar - Tangiers	Repaired 1st inst				Repaired 1st inst	
1693	21/04/1893	St Thome - Loanda	Interrupted 11th inst				Interrupted 11th inst	
1694	21/04/1893	Paramaribo - Cayenne	Interrupted 15th inst				Interrupted 15th inst	
1695	28/04/1893	Accra - Grand Bassam	Repaired 11th inst				Repaired 11th inst	
1696	28/04/1893	St Thome - Loanda	Repaired 25th inst				Repaired 25th inst	
1697	28/04/1893	Santiago de Cuba - Mole St Nicholas	Interrupted 20th inst				Interrupted 20th inst	
1698	04/05/1893	Porthcurno - Lisbon Direct	1 fault Repaired; 1fault remaining	1 fault Repaired; 1fault remaining		CS Electra		
1699	04/05/1893	St Vincent - Pernambuco	Repaired 28th ulto	Repaired 28th ulto		CS Mirror		
1700	04/05/1893	Aden - Bombay No 1	Under repair	Under repair		CS Chiltern		
1701	04/05/1893	"Red Sea Cables"	To be repaired	To be repaired by CS Chiltern		CS Chiltern		
1702	04/05/1893	St Thome - Loanda	Repaired 25th ulto	Repaired 25th ulto		CS John Pender		
1703	05/05/1893	Para - Maranham	Interrupted 20th March				Interrupted 20th March	
1704	05/05/1893	Paramaribo - Cayenne	Interrupted 15th April				Interrupted 15th April	
1705	05/05/1893	Santiago de Cuba - Mole St Nicholas	Interrupted 20th April				Interrupted 20th April	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1706	05/05/1893	Gibraltar - Tangiers	Interrupted 29th April				Interrupted 29th April	
1707	18/05/1893	Tangier cable	Repaired 15th inst	Repaired 15th inst		CS Mirror		
1708	18/05/1893	Aden - Bombay No 1	Repaired 5th inst	Repaired 5th inst		CS Chiltern		
1709	18/05/1893	"Red Sea Cables"	Under repair	Under repair		CS Chiltern		
1710	18/05/1893	Suez - Aden	Under repair	Under repair		CS Chiltern		
1711	19/05/1893	Gibraltar - Tangiers	Repaired 16th inst				Repaired 16th inst	
1712	19/05/1893	Asab - Massowah	Interrupted 15th inst				Interrupted 15th inst	
1713	26/05/1893	Para - Maranham	Repaired 21st inst				Repaired 21st inst	
1714	26/05/1893	Assab - Massacuah	Repaired 25th inst				Repaired 25th inst	
1715	01/06/1893	St Thome - Loanda	Interrupted 31st Ulto	Interrupted 31st ulto. CS John Pender to repair		CS John Pender		
1716	01/06/1893	Suakim - Aden No 2	Repaired 20th ulto	Repaired 20th ulto		CS Chiltern		
1717	02/06/1893	St Thome - Loanda	Interrupted 30th ulto				Interrupted 30th ulto	
1718	02/06/1893	Santiago de Cuba - Mole St Nicholas	Repaired 7th inst				Repaired 7th inst	
1719	15/06/1893	Suakim - Aden No 2	3 Faults repaired 11th inst	3 Faults repaired 11th inst		CS Chiltern		
1720	15/06/1893	Perim - Aden	Under repair	Under repair		CS Chiltern		
1721	15/06/1893	Aden - Bombay No 1	Fault since heavy Monsoon	Fault since heavy Monsoon. CS Chiltern to repair		CS Chiltern		
1722	29/06/1893	Oranto - Corfu	Repaired 24th inst	Repaired 24th inst		CS Amber		
1723	29/06/1893	Malta - Bona No 1	Fault	Fault 2.5nm from Bona. CS Amber to repair		CS Amber		
1724	29/06/1893	Aden - Perim No 1	Repaired 22nd inst	Repaired 22nd inst		CS Chiltern		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1725	30/06/1893	Fao - Bushire	Interrupted 25 inst. Repaired 28th inst				Interrupted 25 inst. Repaired 28th inst	
1726	13/07/1893	Malta - Bona No 1	Repaired 2nd inst	Repaired 2nd inst by CS Amber. Shore end repaired by station superintendent		CS Amber		
1727	13/07/1893	St Thome - Loanda	Under repair	Under repair		CS John Pender		
1728	21/07/1893	St Thome - Loanda	Repaired 18th inst				Repaired 18th inst	
1729	27/07/1893	Gibraltar - Lisbon No 1	Repaired 19th inst	Repaired 19th inst		CS Mirror		
1730	27/07/1893	Lisbon - Vigo	Repaired 22nd inst	Repaired 22nd inst		CS Mirror		
1731	27/07/1893	Tangier cable	Under repair	Under repair		CS Mirror		
1732	27/07/1893	Suakim - Aden No 2	Repaired 22nd inst	Repaired 22nd inst		CS Chiltern		
1733	27/07/1893							
1734	27/07/1893	Suez - Suakim No 2	Fault but position unknown	Fault but location unknown and cable working reasonably well so leave until worse				
1735	27/07/1893	St Thome - Loanda	Repaired 18th inst	Repaired 18th inst		CS John Pender		
1736	11/08/1893	Paramaribo	Interrupted 15th April. Repaired 7th inst				Interrupted 15th April. Repaired 7th inst	
1737	11/08/1893	Aden - Zanzibar	Interrupted 9th inst				Interrupted 9th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1738	22/08/1893	Ireland - Newfoundland (1874)	Repairs		NMM TCM/8/53 CABLE ENGINEERS' LOGBOOKS. Ireland - Newfoundland (1874), CALABRIA, 17 July - 22 August 1893	CS Calabria		
1739	25/08/1893	Falmouth - Bilbao (Direct Spanish)	Interrupted 17th inst				Interrupted 17th inst	
1740	01/09/1893	Falmouth - Bilbao (Direct Spanish)	Repaired 25th ulto				Repaired 25th ulto	
1741	08/09/1893	Paramaribo - Ceara	Interrupted 9th ulto				Interrupted 9th ulto	
1742	21/09/1893	Bilbao cable of the Spanish Direct Teleg Co	Fault repaired 24th August	Fault. Request for ETC to repair. Repaired 24th August by CS Electra		CS Electra		
1743	15/09/1893	Aden - Zanzibar	Repaired 9th inst				Repaired 9th inst	
1744	21/09/1893	Vigo - Lisbon	Repaired 19th inst	Repaired 19th inst		CS John Pender		
1745	21/09/1893	Tangier cable	Repaired 17th inst	Repaired 17th inst		CS Mirror		
1746	21/09/1893	Suez- - Suakim No 2	Repaired 5thulto	Repaired 5th ulto		CS Chiltern		
1747	21/09/1893	Aden - Zanzibar	Repaired 9th inst	Repaired 9th inst		CS Chiltern		
1748	21/09/1893	Perim - Suakim	Repaired 19th inst	Repaired 19th inst		CS Chiltern		
1749	27/09/1893	Ireland - Newfoundland (1874)	Repairs		NMM TCM/8/54 CABLE ENGINEERS' LOGBOOKS. Ireland - Newfoundland (1874), CALABRIA, 22 August - 27 September 1893	CS Calabria		
1750	05/10/1893	Vigo - Lisbon	Repaired 28th ulto	Repaired 28th ulto		CS John Pender		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1751	05/10/1893	Belem Starits Cable	Repaired 4th inst	Repaired 4th inst		CS John Pender		
1752	05/10/1893	Suez - Suakim No 1	Under repair	Under repair by CS Chiltern		CS Chiltern		
1753	05/10/1893	Bona - Malta No 1	Under repair with difficulty	Under repair with difficulty		CS Amber		
1754	10/10/1893	Atlantic (1872)	Repairs		NMM TCM/9/33 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Atlantic (1872), CALABRIA, 17 July - 10 October 1893	CS Calabria		
1755	19/10/1893	Gibraltar - Cadiz	Repaired	Repaired		CS John Pender		
1756	19/10/1893	Suez - Suakim No 1	Repaired 10th inst	Repaired 10th inst		CS Chiltern		
1757	02/11/1893	Alexandria - Malta No 2	To be repaired	To be repaired by CS Electra		CS Electra		
1758	02/11/1893	Italian Sardinia cable (1875)	Fault to be repaired for Italian Govt	Fault to be repaired for Italian Govt				
1759	02/11/1893	Suakim shore ends	Repaired	Repaired by CS Amber		CS Amber		
1760	16/11/1893	Tangier cable	Repaired 13th inst	Repaired 13th inst				
1761	16/11/1893	Perim - Obeck (French Govt)	Interrupted 9th ulto	Interrupted 9th ulto. CS Amber to repair		CS Amber		
1762	16/11/1893	Suakim - Perim	Interrupted 16th inst	Interrupted 16th inst				
1763	16/11/1893	Alexandria - Malta No 2	Repaired 6th inst	Repaired 6th inst		CS Electra		
1764	16/11/1893	Alexandria - Sika	Repaired 14th inst	Repaired 14th inst		CS Electra		
1765	16/11/1893	Zante - Candia	To be repaired	To be repaired by CS Electra		CS Electra		
1766	17/11/1893	Perim - Obeck (French Govt)	Interrupted 10th inst				Interrupted 10th inst	
1767	24/11/1893	Perim - Obeck (French Govt)	Repaired 17th inst				Repaired 17th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1768	30/11/1893	Gibraltar - Lisbon	Under repair	Under repair		CS Mirror		
1769	30/11/1893	Perim - Obeck (French Govt)	Repaired	Repaired		CS Amber		
1770	30/11/1893	Suakim - Aden No 2	Repaired 17th inst	Repaired 17th Inst		CS Amber		
1771	30/11/1893	Suakim - Perim	Repaired 21st inst	Repaired 21st inst		CS Amber		
1772	30/11/1893	Aden - Bombay	To be repaired	To be repaired by CS Amber		CS Amber		
1773	30/11/1893	Zante - Candia	Repaired 26th inst	Repaired 26th inst		CS Electra		
1774	30/11/1893	Sardinia cable	To be repaired	To be repaired by ETC for the Italian Govt. CS Electra		CS Electra		
1775	01/12/1893	Cayenne - Vizeu	Interrupted 25th ulto				Interrupted 25th ulto	
1776	01/12/1893	Jamaica - Colon	Interrupted 25th ulto				Interrupted 25th ulto	
1777	01/12/1893	Bissau - Balloma	Interrupted 24th ulto				Interrupted 24th ulto	
1778	04/12/1893	Gibraltar - Lisbon	Repaired 30th ulto	Repaired 30th ulto		CS Mirror		
1779	04/12/1893	Aden - Bombay No 1	Interrupted	Interrupted 50 nm from Aden. Under repair by CS Amber		CS Amber		
1780	04/12/1893	Bona - Malta No 2	Under repair	Under repair by CS Electra		CS Electra		
1781	04/12/1893	Sardinia cable	Repaired 3rd inst	Repaired 3rd inst		CS Electra		
1782	08/12/1893	Kotonou - Accra	Interrupted 4th inst				Interrupted 4th inst	
1783	08/12/1893	Lagos - Brass	Interrupted 4th inst				Interrupted 4th inst	
1784	15/12/1893	San Domingo - Mozambique	Interrupted 10th inst				Interrupted 10th inst	
1785	15/12/1893	Haiphong - Hong Kong	Interrupted 11th inst				Interrupted 11th inst	
1786	15/12/1893	Singapore - Saigon	Interrupted 11th inst				Interrupted 11th inst	

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1		Cable	Event	ETC Board Minute Books	Engineer's Reports (and other sources)	Ship	The Electrician	The Times
1787	22/12/1893	Bonny - Camaroons	Interrupted 18th inst				Interrupted 18th inst	
1788	29/12/1893	Jamaica - Colon	Repaired 26th inst				Repaired 26th inst	
1789	29/12/1893	Kotonou - Accra	Repaired 27th inst				Repaired 27th inst	
1790	29/12/1893	Garachico - Santa Cruz de Palma	Interrupted 27th inst				Interrupted 27th inst	
1791	11/01/1894	Aden - Bombay No 1	Repaired 27th ulto	Repaired 27th ulto		CS Amber		
1792	11/01/1894	Aden - Suakim No 2	Repaired 30th ulto	Repaired 30th ulto		CS Amber		
1793	11/01/1894	Bona - Malta No 2	Repaired 14th ulto. A fault still exists	Repaired 14th ulto. Fault still exists; to be repaired by CS Electra later		CS Electra		
1794	11/01/1894	Patros - Zante	Repaired 21st ulto	Repaired 21st ulto		CS Electra		
1795	11/01/1894	Salonica - Limnos	Repaired 31st ulto	Repaired 31st ulto		CS Electra		
1796	11/01/1894	Chios - Tenedos	Repaired 1st inst	Repaired 1st inst		CS Electra		
1797	11/01/1894	Alexandria - Malta No 2	Repaired 9th inst	Repaired 9th inst		CS Electra		
1798	12/01/1894	San Domingo - Mozambique	Repaired 8th inst				Repaired 8th inst	
1799	19/01/1894	Lagos - Brass	Repaired 11th inst				Repaired 11th inst	
1800	19/01/1894	Penang - Medan	Interrupted 14th inst				Interrupted 14th inst	
1801	19/01/1894	Foochow - Shanghai	Interrupted 15th inst				Interrupted 15th inst	
1802	22/01/1894	Bona - Malta No 2	Interrupted	Interrupted				
1803	22/01/1894	Malta - Sicily no 2	Interrupted	Interrupted				
1804	22/01/1894	Alexandriaandra - Port Said	Repaired 20th inst	Repaired 20th inst		CS Electra		
1805	22/01/1894	Perim - Suakim	Repaired 11th inst	Repaired 11th inst		CS Amber		
1806	22/01/1894	Bombay Nos 1&2	Shore ends repalaced	Shore ends repalced		CS Amber		
1807	22/01/1894	Bombay No 1	Fault	Fault to be repaired by CS Amber		CS Amber		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1808	22/01/1894	Suez - Suakim No 1	Interrupted	Interrupted. CS Amber to repair		CS Amber		
1809	22/01/1894	Black Sea cable	Interrupted & Repaired	Interrupted. Repaired by Superintendent at Odessa				
1810	22/01/1894	Maranham - Ceara	Repaired 22nd inst				Repaired 22nd inst	
1811	25/01/1894	Lisbon - Vigo	Interrupted 18th inst. Repaired 20th inst	Interrupted 18th inst; repaired 20th inst		CS Mirror		
1812	25/01/1894	Suez - Aden No 3	To be repaired	To be repaired by CS Amber		CS Amber		
1813	26/01/1894	Bonny - Camaroons	Repaired 18th inst				Repaired 18th inst	
1814	26/01/1894	Foochow - Shanghai	Repaired 19th inst				Repaired 19th inst	
1815	26/01/1894	Penang - Medan	Repaired 24th inst				Repaired 24th inst	
1816	02/02/1894	Constantinople - Odessa	Interrupted 31st ulto				Interrupted 31st ulto	
1817	02/02/1894	Saigon - Thuan-Am	Interrupted 1st inst				Interrupted 1st inst	
1818	08/02/1894	Suez - Aden No 3	Repaired 30th ulto	Repaired 30th ulto		CS Amber		
1819	08/02/1894	Suez - Suakim No 1	Repaired 1st inst	Repaired 1st inst		CS Amber		
1820	08/02/1894	Perim - Suakim	To be repaired	To be repaired by CS Amber		CS Amber		
1821	08/02/1894	Bombay	Fault to be repaired.	Fault to be repaired by CS Amber		CS Amber		
1822	08/02/1894	Black Sea cable	Interrupted 5nm from Odessa	Interrupted 5nm from Odessa. To be repaired by local steamer				
1823	09/02/1894	St Thome - Loanda	Interrupted 5th inst				Interrupted 5th inst	
1824	16/02/1894	Cayenne - Vizeu	Repaired 14th inst				Repaired 14th inst	
1825	16/02/1894	Saigon - Thuan-Am	Repaired 14th inst				Repaired 14th inst	
1826	16/02/1894	Maranham - Ceara	Interrupted 12th inst				Interrupted 12th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1827	18/02/1894	Greetsiel - Valentia	Repairs		NMM TCM/8/55 CABLE ENGINEERS' LOGBOOKS. Greetsiel - Valentia, BRITANNIA, 2 - 18 February 1894	CS Britannia		
1828	23/02/1894	Constantinople - Odessa	Repaired 17th inst				Repaired 17th inst	
1829	03/03/1894	Malta - Sicily no 2	Repaired	Repaired by Malta Supt				
1830	03/03/1894	Bona - Malta No 2	Repaired	Repaired by Malta Supt				
1831	03/03/1894	Bona - Malta No 2	Fault150nm from Bona. CS Amber to repair	Fault150nm from Bona. CS Amber to repair		CS Amber		
1832	03/03/1894	Bombay No 1	Interrupted	Interrupted 130 nm from Bombay				
1833	09/03/1894	Malta - Pozzala	Interrupted 21st Feb. Repaired 5th inst				Interrupted 21st Feb. Repaired 5th inst	
1834	09/03/1894	St Thome - Loanda	Repaired 5th inst				Repaired 5th inst	
1835	19/03/1894	Hoyer - Arendal	Repairs		NMM TCM/8/56 CABLE ENGINEERS' LOGBOOKS. Hoyer - Arendal, BRITANNIA, 20 February - 19 March 1894	CS Britannia		
1836	30/03/1894	Fao - Bushire	Interrupted 20th inst				Interrupted 20th inst	
1837	30/03/1894	Bonny - Camaroons	Interrupted 21st inst				Interrupted 21st inst	
1838	30/03/1894	Brest - St Pierre (PQ Co)	Interrupted 29th inst				Interrupted 29th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1839	05/04/1894	Bona - Malta No 2	Damaged by CS Electra when grappling fro No 1	Damaged by CS Electra when grappling fro No 1		CS Electra		
1840	05/04/1894	Bombay No 1	Repaired 11th ulto	Repaired 11th ulto		CS Amber		
1841	05/04/1894	Bombay No 1	Another fault	Another fault under repair by CS Amber		CS Amber		
1842	19/04/1894	Tangier - Tenerife (Spanish Govt)	Fault	Fault to be repaired by CS Mirror		CS Mirror		
1843	03/05/1894	Levant cable	Repaired	Repaired		CS Electra		
1844	03/05/1894	Corfu - Trieste	Fault	Fault to be repaired by CS Electra		CS Electra		
1845	03/05/1894	Lisbon - Gibraltar	Fault 22nd April, repaired 30th April	Fault 22nd April, repaired 30th April		CS Electra		
1846	03/05/1894	St Vincent - Gibraltar	2 Faults	2 Faults				
1847	03/05/1894	Aden - Bombay No 1	Under repair	Under repair but weather bad		CS Amber		
1848	03/05/1894	Bilbao cable of the Spanish Direct Teleg Co	Shore ends repaired 1st May	Shore ends repaired 1st May		CS Duplex		
1849	25/05/1894	Accra - Lagos	Interrupted 21st inst				Interrupted 21st inst	
1850	31/05 1894	Gibraltar - Lisbon	3rd fault repaired 28th inst	3rd fault repaired 28th inst		CS Mirror		
1851	31/05 1894	Corfu - Trieste	Repaired 8th inst	Repaired 8th inst		CS Electra		
1852	31/05 1894	Zante - Cania	Repaired 30th inst	Repaired 30th inat		CS Electra		
1853	31/05 1894	Bilbao cable of the Spanish Direct Teleg Co	New shore ends	New shore ends		CS Duplex		
1854	31/05 1894	Aden - Bombay N o 1	Still bad weather	Still bad weather		CS Amber		
1855	31/05 1894	Corfu - Trieste	Repaired 8th inst	Repaired 8th inst		CS Electra		
1856	31/05 1894	Zante - Canea	Repaired 30th inst	Repaired 30th inat		CS Electra		
1857	01/06.1894	Cayenne - Pernambuco	Repaired 29th ulto				Repaired 29th ulto	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1858	08/06/1894	Lagos - Accra	Repaired 6th inst				Repaired 6th inst	
1859	14/06/1894	Tangier - Terefa (Spanish Govt)	Interrupted	Interrupted. CS Electra to repair		CS Electra		
1860	14/06/1894	Aden - Bombay No 1	Still unable to repair due to Monsoon	Still unable to repair due to Monsoon		CS Amber		
1861	15/06/1894	Accra- Kotonou	Interrupted 14th inst				Interrupted 14th inst	
1862	22/06/1894	Brest - St Pierre (PQ Co)	Repaired 13th inst				Repaired 13th inst	
1863	22/06/1894	Tangier - Terefa (Spanish Govt)	Repaired 24th inst				Repaired 24th inst	
1864	28/06/1894	Tangier - Terefa (Spanish Govt)	Repaired 23rd inst	Repaired 23rd inst		CS Electra		
1865	28/06/1894	Vigo - Camhina	Interrupted and repaired by Superintendent	Interrupted and repaired by Superintendent				
1866	06/07/1894	Accra - Sierra Leone	Interupted 2nd inst				Interrupted 2nd inst	
1867	12/07/1894	Dardanelles cable	Interrupted by Earthquake	Interrupted by earthquake. CS Electra to repair		CS Electra		
1868	12/07/1894	Perim - Suakin No 1	Interrupted 3rd inst	Interrupted 3rd inst. CS Amber to repair		CS Amber		
1869	20/07/1894	Bissau - Balloma	Interrupted 14th inst				Interrupted 12th inst	
1870	26/07/1894	Dardanelles cable	Repaired 12th inst	Repaired 12th inst		CS Electra		
1871	26/07/1894	Bona - Malta No 1	Repaired 23rd inst	Repaired 23rd inst		CS Electra		
1872	26/07/1894	Perim - Suakim No 1	Repaired 20th inst	Repaired 20th inst		CS Amber		
1873	27/07/1894	Sierra Leone - Accra	Repaired 25th inst				Repaired 25th inst	
1874	27/07/1894	Para - Maranham	Interrupted 23rd inst				Interrupted 23rd inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1875	10/08/1894	Salcombe - Brignogan	Repairs		NMM TCM/8/57 CABLE ENGINEERS' LOGBOOKS. Salcombe - Brignogan, COLUMBIA, BRITANNIA, 12 July - 10 August 1894	CS Columbia; CS Britannia		
1876	10/08/1894	Para - Maranham	Repaired 3rd inst				Repaired 3rd inst	
1877	07/09/1894	Zanzibar - Mombassa	Interrupted 4th inst				Interrupted 4th inst	
1878	20/09/1894	Porthcurno - Vigo	Interrupted 25th ulto. Repaired 6th inst.	Interrupted 25th ulto. Repaired 6th inst.		CS John Pender		
1879	20/09/1894	Bona - Malta No2	Repaired 17th inst	Repaired 17th inst		CS Electra		
1880	20/09/1894	Suez - Suakin No 1	Repaired 16th ulto	Repaired 16th ulto		CS Amber		
1881	20/09/1894	Tripoli - Malta	Repaired 9th inst	Repaired 9th inst		CS Amber		
1882	20/09/1894	Perim - Suakin No 1	Repaired 2nd inst	Repaired 2nd inst		CS Chiltern		
1883	20/09/1894	Suakin - Aden	Repaired 11th inst	Repaired 11th inst		CS Chiltern		
1884	20/09/1894	Obock cable	Repaired 12th inst	Repaired 12th inst		CS Chiltern		
1885	21/09/1894	Benguela - Mossamedes	Interrupted 16th inst				Interrupted 16th inst	
1886	28/09/1894	Benguela - Mossamedes	Repaired 26th inst				Repaired 26th inst	
1887	28/09/1894	Macao - Hong Kong	Interrupted 25th inst				Interrupted 25th inst	
1888	04/10/1894	Dardanelles cable	To be repaired	To be repaired by CS Electra		CS Electra		
1889	04/10/1894	Suakin - Aden No 2	Repaired 20th ulto	Repaired 20th ulto		CS Chiltern		
1890	04/10/1894	Suakin - Perim	Repaired 3rd inst	Repaired 3rd Inst		CS Chiltern		
1891	18/10/1894	Vigo - Lisbon	To be repaired	To be repaired by CS John Pender		CS John Pender		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1892	18/10/1894	Porthcurno - Lisbon	Interrupted 180nm from Porthcurno	Interrupted 180nm from Porthcurno. To be repaired by CS John Pender		CS John Pender		
1893	18/10/1894	Dardanelles cable	Repaired 11th inst	Repaired 11th inst		CS Electra		
1894	18/10/1894	Aden - Bombay No 1	Repairs to be completed	Repairs to be completed		CS Chiltern		
1895	26/10/1894	Macao - Hong Kong	Repaired 19th inst				Repaired 19th inst	
1896	01/11/1894	St Vincent - Pernambuco (BSTC)	Interrupted 27th ulto	Interrupted 27th ulto. CS Mirror to repair		CS Mirror		
1897	01/11/1894	St Vincent - St Jago (Africa Direct Teleg Co)	To be repaired	To be repaired by CS Mirror		CS Mirror		
1898	01/11/1894	Vigo - Lisbon	Repaired 30th ulto	Repaired 30th ulto		CS John Pender		
1899	01/11/1894	Porthcurno - Lisbon	To be repaired	To be repaired by CS John Pender		CS John Pender		
1900	01/11/1894	Vigo - Lisbon	Faulty	Fault to be repaired by CS John Pender		CS John Pender		
1901	01/11/1894	Aden - Bombay No 1	Under repair	Under repair		CS Chiltern		
1902	15/11/1894	St Vincent - St Jago (Africa Direct Teleg Co)	Under repair	Under repair		CS Mirror		
1903	15/11/1894	St Vincent - Pernambuco	To be repaired	To be repaired by CS Mirror		CS Mirror		
1904	15/11/1894	Vigo - Carcavellos	Interrupted 12th inst	Interrupted 12th inst.				
1905	15/11/1894	Vigo - Carmenha	Interrupted 13th inst	Interrupted 13th inst				
1906	15/11/1894	Aden - Bombay No 1	Under repair	Under repair		CS Chiltern		
1907	16/11/1894	Para - Maranham	Interrupted 10th inst				Interrupted 10th inst	
1908	16/11/1894	Sierra Leone - Accra	Interrupted 13th inst				Interrupted 13th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1909	23/11/1894	Para - Maranham	Repaired 19th inst				Repaired 19th inst	
1910	23/11/1894	Sierra Leone - Accra	Repaired 18th inst				Repaired 18th inst	
1911	23/11/1894	Hong Kong - Amoy	Interrupted 16th inst				Interrupted 16th inst	
1912	23/11/1894	St Vincent - Thiago	Faulty 19th inst				Faulty 19th inst	
1913	29/11/1984	St Vincent shore ends	Fault repaired 18th instant	Fault repaired 18th inst		CS Mirror		
1914	29/11/1984	St Vincent - Pernambuco	Under repair	Under repair by CS Mirror		CS Mirror		
1915	29/11/1984	Aden - Bombay No 1	Under repair	Under repair		CS Chiltern		
1916	29/11/1984	Suez - Suakin No 2	Interrupted 16th inst and repaired 20th inst by Mr Tuck, the Supt at Suez	Interrupted 16th inst and repaired 20th inst				
1917	29/11/1984	Porthcurno - Lisbon	Under repair and further interruption	Under repair and further interruption. CS John Pender		CS John Pender		
1918	30/11/1894	Zanzibar - Mombassa	Repaired 28th inst				Repaired 28th inst	
1919	30/11/1894	St Vincent - St Thome	Repaired 23rd inst				Repaired 23rd inst	
1920	30/11/1894	Hong Kong - Amoy	Repaired 28th inst				Repaired 28th inst	
1921	30/11/1894	Bilbao - Falmouth	Interrupted 15th inst				Interrupted 15th inst	
1922	30/11/1894	Ceara - Maranham	Interrupted 25th inst				Interrupted 25th inst	
1923	30/11/1894	Latukia - Cyprus	Interrupted 27th inst				Interrupted 27th inst	
1924	07/12/1894	Bilbao - Falmouth	Repaired 5th inst				Repaired 5th inst	
1925	13/12/1894	St Vincent - Pernambuco	Repaired 5th inst	Repaired 5th inst		CS Mirror		
1926	13/12/1894	Aden - Bombay No 1	Repaired 10th inst	Repaired 10th inst		CS Chiltern		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1927	13/12/1894	Falmouth - Bilbao No 1	Repaired 2nd inst	Repaired 2nd inst		CS John Pender		
1928	13/12/1894	Porthcurno - Lisbon	Another fault repaired 6th inst	Another fault repaired 6th inst				
1929	13/12/1894	Vigo - Lisbon	2 faults under repair	2 faults under repair		CS John Pender		
1930	13/12/1894	Euboea - Andros	Repaired 7th inst	Repaired 7th inst				
1931	13/12/1894	Zea - Loruim	Repaired 11th inst	Repaired 11th inst				
1932	14/12/1894	Ceara - Maranham	Repaired 9th inst				Repaired 9th inst	
1933	14/12/1894	Amoy - Gutzlaff	Interrupted 10th ulto				Interrupted 10th ulto	
1934	14/12/1894	Lorenco Marques - Durban	Interrupted 10th inst				Interrupted 10th inst	
1935	28/12/1894	Amoy - Gutzlaff	Repaired 20th inst				Repaired 20th inst	
1936	28/12/1894	Lorenco Marques - Durban	Repaired 21st inst				Repaired 21st inst	
1937	28/12/1894	Aden - Zanzibar	Interrupted 21st inst				Interrupted 21st inst	
1938	28/12/1894	Cadiz - Teneriffe	Interrupted 26th inst				Interrupted 26th inst	
1939	04/01/1895	Hong Kong - Macao	Interrupted 31st ulto				Interrupted 31st ulto	
1940	10/01/1895	Alexandria - Port Said	Repaired 21st ulto	Repaired 21st ulto		CS Electra		
1941	10/01/1895	Messena Straits cables	To be repaired	To be repaired by CS Electra		CS Electra		
1942	10/01/1895	Aden - Bombay No 2	Fault repaired 30th ulto	Fault repaired 30th ulto		CS Chiltern		
1943	10/01/1895	Aden - Bombay No 1	Fault under repair	Fault under repair by CS Chiltern		CS Chiltern		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1944	10/01/1895	Vigo - Lisbon	Interruptions x3 by Portugese trawlers. Proceedings to be taken against owners of the trawlers throughthe Portugese Govt	Interruptions x3 by Portugese trawlers. Proceedings to be taken against owners of the trawlers throughthe Portugese Govt. Repaired by CS John Pender		CS John Pender		
1945	10/01/1895	Vigo - Caminha	Under repair	Under repair but bad weather		CS John Pender		
1946	11/01/1895	Aden - Zanzibar	Repaired 10th inst				Repaired 10th inst	
1947	18/01/1895	Pernambuco - Ceara	Interrupted 12th inst				Interrupted 12th inst	
1948	18/01/1895	Gibraltar - Tangier	Interrupted 14th inst				Interrupted 14th inst	
1949	22/01/1895	Greetsiel-Valentia	Repairs		NMM TCM/8/58 CABLE ENGINEERS' LOGBOOKS. Greetsiel-Valentia, BRITANNIA, 3-22 January 1895	CS Britannia		
1950	24/01/1895	Messena Strait cables	Repaired 14th inst	Repaired 14th inst		CS Electra		
1951	24/01/1895	Bona - Malta No 1	Under repair	Under repair		CS Electra		
1952	24/01/1895	Aden - Bombay No 1	Faulty joints repaired 15th inst	Faulty joints repaired 15th inst		CS Chiltern		
1953	24/01/1895	Aden - Bombay No 1	Interrupted by stern trawler "Premier of London" 22nd inst	Interrupted by stern trawler "Premier of London" 22nd inst		CS Chiltern		
1954	24/01/1895	Porthcurno - Lisbon	Repaired 22nd inst	Repaired 22nd inst (delayed by bad weather)		CS John Pender		
1955	25/01/1895	St Thome - Loanda	Interrupted 22nd inst				Interrupted 22nd inst	
1956	01/02/1895	Gibraltar - Tangier	Repaired 30th ulto				Repaired 30th ulto	
1957	07/02/1895	Vigo - Lisbon	Repaired 24th ulto	Repaired 24th ulto		CS John Pender		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1958	07/02/1895	Tangier cable	Repaired 29th ulto	Repaired 29th ulto		CS John Pender		
1959	07/02/1895	Gibraltar - Carcavellos	Interrupted 7th inst	Interrupted 7th inst				
1960	07/02/1895	Bona - Malta No 1	Faults removed 6th inst	Faults removed 6th inst		CS Electra		
1961	08/02/1895	Gibraltar - Cadiz	Repaired 4th inst				Repaired 4th inst	
1962	08/02/1895	Pernambuco - Ceara	Repaired 3rd inst				Repaired 3rd inst	
1963	15/02/1895	St Thome - Loanda	Repaired 9th inst				Repaired 9th inst	
1964	15/02/1895	Gibraltar - Cadiz	Repaired 12th inst				Repaired 12th inst	
1965	15/02/1895	Cadiz - Teneriffe	Repaired 13th inst				Repaired 13th inst	
1966	21/02/1895	Gibraltar - Cadiz	2 Faults repaired 9th & 14th inst	2 Faults repaired 9th & 14th inst		CS John Pender		
1967	21/02/1895	Lisbon - Gibraltar	Under repair	Under repair		CS John Pender		
1968	21/02/1895	Perim - Suakin	Repaired 21st inst	Repaired 21st inst		CS Chiltern		
1969	21/02/1895	Kilia - Odessa	Faulty	Faulty but weather very bad				
1970	01/03/1895	Constantinople - Odessa	Interrupted 25th ulto				Interrupted 25th ulto	
1971	07/03/1895	Lisbon - Gibraltar	Repaired 2nd inst	Repaired 2nd inst		CS John Pender		
1972	07/03/1895	Vigo - Carminha	Under repair	Under repair by CS John Pender		CS John Pender		
1973	07/03/1895	Perim - Suakin	Repaired 26 ulto. Now repairing 2nd interruption	Repaired 26 ulto. Now repairing 2nd interruption		CS Chiltern		
1974	15/03/1895	Constantinople - Odessa	Repaired 12th inst				Repaired 12th inst	
1975	15/03/1895	Alexandria - Port Said	Interrupted 2nd inst; repaired 13th inst				Interrupted 2nd inst; repaired 13th inst	
1976	15/03/1895	St Louis - Noronha	Interrupted 12th inst				Interrupted 12th inst	
1977	21/03/1895	Vigo - Carminha	Repaired 16th inst	Repaired 16th inst		CS John Pender		
1978	21/03/1895	Alexandria - Port Said	Repaired 13th inst	Repaired 13th inst		CS Electra		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1979	21/03/1895	Marsailles - Bona	Interrupted	Interrupted. CS Electra to repair		CS Electra		
1980	21/03/1895	Perim - Suakin	Repaired 11th inst	Repaired 11th inst		CS Chiltern		
1981	29/03/1895	Martinique - Paramaribo	Repaired 21st inst				Repaired 21st inst	
1982	03/04/1895	Salcombe-Brignogan	Repairs		NMM TCM/8/59 CABLE ENGINEERS' LOGBOOKS. Salcombe-Brignogan, BRITANNIA, 5 March - 3 April 1895	CS Britannia		
1983	04/04/1895	Porthcurno - Lisbon Direct	To be repaired	To be repaired by CS John Pender		CS John Pender		
1984	04/04/1895	Marsailles - Bona	Repaired 25th ulto	Repaired 25th ulto		CS Electra		
1985	04/04/1895	Malta - Bona	To be repaired	To be repaired by CS Electra		CS Electra		
1986	04/04/1895	Suez - Suakin No 1	Fault repaired 23rd ulto. Break repaired 28th ulto	Fault repaired 23rd ulto. Break repaired 28th ulto		CS Chiltern		
1987	12/04/1895	Cadiz - Teneriffe	Repaired 8th inst				Repaired 8th inst	
1988	12/04/1895	St Vincent - San Luiago	Interrupted 5th inst				Interrupted 5th inst	
1989	19/04/1895	St Vincent - San Thiago	Interrupted 5th inst				Interrupted 5th inst	
1990	19/04/1895	Constantinople - Dardanelles	Interruupted 9th inst				Interrupted 9th inst	
1991	26/04/1895	Constantinople - Dardanelles	Repaired 17th inst				Repaired 17th inst	
1992	28/04/1895	Porthcurno - Lisbon Direct	Repaired 19th ulto	Repaired 19th ulto		CS John Pender		
1993	28/04/1895	Gibraltar - Tangier	To be repaired	To be repaired by CS John Pender		CS John Pender		
1994	28/04/1895	Kartal - Nagara	2 Faults repaired 16th and 23rd ulto	2 Faults repaired 16th and 23rd ulto		CS Electra		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
1995	28/04/1895	Malta - Alexandria No 2	Repaired 30th ulto	Repaired 30th ulto		CS Electra		
1996	28/04/1895	Patras - Corinth	Repaired 28th inst	Repaired 28th inst		CS Electra		
1997	28/04/1895	Suez - Suakin	Repaired 7th inst	Repaired 7th inst		CS Chiltern		
1998	28/04/1895	Aden - Suakin No 2	Repaired 20th inst	Repaired 20th inst		CS Chiltern		
1999	03/05/1895	St Louis - Noronha	Interrupted 12th March, Repaired 25th April				Interrupted 12th March, Repaired 25th April	
2000	03/05/1895	St Vincent - San Thiago	Interrupted 5th April; repaired 25th April				Interrupted 5th April; repaired 25th April	
2001	03/05/1895	Gibraltar - Tangiers	Interrupted 24th ulto				Interrupted 24th ulto	
2002	16/05/1895	Gibraltar - Tangier	Repaired 15th inst	Repaired 15th inst		CS John Pender		
2003	16/05/1895	Patras - Corinth	Repaired 4th inst	Repaired 4th inst		CS Electra		
2004	16/05/1895	Bona - Malta No 2	Faulty	Faulty				
2005	24/05/1895	Latakia - Cyprus	Repaired 22nd inst				Repaired 22nd inst	
2006	24/05/1895	Gibraltar - Tangier	Repaired 16th inst				Repaired 16th inst	
2007	30/05/1895	Gibraltar - Lisbon	Repaired 22nd inst	Repaired 22nd inst		CS John Pender		
2008	30/05/1895	Bona - Malta No 2	Repaired 21st inst	Repaired 21st inst		CS Electra		
2009	30/05/1895	Perim - Suakin	Repaired 28th inst	Repaired 28th inst		CS Chiltern		
2010	07/06/1895	Chorillos - Iquique	Interrupted 4th inst				Interrupted 4th inst	
2011	07/06/1895	Mollendo - Arica	Interrupted 4th inst				Interrupted 4th inst	
2012	13/06/1895	Porthcurno - Lisbon Direct	Under repair - Bad weather	Under repair - Bad weather				
2013	14/06/1895	Chorillos - Iquique	Repaired 5th inst				Repaired 5th inst	
2014	14/06/1895	Laurenco Marques - Mozambique	Interrupted 9th inst				Interrupted 9th inst	
2015	21/06/1895	Mollendo - Arica	Repaired 15th inst				Repaired 15th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2016	21/06/1895	Laurenco Marques - Mozambique	Repaired 17th inst				Repaired 17th inst	
2017	21/06/1895	Arica - Iquique	Repaired 17th inst				Repaired 17th inst	
2018	27/06/1895	Vigo - Carcavellos	Repaired 22nd inst	Repaired 22nd inst		CS John Pender		
2019	27/06/1895	Marsailles - Bona No 1	Shore ends renewed 18th inst	Shore ends renewed 18th inst		CS John Pender		
2020	11/07/1895	Porthcurno - Lisbon Direct	Repairs completed 4th inst	Repairs completed 4th inst		CS John Pender		
2021	11/07/1895	Perim - Suakin	2 faults repaired 3rd inst	2 faults repaired 3rd inst		CS Chiltern		
2022	25/07/1895	Perim - Suakin (off Zebryvi Islands)	Repaired 20th inst	Repaired 20th inst		CS Chiltern		
2023	25/07/1895	Suez - Suakin	2 breaks & 1 fault to be repaired	2 breaks & 1 fault to be repaired by CS Chiltern		CS Chiltern		
2024	16/08/1895	Accra - Kolonou	Interrupted 9th inst				Interrupted 9th inst	
2025	16/08/1895	Accra - Lagos	Interrupted 12th inst				Interrupted 12th inst	
2026	23/08/1895	Accra - Kolonou	Repaired 17th inst				Repaired 17th inst	
2027	30/08/1895	Former "PQ" Atlantic	Repaired 28th inst				Repaired 28th inst	
2028	06/09/1895	Accra - Lagos	Repaired 23rd ulto				Repaired 23rd ulto	
2029	13/09/1895	Aden - Zanzibar	Interrupted 2nd inst				Interrupted 2nd inst	
2030	19/09/1895	Zante - Canea	Under repair	Under repair by CS Amber		CS Amber		
2031	19/09/1895	Malta shore ends	Being overhauled 7th ulto	Being overhauled by CS Mirror 7th ulto		CS Mirror		
2032	19/09/1895	Gibraltar shore ends	Moved 7th ulto	Moved 7th ulto		CS Mirror		
2033	19/09/1895	St Vincent - Pernambuco	Interrupted	Interrupted. To be repaired by CS Mirror		CS Mirror		
2034	19/09/1895	Suez - Suakin No 1	Repaired 9th ulto	Repaired 9th ulto		CS Chiltern		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2035	27/09/1895	Cadiz - Teneriffe	Interrupted 25th inst				Interrupted 25th inst	
2036	03/10/1895	Lisbon - Gibraltar	Repaired 26th inst	Repaired 26th inst		CS Mirror		
2037	03/10/1895	Lisbon - Gibraltar	Another repair near Cadiz 28th inst	Another repair near Cadiz 28th inst		CS Mirror		
2038	04/10/1895	Aden - Zanzibar	Repaired 1st inst				Repaired 21st inst	
2039	10/10/1895	Lisbon - Gibraltar	2 faults repaired 26th & 28th ulto	2 faults repaired 26th & 28th ulto		CS Mirror		
2040	10/10/1895	Zante - Canea	Repaired 22nd ulto	Repaired 22nd ulto		CS Amber		
2041	10/10/1895	Aden - Bombay No 1	Fault 200nm from Aden	Fault 200nm miles from Aden. CS Chiltern to repair		CS Chiltern		
2042	17/10/1895	Perim - Suakin	Faulty	Faulty. CS Chiltern to repair		CS Chiltern		
2043	18/10/1895	Maranharn - Para	Interrupted 10th inst				Interrupted 10th inst	
2044	31/10/1895	Lipani - Salina	Repaired 31st inst	Repaired 31st inst		CS Mirror		
2045	31/10/1895	Aden - Bombay No 1	Repaired 17th inst	Repaired 17th inst		CS Chiltern		
2046	01/11/1895	Bonny - Camaroons	Interrupted 30th ulto				Interrupted 30th ulto	
2047	08/11/1895	Maranharn - Para	Repaired 4th inst				Repaired 4th inst	
2048	08/11/1895	Bonny - Laurenco Marques	Repaired 5th inst				Repaired 5th inst	
2049	14/11/1895	Porthcurno - Lisbon No 1	Repaired 9th inst	Repaired 9th inst despite bad weather		CS Mirror		
2050	14/11/1895	Lisbon - Vigo	Fault	Fault. CS Mirror to repair		CS Mirror		
2051	14/11/1895	Perim - Suakin No 1	Fault	Fault. To be repaired by CS Chiltern		CS Chiltern		
2052	22/11/1895	Perim - Assab	Interrupted 19th inst				Interrupted 19th inst	
2053	28/11/1895	Lisbon - Vigo	Repaired 23rd inst	Repaired 23rd inst		CS Mirror		
2054	28/11/1895	Caminha - Cable	Fault repaired 25th inst	Fault repaired 25th inst		CS Mirror		
2055	28/11/1895	Lisbon - Madiera (BSTC)	Fault	Fault. To be repaired by CS Mirror		CS Mirror		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2056	28/11/1895	Terifa - Tangier (Spanish Govt)	Fault put out to tender	Fault put out to tender				
2057	28/11/1895	Perim - Suakin	Repaired 18th inst	Repaired 18th inst		CS Chiltern		
2058	28/11/1895	Perim - Assab Massawah (Italian Govt)	Repaired 25th inst	Repaired 25th inst		CS Chiltern		
2059	28/11/1895	Aden - Suakin No 2	Repaired 27th inst	Repaired 27th inst		CS Chiltern		
2060	29/11/1895	Cadiz - Tenariffe	Repaired 22nd inst				Repaired 22nd inst	
2061	29/11/1895	Perim - Assab	Repaired 26th inst				Repaired 26th inst	
2062	12/12/1895	Lisbon - Vigo	Repaired 8th inst	Repaired 8th inst		CS Mirror		
2063	12/12/1895	Carcavellos - Gibraltar	2 faults repaired 11inst	2 faults repaired 11inst		CS Mirror		
2064	12/12/1895	Lisbon - Madiera (BSTC)	Repair of fault postponed by BSTC	Repair of fault postponed by BSTC				
2065	12/12/1895	Suez - Suakin No 1	Repaired 6th inst	Repaired 6th inst				
2066	20/12/1895	Puerto Plata - Martinique	Interrupted 19th inst				Interrupted 19th inst	
2067	27/12/1895	Maranharn - Para	Repaired 21st inst				Repaired 21st inst	
2068	27/12/1895	Aden - Zanzibar	Interrupted 24th inst				Interrupted 24th inst	
2069	31/12/1895	Flodrig - Hoyer	Repairs		NMM TCM/8/60 CABLE ENGINEERS' LOGBOOKS. Flodrig - Hoyer, BRITANNIA, 18 - 31 December 1895	CS Britannia		

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1		Cable	Event	ETC Board Minute Books	Engineer's Reports (and other sources)	Ship	The Electrician	The Times
2070	31/12/1895	Sylt - Arendal	Repairs		NMM TCM/9/38 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Sylt - Arendal, BRITANNIA, 18 - 31 December 1895	CS Britannia		
2071	09/01/1896	Direct US Cable	To be repaired	To be repaired under charter by CS Amber		CS Amber		
2072	09/01/1896	Lisbon - Gibraltar	Break repaired 31st ulto; 2nd break repaired 6th inst	Break repaired 31st ulto; 2nd break repaired 6th inst		CS Mirror		
2073	09/01/1896	Aden - Zanzibar (E&S African Teleg Co)	Repaired 4th inst	Repaired 4th inst		CS Chiltern		
2074	10/01/1896	Aden - Zanzibar	Repaired 4th inst				Repaired 4th inst	
2075	10/01/1896	Perin - Obock	Interrupted 2nd inst				Interrupted 2nd inst	
2076	17/01/1896	Sierra Leone - Accra	Interrupted 13th inst; Repaired 15th inst				Interrupted 13th inst; Repaired 15th inst	
2077	17/01/1896	Bathurst - Sierra Leone	Interrupted 14th inst				Interrupted 14th inst	
2078	17/01/1896	Konakry - Sierra Leone	Interrupted 14th inst				Interrupted 14th inst	
2079	17/01/1896	St Thome - Loanda	Interrupted 15th inst				Interrupted 15th inst	
2080	23/01/1896	Direct US Cable	Repaired 11th inst	Repaired 11th inst		CS Amber		
2081	23/01/1896	Lisbon - Gibraltar	Repaired 14th inst	Repaired 14th inst		CS Mirror		
2082	23/01/1896	Tangier - Tarifa (Spanish Govt)	To be repaired	To be repaired by CS Mirror		CS Mirror		
2083	23/01/1896	Aden - Suakin No 2	Fault repaired 11th inst	Fault repaired 11th inst		CS Chiltern		
2084	23/01/1896	Perim - Obock (French Govt)	To be repaired	To be repaired by CS Chiltern		CS Chiltern		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2085	24/01/1896	Bathurst - Sierra Leone	Repaired 14th inst				Repaired 14th inst	
2086	24/01/1896	Konakry - Sierra Leone	Repaired 14th inst				Repaired 14th inst	
2087	24/01/1896	Odessa - Constantinopal	Interrupted 17th inst				Interrupted 17th inst	
2088	24/01/1896	Durban - Laurenco Marques	Interrupted 19th Inst. Repaired 22nd inst				Interrupted 19th Inst. Repaired 22nd inst	
2089	31/01/1896	St Thome - Loanda	Repaired 26th inst				Repaired 26th inst	
2090	31/01/1896	Aden - Zanzibar	Interrupted 26th inst				Interrupted 26th inst	
2091	06/02/1896	Lisbon - Gibraltar	To be repaired	To be repaired by CS John Pender		CS John Pender		
2092	06/02/1896	Perim - Obock	Repaired 26th ulto	Repaired 26th ulto		CS Chiltern		
2093	06/02/1896	Aden - Zanzibar	Repaired 5th inst	Repaired 5th inst		CS Chiltern		
2094	06/02/1896	Kilia - Odessa	Being repaied by local staff	Being repaired by local staff. Ice blocking harbour				
2095	07/02/1896	Aden - Zanzibar	Repaired 5th inst				Repaired 5th inst	
2096	20/02/1896	Lisbon - Gibraltar	Repaired 9th inst	Repaired 9th inst		CS John Pender		
2097	20/02/1896	Tangier - Terifa (Spanish Govt)	Repaired 10th inst	Repaired 10th inst		CS Mirror		
2098	20/02/1896	Suakin - Aden No 2	To be repaired	To be repaired by CS Chiltern		CS Chiltern		
2099	20/02/1896	Suakin - Perim No 1	To be repaired	To be repaired		CS Chiltern		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2100	23/02/1896	Greetsiel - Valentia (1882)	Repairs		NMM TCM/8/61 CABLE ENGINEERS' LOGBOOKS. Greetsiel - Valentia, BRITANNIA, 24 January - 23 February 1896. TCM/9/39 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Greetsiel - Valentia (1882), BRITANNIA, 24 January - 23 February 1896	CS Britannia		
2101	28/02/1896	Perim - Obock	Repaired 27th ulto				Repaired 27th ulto	
2102	28/02/1896	Odessa - Constantinopal	Repaired 17th inst				Repaired 17th inst	
2103	05/03/1896	Porthcurno - Vigo	To be repaired	To be repaired by CS Mirror		CS Mirror		
2104	05/03/1896	Suakin - Aden No 2	Repaired24th ulto	Repaired 24th ulto		CS Chiltern		
2105	05/03/1896	Aden - Bombay No 2	To be repaired	To be repaired by CS Chiltern		CS Chiltern		
2106	05/03/1896	Suakin - Aden No 1	Repaired	Repaired		CS Chiltern		
2107	13/03/1896	Zanzibar - Mombassa	Interrupted 9th inst				Interrupted 9th inst	
2108	20/03/1896	Aden - Zanzibar	Interrupted 16th inst				Interrupted 16th inst	
2109	19/03/1896	Porthcurno - Vigo	Repaired 12th inst	Repaired 12th inst		CS Mirror		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2110	19/03/1896	Porthcurno - Gibraltar No 2	Repaired 13th inst	Repaired 13th inst		CS Mirror		
2111	19/03/1896	Aden - Bombay No 2	Repaired 14th inst	Repaired 14th inst		CS Chiltern		
2112	19/03/1896	Aden - Bombay No 1	Fault to be left until after the Monsoom	Fault to be left until after the Monsoom				
2113	19/03/1896	Aden - Zanzibar	Interrupted 16th inst	Interrupted 16th inst to be repaired by CS Gt Northern		CS Gt Northern		
2114	03/04/1896	Aden - Zanzibar	Repaired 22nd ulto				Repaired 22nd ulto	
2115	03/04/1896	Fantarem - Manous	Interrupted 27th ulto				Interrupted 27th ulto	
2116	05/04 1896	Valentia - Greetsiel	Repairs		NMM TCM/8/62 CABLE ENGINEERS' LOGBOOKS. Valentia - Greetsiel, BRITANNIA, 1 - 5 April, 1896	CS Britannia		
2117	16/04/1896	Lipari - Milazzo (Italian Govt)	To be repaired	To be repaired by CS Mirror		CS Mirror		
2118	16/04/1896	Suez - Suakin No 1	Repaired	Repaired		CS Chiltern		
2119	16/04/1896	Perim - Assab Massawah (Italian Govt)	To be repaired	To be repaired		CS Chiltern		
2120	16/04/1896	Perim - Suakin No 2	Faulty	Faulty				
2121	16/04/1896	Suez - Aden No 3	Interrupted 22nd ulto by Russian Man-o'-War; repaired by Aden Superintendent	Interrupted 22nd ulto by Russian Man-o'-War; repaired by Aden Superintendent				
2122	10/04/1896	Fantarem - Manous	Repaired 28th ulto				Repaired 28th ulto	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2123	10/04/1896	Assab - Massowah	Interrupted 29th ulto				Interrupted 29th ulto	
2124	24/04/1896	Assab - Massowah	Repaired 18th inst				Repaired 18th inst	
2125	30/04/1896	Lipari - Milazzo (Italian Govt)	Repaired 23rd inst	Repaired 23rd inst		CS Mirror		
2126	30/04/1896	Messena Straits cables	Repaired 26th inst	Repaired 26th inst		CS Mirror		
2127	30/04/1896	Bona - Marsailles	Fault	Fault to be repaired by CS Mirror		CS Mirror		
2128	30/04/1896	Perim - Assab Massawah (Italian Govt)	Repaired 17th inst	Repaired 17th inst		CS Chiltern		
2129	30/04/1896	Perim - Aden No 2	Repaired 22nd inst	Repaired 22nd inst		CS Chiltern		
2130	30/04/1896	Lisbon - Vigo	Repaired	Repaired by CS Duplex (Safrican Teleg Co)		CS Duplex		
2131	30/04/1896	Syra - Chio No 1	Interrupted & Repaired	Interrupted and repaired by Superintendent				
2132	01/05/1896	Ceara - Maranham	Interrupted 28th March				Interrupted 28th March	
2133	08/05/1896	St Thome - Loanda	Interrupted 2nd May				Interrupted 2nd May	
2134	08/05/1896	Monte Alegre - Santarem	Interrupted 5th May				Interrupted 5th May	
2135	14/05/1896	Bona - Marsailles No 2	Fault but on testing it was decided to leave alone a stable and cable working well	Fault but on testing it was decided to leave alone a stable and cable working well		CS Mirror		
2136	14/05/1896	Sardinia cable (Italian)	Faulty	Faulty				
2137	14/05/1896	St Thome - Loanda (W African Teleg Co)	To be repaired	To be repaired by CS bJohn Pender		CS John Pender		
2138	14/05/1896	Levant cable	Repaired 4th inst	Repaired 4th inst by Chio Station electrician in a hired tug				

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2139	15/05/1896	Shanghai - Nagasaki	Interrupted 5th May; repaired 7th May				Interrupted 5th May; repaired 7th May	
2140	22/05/1896	St Thome - Loanda	Repaired 21st May				Repaired 21st May	
2141	30/05/1896	Brest - St Pierre (1879), Poinyer Quertier	Repairs (Also see below)		NMM TCM/8/63 CABLE ENGINEERS' LOGBOOKS. Brest - St Pierre (1879), Poinyer Quertier, SEINE, 24 April - 30 May 1896. TCM/9/40 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. North Atlantic, SEINE, 24 April - 30 May 1896	CS Seine		
2142	05/06/1896	Brest - St Pierre (PQ Co)	(Interrupted June 1895) Repaired21st May 1896 (Also see above)				(Interrupted June 1895) Repaired21st May 1896	
2143	12/06/1896	Cadiz - Teneriffe	Interrupted 6th inst				Interrupted 6th inst	
2144	19/06/1896	Jamaica - Colon	Interrupted 10th inst				Interrupted 10th inst	
2145	26/06/1896	Ceara - Maranham	Repaired 16th inst				Repaired 16th inst	
2146	10/07/1896	Jamaica - Colon	Repaired 3rd inst				Repaired 3rd inst	
2147	10/07/1896	Para - Maranham	Interrupted 9th inst				Interrupted 9th inst	
2148	17/07/1896	Cadiz - Teneriffe	Repaired 16th inst				Repaired 16th inst	
2149	17/07/1896	Para - Maranham	Repaired 16th inst				Repaired 16th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2150	17/07/1896	Lorenco Marques - Durban	Interrupted 13th inst				Interrupted 13th inst	
2151	23/07/1896	Sardinia cable (Italian)	Repaired 15th inst	Repaired 15th inst		CS Amber		
2152	23/07/1896	Cania - Retino	Repaired 20th inst	Repaired 20th inst		CS Amber		
2153	24/07/1896	Nagasaki - Gutzlass	Interrupted 22nd inst				Interrupted 22nd inst	
2154	31/07/1896	Lorenco Marques - Durban	Repaired 25th inst				Repaired 25th inst	
2155	31/07/1896	Gibraltar - Tangier	Interrupted 28th inst				Interrupted 28th inst	
2156	07/08/1896	Nagasaki - Gutzlass	Repaired 2nd inst				Repaired 2nd inst	
2157	14/08/1896	Gibraltar - Tangier	Repaired 11th inst				Repaired 11th inst	
2158	28/08/1896	Brest - Penzance	Repairs		NMM TCM/9/41 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Brest - Penzance, BRITANNIA, 4 - 28 July 1896. TCM/8/64 CABLE ENGINEERS' LOGBOOKS. Brest - Penzance, BRITANNIA, 4 - 28 July 1896	CS Britannia		
2159	28/08/1896	Zanzibar - Mombassa	Interrupted 23rd inst				Interrupted 23rd inst	
2160	11/09/1896	Zanzibar - Mombassa	Repaired 5th inst				Repaired 5th inst	
2161	11/09/1896	Bahia - Rio de Janiero	Interrupted 4th inst				Interrupted 4th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2162	11/09/1896	Penang - Medan	Interrupted 7th inst				Interrupted 7th inst	
2163	17/09/1896	Cyprus - Alexandria	Repaired 30th July	Repaired 30th July		CS Mirror		
2164	17/09/1896	Tangier - Gibraltar	Repaired 11th Aug	Repaired 1th Aug		CS Mirror		
2165	17/09/1896	Gibraltar - Malta No 1	Repaired 19th Aug	Repaired 19th Aug		CS Amber		
2166	17/09/1896	Malta - Alexandria No 1	Repaired 15th inst	Repaired 15th inst		CS Amber		
2167	18/09/1896	Loanda - Benguela	Interrupted 13th inst				Interrupted 13th inst	
2168	25/09/1896	Para - Maranham	Repaired 21st inst				Repaired 21st inst	
2169	25/09/1896	Zanzibar - Mombassa	Interrupted 23rd inst				Interrupted 23rd inst	
2170	27/09/1896	Borkum - Vigo	Repairs		NMM TCM/8/65 CABLE ENGINEERS' LOGBOOKS. Borkum - Vigo, cable laying, BRITANNIA, 11 - 27 September 1896	CS Britannia		
2171	01/10/1896	Alexandria - Sitia	Interrupted	Interrupted but repair delayed by quarantine		CS Amber		
2172	02/10/1896	Loanda - Benguela	Repaired 28th ulto				Repaired 28th ulto	
2173	02/10/1896	Zanzibar - Mombassa	Repaired 26th ulto				Repaired 26th ulto	
2174	09/10/1896	Bahia - Rio de Janiero	Repaired 3rd inst				Repaired 3rd inst	
2175	09/10/1896	Penang - Medan	Repaired 27th ulto				Repaired 27th ulto	
2176	09/10/1896	Para - Maranham	Interrupted 8th inst				Interrupted 8th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2177	15/10/1896	Lisbon - Gibraltar	To be repaired	To be repaired by CS Chiltern		CS Chiltern		
2178	15/10/1896	Aden - Zanzibar	Fault repaired 11inst	Fault at Aden shore end repaired 11th inst		CS Amber		
2179	15/10/1896	Perim - Suakin No 1	Faulty	Faulty CS Amber to repair		CS Amber		
2180	15/10/1896	Aden - Bombay No 2	Interrupted	Interrupted CS Amber to repair		CS Amber		
2181	29/10/1896	Gibraltar - Carcavellos	2 faults repaired	2 faults repaired		CS Chiltern		
2182	29/10/1896	Porthcurno - Vigo	Interrupted near Vigo	Interrupted near Vigo. Superintendent to repair				
2183	29/10/1896	Aden - Bombay No 2	Repaired 17th inst	Repaired 17th inst		CS Amber		
2184	29/10/1896	Perim - Obock	Repaired 18th inst	Repaired 18th inst		CS Amber		
2185	29/10/1896	Perim - Suakin No 1	To be repaired	To be repaired		CS Amber		
2186	12/11/1896	Lipari - Salina (Italian Govt)	Repaired 8th inst	Repaired 8th inst		CS Chiltern		
2187	12/11/1896	Malta - Bona No 1	Faulty	Faulty				
2188	12/11/1896	Perim - Suakin No 1	Repaired 30th ulto	Repaired 30th ulto		CS Amber		
2189	12/11/1896	Suez - Perim No 3	Repaired 8th inst	Repaired 8th inst		CS Amber		
2190	12/11/1896	Porthcurno - Vigo	Interrupted & repaired	Interrupted near Vigo repaired by station superintendent				
2191	13/11/1896	Monte Alegre - Santarem	Repaired 6th inst				Repaired 6th inst	
2192	26/11/1896	Gibraltar - Lisbon No 1	Repaired 14th inst	Repaired 14th inst		CS Chiltern		
2193	26/11/1896	Malta - Bona	Repaired 20th inst	Repaired 20th inst		CS Chiltern		
2194	27/11/1896	Chio - Tenedos	Interrupted 24th inst				Interrupted 24th inst	
2195	04/12/1896	Chio - Tenedos	Repaired 28th inst				Repaired 28th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2196	10/12/1896	Vigo - Lisbon	Interrupted 4th inst	Interrupted 4th inst. CS Electra to repair		CS Electra		
2197	10/12/1896	Vigo - Caminha	Interrupted 4th inst	Interrupted 4th inst. CS Electra to repair		CS Electra		
2198	10/12/1896	Chio - Tenedos	Repaired 3rd inst	Repaired 3rd Inst		CS Chiltern		
2199	10/12/1896	Katacola - Zante	Repaired 5th inst	Repaired 5th inst		CS Chiltern		
2200	10/12/1896	Cania - Retino	Repaired 7th inst	Repaired 7th inst		CS Chiltern		
2201	10/12/1896	Perim - Aden No 2	Repaired 8th inst	Repaired 8th inst		CS Amber		
2202	10/12/1896	Jedah - Suakin	Interrupted 8th inst	Interrupted 8th inst.				
2203	11/12/1896	Ceara - Maranham	Interrupted 2nd inst				Interrupted 2nd inst	
2204	11/12/1896	Suakin -Djedda	Interrupted 5th inst				Interrupted 5th inst	
2205	11/12/1896	Obidos - Parintius	Interrupted 7th inst				Interrupted 7th inst	
2206	17/12/1896	New York - Cape Haiti	Repairs		NMM TCM/8/67 CABLE ENGINEERS' LOGBOOKS. New York - Cape Haiti, SEIEN, 2 November - 17 December 1896	CS Seine		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2207	18/12/1896	Greetsiel-Valentia	Repairs		NMM TCM/9/42 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Greetsiel-Valentia, BRITANNIA, 27 November - 18 December 1896. TCM/9/43 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Greetsiel - Valentia, BRITANNIA, 27 November - 18 December 1896. TCM/8/66 CABLE ENGINEERS' LOGBOOKS. Valentia - Greetsiel, BRITANNIA, 27 November - 18 December 1896	CS Britannia		
2208	25/12/1896	Para - Maranham	Repaired 22nd inst				Repaired 22nd inst	
2209	01/01/1897	Mozambique - Delgoa bay	Interrupted 24th ulto				Interrupted 24th ulto	
2210	07/01/1897	Porthcurno - Vigo	New shore ends 12th ulto	New shore ends 12th ulto		CS Electra		
2211	07/01/1897	Porthcurno - Vigo	Repair delayed by bad weather	Repair delayed by bad weather		CS Electra		
2212	07/01/1897	Vigo -Caminha	Repaired 3rd inst	Repaired 3rd Inst		CS Electra		
2213	07/01/1897	Perim - Aden No1	Repaired 19th ulto	Repaired 19th ulto		CS Amber		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2214	07/01/1897	Jedah - Suakin	Repaired 4th inst	Repaired 4th inst		CS Amber		
2215	08/01/1897	Jedah - Suakin	Repaired 4th inst				Repaired 4th inst	
2216		Mozambique - Delgoa bay	Repaired 4th inst				Repaired 4th inst	
2217	15/01/1897	Hong King - Macao	Interrupted 5th inst				Interrupted 5th inst	
2218	04/02/1897	Suez - Suakin No 1	To be repaired by CS Amber but she bottomed cutting Jedda - Suakin. Repaired 30th ulto	To be repaired by CS Amber but she bottomed cutting Jedda - Suakin. Repaired 30th ulto		CS Amber		
2219	04/02/1897	Suakin - Perim No 2	Faulty	Faulty				
2220	05/02/1897	Saigon - Bankok	Interrupted 3rd inst				Interrupted 3rd inst	
2221	18/02/1897	Suez - Suakin No 1	Repaired 5th inst	Repaired 5th inst		CS Amber		
2222	18/02/1897	Suez - Suakin No 2	Interrupted & Repaired 16th inst	Interrupted & Repaired 16th inst		CS Amber		
2223	18/02/1897	Perim - Suakin	To be repaired	To be repaired by CS Amber		CS Amber		
2224	18/02/1897	Besika - Tenedos	Interrupted 1nm from Tenedos	Interrupted 1nm from Tenedos and repaired by station staff				
2225	19/02/1897	Ceara - Maranham	Repaired 4th inst				Repaired 4th inst	
2226	19/02/1897	Emden - Vigo	Interrupted 10th inst; Repaired 14th inst				Interrupted 10th inst; Repaired 14th inst	
2227	19/02/1897	Jamaica - Colon	Interrupted 2nd inst				Interrupted 2nd inst	
2228	19/02/1897	Pernambuco - Ceara	Interrupted 4th inst				Interrupted 4th inst	
2229	26/02/1897	Grenada - Trinidad	Interrupted 4th inst				Interrupted 4th inst	
2230	26/02/1897	Assab - Massowah	Interrupted 20th inst				Interrupted 20th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2231	04/03/1897	Porthcurno - Lisbon Direct	Interrupted 27nm from Lisbon	Interrupted 27nm from Lisbon. CS Electra to repair		CS Electra		
2232	04/03/1897	Vigo - Lisbon	Interrupted 60nm from Lisbon	Interrupted 60nm from Lisbon				
2233	04/03/1897	Porthcurno - Vigo	Faulty	Faulty - working slowly. CS Electra to repair		CS Electra		
2234	04/03/1897	Perim - Suakin No 2	Repaired 23rd ulto	Repaired 23rd ulto		CS Amber		
2235	10/03/1897	Valentia - Greetsiel	Repairs		NMM TCM/8/68 CABLE ENGINEERS' LOGBOOKS. Valentia - Greetsiel, BRITANNIA, 27 February - 10 March 1897	CS Britannia		
2236	12/03/1897	Granada - Trinidad	Repaired 9th inst				Repaired 9th inst	
2237	14/03/1897	Salcombe - Brignogan	Repairs		NMM TCM/8/69 CABLE ENGINEERS' LOGBOOKS. Salcombe - Brignogan, BRITANNIA, 10 - 14 March 1897	CS Britannia		
2238	18/03/1897	Porthcurno - Lisbon Direct	Repaired 4th inst	Repaired 4th inst 26nm from Lisbon		CS Electra		
2239	18/03/1897	Porthcurno - Lisbon Direct	Further interruption	Further interruption 57nm from Lisbon. Repaired 7th inst		CS Electra		
2240	18/03/1897	Vigo - Lisbon	Repaired 10th inst	Repaired 10th inst		CS Electra		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2241	18/03/1897	Vigo - Porthcurno	Interrupted	Interrupted 95nm from Vigo. Repair delayed by bad weather. Finally repaired 17th inst		CS Electra		
2242	18/03/1897	Bona - Malta No 1	Interrupted 13th inst	Interrupted 13th inst 3nm from Bona. CS Electra to repair		CS Electra		
2243	18/03/1897	Perim - Suakin	Interrupted 8th inst & Repaired 17th inst	Interrupted 8th inst near Suakin. Repaired 18th inst		CS Amber		
2244	19/03/1897	Hong King - Macao	Interrupted 20th ulto				Interrupted 20th ulto	
2245	26/03/1897	Emden - Vigo	Interrupted 24th inst				Interrupted 24th inst	
2246	26/03/1897	Malta - Alexandria	Interrupted 23rd inst				Interrupted 23rd inst	
2247	26/03/1897	Tenedos - Dardenelles	Interrupted 23rd inst				Interrupted 23rd inst	
2248	01/04/1897	Borkum - Vigo No 1 (German Cable Company)	Interrupted ?ulto. Repaired 30th ulto	Interrupted ?ulto. Repaired 30th ulto (delayed by bad weather)		CS Chiltern		
2249	01/04/1897	Western Union Cable off Lands End	To be repaired under contract	To be repaired under contract		CS Chiltern		
2250	01/04/1897	Porthcurno - Vigo	Repaired 20th ulto	Repaired 20th ulto				
2251	01/04/1897	Bona - Malta No 1	Repaired 25th ulto	Repaired 25th ulto		CS Electra		
2252	01/04/1897	Alexandriaandra - Malta No 1	Interrupted 22nd ulto ; repaired 31st ulto	Interrupted 22nd ulto ; repaired 31st ulto		CS Electra		
2253	01/04/1897	Alexandriaendra - Malta No 2	Interrupted 23rd ulto; repaired 1st inst	Interrupted 23rd ulto; repaired 1st inst		CS Electra		
2254	01/04/1897	Alexandriaandra - Port Said	Interrupted 1st inst	Interrupted 1st inst 75nm from Alexandria. CS Electra to repair		CS Electra		
2255	01/04/1897	Perim Suakin No 2	Repaired 22nd ulto	Repaired 22nd ulto		CS Amber		
2256	01/04/1897	Suez - Suakin No 1	Repaired	Repaired		CS Amber		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2257	02/04/1897	Assab - Massowah	Repaired 25th ulto				Repaired 25th ulto	
2258	02/04/1897	Malta - Alexandria	Repaired 29th ulto				Repaired 29th ulto	
2259	02/04/1897	Tenedos - Dardenelles	Repaired 29th ulto				Repaired 29th ulto	
2260	09/04/1897	Emden - Vigo	Repaired 30th ulto				Repaired 30th ulto	
2261	16/04/1897	Mossamedes - Benguela	Interrupted 13th inst				Interrupted 13th inst	
2262	23/04/1897	Hong Kong - Macao	Repaired 22nd inst				Repaired 22nd inst	
2263	29/04/1897	Western Union Cable off Lands End	Bad weather and interrupted near shore	Bed weather and interrupted near shore. Repair to be affected by tug and diver		CS Chiltern		
2264	29/04/1897	Alexandriaandra - Port Said	Repaired 3rd inst	Repaired 3rd Inst		CS Electra		
2265	29/04/1897	Malta - Bona No 1	Repaired 11th inst	Repaired 11th inst		CS Electra		
2266	29/04/1897	Suex - Suakin No 1	Under repair	Under repair		CS Amber		
2267	30/04/1897	Assab - Massowah	Interrupted 25th inst				Interrupted 25th inst	
2268	30/04/1897	Konakry - Sierra Leone	Interrupted 28th inst				Repaired 28th inst	
2269	07/05/1897	Mossamedes - Benguela	Repaired 1st inst				Repaired 1st inst	
2270	07/05/1897	Assab - Massowah	Repaired 25th ulto				Repaired 25th ulto	
2271	07/05/1897	Hong Kong - Macao	Interrupted 3rd inst				Interrupted 3rd ulto	
2272	07/05/1897	Para - Maranham	Interrupted 5th inst				Interrupted 5th inst	
2273	13/05/1897	Vigo - Lisbon	Under repair	Under repair but weather bad		CS Chiltern		

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1		Cable	Event	ETC Board Minute Books	Engineer's Reports (and other sources)	Ship	The Electrician	The Times
2274	13/05/1897	Suez - Suakin No 4	Repaired 30th ulto	Repaired 30th ulto. Hook and rope found on damaged cable marked "owned by Messrs Piribhi & Co, Italy"!		CS Amber		
2275	13/05/1897	Perim - Suakin No 1	Repaired 9th inst	Repaired 9th inst.		CS Amber		
2276	14/05/1897	Hong Kong - Macao	Repaired 4th inst				Repaired 4th inst	
2277	21/05/1897	Saigon - Bankok	Repaired 18th inst				Repaired 1st inst	
2278	27/05/1897	Porthcurno - Lisbon	Fault repaired 20th inst	Fault repaired 20th inst		CS Chiltern		
2279	27/05/1897	Vigo - Porthcurno	Repaired 22nd inst	Repaired 22nd inst		CS Chiltern		
2280	27/05/1897	Porthcurno - Lisbon	Another fault	Another fault. CS Chiltern to repair		CS Chiltern		
2281	27/05/1897	Suez - Suakin No 1	Interrupted	Interrupted. CS Amber to repair		CS Amber		
2282	28/05/1897	Konakry - Sierra Leone	Repaired 24th inst				Repaired 24th inst	
2283	28/05/1897	Assab - Massowah	Interrupted 21st inst				Interrupted 21st inst	
2284	04/06/1897	Para - Maranham	Repaired 1st inst				Repaired 1st inst	
2285	04/06/1897	Laurenco Marques - Durban	Interrupted 29th ulto				Interrupted 29th ulto	
2286	04/06/1897	Granada - Trinidad	Interrupted 2nd inst				Interrupted 2nd inst	
2287	11/06/1897	Assab - Massowah	Repaired 28th ulto				Repaired 28th inst	
2288	11/06/1897	Laurenco Marques - Durban	Repaired 6th inst				Repaired 6th inst	
2289	18/06/1897	Medan - Penang	Interrupted 16th inst				Repaired 16th inst	
2290	24/06/1897	Perim - Suakin No1	3 faults repaired 12th inst	3 faults repaired 12th inst		CS Amber		
2291		Perim - Suakin No2	Repaired 20th inst	Repaired 20th inst		CS Amber		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2292	25/06/1897	Medan - Penang	Repaired 20th inst				Repaired 20th inst	
2293	02/07/1897	Bonny - Camaroons	Interrupted 25th ulto				Interrupted 25th ulto	
2294	08/07/1897	Emden - Vigo	Interrupted 4th inst; repaired by Vigo Superintendent 5th inst	Interrupted 4th inst; repaired by Vigo Superintendent 5th inst				
2295	08/07/1897	Bona - Malta	Interrupted 4th inst; repaired 6th inst	Interrupted 4th inst; repaired 6th inst by CS Electra		CS Electra		
2296	08/07/1897	Perim - Suakin No 2	1 fault Repaired; 1fault remaining 28th ulto	1 fault Repaired; 1fault remaining 28th ulto by CS Amber		CS Amber		
2297	09/07/1897	Granada - Trinidad	Repaired 6th inst				Repaired 6th inst	
2298	16/07/1897	Bonny - Camaroons	Repaired 12th inst				Repaired 12th inst	
2299	16/07/1897	Zanzibar - Mombassa	Interrupted 13th inst				Interrupted 13th inst	
2300	16/07/1897	Accra - Ketonou	Interrupted 15th inst				Interrupted 15th inst	
2301	22/07/1897	Perim - Suakin No 1	Fault repaired 10th inst	Fault repaired 10th inst by CS Amber		CS Amber		
2302	22/07/1897	Bona - Malta No 2	Repaired 6th inst	Repaired 6th inst by CS Electra		CS Electra		
2303	23/07/1897	Puerto Plata - Martinique	(Interrupted June 1895) Repaired21st May 1896				(Interrupted June 1895) Repaired21st May 1896	
2304	30/07/1897	Cape Town - Mossamedes	Interrupted 9th inst; repaired 28th inst				Interrupted 9th inst; repaired 28th inst	
2305	30/07/1897	Accra - Ketonou	Repaired 24th inst				Repaired 24th inst	
2306	30/07/1897	Cayenne - Para	Interrupted 22nd inst				Interrupted22nd inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2307	30/07/1897	Aden - Zanzibar	Interrupted 27th inst				Interrupted 27th inst	
2308	31/07/1897	Brest - St Pierre (1879), Poinyer Quertier	Repairs		NMM TCM/8/70 CABLE ENGINEERS' LOGBOOKS. Brest - St Pierre (1879), Poinyer Quertier, SEINE, 26 May - 31 July 1897	CS Seine		
2309	13/08/1897	Cape Town - Mossamedes	Interrupted 7th inst; repaired 10th inst				Interrupted 7th inst; repaired 10th inst	
2310	03/09/1897	Zanzibar - Mombassa	Repaired 31st ulto				Repaired 31st ulto	
2311	03/09/1897	Cayenne - Para	Repaired 30th ulto				Repaired 30th ulto	
2312	03/09/1897	St Vincent - St Jago (Africa Direct Teleg Co)	Interrupted 1st inst				Interrupted 1st inst	
2313	10/09/1897	Aden - Zanzibar	Repaired 4th inst	Repaired 4th inst by CS Amber		CS Amber	Repaired 4th inst	
2314	10/09/1897	Laurenco Marques - Mozambique	Interrupted 4th inst				Interrupted 4th inst	
2315	14/09/1897	Mombassa cable	Repaired 30th ulto	Repaired 30th ulto				
2316	14/09/1897	Perim - Suakin No 1	To be repaired	To be repaired by CS Amber		CS Amber		
2317	14/09/1897	Mozambique cable	Interrupted 4th inst	Interrupted 4th inst, to be repaired by CS John Pender		CS John Pender		
2318	14/09/1897	St Vincent - St Jago (Africa Direct Teleg Co)	Interrupted 31st ulto	Interrupted 31st ulto. To be repaired by CS Duplex		CS Duplex		
2319	14/09/1897	Gibraltar - Lisbon No 2	Repaired 3rd inst	Repaired 3rd inst by Cs Mirror		CS Mirror		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2320	14/09/1897	Porthcurno - Lisbon No 1	Repaired 10th ulto	Reapaired 10th ulto by CS Mirror		CS Mirror		
2321	14/09/1897	Emden - Vigo	Interrupted 14th inst	Repaired 14th inst. CS Mirror to repair		CS Mirror		
2322	14/09/1897	Levant cable	Repaired 24 July	Repaired 24th July		CS Electra		
2323	14/09/1897	Brest - St Pierre (1879), Poinyer Quertier	Repairs		NMM TCM/8/71 CABLE ENGINEERS' LOGBOOKS. Brest - St Pierre (1879), Poinyer Quertier, SEINE, 31 July - 14 September 1897. TCM/8/72 CABLE ENGINEERS' LOGBOOKS. Brest - St Pierre (1879), Poinyer Quertier, SEINE, 15 September - 16 October 1897 TCM/8/73 CABLE ENGINEERS' LOGBOOKS. Brest - St Pierre (1879), Poinyer Quertier, SEINE, 16 October 1897 - 13 November 1897	CS Seine		
2324	17/09/1897	St Vincent - St Jago (Africa Direct Teleg Co)	Repaired 15th inst				Repaired 15th inst	
2325	17/09/1897	Bolamo - Bissau	Interrupted 13th inst				Interrupted 13th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2326	24/09/1897	Mozambique - Lorenco Marques	Repaired 22nd inst				Repaired 22nd inst	
2327	29/11/1897	Australia Cables	Complaints of delays GB to Australia					Letter of complaint to the Times about repeated delays in cables to/from Australia
2328	30/09/1897	Emden - Vigo	Repaired 17th inst	Repaired 17th inst		CS Mirror	Repaired 17th inst	
2329	30/09/1897	"Cable off Lands End"	Repaired 25th inst	Repaired 25th inst by CS Mirror hired by TCM		CS Mirror		
2330	01/10/1897	Cyprus - Latakia	Repaired 28th ulto				Repaired 28th ulto	
2331	01/10/1897	Hong Kong - Macao	Interrupted 28th ulto				Interrupted 28th ulto	
2332	01/10/1897	Cayenne - Pinheiro	Interrupted 29th ulto				Interrupted 29th ulto	
2333	08/10/1897	Bolamo - Bissau	Repaired 2nd inst				Repaired 2nd inst	
2334	14/10/1897	Lisbon - Gibraltar No 1	Repaired 3rd inst	Repaired 3rd inst by CS Mirror		CS Mirror		
2335	14/10/1897	Patros - Corinth	Repaired 12th inst	Repaired 12th inst by CS Electra		CS Electra		
2336	14/10/1897	Perim - Suakin No 1	Repaired 11th inst	Repaired 11th inst by CS Amber		CS Amber		
2337	15/10/1897	Oranto - Valona	Interrupted 11th inst				Interrupted 11th inst	
2338	28/10/1897	Cadiz - Teneriffe	Interrupted	Interrupted				
2339	28/10/1897	Alexandria - Malta No 1	Interrupted	Interrupted. CS Electra to repair		CS Electra		
2340	28/10/1897	Aden - Bombay No 1	Fault repaired 26th inst	Fault repaired 26th inst by CS Amber		CS Amber		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2341	29/10/1897	Alemquer - Santarem	Interrupted 21st inst				Interrupted 21st inst	
2342	29/10/1897	Paramaribo - Cayenne	Interrupted 25th inst				Interrupted 25th inst	
2343	29/10/1897	Cadiz - Tenariffe	Interrupted 26th inst				Interrupted 26th inst	
2344	05/11/1897	Santiago de Cuba - Guantanamo	Interrupted 29th ulto				Interrupted 29th ulto	
2345	05/11/1897	Bundaberg - New Caledonia	Interrupted 4th inst				Interrupted 4th inst	
2346	12/11/1897	Bundaberg - New Caledonia	repaired 9th inst				Repaired 9th inst	
2347	12/11/1897	St Thome - Loanda	Interrupted 9th inst				Interrupted 9th inst	
2348	19/11/1897	Hong Kong - Macao	Repaired 9th inst				Repaured 9th inst	
2349	19/11/1897	Pineiro -Cayenne	Repaired 17th inst				Repaired 7th inst	
2350	19/11/1897	Santiago de Cuba - Guantanamo	Repaired 9th inst				Repaired 9th inst	
2351	25/11/1897	Greetsiel - Valentia	Repairs		NMM TCM/9/46 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Greetsiel - Valentia, SEINE, 25 November - 10 December 1897; TCM/8/74CABLE ENGINEERS' LOGBOOKS. Valentia - Greetsiel, SEINE, 25 November - 11 December 1897	CS Seine		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2352	25/11/1897	Cadiz - Tenariffe	Repaired 19th inst	Repaired 19th inst by CS Mirror		CS Mirror		
2353	25/11/1897	Lisbon - Gibraltar	Repaired 23rd inst	Repaired 23rd inst by CS Mirror		CS Mirror		
2354	25/11/1897	Alexandria - Malta No 2	Repaired 14th inst	Repaired 14th inst by CS Electra		CS Electra		
2355	26/11/1897	Cadiz -Tenariffe	Repaired 20th inst				Repaired 20th inst	
2356	26/11/1897	Pernambuco - Ceara	Interrupted 22st inst				Interrupted 22nd inst	
2357	03/12/1897	Paramaribo - Cayenne	Repaired 2nd inst				Repaired 2nd inst	
2358	03/12/1897	St Thome - Loanda	Repaired 29th ulto				Repaired 29th ulto	
2359	03/12/1897	Emden - Vigo	Interrupted 28th ulto				Interrupted 28th ulto	
2360	09/12/1897	Madiera No 2	Repaired 6th inst	Repaired 6th inst by CS Mirror		CS Mirror		
2361	09/12/1897	Emden - Vigo	Interrupted 26th ulto	Interrupted 26th ulto. CS Mirror to repair		CS Mirror		
2362	10/12/1897	Pernambuco - Ceara	Repaired 2nd inst				Repaired 2nd inst	
2363	10/12/1897	Sita - Rhodes	Interrupted 7th inst				Interrupted 7th	
2364	10/12/1897	St Thome - Loanda	Interrupted 4th inst				Interrupted 4th inst	
2365	17/12/1897	St Thome - Loanda	Repaired 12th inst				Repaired 12th inst	
2366	17/12/1897	Sita - Rhodes	Repaired 10th inst				Repaired 10th inst	
2367	17/12/1897	St Thome - Loanda	Interrupted again 13th inst				Interrupted again 13th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2368	21/12/1897	Greetsiel - Valentia	Repairs		NMM TCM/9/47 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Greetsiel - Valentia, BRITANNIA, 21 December 1897 - 15 January 1898; TCM/8/75 CABLE ENGINEERS' LOGBOOKS. Valentia - Greetsiel, BRITANNIA, 21 December 1897 - 15 January 1898	CS Britannia		
2369	24/12/1897	Emden - Vigo	Repaired 17th inst				Repaired 17th inst	
2370	31/12/1897	Ceara - Maranham	Intewrrupted 23rd inst				Interrupted 23rd inst	
2371	31/12/1897	Teneriffe - St Louis (Senegal)	Interrupted 24th inst				Interrupted 24th inst	
2372	31/12/1897	Emden - Vigo	Interrupted again 24th inst				Interrupted again 24th inst	
2373	06/01/1898	Emden - Vigo	Repaired 17th ulto	Repaired 17th ulto by CS Mirror		CS Mirror		
2374	06/01/1898	Emden - Vigo	Interrupted again by trawlers 27th ulto	Interrupted again by steam trawlers 27th ulto. CS Mirror to repair and alter course of cable		CS Mirror		
2375	06/01/1898	Bona - Malta No 1	Repaired 13th ulto	Repaired 13th ulto by CS Electra		CS Electra		
2376	06/01/1898	Lisbon - Vigo	Repaired 22nd ulto	Repaired 22nd ulto by CS Electra		CS Electra		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2377	06/01/1898	Madiera - St Vincent No 1	Interrupted and repaired 29th ulto	Interrupted and repaired 29th ulto by CS Electra		CS Electra		
2378	06/01/1898	Aden - Bombay No 1	Fault repaired 12th ulto	Fault repaired 12th ulto and shorend repaired at Bombay end		CS Amber		
2379	06/01/1898	Suez - Suakin No 1	Repaired 1st inst	Repaired 1st inst by CS Amber		CS Amber		
2380	06/01/1898	Suez - Suakin No 2	Repaired 5th inst	Repaired 5th inst by CS Amber		CS Amber		
2381	06/01/1898	Malta - Bona No 2	Repaired	Repaired by Station staff at Malta				
2382	07/01/1898	Emden - Vigo	Repaired 5th inst				Repaired 5th inst	
2383	07/01/1898	Para - Maranham	Interrupted 3rd inst				Interrupted 3rd inst	
2384	07/01/1898	Curacao - La Guayra	Interrupted 5th inst				Interrupted 5th inst	
2385	07/01/1898	Oranto - Valona	Repaired 31st ulto				Repaired 31st ulto	
2386	14/01/1898	St Thome - Loanda	Repaired 10th inst				Repaired 10th inst	
2387	20/01/1898	Vigo - Lisbon	Under repair	Under repair		CS Chiltern		
2388		Suez - Suakin No2	Fault repaired 7th inst	Fault repaired 7th inst		CS Amber		
2389	21/01/1898	Bundaberg - New Caledonia	(interrupted 4/11/1897) Repaired 20th inst				(interrupted 4/11/1897) Repaired 20th inst	
2390	21/01/1898	Para - Maranham	Repaired 15th inst				Repaired 15th inst	
2391	21/01/1898	Para- Caminha	Interrupted 13th inst				Interrupted 13th inst	
2392	28/01/1898	Tenareffe - St Louis (Senegal)	Repaired 23rd inst				Repaired 23rd inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2393	02/02/1898	Ballinskellig - Halifax (1874)	Repairs		TCM/9/48 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Ballinskellig - Halifax (1874), SCOTIA, 2 - 8 February 1898	CS Scotia		
2394	03/02/1898	Lisbon - Vigo	Repaired 21st ulto	Repaired 21st ulto by CS Chiltern		CS Chiltern		
2395		Cadiz - Gibraltar	Under repair	Under repair by CS Chiltern but grappled and broke Gib - Vigo cable on 2nd inst. Repaired the same day. "Cables too close together"		CS Chiltern		
2396		Malta - Alexandria	Under repair	Under repair but second interruption occurred		CS Electra		
2397		Suez - Suakin No 1	Fault repaired 2nd inst	Fault repaired 2nd inst by CS Chiltern		CS Chiltern		
2398	04/02/1898	Para - Cameta	Interrupted 13th ulto; repaired 27th ulto				Interrupted 13th ulto; repaired 27th ulto	
2399	04/02/1898	Boloma - Bissau	Interrupted 28th ulto				Interrupted 28th ulto	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2400	07/02/1898	Sylt - Arendal	Repairs		NMM TCM/9/49 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Sylt - Arendal, BRITANNIA, 7 February - 1 March 1898; TCM/9/50 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Sylt - Arendal, BRITANNIA, 7 February - 1 March 1898	CS Britannia		
2401	11/02/1898	Para - Maranham	Repaired 7th inst				Repaired 7th inst	
2402	11/02/1898	Emden - Vigo	Interrupted 7th inst				Interrupted 7th inst	
2403	17/02/1898	Cadiz - Gibraltar	Repaired 6th inst	repaired 6th inst by CS Chiltern		CS Chiltern		
2404		Emden - Vigo	Interrupted by fishing trawler 7th inst & repaired 15th inst	Inyerrupted 7th inst by fishing trawler. Bad weather delayed repair until 15th inst		CS Chiltern		
2405		Perim - Suakin No 1	Repaired 7th inst	Repaired 7th inst by CS Amber		CS Amber		
2406		Suez - Aden No 3	Repaired 11th inst	Repaired 11th inst by CS Amber		CS Amber		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2407	18/02/1898	Ceara - Maranham	Repairs		TCM/9/49 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Sylt - Arendal, BRITANNIA, 7 February - 1 March 1898; TCM/9/50 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Sylt - Arendal, BRITANNIA, 7 February - 1 March 1898		Repaired 17th inst	
2408	18/02/1898	Curacao - La Guayra	Repaired 15th inst				Repaired 15th inst	
2409	18/02/1898	Boloma - Bissau	Repaired 14th inst				Repaired 14th inst	
2410	18/02/1898	Lataki - Cyprus	Interrupted 10th inst				Interrupted 10th inst	
2411	22/02/1898	Emden - Vigo	Repaired 17th ulto	Repaired 17th ulto by CS Chiltern		CS Chiltern		
2412	22/02/1898	Cadiz - Gibraltar	Repaired 25th ulto	Repaired 25th ulto by CS Chiltern		CS Chiltern		
2413	22/02/1898	Alexandria - Malta No 2	2nd break repaired 22nd ulto. Fault removed near Malta 28th ulto	2nd break repaired 22nd ulto. Fault removed near Malta by CS Electra 28th ulto		CS Electra		
2414	25/02/1898	Emden - Vigo	Repaired 18th inst				Repaired 18th inst	
2415	25/02/1898	Boloma - Bissau	Interrupted again 19th inst				Interrupted again 19th inst	
2416	11/03/1898	Aden - Zanzibar	Interrupted 8th ulto; repaired 4th inst				Interrupted 8th ulto; repaired 4th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2417	11/03/1898	Saigon - Hong Kong	Interrupted 28th ulto				Interrupted 28th ulto	
2418	17/03/1898	Carcavelos - Porthcurno No 2	Repaired 14th inst	Repaired 14th inst by CS Chitern (delay due to bad weather		CS Chiltern		
2419	17/03/1898	Alexandria - Port Said	Under repair	Under repair by CS Electra but bad weather		CS Electra		
2420	25/03/1898	Gibraltar - Tangiers	Interrupted 19th inst				Interrupted 19th inst	
2421	25/03/1898	Laurenco Marques - Durban	Interrupted 24th inst				Interrupted 24th inst	
2422	25/03/1898	Cyenne - Pinheire	Interrupted 24th inst				Interrupted 24th inst	
2423	31/03/1898	Cable off Le Havre (Commercial Cable Co)	Interrupted	To be repaired under contract bt ETC				
2424	31/03/1898	Vigo - Carcavelos	Repaired 18th inst	Repaired 18th inst by CS Chiltern		CS Chiltern		
2425	31/03/1898	Gibraltar - Tangiers	Repaired 26th inst	Repaired 26th inst by CS Chiltern		CS Chiltern		
2426	31/03/1898	Alexandria - Port Said	Repaired 17th inst	Repaired 17th inst by CS Electra		CS Electra		
2427	31/03/1898	Durban Cable	Repaired 25th inst	Repaired 25th inst		CS John Pender		
2428	01/04/1898	Laurenco Marques - Durban	Repaired 25th ulto				Repaired 25th ulto	
2429	01/04/1898	Gibraltar - Tangiers	Repaired 28th ulto				Repaired 28th ulto	
2430	01/04/1898	Odessa - Constantinopal	Interrupted 28th ulto				Interrupted 28th ulto	
2431	08/04/1898	Odessa - Constantinopal	Repaired 1st inst				Repaired 1st inst	
2432	15/04/1898	Sierra Leone - Accra	Interrupted 9th inst				Interrupted 9th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2433	15/04/1898	Bissau - Balloma	Interrupted again 12th inst				Interrupted again 12th inst	
2434	15/04/1898	Cape Town - Mossamedes	Interrupted 14th inst				Interrupted 19th inst	
2435	22/04/1898	Sierra Leone - Accra	Repaired 19th inst				Repaired 19th inst	
2436	22/04/1898	Maranham - Para	Interrupted 17th inst				Interrupted 17th inst	
2437	22/04/1898	Benguela - Mossamedes	Interrupted 20th inst				Interrupted 20th inst	
2438	28/04/1898	Le Havre cable	Repaired 2nd inst	Repaired 2nd inst		CS Mirror		
2439	28/04/1898	Bombay - Aden No 1	Interrupted 24th inst	Interrupted 24th inst near Bombay. CS Patrick Stewart of the Indo-European Telegraph Dept to repair		CS Patrick Stewart		
2440	29/04/1898	Lataki - Cyprus	Interrupted 10th Feb				Interrupted 10th Feb	
2441	29/04/1898	Cayenne - Pinheiro	Intewrrupted 24th ulto				Interrupted 24th ulto	
2442	29/04/1898	Bissau - Balloma	Interrupted 12th inst				Interrupted 12th inst	
2443	29/04/1898	Cape Town - Mossamedes	Interrupted 14th inst				Interrupted 14th inst	
2444	29/04/1898	Maranham - Para No 1	Interrupted 17th inst				Interrupted 17th inst	
2445	29/04/1898	Kotonou - San Thome	Interrupted 27th inst				Interrupted 27th inst	
2446	06/05/1898	Hong Kong - Manila	Interrupted 3rd inst				Interrupted 3rd inst	
2447	06/05/1898	San Thome - Loanda	Interrupted 4th inst				Interrupted 4th inst	
2448	12/05/1898	Gibraltar - Malta No 1	Repaired 11th inst	Repaired 11th inst by CS Chiltern		CS Chiltern		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2449	12/05/1898	Malta - Alexandria No 2	Interrupted	Interrupted, CS Electra to repair		CS Electra		
2450	12/05/1898	Aden - Bombay No 1	Repaired 29th ulto	Repaired 29th ulto by CS John Pender		CS John Pender		
2451	13/05/1898	Monte Video - Rio Grande	Interrupted 9th inst				Interrupted 9th inst	
2452	20/05/1898	Cayenne - Pinheiro	Repaired 14th inst				Repaired 14th inst	
2453	20/05/1898	San Thome - Loanda	Repaired 14th inst				Repaired 14th inst	
2454	20/05/1898	Monte Video - Rio Grande	Repaired 18th inst				Repaired 18th inst	
2455	20/05/1898	Laurenco Marques - Durban	Interrupted 14th inst				Interrupted 14th inst	
2456	20/05/1898	Zanzibar - Mombassa	Interrupted 18th inst				Interrupted 18th inst	
2457	26/05/1898	Cable off Le Havre (Commercial Cable Co)	Repaired 16th inst	Repaired 16th inst by CS Mirror		CS Mirror		
2458	26/05/1898	Emden - Vigo	Interrupted 18th inst. Repaired 20th inst	Interrupted 18th inst. Repaired 20th inst by CS Electra		CS Electra		
2459	26/05/1898	Malta - Alexandria No 2	Found to be in very bad condition	Found to be in very bad condition with several faults by CS Electra		CS Electra		
2460	26/05/1898	Suez - Suakin No 1	Repaired 18th inst	Repaired 18th inst by CS Amber		CS Amber		
2461	27/05/1898	Kotonou - San Thome	Repaired 25th inst				Repaired 25th inst	
2462	27/05/1898	Laurenco Marques - Durban	Repaired 20th inst				Repaired 20th inst	
2463	03/06/1898	Zanzibar - Mombassa	Repaired 30th ulto				Repaired 30th ulto	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2464	09/06/1898	Weston-Super-Mare - Waterlooville (Commercial Cable Co)	Interrupted	Interrupted. To be repaired by CS Mirror		CS Mirror		
2465	09/06/1898	Porthcurno - Lisbon	Interrupted	Interrupted. To be repaired by CS Mirror		CS Mirror		
2466	09/06/1898	Alexandriaandra - Malta No 2	Under repair	Under repaire by CS Electra		CS Electra		
2467	10/06/1898	Loanda - St Thome	Interrupted 3rd inst				Interrupted 3rd inst	
2468	17/06/1898	Mozambique-Laurenco Marques	Interrupted 14th inst				Interrupted 14th inst	
2469	23/06/1898	Weston-Super-Mare - Waterlooville (Commercial Cable Co)	Repaired 12th inst	Repaired 12th inst by CS Mirror		CS Mirror		
2470	23/06/1898	Porthcurno - Lisbon No2	Repaired 17th inst	Repaired 17th inst by CS Mirror		CS Mirror		
2471	23/06/1898	Malta - Alexandria N o 2	Interrupted	18nm gap of rotted cable found by CS Electra		CS Electra		
2472	23/06/1898	Suakin - Perim No 1	Repaired 23rd inst	Repaired 23rd inst by CS Amber		CS Amber		
2473	23/06/1898	Aden - Perim No 2	Interrupted	Interrupted CS Amber to repair		CS Amber		
2474	23/06/1898	Boloma T-piece off Seirra Leone cable	Repaired	Repaired by CS John Pender		CS John Pender		
2475	24/06/1898	Mozambique - Lorenco Marques	Repaired 20th inst				Repaired 20th inst	
2476	01/07/1898	Ceara - Pernambuco	Interrupted 28th ulto				Interrupted 28th ulto	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2477	01/07/1898	Laurenco Marques - Durban	Interrupted 30th ulto				Interrupted 30th ulto	
2478	07/07/1898	Falmouth - Bilbao Cable (Direct Spanish)	Repaired 23rd ulto	Repaired 23rd ulto byCS Mirror		CS Mirror		
2479	07/07/1898	Malta - Alexandria No 2	Gap now found to be 108nm	Gap now found to be 108nm		CS Electra		
2480	07/07/1898	Perim - Suakin No 2	Repaired 24th ulto	Repaired 24th ulto by CS Amber		CS Amber		
2481	08/07/1898	Loanda - St Thome	Repaired 2nd inst				Repaired 2nd inst	
2482	08/07/1898	Ceara - Pernambuco	Repaired 2nd inst				Repaired 2nd inst	
2483	15/07/1898	Laurenco Marques - Durban	Repaired 8th inst				Repaired 8th inst	
2484	15/07/1898	Bilbao - Falmouth	Repaired 13th inst	Repaired by CS Mirror 14th inst			Repaired 13th inst	
2485	21/07/1898	Alexandria - Malta No 1	Under repair	Under repair by CS Electra		CS Electra		
2486		Gibraltar - Lisbon No 1	Repaired 15th inst	Repaired 15th by CS John Pender		CS John Pender		
2487	22/07/1898	Maranham - Para	(interrupted 17/04/1898) Repaired 15th inst				(interrupted 17/04/1898) Repaired 15th inst	
2488	22/07/1898	Bissau - Balloma	Interrupted 21st inst				Interrupted 21st inst	
2489	12/08/1898	Accra - Ketonou	Interrupted 8th inst				Interrupted 8th inst	
2490	12/08/1898	Cape Town - Mossamedes	Interrupted 2nd inst				Interrupted 2nd inst	
2491	19/08/1898	Cape Town - Mossamedes	Repaired 12th inst				Repaired 12th inst	
2492	19/08/1898	Cape St James - Hong Kong	Interupted 13th inst				Interrupted 13th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2493	26/08/1898	Hong Kong - Manila	Repaired 21st inst				Repaired 21st inst	
2494	02/09/1898	Cape St James - Hong Kong	Repaired 31st ulto				Repaired 31st ulto	
2495	23/09/1898	Lataki - Cyprus	Repaired 15th inst				Repaired 15th inst	
2496	23/09/1898	Seychelle - Mauritius	Interrupted 18th inst				Interrupted 18th inst	
2497	29/09/1898	Lisbon - Porthcurno Direct	Repaired 22nd ulto	Repaired 22nd ulto by CS Chiltern		CS Chiltern		
2498	29/09/1898	Alexandria - Malta No 2	Repaired 11th ulto and fault repaired 24th ulto	Repaired 11th ulto and fault repaired 24th ulto by CS Electra		CS Electra		
2499	29/09/1898	Suez - Aden No 3	Repaired 12th ulto	Repaired 12th ulto by CS Amber		CS Amber		
2500	29/09/1898	Port Said - Alexandria	Repaired 24th ulto	Repaired 24th ulto by CS Amber		CS Amber		
2501	07/10/1898	Seychelle - Mauritius	Repaired 1st inst				Repaired 1st inst	
2502	13/10/1898	Suez - Suakin No 1	Repaired 2nd inst	Repaired 2nd inst by CS Chiltern		CS Chiltern		
2503	13/10/1898	Suez - Suakin No 2	Repaired 7th inst	Repaired 7th inst by CS Chiltern		CS Chiltern		
2504	13/10/1898	Malta - Tripoli	Repaired 12th inst	Repaired 12th inst by CS Amber		CS Amber		
2505	13/10/1898	Le Havre cable	Repaired 8th inst	Repaired 8th inst by CS Electra		CS Electra		
2506	14/10/1898	Accra - Ketonou	Repaired 27th ulto				Repaired 27th ulto	
2507	21/10/1898	St Louis - Noronha	Interrupted 17th inst				Interrupted 17th inst	
2508	27/10/1898	Perim - Aden No 1	Repaired 15th inst	Repaired 15th inst by CS Chiltern		CS Chiltern		
2509	27/10/1898	Marsailles - Bona	Repaired 17th inst	Repaired 17th inst by CS Amber		CS Amber		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2510	27/10/1898	Alexandria - Malta No 2	Repaired 23rd inst	Repaired 23rd inst by CS Amber		CS Amber		
2511	11/11/1898	Gibraltar - Tangiers	Interrupted 4th inst				Interrupted 4th inst	
2512	18/11/1898	Bissau - Balloma	Repaired 17th inst				Repaired 17th inst	
2513	18/11/1898	Ceara - Maranham	Interrupted 15th inst				Interrupted 15th inst	
2514	18/11/1898	Gibraltar - Malta No 1	Repaired 2nd inst	Repaired 2nd inst by CS Mirror		CS Mirror		
2515	18/11/1898	Gibraltar - Tangiers	Repaired 3rd inst	Repaired 3rd inst by CS Mirror		CS Mirror		
2516	18/11/1898	Gibraltar - Lisbon No 2	Repaired 8th inst	Repaired 8th inst by CS Mirror		CS Mirror		
2517	18/11/1898	Suez - Aden No 3	Repaired 9th inst	Repaired 9th inst by CS Chiltern		CS Chiltern		
2518	23/11/1898	Salcombe - Brignogan	Repairs		NMM TCM/9/51 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Salcombe - Brignogan, BRITANNIA, 23 - 29 November 1898	CS Britannia		
2519	24/11/1898	Porthcurno - Lisbon Direct	Repaired 20th inst	Repaired 20th inst by CS Mirror		CS Mirror		
2520	24/11/1898	Aden - Bombay No 2	Repaired 20th inst	Repaired 20th inst by CS Chiltern		CS Chiltern		
2521	24/11/1898	Alexandria -Port Said	Repairs		NMM TCM/9/52 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Alexandria -Port Said, ANGLIA, 24 - 25 November 1899	CS Anglia		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2522	25/11/1898	Pernambuco - Ceara	Repaired 22nd inst				Repaired 22nd inst	
2523	08/12/1898	Western Union Teleg Co Cable	Interrupted 94 miles for Sennes	Interrupted 94nm from Sennes. To be repaired under charter by CS Amber		CS Amber		
2524	08/12/1898	Bona - Malta No 1	Repaired 5th inst	Repaired 5th inst by CS Mirror		CS Mirror		
2525	08/12/1898	Perim Suakin Nos 1 & 2	Under repair	Under repair by CS Chilern		CS Chiltern		
2526	16/12/1898	St Louis - Noronha	Repaired 12th inst				Repaired 12th inst	
2527	29/12/1898	Valentia - Greetsiel	Repairs		NMM TCM/8/76 CABLE ENGINEERS' LOGBOOKS. Valentia - Greetsiel, BRITANNIA, 29 December 1898 - 4 February 1899; TCM/9/54 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Greetsiel - Valentia, BRITANNIA, 29 December 1898 - 4 February 1899	CS Britannia		
2528	05/01/1899	Western Union Teleg Co Cable	Repaired 15th ulto	Repaired 15th ulto by CS Electra		CS Electra		
2529	05/01/1899	Salina - Lipani (Italian Govt)	Repaired 8th ulto	Repaired 8th ulto by CS Mirror		CS Mirror		
2530	05/01/1899	Gibraltar - Cadiz	Repaired 16th ulto	Repaired 16th inst by CS Mirror		CS Mirror		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2531	05/01/1899	Perim - Assab	Repaired 26th ulto	Repaired 26th ulto by CS Chiltern		CS Chiltern		
2532	05/01/1899	Perim - Suakin No 1	Repaired 1st inst	Repaired 1st by CS by 28th ulto		CS Chiltern		
2533	05/01/1899	Perim - Obock	Shorend repaired	Shorend repaired by CS Chiltern		CS Chiltern		
2534	19/01/1899	Porthcurno - Carcavellos Direct	Interrupted 6th inst	Interrupted 6th inst. 170nm from Porthcurno. Rough weather delaying repaired by CS Mirror		CS Mirror		
2535	19/01/1899	Perim - Suakin No 2	Fault repaired 10th inst	Fault repaired 10th inst by CS Chiltern		CS Chiltern		
2536	02/02/1899	Porthcurno - Carcavellos Direct	Repaired 29th ulto	Repaired 29th ulto by CS Mirror		CS Mirror		
2537	02/02/1899	Perim - Suakin No 1	Fault repaired 25th ulto	Fault repaired 25th ulto by CS Chiltern		CS Chiltern		
2538	10/02/1899	Para - Maranham	Repaired 4th inst				Repaired 4th inst	
2539	10/02/1899	Dakar - Bathurst	Interrupted 9th inst				Interrupted 9th inst	
2540	16/02/1899	Suez - Suakin No 1	Repaired 5th inst	Repaired 5th inst by CS Chiltern		CS Chiltern		
2541	16/02/1899	Suez - Suakin No 2	Repaired 15th inst	Repaired 15th inst by CS Chiltern		CS Chiltern		
2542	17/02/1899	Paramaribo - Cayenne	Interrupted 10th inst				Interrupted 10th inst	
2543	17/02/1899	Valentia - Greetsie	Repairs		NMM TCM/8/77 CABLE ENGINEERS' LOGBOOKS.Valentia - Greetsiel, BRITANNIA, 11 - 17 February 1899	CS Britannia		
2544	02/03/1899	Vigo - Caminha	Repaired 16th ulto	Repaired 16th ulto by CS Mirror		CS Mirror		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2545	02/03/1899	Lisbon - Porthcurno Direct	Repaired 22nd ulto	Repaired 22nd ulto by CS Mirror		CS Mirror		
2546	02/03/1899	Cadiz - Gibraltar	Repaired 24th ulto	Repaired 24th ulto by CS Mirror		CS Mirror		
2547	02/03/1899	Suez - Suakin No 1	2 faults repaired 19th & 20th ulto	2 faults repaired 19th & 20th ulto by CS Chiltern but 3 faults remain. However signals good		CS Chiltern		
2548	17/03/1899	Cayenne - Pinheiro	Interrupted 10th inst				Interrupted 10th inst	
2549	24/03/1899	Dakar - Bathurst	Repaired 15th inst				Repaired 15th inst	
2550	13/04/1899	Emden - Vigo	Interrupted 12th inst	Interrupted 12th inst 12nm from Dunginess. CS Electra to repair		CS Electra		
2551	13/04/1899	Gibraltar - Cadiz	Repaired 28th ulto	Repaired 28th ulto by CS Mirror		CS Mirror		
2552	13/04/1899	Suez - Suakin No 1	Repaired 12th inst	Repaired 12th inst by CS Chiltern		CS Chiltern		
2553	14/04/1899	Paramaribo - Cayenne	Repaired 10th inst				Repaired 10th inst	
2554	14/04/1899	Maranham - Para	Interrupted 10th inst				Interrupted 10th inst	
2555	27/04/1899	Emden - Vigo	Repaired 17th inst	Repaired 17th inst by CS Electra		CS Electra		
2556	27/04/1899	Perim - Suakin No 2	Interrupted	Interrupted, CS Chiltern to repair		CS Chiltern		
2557	12/05/1899	Cayenne - Para	Repaired 2nd inst				Repaired 2nd inst	
2558	12/05/1899	Ilolla- Bacolod	Interrupted 5th inst				Interrupted 5th inst	
2559	26/05/1899	Ilolla- Bacolod	Repaired 21st inst				Repaired 21st inst	
2560	02/06/1899	Laurenco Marques - Mozambique	Interrupted 26th ulto				Interrupted 26th ulto	
2561	08/06/1899	Gibraltar - Lisbon No 1	Repaired 2nd inst	Repaired 2nd inst by CS Mirror		CS Mirror		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2562	08/06/1899	Gibraltar - Malta No 1	Repaired 7th inst	Repaired 7th inst by CS Mirror		CS Mirror		
2563	08/06/1899	Gibraltar - Lisbon No 2	Repaired 2nd inst	Repaired 2nd inst by CS Mirror		CS Mirror		
2564	08/06/1899	Gibraltar - Malta No 1	Repaired 7th inst	Repaired 7th inst by CS Mirror		CS Mirror		
2565	08/06/1899	Suez - Suakin No 2	Repaired 16th ulto	Repaired 16th ulto by CS Chiltern		CS Chiltern		
2566	08/06/1899	Suez - Suakin No 1	Fault repaired 19th ulto	Fault repaired 19th ulto by CS Chiltern		CS Chiltern		
2567	08/06/1899	Suez - Aden No 3	Repaired 22nd ulto	Repaired 22nd ulto by CS Chiltern		CS Chiltern		
2568	08/06/1899	Aden - Bombay No 2	Fault but repair delayed until after Monsoon	Fault but repair delayed until after Monsoon. To be repaired by CS Chiltern		CS Chiltern		
2569	09/06/1899	Bonny - Carcavellos	Interrupted 29th ulto				Interrupted 29th ulto	
2570	16/06/1899	Laurenco Marques - Mozambique	Repaired 9th inst				Repaired 9th inst	
2571	22/06/1899	Madiera - St Vincent No 1	Interrupted	Interrupted. To be repaired by CS Electra		CS Electra		
2572	22/06/1899	Caminha - Vigo	Fault	Fault				
2573	22/06/1899	Suakin - Perim No 1	2 faults repaired 12th inst	2 faults repaired 12th inst by CS Chiltern		CS Chiltern		
2574	23/06/1899	Lataki - Cyprus	Interrupted 21st inst				Interrupted 21st inst	
2575	06/07/1899	St Vincent - Madiera	Repaired 25th ulto	Repaired 25th ulto by CS Mirror		CS Mirror		
2576	06/07/1899	Carminha - Vigo	Repaired 30th ulto	Repaired 30th ulto by CS Electra		CS Electra		
2577	06/07/1899	Gibraltar - Malta No 1	To be repaired	To be repaired by CS Electra		CS Electra		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2578	06/07/1899	Suez - Suakin No 1	Fault repaired 1st inst	Fault repaired 1st inst by CS Chiltern. Further fault to be repaired		CS Chiltern		
2579	07/07/1899	Jamaica - Colon	Interrupted 1st inst				Interrupted 1st inst	
2580	20/07/1899	Gibraltar - Malta No 1	Repaired 13th inst	Repaired 13th inst by CS Chiltern		CS Chiltern		
2581	28/07/1899	"Commercial Cable Co's cable"	Repaired 3rd inst	Repaired 3rd inst by CS Mirror		CS Mirror		
2582	28/07/1899	"Western Union's cable"	Repaired 24th inst	Repaired 24th inst by CS Mirror		CS Mirror		
2583	28/07/1899	Lisbon - Gibraltar No 1	Repaired 20th inst	Repaired 20th inst by CS Electra		CS Electra		
2584	28/07/1899	Porthcurno - Gibraltar No 2	Fault repaired	Fault repaired by CS Electra		CS Electra		
2585	28/07/1899	Tenareffe - Tangier	Repaired 23rd inst	Repaired 23rd inst by CS Electra		CS Electra		
2586	28/07/1899	Maranham - Ceara	Interrupted 25th inst				Interrupted 25th inst	
2587	04/08/1899	Boloma - Bissau	Interrupted 28th ulto				Interrupted 28th ulto	
2588	04/08/1899	Accra - Grand Bassam	Interrupted 28th ulto				Interrupted 28th ulto	
2589	18/08/1899	Maranham - Ceara	Repaired 15th inst				Repaired 15th inst	
2590	18/08/1899	Florida - Bahama	Interrupted 14th inst				Interrupted 14th inst	
2591	18/08/1899	Jamaica - Porto Rico	Interrupted 15th inst				Interrupted 15th inst	
2592	25/08/1899	Bonny - Camaroons	Repaired 21st inst				Repaired 21st inst	
2593	25/08/1899	Florida - Bahama	Repaired 16th inst				Repaired 16th inst	
2594	25/08/1899	Jamaica - Porto Rico	Repaired 22nd inst				Repaired 22nd inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2595	01/09/1899	Maranham - Para	Repaired 25th ulto				Repaired 25th ulto	
2596	01/09/1899	Serena - Valparaiso	Repaired 25th ulto				Repaired 25th ulto	
2597	08/09/1899	Accra - Grand Bassam	Interrupted 1st inst				Interrupted 1st inst	
2598	15/09/1899	Accra - Grand Bassam	Repaired 8th inst				Repaired 8th inst	
2599	15/09/1899	Sheik Seyd - Perim	Interrupted 3rd inst				Interrupted 3rd inst	
2600	22/09/1899	Jamaica - Colon	Repaired 13th inst				Repaired 13th inst	
2601	22/09/1899	Boloma - Bissau	Repaired 19th inst				Repaired 19th inst	
2602	22/09/1899	Sheik Seyd - Perim	Repaired 17th				Repaired 17th inst	
2603	27/09/1899	Suez - Suakin No 1	Repaired 30th ulto	Repaired 30th ulto by CS Chiltern		CS Chiltern		
2604	27/09/1899	Aden No 1	Repaired 6th inst	Repaired 6th inst by CS Chiltern		CS Chiltern		
2605	27/09/1899	Aden No 2	Repaired 10th inst	Repaired 10th by CS Chiltern		CS Chiltern		
2606	27/09/1899	Sheik Seyd - Perim	Repaired 14th inst	Repaired 14th inst by CS Chiltern		CS Chiltern		
2607	27/09/1899	Suakin - Perim No 1	Interrupted	Interrupted				
2608	27/09/1899	BSTC No 2	Interrupted 27th inst	Interrupted 27th inst near St Vincent				
2609	27/09/1899	Aden - Bombay No 2	Repaired 24th ulto and 12th inst	Repaired 24th ulto and 12th inst		CS Chiltern		
2610	12/10/1899	Aden - Bombay No 2	Repaired 9th inst	Repaired 9th inst by CS Chiltern		CS Chiltern		
2611	12/10/1899	Madiera - St Vincent (BSTCo)	Repaired 3rd inst	Repaired 3rd inst by CS Amber		CS Amber		
2612	13/10/1899	Cayenne - Pinheiro	Interrepted 11th inst				Interrupted 11th inst	
2613	13/10/1899	Bilbao - Falmouth	Interrupted 12th inst				Interrupted 12th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2614	20/10/1899	Bilbao - Falmouth	Repaired 19th inst				Repaired 19th inst	
2615	26/10/1899	Falmouth - Bilbao Cable (Direct Spanish)	Repaired 18th inst	Repaired 18th inst by CS Mirror		CS Mirror		
2616	26/10/1899	Tangier Cable	Repair abandoned because of bad weather	Repair by CS Electra abandoned because of rough weather		CS Electra		
2617	27/10/1899	Para - Maranham	Interrupted 20th inst				Interrupted 20th inst	
2618	03/11/1899	Para - Maranham	Repaired 28th ulto				Repaired 28th ulto	
2619	03/11/1899	Zanzibar - Mombassa	Interrupted 27th ulto				Interrupted 27th ulto	
2620	03/11/1899	Laurenco Marques - Mozambique	Interrupted 31st ulto				Interrupted 31st ulto	
2621	09/11/1899	Waterville - Le Havre	Under repair	Under repair by CS Mirror but delayed by bad weather		CS Mirror		
2622	09/11/1899	Gibraltar - Tangiers	Repaired 1st inst	Repaired 1st inst by CS Duplex		CS Duplex		
2623	09/11/1899	Mozambique - Delagoa Bay section of East Coast Cable	Interrupted 31st ulto	Interrupted 31st ulto. Under repair by CS Gt Northern		CS Gt Northern		
2624	09/11/1899	Mozambique - Zanzibar	Interrupted 8th inst	Interrupted 8th inst				
2625	17/11/1899	Interrupted 31st ulto	Repaired 15th inst				Repaired 15th inst	
2626	23/11/1899	Waterville - Le Havre	Repaired 18th inst	Repaired 18th inst by CS Mirror		CS Mirror		
2627	23/11/1899	Perim - Obock	Repaired 15th inst	Repaired 15th inst by CS Electra		CS Electra		
2628	23/11/1899	Suez - Aden No 3	Repaired 22nd inst	Repaired 22nd inst by CE Electra		CS Electra		
2629	23/11/1899	Suez - Suakin No 1	Under repair	Under repair by CS Electra		CS Electra		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2630	23/11/1899	Mozambique - Delagoa Bay section of East Coast Cable	Repaired 15th inst	Repaired 15th inst by CS Gt Northern		CS Gt Northern		
2631	01/12/1899	Aden - Zanzibar	Interrupted 26th ulto				Interrupted 26th ulto	
2632	07/12/1899	Waterville - Le Havre	Repaired 24th ulto	Repaired 24th ulto by CS Mirror		CS Mirror		
2633	07/12/1899	Suez - Suakin No 1	Repaired 24th ulto	Repaired 24th ulto by CS Electra		CS Electra		
2634	07/12/1899	Zanzibar - Mozambique	Under repair	Under repair by CS Chiltern		CS Chiltern		
2635	07/12/1899	Aden - Zanzibar	Interrupted 25th ulto. Repaired 3rd inst	Interrupted 25th ulto. Repaired 3rd inst by CS Chiltern		CS Chiltern		
2636	08/12/1899	Aden - Zanzibar	Repaired 3rd inst				Repaired 3rd inst	
2637	15/12/1899	St Thome - Loanda	Interrupted 11th inst				Interrupted 11th inst	
2638	21/12/1899	Perim - Aden No 2	Repaired 9th inst	Repaired 9th inst by CS Electra		CS Electra		
2639	21/12/1899	Obok - Djubouti	Repaired 14th inst	Repaired 14th inst by CS Electra		CS Electra		
2640	21/12/1899	Zanzibar - Mozambique	Repaired 15th inst	Repaired 15th inst by CS Chiltern		CS Chiltern		
2641	21/12/1899	Delgoa Bay - Mozambique	Interrupted 17th inst	Interrupted 17th inst by by cyclone. CS Gt Northern to repair		CS Gt Northern		
2642	22/12/1899	St Thome - Loanda	Repaired 15th inst				Repaired 15th inst	
2643	22/12/1899	Laurenco Marques - Mozambique	Interrupted 17th inst				Interrupted 17th inst	
2644	05/01/1900	Gibraltar - Tangiers	Interrupted 31st ulto				Interrupted 31st ulto	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2645	12/01/1900	Gibraltar - Tangiers	Repaired 3rd inst				Repaired 3rd inst	
2646	12/01/1900	Tangier - Terifa	Interrupted 3rd inst				Interrupted 3rd inst	
2647	12/01/1900	Iqueique - Valparaiso	Interrupted 9th inst				Interrupted 9th inst	
2648	12/01/1900	Serena - Valparaiso	Interrupted 9th inst				Interrupted 9th inst	
2649	18/01/1900	Gibraltar - Tangier (see above)	Repaired 3rd inst	Repaired 3rd inst by CS Duplex		CS Duplex		
2650	18/01/1900	Gibraltar - Cadiz	Repaired 9th inst	Repaired 9th inst by CS Duplex		CS Duplex		
2651	18/01/1900	Malta - Bona No 1	Repaired 15th inst	Repaired 15th inst		CS Duplex		
2652	18/01/1900	Perim - Suakin No 2	Repaired 23rd ulto	Repaired 23rd ulto by CS Electra		CS Electra		
2653	19/01/1900	Zanzibar - Mombassa	Repaired 13th inst				Repaired 13th inst	
2654	26/01/1900	Iqueique - Valparaiso	Repaired 19th inst				Repaired 19th inst	
2655	01/02/1900	Bona - Malta No 2	Under repair	Under repair by CS Duplex but deleyed by bad weather		CS Duplex		
2656	02/02/1900	Laurenco Marques - Mozambique	Repaired 12th ulto				Repaired 12th ulto	
2657	02/02/1900	Tangier - Terifa	Interrupted 3rd ulto				Interrupted 3rd ulto	
2658	02/02/1900	Serena - Valparaiso	Repaired 26th ulto				Repaired 26th ulto	
2659	02/02/1900	St Thome - Loanda	Repaired 31st ulto				Repaired 31st ulto	
2660	15/02/1900	Madiera - St Vincent No 2	Under repair	Under repair by CS Mirror		CS Mirror		
2661	15/02/1900	Bona - Malta No 2	Repaired 4th inst	Repaired 4th inst by CS Duplex		CS Duplex		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2662	15/02/1900	Gibraltar - Malta No 1	Under repair	Under repair by CS Duplex but bad weather		CS Duplex		
2663	15/02/1900	Perim - Aden No 2	Repaired 8th inst	Repaired 8th inst by CS Electra		CS Electra		
2664	15/02/1900	Perim - Suakin No 1	Repaired 14th inst	Repaired 14th inst by CS Electra		CS Electra		
2665	22/02/1900	Penzance - Brignogan	Repairs		NMM TCM/8/78 CABLE ENGINEERS' LOGBOOKS. Penzance - Brignogan, BRITANNIA, 10 - 22 February 1900	CS Britannia		
2666	23/02/1900	Paramaribo - Cayenne	Interrupted 16th inst				Interrupted 16th inst	
2667	23/02/1900	Caera - Maranham	Interrupted 20th inst				Interrupted 20th inst	
2668	01/03/1900	Madiera - St Vincent No 2	Repaired 19th ulto	Repaired 19th ulto by CS Mirror		CS Mirror		
2669	01/03/1900	Gibraltar - Malta No 1	Repaired 23rd ulto	Repaired 23rd ulto by CS Duplex		CS Duplex		
2670	01/03/1900	Gibraltar - Tangiers	Repaired 26th ulto	Repaired 26th ulto by CS Duplex		CS Duplex		
2671	01/03/1900	Assab - Massowah	Repaired 20th ulto	Repaired 20th ulto by CS Electra		CS Electra		
2672	01/03/1900	Aden - Bombay No 2	Under repair	Under repair by CS Electra		CS Electra		
2673	01/03/1900	2 Straits of Messena Cables	Interrupted	Interrupted. To be repaired by Italian CS Citta de Melano		CS Citta de Melano		
2674	09/03/1900	Mole - St Nicholas - Cap Haiten	Interrupted 3rd inst				Interrupted 3rd inst	
2675	15/03/1900	Porthcurno - Vigo	Under repair	Under repair by CS Mirror		CS Mirror		
2676	15/03/1900	Aden - Bombay No 2	Repaired 4th inst	Repaired 4th inst by CS Electra		CS Electra		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2677	15/03/1900	Mozambique - Delagoa Bay section of East Coast Cable	Under repair	Under repair by CS Chiltern		CS Chiltern		
2678	15/03/1900	Patras - Corinth	Interrupted	Interrupted. CS Chiltern to repair		CS Chiltern		
2679	16/03/1900	Hong Kong - Macao	Interrupted 6th inst. Repaired 11th inst				Interrupted 6th inst. Repaired 11th inst	
2680	16/03/1900	Jeddah - Suakin	Interrupted 13th inst				Interrupted 13th inst	
2681	29/03/1900	Porthcurno - Vigo	Under repair	Under repair but bad weather		CS Mirror		
2682	29/03/1900	Emden - Vigo	Interrupted	Interrupted				
2683	29/03/1900	Perim - Suakin No 2	Repaired 23rd inst	Repaired 23rd by CS Electra		CS Electra		
2684	29/03/1900	Jeddah - Suakin	Repaired	Repaired by Suakin Stn Staff. Given a 1 month bonus				
2685	30/03/1900	Jeddah - Suakin	Repaired 23rd inst				Repaired 23rd inst	
2686	06/04/1900	Emden - Vigo	Interrupted 26th ulto				Interrupted 26th ulto	
2687	06/04/1900	Trinidad - Demerara	Interrupted 30th ulto				Interrupted 30th ulto	
2688	13/04/1900	Emden - Vigo	Repaired 6th inst				Repaired 6th inst	
2689	20/04/1900	Manila - Iloilo	Interrupted 9th inst				Interrupted 9th inst	
2690	21/04/1899	Brest - St Pierre	Repairs		NMM TCM/8/79 CABLE ENGINEERS' LOGBOOKS.Brest - St Pierre, BRITANNIA, 17 March - 21 April 1900	CS Britannia		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2691	26/04/1900	Porthcurno - Vigo	Repaired 30th ulto	Repaired 30th ulto by CS Mirror		CS Mirror		
2692	26/04/1900	Emden - Vigo	Repaired 5th inst	Repaired 5th inst by CS Mirror		CS Mirror		
2693	26/04/1900	Sennen - Canso	Repaired 9th inst	Repaired 9th inst by CS Mirror		CS Mirror		
2694	26/04/1900	Porthcurno - Vigo	Another fault repaired 20th inst	Another fault repaired 20th inst by CS Mirror		CS Mirror		
2695	26/04/1900	Bona - Malta No 1	Repaired 16th inst	Repaired 16th by CS Duplex		CS Duplex		
2696	26/04/1900	Assab - Massowah	Repaired 6th inst	Repaired 6th by CS Electra		CS Electra		
2697	26/04/1900	Suez - Suakin No 1	Repaired 23rd inst	Repaired 23rd inst by CS Chiltern		CS Chiltern		
2698	10/05/1900	Perim - Suakin No 2	Repaired 5th inst	Repaired 5th inst by CS Electra		CS Electra		
2699	10/05/1900	Perim - Sheikh Seyd	Repaired 7th inst	Repaired 7th inst by CS Electra		CS Electra		
2700	10/05/1900	Levant cable (Rhodes Section)	Repaired 3rd inst	Repaired 3rd inst by CS Chiltern		CS Chiltern		
2701	10/05/1900	Peraeus - Kalomaki No 2	Repaired 5th inst	Repaired 5th inst by CS Chiltern		CS Chiltern		
2702	10/05/1900	Corinth - Petras	Repaired 8th inst	Repaired 8th inst by CS Chiltern		CS Chiltern		
2703	10/05/1900	Zante - Canea	Under repair	Under repair by CS Chiltern		CS Chiltern		
2704	11/05/1900	Trinidad - Demerara	Repaired 8th inst				Repaired 8th inst	
2705	11/05/1900	St Dominguez - Curac	Interrupted 6th inst				Interrupted 6th inst	
2706	18/05/1900	St Dominguez - Curac	Repaired 13th inst				Repaired 13th inst	
2707	24/05/1900	Zante - Canea	Under repair	Under repair by CS Chiltern		CS Chiltern		
2708	25/05/1900	St Thome - Loanda	Interrupted 20th inst				Interrupted 23rd inst	
2709	01/06/1900	Manila - Iloilo	Repaired 29th ulto				Repaired 29th ulto	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2710	08/06/1900	Durban - Delgoa Bay	Interrupted 31st ulto				Interrupted 31st ulto	
2711	15/06/1900	St Thome - Loanda	Repaired 11th inst				Repaired 11th inst	
2712	15/06/1900	Durban - Delgoa Bay	Repaired 10th inst				Repaired 10th inst	
2713	21/06/1900	Zante - Canea	Repaired 1st inst	Repaired 1st inst by CS Chiltern		CS Chiltern		
2714	21/06/1900	Malta - Alexandria No 2	Repaired 8th inst	Repaired 8th inst by CS Chiltern		CS Chiltern		
2715	21/06/1900	Aden - Bombay No 1	Repair delayed by Monsoon	Repair delayed by Monsoon		CS Electra		
2716	21/06/1900	Suez - Aden No 3	Interrupted	Interrupted. To be repaired by CS Electra		CS Electra		
2717	05/07/1900	Vigo - Caminha	Repaired 27th ulto	Repaired 27th ulto by CS Chiltern		CS Chiltern		
2718	05/07/1900	Gibraltar - Malta No 1	Repaired 15th ulto	Repaired 15th ulto by CS Amber		CS Amber		
2719	05/07/1900	Assab - Massowah	Repaired 26th ulto	Repaired 26th ulto by CS Electra		CS Electra		
2720	06/07/1900	Gibraltar - Tangiers	Interrupted 28th ulto				Interrupted 28th ulto	
2721	06/07/1900	Hong Kong - Macao	Interrupted 28th ulto				Interrupted 28th ulto	
2722	13/07/1900	Gibraltar - Tangiers	Repaired 5th inst				Repaired 5th inst	
2723	13/07/1900	Hong Kong - Macao	Repaired 9th inst				Repaired 9th inst	
2724	19/07/1900	Gibraltar - Malta No 1	Repaired again 19th inst	Repaired again 19th inst by CS Amber		CS Amber		
2725	19/07/1900	Bona - Malta	Repaired 19th inst	Repaired 19th inst by CS Amber		CS Amber		
2726	27/07/1900	Paramaribo - Cayenne	Repaired 19th inst				Repaired 19th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2727	17/08/1900	Serena - Valparaiso	Interrupted 2nd inst				Interrupted 2nd inst	
2728	17/08/1900	Iqueique - Valparaiso	Interrupted 2nd inst				Interrupted 2nd inst	
2729	24/08/1900	Serena - Valparaiso	Repaired 17th inst				Repaired 17th inst	
2730	24/08/1900	Iqueique - Valparaiso	Repaired 21st inst				Repaired 21st inst	
2731	21/09/1900	Cayenne - Pinheiro	(interrupted 11/10/18990 Repaired 17th inst				Repaired 17th inst	
2732	21/09/1900	Pernambuco - Para	Interrupted 19th ulto				Interrupted 19th ulto	
2733	27/09/1900	Porthcurno - Lisbon Direct	Repaired 11th inst	Repaired 11th inst by CS Mirror		CS Mirror		
2734	27/09/1900	Gibraltar - Tangiers	Repaired 30th July	Repaired 30th July bu CS Amber		CS Amber		
2735	27/09/1900	Gibraltar - Lisbon No 1	Repaired 9th inst	Repaired 9th inst by CS Amber		CS Amber		
2736	27/09/1900	Suez - Suakin No 1	Repaired 13th inst	Repaired 13th inst by CS Electra		CS Electra		
2737	27/09/1900	Messena Straits Cable	Repaired 10th August	Repaired 10th August by CS Cita di Melano		CS Cita di Melano		
2738	28/09/1900	Zanzibar - Mombassa	Interrupted 20th inst				Interrupted 20th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2739	30/09/1900	St Vincent - Pernambuco (1884)	Repairs		NMM TCM/8/80 CABLE ENGINEERS' LOGBOOKS. St Vincent - Pernambuco (1884), SCOTIA, 29 - 30 September 1900; TCM/9/55 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. St Vincent - Pernambuco (1884), SCOTIA, 29 - 30 September 1900	CS Scotia		
2740	05/10/1900	Pernambuco - Para	Repaired 28th ulto				Repaired 28th ulto	
2741	12/10/1900	Paramaribo - Cayenne	Interrupted 6th inst				Interrupted 6th inst	
2742	18/10/1900	Lisbon - Gibraltar No 1	Repaired 18th inst	Repaired 18th inst by CS Mirror		CS Mirror		
2743	18/10/1900	Vigo - Gibraltar	Repaired 8th inst	Repaired 8th inst by CS Amber		CS Amber		
2744	18/10/1900	Vigo - Caminha	Repaired 8th inst	Repaired 8th inst by CS Amber		CS Amber		
2745	18/10/1900	Perim - Suakin No 2	Bad Fault under repair	Bad fault under repair by CS John Pender		CS John Pender		
2746	25/10/1900	Lisbon - Gibraltar No 1	Repaired 18th inst	Repaired 18th inst by CS Mirror		CS Mirror		
2747	25/10/1900	Suez - Suakin No 1	Under repair	Under repair by CS Electra		CS Electra		
2748	25/10/1900	Aden - Bombay No1	Interrupted	Interrupted CS Electra to repair		CS Electra		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2749	26/10/1900	Cape St James - Saigon - Thuanan	Interrupted 23rd inst				Interrupted 23rd inst	
2750	02/11/1900	Cape St James - Saigon - Thuanan	Repaired 28th ulto				Repaired 28th ulto	
2751	08/11/1900	Gibraltar - Tangiers	Fault repaired	Fault repaired 7th inst by CS Mirror		CS Mirror		
2752	08/11/1900	Vigo - Caminha	Interrupted	Interrupted near Vigo				
2753	08/11/1900	Suez - Suakin No 1	"very bad condition"	Bad weather. Cable in very bad condition. Unable to lift. CS Electra		CS Electra		
2754	08/11/1900	Aden - Bombay No 1	Interrupted	Interrupted. To be repaired by CS Electra		CS Electra		
2755	08/11/1900	Perim - Suakin No 2	Interrupted	Interrupted. To be repaired by CS John Pender after 25nm new cable retrieved in attempt to repair No1		CS John Pender		
2756	08/11/1900	Aden - Zanzibar	Interrupted	Interrupted. To be repaired by CS John Pender		CS John Pender		
2757	16/11/1900	Ceara - Maranham	(Interrupted 20/2/1900) Repaired 13th inst				(Interrupted 20/2/1900) Repaired 13th inst	
2758		Havre - Waterville	Interrupted 8th inst				Interrupted 8th inst	
2759		Aden - Zanzibar	Interrupted 9th inst				Interrupted 9th inst	
2760	22/11/1900	Havre - Waterville	Under repair	Under repair but weather very bad. CS Amber		CS Amber		
2761	22/11/1900	Falmouth - Bilbao Cable (Direct Spanish)	Interrupted	Interrupted				
2762	22/11/1900	Vigo - Caminha	Faulty	Faulty near Caminha. CS Mirror to repair		CS Mirror		
2763	22/11/1900	Carcavelos - Madiera No 1	Interrupted	Under repair but very bad weather. CS Mirror		CS Mirror		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2764	22/11/1900	Doro Channel Cable	Repaired 20th inst	Repaired 20th inst by SS Albania		SS Albania		
2765	22/11/1900	Chios - Tenedos	Interrupted	Interrupted				
2766	22/11/1900	Syra - Chios No 1	Faulty	Faulty				
2767	23/11/1900	Mole - St Nicholas - Cap Haiten	Repaired 14th inst (Interrupted 7/3/1900				Repaired 14th inst	
2768	23/11/1900	Paramaribo - Cayenne	Repaired 21st inst				Repaired 21st inst	
2769	23/11/1900	Falmouth - Bilbao Cable (Direct Spanish)	Repaired 19th inst				Repaired 19th inst	
2770	30/11/1900	Havre - Waterville	Repaired 21st inst				Repaired 21st inst	
2771	30/11/1900	Cayenne - Pinheiro	Interrupted 26th inst				Interrupted 26th inst	
2772	06/12/1900	Havre - Waterville	Repaired 22nd ulto	Repaired 22 ulto by CS Amber		CS Amber		
2773	06/12/1900	Aden - Bombay No1	Under repair	Under repair by CS Electra		CS Electra		
2774	06/12/1900	Carcavelos - Madiera No 1	Under repair	Under repair. Bad weather				
2775	06/12/1900	Aden - Zanzibar	Repaired 24th ulto	Repaired 24th ulto by CS John Pender		CS John Pender		
2776	06/12/1900	Perim - Suakin No 2	Interrupted	Interrupted. To be repaired by CS John Pender		CS John Pender		
2777	07/12/1900	Ceara - Pernambuco	Interrupted 29th ulto				Interrupted 29th ulto	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2778	12/12/1900	Borkum - Fayal (1900 Nos 1 & 2)	Repairs		NMM TCM/9/57 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Borkum - Fayal (1900 No1, No2), BRITANNIA, 15 November - 12 December 1900 TCM/8/81 CABLE ENGINEERS' LOGBOOKS. Borkum - Fayal, BRITANNIA, 15 November - 8 December 1900; TCM/8/82 CABLE ENGINEERS' LOGBOOKS. Borkum - Fayal, BRITANNIA, 8 December - 12 December 1900	CS Britannia		
2779	14/12/1900	Zanzibar - Mombassa	Repaired 9th inst (Interrupted 20/09/1900)				Repaired 9th inst	
2780	18/12/1900	Falmouth - Bilbao Cable (Direct Spanish)	Repaired	Repaired by CS Amber		CS Amber		
2781	18/12/1900	Vigo - Lisbon	Interrupted	Interrupted				
2782	18/12/1900	Perim - Suakin No 2	Repaired 14th inst	Repaired 14th inst by CS John Pender		CS John Pender		
2783	18/12/1900	Perim - Obock	Under repair	Under repair by CS John Pender		CS John Pender		
2784	18/12/1900	Suez - Aden No 1	Interrupted	Interrupted				

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2785	18/12/1900	Suez - Aden No 2	Faulty	Faulty				
2786	18/12/1900	Aden - Bombay No 1	Repaired 14th inst	Repaired 14th inst		CS Electra		
2787	18/12/1900	Syra - Chios No 1	Repaired	Repaired by CS Cilla di Milano		CS Cilla di Milano		
2788	21/12/1900	Falmouth - Bilbao Cable (Direct Spanish)	Repaired 19th inst				Repaired 19th inst	
2789	28/12/1900	Tangier - Terifa	Repaired 21st inst (Interrupted 3/1/1900)				Repaired 21st inst	
2790	04/01/1901	Boloma - Bissau	Interrupted 23rd ulto				Interrupted 23rd ulto	
2791	04/01/1901	Falmouth - Bilbao Cable (Direct Spanish)	Interrupted 28th ulto				Interrupted 28th ulto	
2792	07/01/1901	Atlantic (1874)	Repairs		NMM TCM/9/58 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Atlantic (1874), BRITANNIA, 3 - 7 January 1901; TCM/8/83 CABLE ENGINEERS' LOGBOOKS. Valentia - Hearts Content (1874), BRITANNIA, 3 - 11 January 1901	CS Britannia		
2793	11/01/1901	Boloma - Bissau	Repaired 6th inst				Repaired 6th inst	
2794	11/01/1901	Marseilles - Barcelona	Interrupted 7th inst				Interrupted 7th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2795	16/01/1901	Porthcurno - Lisbon Direct	Under repair	Under repair but in very bad condition and therefore delayed. CS Chiltern		CS Chiltern		
2796	16/01/1901	Vigo - Carcavelos	Repaired 28th ulto	Repaired 28th ulto by CS Amber		CS Amber		
2797	16/01/1901	Gibraltar - Lisbon	Repaired 31st ulto	Repaired 31st ulto by CS Amber		CS Amber		
2798	16/01/1901	Falmouth - Bilbao Cable (Direct Spanish)	Fault repaired 7th inst	Fault repaired 7th inst by CS Amber		CS Amber		
2799	16/01/1901	Lisbon - Madiera	Under repair	Under repair by CS Mirror. Very bad weather		CS Mirror		
2800	16/01/1901	Aden - Bombay No 1	Repaired 27th ulto	Repaired 27th ulto by CS Electra		CS Electra		
2801	16/01/1901	Perim - Obock	Repaired 21st ulto	Repaired 21st ulto by CS Electra		CS Electra		
2802	16/01/1901	Perim - Suakin No 1	Repaired 22nd ulto	Repaired 22nd ulto by CS John Pender		CS John Pender		
2803	16/01/1901	Perim - Suakin No 2	Repaired 9th inst	Repaired 9th inst by CS John Pender		CS John Pender		
2804	16/01/1901	Chios - Tenedos	Repaired 23rd ulto	Repaired 23rd ulto by CS Cilla di Milano		CS Cilla di Milano		
2805	16/01/1901	Sardinian Cable	Interrupted	Interrupted				
2806	16/01/1901	Marsailles - Barcelona (Direct Spanish)	Interrupted	Interrupted				
2807	16/01/1901	Malta - Alexandria Nos 1 & 2	Interrupted by gales	Interrupted by gales				
2808	18/01/1901	Shanghai - Foochow	Interrupted 16th inst				Interrupted 16th inst	
2809	18/01/1901	Shanghai - Amoy	Interrupted 17th inst				Interrupted 17th inst	
2810	25/01/1901	Havre - Waterville	Interrupted 19th inst				Interrupted 19th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2811	25/01/1901	Falmouth - Bilbao Cable (Direct Spanish)	Repaired 24th inst				Repaired 24th inst	
2812	28/01/1901	Porthcurno - Lisbon	Still under repair	Still under repair - bad weather		CS Chiltern		
2813	28/01/1901	Falmouth - Bilbao Cable (Direct Spanish)	Repaired 23rd inst	Repaired 23rd inst by CS Amber		CS Amber		
2814	28/01/1901	Havre - Waterville	Under repair	Under repair		CS Amber		
2815	28/01/1901	Madiera - St Vincent	Repaired 26th inst	Repaired 26th inst by CS Mirror		CS Mirror		
2816	28/01/1901	Malta - Alexandria No 1	Interrupted	Interrupted				
2817	28/01/1901	Malta - Alexandria No 2	Repaired	Repaired by station staff at Alexandria				
2818	28/01/1901	Port Said - Alexandria No 1	Interrupted	Interrupted 40nm from Alexandria				
2819	28/01/1901	Messena Straits Cable	Interrupted	Interrupted				
2820	28/01/1901	Emden - Vigo	Interrupted 27th inst	Interrupted 27th inst 100nm from Emden				
2821	28/01/1901	Sardinian Cable	Repaired	Repaired by CS Cilla di Milano		CS Cilla di Milano		
2822	28/01/1901	Marsailles - Barcelona (Direct Spanish)	Interrupted	Interrupted				
2823	01/02/1901	Malta- Tripoli	Interrupted 24th ulto				Interrupted 24th ulto	
2824	01/02/1901	Singapore - Banjoewangie	Interrupted 25th ulto				Interrupted 25th ulto	
2825	01/02/1901	Shanghai - Foochow	Repaired 23rd ulto				Repaired 23rd ulto	
2826	08/02/1901	Havre - Waterville	Repaired 2nd inst				Repaired 2nd inst	
2827	08/02/1901	Malta - Tripoli	Repaired 5th inst				Repaired 5th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2828	08/02/1901	Singapore - Banjoewangie	Repaired 1st inst				Repaired 1st inst	
2829	12/02/1901	Pernambuco - St Vincent (1874)	Repairs		NMM TCM/8/84 CABLE ENGINEERS' LOGBOOKS. Pernambuco - St Vincent (1874), ANGLIA, 31 January - 12 February 1901; TCM/9/59 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Pernambuco - St Vincent (1874), ANGLIA, 31 January - 12 February 1901	CS Anglia		
2830	13/02/1901	Canso - Waterville (Commercial Cable Co)	Repaired 5th inst	Repaired 5th inst by CS Chiltern		CS Chiltern		
2831	13/02/1901	Havre - Waterville	Interrupted again	Interrupted again . CS Chiltern to repair		CS Chiltern		
2832	13/02/1901	Porthcurno - Lisbon No 1	Repaired 1st inst	Repaired 1st inst by CS Mirror		CS Mirror		
2833	13/02/1901	Porthcurno - Lisbon No 2	Repaired 9th inst	Repaired 9th inst by CS Mirror		CS Mirror		
2834	13/02/1901	Emden - Azores (German Atlantic Company)	Interrupted	Interrupted Under repair by CS Mirror				
2835	13/02/1901	Emden - Vigo	Interrupted	Interrupted, CS Mirror to repair		CS Mirror		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2836	13/02/1901	Malta - Alexandria No 1	New shore end 30th ulto	New shore end installed 30th ulto by CS John Pender		CS John Pender		
2837	13/02/1901	Malta - Tripoli	Repaired 5th inst	Repaired 5th inst by CS John Pender		CS John Pender		
2838	13/02/1901	Malta - Alexandria No 2	Fault repaired 7th inst	Fault repaired 7th inst by CS John Pender		CS John Pender		
2839	13/02/1901	Marseilles - Barcelona	Under repair	Under repair		CS Cilla di Milano		
2840	13/02/1901	Port Said - Alexandria	Fault under repair	Fault under repair by CS Levant		CS Levant		
2841	13/02/1901	Perim - Aden No 2	Repaired 7th inst	Repaired 7th inst by CS Electra		CS Electra		
2842	15/02/1901	Fao - Bushire	Interrupted 6th inst				Interrupted 6th inst	
2843	15/02/1901	Havre - Waterville	Interrupted 13th inst				Interrupted 13th inst	
2844	22/02/1901	Fao - Bushire	Repaired 20th inst				Repaired 20th inst	
2845	22/02/1901	Havre - Waterville	Repaired 20th inst				Repaired 20th inst	
2846	27/02/1901	Havre - Waterville	Repaired 19th inst	Repaired 19th inst by CS Chiltern		CS Chiltern		
2847	27/02/1901	Brest - St Pierre	Interrupted	Interrupted				
2848	27/02/1901	Emden - Azores (German Atlantic Company)	Repaired 20th inst	Repaired 20th inst by CS Mirror		CS Mirror		
2849	27/02/1901	Messena Straits Cable	Repaired 21st inst	Repaired 21st inst by CS John Pender		CS John Pender		
2850	27/02/1901	Malta - Bona	Repaired 22nd inst	Repaired 22nd inst by CS John Pender		CS John Pender		
2851	27/02/1901	Alexandria -Port Said	Repaired 18th inst	Repaired 18th inst by CS Levant		CS Levant		
2852	27/02/1901	Oranto - Zante	Interrupted	Interrupted				
2853	27/02/1901	Perim - Suakin No 1	Repaired 15th inst	Repaired 15th inst by CS Electra		CE Electra		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2854	01/03/1901	Pinheiro - Cayenne	Repaired 27th ulto (interrupted 26/11/1900)				Repaired 27th ulto	
2855	01/03/1901	Shanghai - Amoy	Repaired 25th ulto				Repaired 25rh ulto	
2856	13/03/1901	Brest - St Pierre	Repaired 12th inst	Repaired 12th inst by CS Chiltern		CS Electra		
2857	13/03/1901	Aden - Bombay No 1	Interrupted	Interrupted				
2858	13/03/1901	Malta - Alexandria No 2	Faulty	Faulty				
2859	15/03/1901	Fao - Bushire	Interrupted 7th inst				Interrupted 7th inst	
2860	27/03/1901	Vigo - Caminha	Interrupted	Interrupted				
2861	27/03/1901	Aden - Bombay No 1	Repaired 25th inst	Repaired 25th inst by CS Electra		CS Electra		
2862	27/03/1901	Aden - Bombay No2	Fault	Fault 70nm from Aden				
2863	27/03/1901	Perim - Suakin No 1	Interrupted again	Interrupted again				
2864	29/03/1901	Perim - Obock	Interrupted 22st inst				Interrupted 22nd inst	
2865	05/04/1901	St Louis - Bathurst	Repaired 29th ulto				Repaired 29th ulto	
2866	05/04/1901	Sierra Leone - Conakry	Interrupted 2nd inst				Interrupted 2nd inst	
2867	12/04/1901	Bonny - Camaroons	Interrupted 31st ulto. Repaired 7th inst				Interrupted 31st ulto. Repaired 7th inst	
2868	12/04/1901	Marseilles - Barcelona	Repaired 9th inst				Repaired 9th inst	
2869	12/04/1901	Fao - Bushire	Repaired 11th inst				Repaired 11th inst	
2870	19/04/1901	Perim - Obock	Repaired 15th inst				Repaired 15th inst	
2871		Seirra Leone - Conakry	Repaired 16th inst				Repaired 16th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2872		Bali - Macassar	Interrupted 14th inst				Interrupted 14th inst	
2873	24/04/1901	Alexandria - Malta No 2	Repaired 9th inst	Repaired 9th inst by CS Mirror		CS Mirror		
2874	24/04/1901	Gibraltar - Malta No 1	Faulty	Fault to be repaired by CS Mirror		CS Mirror		
2875	24/04/1901	Marseilles - Barcelona	Repaired 7th inst	Repaired 7th inst by CS John Pender		CS John Pender		
2876	24/04/1901	Perim - Suakin No 1	Repaired 1st inst	Repaired 1st inst by CS Electra		CS Electra		
2877	24/04/1901	Aden - Bombay No 2	Fault repaired 8th inst	Fault repaired 8th inst by CS Electra		CS Electra		
2878	24/04/1901	Perim - Obock	Repaired 14th inst	Repaired 14th inst by CS Electra		CS Electra		
2879	24/04/1901	Aden - Bombay No 2	Interrupted; repaired 18th inst	Interrupted and repaired by CS Patrick Stewart of the Indo-European Teleg Dept on the 18th inst		CS Patrick Stewart		
2880	26/04/1901	Cayenne - Pinheiro	Interrupted 21st inst				Interrupted 21st inst	
2881	08/05/1901	Gibraltar - Malta No 1	Repaired 25th ulto	Repaired 25th ulto by CS Mirror		CS Mirror		
2882	22/05/1901	Porthcurno - Vigo	Interrupted 17th inst	Interrupted 17th inst 180nm from Porthcurno				
2883	24/05/1901	Boloma - Bissau	Interrupted 20th inst				Interrupted 20th inst	
2884	31/05/1901	Bali - Macassar	Interrupted 30th inst				Interrupted 30th inst	
2885	05/06/1901	Porthcurno - Vigo	Repaired 26th ulto	Repaired 26th ulto by CS John Pender		CS John Pender		
2886	14/06/1901	Gibraltar - Tangier	Interrupted 11th inst				Interrupted 11th inst	
2887	19/06/1901	Tangier Cable	Repaired 12th inst	Repaired 12th inst by CS Mirror		CS Mirror		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2888	19/06/1901	Cadiz - Gibraltar	Repaired 14th inst	Repaired 14th inst by CS Mirror		CS Mirror		
2889	19/06/1901	Cadiz - Gibraltar	Interrupted again 15th inst	Interrupted again 15th inst				
2890	21/06/1901	Gibraltar - Tangier	Repaired 13th inst				Repaired 13th inst	
2891	28/06/1901	Boloma - Bissau	Repaired 26th inst				Repaired 26th inst	
2892	03/07/1901	Gibraltar - Cadiz	Repaired 19th ulto	Repaired 19th ulto by CS Mirror		CS Mirror		
2893	03/07/1901	Gibraltar - Carcavelos No 1	Repaired 25th ulto	Repaired 25th ulto by CS Mirror		CS Mirror		
2894	03/07/1901	Gibraltar - Carcavelos No 1	Another fault	Another fault 200nm from Gibraltar. CS Mirror to repair		CS Mirror		
2895	03/07/1901	Perim - Aden No 2	Repaired 29th ulto	Repaired 29th ulto by CS Electra		CS Electra		
2896	03/07/1901	Suez - Suakin	REPLACED 25th ulto	REPLACED 25th ulto bt CS John Pender		CS John Pender		
2897	05/07/1901	Bali - Lombok	Interrupted 3rd inst				Interrupted 3rd inst	
2898	17/07/1901	Suez - Suakin No 1	Fault repaired 8th inst	Fault repaired 8th inst by CS John Pender		CS John Pender		
2899	19/07/1901	San Domingo - Curacao	Interrupted 12th inst				Interrupted 12th inst	
2900	19/07/1901	Bali - Lombok	Repaired 12th inst				Repaired 12th inst	
2901	02/08/1901	San Domingo - Curacao	Repaired 31st ulto				Repaired 31st ulto	
2902	02/08/1901	Anjer - Kaliander	Interrupted 30th ulto				Interrupted 30th ulto	
2903	02/08/1901	Trinidad - Demerara	Interrupted 30th ulto				Interrupted 30th ulto	
2904	09/08/1901	Anjer - Kaliander	Repaired 5th inst				Repaired 5th inst	
2905	09/08/1901	Trinidad - Demerara	Repaired 6th inst				Repaired 6th inst	
2906	09/08/1901	Cadiz - Tenariffe	Interrupted 6th inst				Interrupted 6th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2907	09/08/1901	Nase, Rinkin - Kelung, Formosa	Interrupted 2nd inst				Interrupted 2nd inst	
2908	23/08/1901	Cadiz - Tenariffe	Interrupted 6th inst				Interrupted 6th inst	
2909	23/08/1901	Boloma - Bissau	Interrupted 16th inst				Interrupted 16th inst	
2910	30/08/1901	Cayenne - Pinheiro	Repaired 26th inst				Repaired 26th inst	
2911	30/08/1901	Nase, Rinkin - Kelung, Formosa	Repaired 28th inst				Repaired 28th inst	
2912	30/08/1901	Trinidad - Demerara	Interrupted 27th inst				Interrupted 27th inst	
2913	13/09/1901	Curacao - Coro	Interrupted 11th inst				Interrupted 1th inst	
2914		Boloma - Bissau	Interrupted 12th inst				Interrupted 12th inst	
2915	20/09/1901	Malta - Tangiers	Interrupted 13th inst				Interrupted 13th inst	
2916	25/09/1901	Vigo - Caminha	Repaired 28th July	Repaired 28th July by CS Chiltern		CS Chiltern		
2917	25/09/1901	Suez - Suakin No 1	Interrupted	Interrupted. To be repaired by CS Chiltern		CS Chiltern		
2918	25/09/1901	Perim - Suakin	Repaired 20th ulto	Repaired 20th ulto by CS Electra		CS Electra		
2919	25/09/1901	Bona - Malta No 1	Repaired 29th ulto	Repaired 29th ulto by CS John Pender		CS John Pender		
2920	25/09/1901	Porthcurno - Vigo	Repaired 12th inst	Repaired 12th inst by CS John Pender		CS John Pender		
2921	25/09/1901	Lisbon - Madiera	Repaired 26th ulto	Repaired 26th ulto by CS Mirror		CS Mirror		
2922	25/09/1901	Porthcurno - Lisbon No 1	Fault repaired 10th inst	Fault repaired 10th inst by CS Mirror		CS Mirror		
2923	25/09/1901	Vigo - Carcavelos	Interrupted	Interrupted. CS Mirror to repair		CS Mirror		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2924	27/09/1901	Trinidad - Demerara	Repaired 20th inst				Repaired 20th inst	
2925	04/10/1901	Zanzibar - Mombassa	Interrupted 27th ulto				Interrupted 27th ulto	
2926	11/10/1901	Cadiz - Tenariffe	Repaired 9th inst				Repaired 9th inst	
2927	11/10/1901	Curacao - Coro	Repaired 4th inst				Repaired 4th inst	
2928	11/10/1901	Gibraltar - Tangier	Repaired 5th inst				Repaired 5th inst	
2929	16/10/1901	Suez - Suakin No 1	Fault repaired 30th ulto	Fault which was due to Terado, repaired by CS Chiltern, 30th ulto		CS Chiltern		
2930	16/10/1901	Suez - Suakin No 2	Fault repaired 9th inst	Fault which was due to Terado, repaired by CS Chiltern, 9th inst		CS Chiltern		
2931	18/10/1901	Zanzibar - Mombassa	Repaired 12th inst				Repaired 12th inst	
2932	18/10/1901	Cayenne - Tinherros	Interrupted 15th inst				Interrupted 15th inst	
2933	18/10/1901	Saigon - Haithong	Interrupted 17th inst				Interrupted 17th inst	
2934	25/10/1901	Bolama cable	Repaired 22nd inst				Repaired 22nd inst	
2935	25/10/1901	Cayenne - Pinheiro	Interrupted 15th inst				Interrupted 15th inst	
2936	25/10/1901	Saigon - Haithong	Interrupted 17th inst. Repaired 24th inst				Interrupted 17th inst. Repaired 24th inst	
2937	30/10/1901	Porthcurno - Lisbon	Under repair	Under repair but bad weather, deep water & irregular bottom		CS Amber		
2938	30/10/1901	Red Sea No 1: Suakin - Perim - Aden	RENEWED. Finished 28th inst	RENEWED. Finished 28th inst by CS John Pender		CS John Pender		
2939	30/10/1901	Vigo - Lisbon	2 faults under repair	2 faults under repair by CS Mirror		CS Mirror		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2940	01/11/1901	Boloma - Bissau	Repaired 28th ulto				Repaired 28th ulto	
2941	08/11/1901	Cayenne - Pinheiro	Repaired 2nd inst				Repaired 2nd inst	
2942	13/11/1901	Porthcurno - Lisbon No 1	Repaired 9th inst	Repaired 9th inst by CS Amber (delayed by fog)		CS Amber		
2943	13/11/1901	Gibraltar - Tangier	Repaired 7th inst	Repaired 7th inst by CS John Pender		CS John Pender		
2944	13/11/1901	Vigo - Lisbon	Repaired 29th ulto	Repaired 29th ulto by CS Mirror		CS Mirror		
2945	13/11/1901	Lemnos - Tenedos	Repaired 12th inst	Repaired 12th inst by CS Levant		CS Levant		
2946	04/12/1901	Marseilles - Barcelona	Interrupted; also a fault 173nm from Barcelona	Interrupted 10nm from Barcelona. Also a fault 175nm from Barcelona. CS John pender to repair		CS John Pender	Reported 6/12/01	
2947	04/12/1901	Porthcurno - Lisbon No 1	Under repair	Under repair but bad weather.		CS Mirror		
2948	04/12/1901	Suez - Suakin No 2	Repaired 21st ulto	Repaired 21st ulto by CS Chiltern		CS Chiltern		
2949	04/12/1901	Black Sea Cable	Repaired 23rd ulto	Repaired 23rd ulto by CS Levant		CS Levant		
2950	04/12/1901	Patras - Corinth	Repaired 2nd inst	Repaired 2nd inst by CS Levant		CS Levant		
2951	13/12/1901	New Brunswick - Prince Edward Island	Interrupted 10th inst				Interrupted 10th inst	
2952	18/12/1901	Marseilles - Barcelona	Faults repaired 9th & 16th inst	Faults repaired 9th & 16th inst by CS John Pender		CS John Pender		
2953	18/12/1901	Porthcurno - Vigo	Repaired 13th inst	Repaired 13th inst by CS Mirror		CS Mirror		
2954	18/12/1901	Porthcurno - Lisbon No 2	Interrupted	Interrupted near Porthcurno				

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2955	20/12/1901	Trinidad - Demerara	Interrupted 14th inst				Interrupted 14th inst	
2956	20/12/1901	Anjer - Kaliander	Interrupted 19th inst				Interrupted 19th inst	
2957	27/12/1901	New Brunswick - Prince Edward Island	Repaired 21st inst				Repaired 21st inst	
2958	27/12/1901	Marseilles - Barcelona	Repaired 17th inst				Repaired 17th inst	
2959	03/10/1902	Trinidad - Demerara	Repaired 31st ulto				Repaired 31st ulto	
2960	03/10/1902	Anjer - Kaliander	Repaired 29th ulto				Repaired 29th ulto	
2961	10/01/1902	Mole - St Nicholas - Porto Prince	Interrupted 28th ulto				Interrupted 28th ulto	
2962	10/01/1902	Coro - Maracaibo	Interrupted 1st inst				Interrupted 1st inst	
2963	13/01/1902	Penzance - Brignogan	Repairs		NMM TCM/8/85 CABLE ENGINEERS' LOGBOOKS. Penzance - Brignogan, BRITANNIA, 31 December 1901 - 13 January 1902; TCM/9/60 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Penzance - Brignogan, BRITANNIA, 31 December 1901 - 13 January 1902	CS Britannia		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2964	15/01/1902	Cadiz - Gibraltar	Repaired 27th ulto	Repaired 27th ulto by CS Amber		CS Amber		
2965	15/01/1902	Vigo - Carcavelos	Repaired 4th inst	Repaired 4th inst by CS Amber		CS Amber		
2966	15/01/1902	Lagos - Brass	Interrupted	Interrupted CS Amber to repair		CS Amber		
2967	15/01/1902	St Thome - Loanda	Interrupted	Interrupted CS Amber to repair		CS Amber		
2968	15/01/1902	Alexandriaandra - Port Said	Repaired 29th ulto	Repaired 29th ulto by CS John Pender		CS John Pender		
2969	15/01/1902	Red Sea Cable, Perim - Aden section	REPLACEMENT completed 14th inst	REPLACEMENT completed 14th inst by CS John Pender		CS John Pender		
2970	15/01/1902	Porthcurno - Lisbon No 2	Repaired 7th inst	Repaired 7th inst by CS Mirror		CS Mirror		
2971	24/01/1902	Coro - Maracaibo	Repaired 16th inst				Repaired 16th inst	
2972	24/01/1902	Alexandria - Larnaca	Interrupted 19th inst				Interrupted 19th inst	
2973	29/01/1902	Vigo - Caminha	Under repair	Under repair by CS Duplex		CS Duplex		
2974	29/01/1902	Red Sea Cable	RREPLACEMENT completed 26th inst	REPLACEMENT completed 26th inst by CS John Pender		CS John Pender		
2975	29/01/1902	Cyprus - Alexandriaandra	Interrupted	Interrupted. CS Levant to repair		CS Levant		
2976	29/01/1902	Alexandria - Port Said	Interrupted	Interrupted. CS Levant to repair		CS Levant		
2977	31/01/1902	Alexandria - Port Said	Repaired 29th ulto				Repaired 29th ulto	
2978	07/02/1902	Trinidad - Demerara	Interrupted 1st inst				Interrupted 1st inst	
2979	12/02/1902	Emden- Vigo	Under repair	Under repair by CS Electra		CS Electra		
2980	12/02/1902	Vigo - Lisbon	To be repaired	To be repaired by CS Electra		CS Electra		
2981	12/02/1902	Alexandria - Port Said	Repaired 1st inst	Repaired 1st inst by CS Levant but shorends still need repalcing		CS Levant		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2982	12/02/1902	Vigo - Caminha	Repaired 30th ulto	Repaired 30th ulto by CS Duplex		CS Duplex		
2983	14/02/1902	Mole - St Nicholas - Porto Prince	Repaired 7th inst				Repaired 7th inst	
2984	21/02/1902	Trinidad - Demerara	Repaired 14th inst				Repaired 21st inst	
2985	21/02/1902	Zanzibar - Mombassa	Interrupted 15th inst				Interrupted 15th inst	
2986	26/02/1902	Emden- Vigo	Repaired 13th inst	Repaired 13th inst by CS Electra		CS Electra		
2987	26/02/1902	Gibralter - Malta	Interrupted	Interrupted, CS Mirror to repair		CS Mirror		
2988	26/02/1902	Malta - Sicily	Interrupted	Interrupted, CS Mirror to repair		CS Mirror		
2989	28/02/1902	Fao - Bushire	Interrupted 25th inst				Interrupted 25th inst	
2990	28/02/1902	Perim - Obock	Interrupted 26th inst				Interrupted 26th inst	
2991	07/03/1902	Zanzibar - Mombassa	Repaired 28th ulto				Repaired 28th ulto	
2992	07/03/1902	Modical - Malta	Interrupted 25th ulto. Repaired 2nd inst				Interrupted 25th ulto. Repaired 2nd inst	
2993	07/03/1902	Fao - Bushire	Repaired 2nd inst				Repaired 2nd inst	
2994	12/03/1902	Carcavellos - Vigo	Repaired 2nd inst	Repaired 2nd inst by CS Electra		CS Electra		
2995	12/03/1902	Cadiz - Villa Real	Repaired 7th inst	Repaired 7th inst by CS Electra		CS Electra		
2996	12/03/1902	Gibraltar - Cadiz	Repaired 8th inst	Repaired 8th inst by CS Electra		CS Electra		
2997	12/03/1902	Emden - Fayal	Interrupted	Interrupted				
2998	12/03/1902	Malta - Gibraltar No 1	Repaired 27th ulto	Repaired 27th ulto by CS Mirror		CS Mirror		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
2999	12/03/1902	Malta - Pozella	Repaired 28th ulto	Repaired 28th ulto by CS Mirror		CS Mirror		
3000	12/03/1902	Alexandria - Malta No 1	Under repair	Under repair but bad weather. CM Mirror		CS Mirror		
3001	12/03/1902	Alexandria	Repairs to shore ends 2nd inst	Repaires to shorends by CS Levant 2nd inst		CS Levant		
3002	14/03/1902	Para - Maranham	Interrupted 2nd inst. Repaired 12th inst				Interrupted 2nd inst. Repaired 12th inst	
3003	14/03/1902	Cayenne - Pinheiro	Interrupted 8th inst				Interrupted 8th inst	
3004	14/03/1902	Carcavellos - Ponta Delgada	Interrupted 11th inst				Interrupted 11th inst	
3005	21/03/1902	Carcavellos - Ponta Delgada	Repaired 16th inst				Repaired 16th inst	
3006	21/03/1902	Jamaica - Colon	Interrupted 14th inst				Interrupted 14th inst	
3007	21/03/1902	Zanzibar - Mombassa	Interrupted 14th inst				Interrupted 14th inst	
3008	21/03/1902	Assab - Massowah	Interrupted 18th inst				Interrupted 18th inst	
3009	04/04/1902	Assab - Massowah	Repaired 2nd inst				Repaired 2nd inst	
3010	09/04/1902	Cadiz - Villa Real	Repaired 8th ulto	Repaired 8th ulto by CS Electra		CS Electra		
3011	09/04/1902	Gibraltar - Cadiz	Repaired 12th ulto	Repaired 12th ulto by CS Electra		CS Electra		
3012	09/04/1902	Carcavellos - San Miguel	Repaired 15th ulto	Repaired 15th ulto by CS Electra		CS Electra		
3013	09/04/1902	Porthcurno - Lisbon	Interrupted 26th ulto	Interrupted 26th ulto near Lisbon				
3014	09/04/1902	Malta - Alexandria Nos 1 & 2	Under repair	Under repair by CS Mirror but very bad weather. To be relieved by CS John Pender		CS Mirror; CS John Pender		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3015	09/04/1902	Perim - Obock	Interrupted	Interrupted to be repaired by CS Citta di Milano		CS Citta di Milano		
3016	18/04/1902	Perim - Obock	Repaired 11th inst				Repaired 11th inst	
3017	18/04/1902	Zanzibar - Mombassa	Repaired 17th inst				Repaired 17th inst	
3018	18/04/1902	Suakin - Jeddah	Interrupted 16th inst				Interrupted 16th inst	
3019	25/04/1902	Bolama cable	Interrupted 19th inst				Interrupted 19th inst	
3020	25/04/1902	Porthcurno - Lisbon Direct	Interrupted	Interrupted 70nm from Finisterre in 2700 fathoms. CS Electra to repair		CS Electra		
3021	25/04/1902	Carcavellos - Gibraltar	Interrupted	Interrupted. CS Mirror to repair		CS Mirror		
3022	25/04/1902	Jeddah cable (Turkish Govt)	Repaired 25th inst	Repaired 25th inst by CS Gt Northern		CS Gt Northern		
3023	25/04/1902	Emden - Vigo	Repaired 18th inst	Repaired 18th inst by SS Podbielskey		SS Podbielskey		
3024	02/05/1902	Cayenne - Penheiro	Repaired 24th ulto				Repaired 24th ulto	
3025	02/05/1902	Suakin - Jeddah	Repaired 25th ulto				Repaired 25th ulto	
3026	07/05/1902	Aden - Perim No 2	Repaired 3rd inst	Repaired 3rd inst by CS Chiltern		CS Chiltern		
3027	07/05/1902	Emden - Vigo	Faulty	Faulty. To be repaired by CS Britannia (TCM)		CS Britannia		
3028	07/05/1902	Carcavellos - Lisbon	Interrupted 5th inst	Interrupted 5th inst. To be repaired by CS Electra		CS Electra		
3029	07/05/1902	Vigo - Gibraltar No 1	Repaired 1st inst	Repaired 1st inst by CS Electra		CS Electra		
3030	07/05/1902	Porthcurno - Caravellos No 2	Faulty	Faulty. To be repaired by CS Electra		CS Electra		
3031	07/05/1902	Malta - Bona	Interrupted	Interrupted				

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3032	07/05/1902	Aden - Perim No 2	Repaired 3rd inst	Repaired 3rd inst by CS Chiltern		CS Chiltern		
3033	09/05/1902	Puerto Plata - Martinique	Interrupted 6th inst				Interrupted 6th inst	
3034	12/05/1902	Borkum - Vigo	Repairs		NMM TCM/9/61 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Borkum - Vigo, BRITANNIA, 6 - 12 May 1902; TCM/8/86 CABLE ENGINEERS' LOGBOOKS. Borkum - Vigo, BRITANNIA, 6 - 11 May 1902	CS Britannia		
3035	16/05/1902	St Lucia - St Vincent	Interrupted 9th inst				Interrupted 9th inst	
3036	16/05/1902	St Lucia - Grenada	Interrupted 9th inst				Interrupted 9th inst	
3037	16/05/1902	Dominica - Martinique	Interrupted 9th inst				Interrupted 9th inst	
3038	16/05/1902	Guadaloupe - Martinique	Interrupted 9th inst				Interrupted 9th inst	
3039	16/05/1902	St Lucia - Martinique	Interrupted 9th inst				Interrupted 9th inst	
3040	30/05/1902	Puerto Plata - Martinique	Repaired 23rd inst				Repaired 23rd inst	
3041	04/06/1902	Malta - Alexandria No 1	Repaired 15th ulto	Repaired 15th ulto by CS John Pender		CS John Pender		
3042	04/06/1902	Malta - Alexandria No 2	Fault repaired 19th ulto	Fault repaired 19th ulto CS John Pender		CS John Pender		

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3043	04/06/1902	Malta - Bona No 1	Repaired 26th ulto	Repaired 26th ulto by CS John Pender		CS John Pender		
3044	04/06/1902	Porthcurno - Carcavellos No 2	Fault repaired 13th ulto	Fault repaired 13th ulto by CS Electra		CS Electra		
3045	04/06/1902	Carcavellos - Gibraltar No 1	Fault repaired 28th May	Fault repaired 28th May by CS Electra. Another fault remains		CS Electra		
3046	04/06/1902	Gibraltar - Malta No 1	Interrupted 1st inst	Interrupted 1st inst 840nm from Gibraltar. CS Electra to repair		CS Electra		
3047	04/06/1902	Suez - Aden No 3	Interrupted	Interrupted				
3048	04/06/1902	Robin Island - Cape Town	Interrupted by shipwreck	Interrupted by shipwreck				
3049	04/06/1902	Cape Town - Mossamedes	Repaired	Repaired by CS Amber		CS Amber		
3050	06/06/1902	Puerto Plata - Fort de France	Interrupted 31st ulto				Interrupted 31st ulto	
3051	06/06/1902	Hong Kong - Manila	Interrupted 4th inst				Interrupted 4th inst	
3052	13/06/1902	Hong Kong - Manila	Repaired 10th inst				Repaired 10th inst	
3053	18/06/1902	Gibraltar - Malta No 1	Repaired 7th inst	Repaired 7th inst by CS Electra		CS Electra		
3054	18/06/1902	Bona - Malta No 1	Interrupted	Interrupted				
3055	18/06/1902	Villa Real cable	Interrupted	Interrupted				
3056	18/06/1902	Jedda - Suakin	Repaired 4th inst	Repaired 4th inst by CS Chiltern		CS Chiltern		
3057	18/06/1902	Suez - Aden No 3	Repaired 16th inst	Repaired 16th inst by CS Chiltern		CS Chiltern		
3058	20/06/1902	Jeddah - Suakin	Interrupted 18th inst				Interrupted 18th inst	
3059	27/06/1902	Mozambique - Majungo (Madagascar)	Interrupted 19th inst				Interrupted 19th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3060	04/07/1902	Puerto Plata - Fort de France	Repaired 30th ulto				Repaired 30th ulto	
3061	07/07/1902	Madiera - St Vincent	Interrupted	Interrupted. CS John Pender to repair		CS John Pender		
3062	07/07/1902	Bona - Malta No 1	Repaired 23rd ulto	Repaired 23rd ulto by CS Electra		CS Electra		
3063	07/07/1902	The Cape Town cable	Repaired 2nd inst	Repaired 2nd inst by CS Amber		CS Amber		
3064	07/07/1902	Cape Town - St Helena	Faulty	Faulty				
3065	11/07/1902	Jeddah - Suakin	Repaired 8th inst				Repaired 8th inst	
3066	11/07/1902	Santa Cruz - Tenariffe	Interrupted 7th inst				Interrupted 7th inst	
3067	16/07/1902	Madiera - St Vincent	Repaired 15th inst	Repaired 15th inst by CS John Pender		CS John Pender		
3068	16/07/1902	Porthcurno - Vigo Direct	Interrupted	Interrupted. To be repaired by CS Electra		CS Electra		
3069	16/07/1902	Lisbon - Gibraltar No 2	Interrupted 13th inst	Interrupted 13th inst. To be repaired by CS Electra		CS Electra		
3070	16/07/1902	Jeddah cable (Turkish Govt)	Repaired 10th inst	Repaired 10th inst by CS Chiltern		CS Chiltern		
3071	18/07/1902	Mozambique - Majungo (Madagascar)	Repaired 11th inst				Repaired 11th inst	
3072	18/07/1902	Puerto Plata - Martinique	Interrupted 10th inst				Interrupted 10th inst	
3073	18/07/1902	Cap St Jacques - Haiphong	Interrupted 12th inst				Interrupted 12th inst	
3074	23/07/1902	Lisbon - Gibraltar No 2	Repaired 20th inst	Repaired 20th inst by CS Electra		CS Electra		
3075	23/07/1902	Porthcurno - Lisbon Direct	To be repaired	To be repaired by CS Electra		CS Electra		
3076	23/07/1902	Cape Town - St Helena	Under repair	Under repair by CS Electra		CS Electra		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3077	01'08/1902	Cap St Jacques - Haiphong	Repaired 28th inst				Repaired 28th inst	
3078	08/08/1902	Anjer - Kaliander	Interrupted 2nd inst				Interrupted 2nd inst	
3079	08/08/1902	Nagasaki - Fusan	Interrupted 5th inst				Interrupted 5th inst	
3080	08/08/1902	Guantanimo - Mole St Nicholas	Interrupted 5th inst				Interrupted 5th inst	
3081	15/08/1902	Cayenne - Pinheiro	Interrupted 13th inst				Interrupted 13th inst	
3082	22/08/1902	Cape Town - Mossamedes	Interrupted 16th inst				Interrupted 16th inst	
3083	29/08/1902	Nagasaki - Fusan	Repaired 21st inst				Repaired 21st inst	
3084	29/08/1902	Cape Town - Mossamedes	Repaired 24th inst				Repaired 24th inst	
3085	29/08/1902	Nagasaki - Fusan	Interrupted again 27th inst				Interrupted again 27th inst	
3086	05/09/1902	Nagasaki - Fusan	Repaired 28th ulto				Repaired 28th ulto	
3087	19/09/1902	St Lucia - St Vincent	Repaired 18th inst				Repaired 18th inst	
3088	23/09/1902	Hearts Content - Valentia (1894)	Repairs		NMM TCM/8/87 CABLE ENGINEERS' LOGBOOKS. Hearts Content - Valentia (1894), BRITANNIA, 13 - 23 September 1902	CS Britannia		
3089	24/09/1902	Porthcurno - Lisbon No 2	Repaired 20th inst	Repaired 20th by CS Duplex		CS Duplex		
3090	24/09/1902	Porthcurno - Lisbon Direct	3 Faults	3 faults to be repaired by CS Duplex		CS Duplex		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3091	24/09/1902	Emden - Vigo	Repaired 23rd	Repaired 23rd by CS Duplex		CS Duplex		
3092	26/09/1902	St Lucia - St Vincent	Interrupted again 19th inst				Interrupted again 19th inst	
3093	26/09/1902	Gibraltar - Tangiers	Interrupted 19th inst				Interrupted 19th inst	
3094	26/09/1902	Maranham - Para	Interrupted 19th inst				Interrupted 19th inst	
3095	26/09/1902	Maranham - Ceara	Interrupted 19th inst				Interrupted 19th inst	
3096	08/10/1902	Gibraltar - Tangiers	Repaired 3rd inst	Repaired 3rd inst by CS Duplex		CS Duplex		
3097	08/10/1902	Porthcurno - Lisbon Direct	Fault repaired 6th inst	Fault repaired 6th inst by CS Electra		CS Electra		
3098	10/10/1902	Gibraltar - Tangiers	Repaired 4th inst				Repaired 4th inst	
3099	17/10/1902	St Lucia - Grenada	Repaired 13th inst				Repaired 13th inst	
3100	22/10/1902	Porthcurno - Vigo	Repaired 9th inst	Repaired 9th inst by CS Electra		CS Electra		
3101	22/10/1902	Lisbon - Azores	Under repair	Under repair by CS Duplex		CS Duplex		
3102	22/10/1902	Perim - Suakin No 2	Faults	Several faults. Under repair by CS Chiltern		CS Chiltern		
3103	22/10/1902	Perim - Aden No 2	Interrupted	Interrupted. To be repaired by CS Chiltern		CS Chiltern		
3104	24/10/1902	Carcavellos - Ponta Delgada	Interrupted 22nd inst				Interrupted 22nd inst	
3105	31/10/1902	Reissi Issa (Yemen) - Camaroon	Interrupted 22nd inst				Interrupted 22nd inst	
3106	07/11/1902	Carcavellos - Ponta Delgada	Repaired 31st ulto				Repaired 31st ulto	
3107	07/11/1902	Ascencion - St Helena	Interrupted 3rd inst				Interrupted 3rd inst	
3108	07/11/1902	Cadiz - Tenariffe	Interrupted 3rd inst				Interrupted 3rd inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3109	07/11/1902	Trinidad - Demerara	Interrupted 3rd inst				Interrupted 3rd inst	
3110	07/11/1902	Porthcurno - Vigo	Further repairs completed 27th ulto	Further repairs completed 27th ulto by CS Electra		CS Electra		
3111	07/11/1902	Porthcurno - Carcavellos	Fault repaired 30th ulto	Fault repaired 30th ulto by CS Electra		CS Electra		
3112	07/11/1902	Malta - Alexandria No 1	Interrupted 30th ulto	Interrupted 30th ulto. To be repaired by CS Electra		CS Electra		
3113	07/11/1902	Alexandria - Port Said	Fault caused by fire on beach. Repaired 2nd inst	Fault caused by fire on beach. Repaired 2nd inst by CS Levant		CS Levant		
3114	07/11/1902	Lisbon - Azores No 3	Repaired 3rd inst	Repaired 3rd inst by CS Duplex		CS Duplex		
3115	07/11/1902	Perim - Aden No 2	Repaired 26th ulto	Repaired 26th ulto by CS Chiltern		CS Chiltern		
3116	07/11/1902	St Helena - St Vincent	Interrupted 30th ulto by a hulk sunk by guns of a gunboat.	Interrupted 30th ulto by a hulk sunk by guns of a gunboat. To be repaired by CS Amber		CS Amber		
3117	14/11/1902	Ascencion - St Helena	Repaired 10th inst				Repaired 10th inst	
3118	14/11/1902	Guadaloupe - Dominica	Interrupeted 6th inst				Interrupted 6th inst	
3119	14/11/1902	Marseilles - Barcelona	Interrupted 8th inst				Interrupted 8th inst	
3120	19/11/1902	Harvre - Waterville	Interrupted	Interrupted. To be repaired by CS Mirror		CS Mirror		
3121	19/11/1902	Alexandria - Malta No 1	Repaired 10th inst	Repaired 10th inst by CS Electra		CS Electra		
3122	19/11/1902	Alexandria - Malta No 2	Faulty	Faulty. To be repaired by CS Electra		CS Electra		
3123	19/11/1902	Bona - Malta	Fault	Fault to be repaired by CS Electra		CS Electra		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3124	19/11/1902	Porthcurno - Lisbon Direct	Repaired 17th inst	Repaired 17th inst by CS Duplex		CS Duplex		
3125	19/11/1902	Vigo - Lisbon	Interrupted	Interrupted 20nm from Lisbon				
3126	19/11/1902	Marseilles - Barcelona	Interrupted	Interrupted				
3127	19/11/1902	Messena Straits cable	Interrupted	Interrupted				
3128	19/11/1902	St Helena - St Vincent	Repaired 9th inst	Repaired 9th inst by CS Mirror. Interruption found to have been caused by under water landslip		CS Mirror		
3129	19/11/1902	Suakin - Perim No 2	Interrupted 18th inst	Interrupted 18th inst				
3130	28/11/1902	Maranham - Ceara	Repaired 21st inst				Repaired 21st inst	
3131	28/11/1902	Marseilles - Barcelona	Repaired 23rd inst				Repaired 23rd inst	
3132	28/11/1902	Zanzibar - Mombassa	Interrupted 25th inst				Interrupted 25th inst	
3133	28/11/1902	Sitoebondo - Bandjermasin	Interrupted 25th inst				Interrupted 25th inst	
3134	03/12/1902	Harvre - Waterville	Repaired 23rd ulto	Repaired 23rd by CS Mirror. Off the coast of Ireland. Bad weather		CS Mirror		
3135	03/12/1902	Alexandriaandra - Malta No 2	Repaired 19th ulto	Repaired 19th ulto by CS Electra		CS Electra		
3136	03/12/1902	Malta - Bona No 2	2 faults repaired 23rd & 29th ulto	2 faults repaired by CS Electra. 23rd & 29th ulto		CS Electra		
3137	03/12/1902	Vigo - Gibraltar	Repaired 20th ulto	Repaired 20th by CS Duplex		CS Duplex		
3138	03/12/1902	Vigo - Lisbon	Under repair	Under repair by CS Duplex but bad weather		CS Duplex		
3139	03/12/1902	Porthcurno - Lisbon Direct	Interrupted	Interrupted 40nm from Lisbon CS Duplex to repair		CS Duplex		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3140	03/12/1902	Marseilles - Barcelona	Repaired 22nd ulto	Repaired 22nd ulto by CS Levant		CS Levant		
3141	03/12/1902	Messena Straits cable	Interrupted	Interrupted. CS Levant to repair		CS Levant		
3142	03/12/1902	Lipara - Selena	Interrupted	Interrupted. CS Levant to repair		CS Levant		
3143	05/12/1902	Trinidad - Demerara	Repaired 2nd inst				Repaired 22nd inst	
3144	12/12/1902	Zanzibar - Mombassa	Repaired 5th inst				Repaired 5th inst	
3145	12/12/1902	Sitoebondo - Bandjermasin	Repaired 6th inst				Repaired 6th inst	
3146	17/12/1902	Porthcurno - Lisbon Direct	Repaired 5th inst	Repaired 5th inst by CS Duplex		CS Duplex		
3147	17/12/1902	Vigo - Lisbon	Repaired 6th inst	Repaired 6th inst by CS Duplex		CS Duplex		
3148	17/12/1902	Porthcurno - Carcavellos No 1	Interrupted again	Interrupted again 21nm from Carcavellos. To be repaired by CS Duplex		CS Duplex		
3149	17/12/1902	Vigo - Gibraltar	Repaired 16th inst	Repaired 16th inst by CS Duplex		CS Duplex		
3150	17/12/1902	No 5 Messena cable	Repaired	Repaired by CS Levant		CS Levant		
3151	17/12/1902	Malta - Bona No 1	Under repair	Under repair by CS Electra		CS Electra		
3152	17/12/1902	Alexandria - Port Said	Fault repaired 15th inst	Fault repaired 15th inst by CS Electra		CS Electra		
3153	17/12/1902	Suez - Aden No 4	Interrupted	Interrupted				
3154	17/12/1902	Suakin - Perim No 2	Repaired 8th inst	Repaired 8th inst by CS Chiltern		CS Chiltern		
3155	19/12/1902	Maranham - Para	Repaired				Repaired	
3156	19/12/1902	Guadaloupe - Dominica	Repaired 12th inst				Repaired 12th inst	
3157	14/01/1903	Sennen - Canso (Western Union)	Under repair	Under repair by CS John Pender but bad weather		CS John Pender		

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1		Cable	Event	ETC Board Minute Books	Engineer's Reports (and other sources)	Ship	The Electrician	The Times
3158	14/01/1903	Harvre - Waterville	Under repair	Under repair by CS Mirror but bad weather		CS Mirror		
3159	14/01/1903	Porthcurno No 1 - Lisbon	Repaired 22nd ulto	Repaired 22nd ulto by CS Duplex		CS Duplex		
3160	14/01/1903	Vigo - Lisbon	Repaired 24th ulto	Repaired 24th ulto by CS Duplex		CS Duplex		
3161	14/01/1903	Gibraltar - Lisbon	Repaired 13th inst	Repaired 13th inst by CS Duplex		CS Duplex		
3162	14/01/1903	Suez - Aden No 4	Repaired 28th ulto	Repaired 28th ulto		CS Electra		
3163	14/01/1903	Suez - Perim No 3	Repaired 13th inst	Repaired 13th inst by CS Electra		CS Electra		
3164	14/01/1903	Aden - Bombay No 1	Repaired 7th inst	Repaired 7th inst by CS Electra		CS Electra		
3165	14/01/1903	Suez - Suakin	Repaired	Repaired by Suez Staff				
3166	26/12/1902	Santa Cruz - Tenariffe	Repaired 21st ulto				Repaired 21st ulto	
3167	26/12/1902	Falmouth - Bilbao Cable (Direct Spanish)	Interrupted 18th inst				Interrupted 18th inst	
3168	26/12/1902	Trinidad - Demerara	Interrupted 23rd inst				Interrupted 23rd inst	
3169	02/01/1903	Assab - Massowah	Interrupted 30th ulto				Interrupted 30th ulto	
3170	09/01/1903	Trinidad - Demerara	Repaired 3rd inst				Repaired 3rd inst	
3171	09/01/1903	Cap St Jacques - Haiphong	Interrupted 3rd inst				Interrupted 3rd inst	
3172	23/01/1903	Bissau - Balloma	Interrupted 17th inst				Interrupted 17th	
3173	23/01/1903	Tenedos - Dardanelles	Interrupted 21st inst				Interrupted 21st inst	
3174	28/01/1903	Sennen - Canso (Western Union)	Repaired 19th inst	Repaired 19th inst by CS John Pender		CS John Pender		
3175	28/01/1903	Tenedos - Besika	Repaired 25th inst	Repaired 25th inst by CS Levant		CS Levant		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3176	28/01/1903	Perim - Aden No 2	Repaired 16th inst	Repaired 16th inst by CS Electra		CS Electra		
3177	28/01/1903	Assab - Massowah (Italian Govt)	Repaired 26th inst	Repaired 26th inst by CS Electra		CS Electra		
3178	28/01/1903	Mozambique - Delgoa Bay	Interrupted	Interrupted. CS Chiltern to repair		CS Chiltern		
3179	30/01/1903	Assab - Massowah	Repaired 22nd inst				Repaired 22nd inst	
3180	30/01/1903	Bissau - Balloma	Repaired 26th inst				Repaired 26th inst	
3181	30/01/1903	Tenedos - Dardanelles	Repaired 27th inst				Repaired 27th inst	
3182	30/01/1903	Sitoebondo - Bandjermasin	Interrupted 26th inst				Interrupted 26th inst	
3183	30/01/1903	Marseilles - Barcelona	Interrupted 28th inst				Interrupted 28th inst	
3184	06/02/1903	Marseilles - Bona	Interrupted 3rd inst				Onterrupted 3rd inst	
3185	11/02/1903	Djbouti - Perim	Repaired 30th ulto	Repaired 30th ulto by CS Electra		CS Electra		
3186	11/02/1903	Gibraltar - Lisbon No 1	Under repair	Under repair by CS Electra. Bad weather		CS Electra		
3187	11/02/1903	Bona - Malta	Interrupted	Interrupted. CS Levant to repair		CS Levant		
3188	11/02/1903	Marseilles cable	Interrupted	Interrupted. CS Levant to repair		CS Levant		
3189	11/02/1903	Messena Straits cable	Under repair	Under repair by Citta di Milano		CS Citta di Milano		
3190	11/02/1903	Falmouth - Bilbao (Direct Spanish)	Repaired	Repaired 3rd inst by CS John Pender		CS John Pender		
3191	11/02/1903	Canso - Waterville	Under repair	Under repair by CS Mirror but bad weather		CS Mirror		
3192	13/02/1903	Falmouth - Bilbao	Repaired 6th inst				Repaired 6th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3193	14/02/1903	Borkum - Vigo	Repairs		NMM TCM/8/88 CABLE ENGINEERS' LOGBOOKS. Borkum - Vigo, BRITANNIA, 19 January - 14 February 1903	CS Britannia		
3194	14/02/1903	Harve - Waterville	Repairs		NMM TCM/8/89 CABLE ENGINEERS' LOGBOOKS. Harve - Waterville, BRITANNIA, 19 January - 14 February 1903; TCM/9/63 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Havre - Waterville, BRITANNIA, 5 - 14 February 1903	CS Britannia		
3195	20/02/1903	Marseilles - Bona	Repaired 14th inst				Repaired 13th inst	
3196	25/02/1903	Sierra Leone - Conakry	Repaired 13th inst	Repaired 13th inst by CS Amber		CS Amber		
3197	25/02/1903	Gibraltar - Lisbon No 1	Repaired 17th inst	Repaired 17th inst by CS Duplex		CS Duplex		
3198	25/02/1903	Suez - Aden No 3	Repaired	Repaired by CS Electra		CS Electra		
3199	25/02/1903	Suez - Aden No 4	Repaired	Repaired by CS Electra		CS Electra		
3200	25/02/1903	Harvre - Waterville	Repaired 16th inst	Repaired 16th inst by CS John Pender		CS John Pender		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3201	25/02/1903	Canso - Waterville	Repaired 13th inst	Repaired 13th inst by CS Mirror		CS Mirror		
3202	25/02/1903	Mozambique - Delgoa Bay	Under repair	Under repair by CS Chiltern		CS Chiltern		
3203	27/03/1903	Marseilles - Barcelona	Repaired 22nd inst				Repaired 22nd inst	
3204	06/03/1903	Sitoebondo - Bandjermasin	Repaired 28th ulto				Repaired 28th ulto	
3205	06/03/1903	Trinidad - Demerara	Interrupted 2nd inst				Interrupted 2nd inst	
3206	11/03/1903	Benguella - Mossamedes	Under repair	Under repair by CS Amber		CS Amber		
3207	11/03/1903	Suez - Aden No 4	Repaired 27th ulto	Repaired 27th ulto by CS Electra		CS Electra		
3208	12/03/1903	Atlantic (1874)	Repairs		NMM TCM/9/64 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Atlantic (1873), BRITANNIA, 25 February - 12 March 1903	CS Brittania		
3209	13/03/1903	Cadiz - Tenariffe	Repaired 5th inst				Repaired 5th inst	
3210	13/03/1903	Zanzibar - Mombassa	Repaired 7th inst				Repaired 7th inst	
3211	20/03/1903	Jamaica - Colon	Interrupted 13th inst				Interrupted 13th inst	
3212	25/03/1903	Benguella - Mossamedes	Repaired 14th inst	Repaired 14th inst by CS Amber		CS Amber		
3213	25/03/1903	Mozambique - Delgoa Bay	Repaired 12th inst	Repaired 12th inst by CS Chiltern		CS Chiltern		
3214	25/03/1903	Durban - Laurenco Marques	Repaired 18th inst	Repaired 18th inst by CS Chiltern		CS Chiltern		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3215	25/03/1903	Mozambique - Delgoa Bay	Fault repaired	Fault repaired by CS Chiltern		CS Chiltern		
3216	25/03/1903	Mozambique - Zanzibar No 1	Interrupted	Interrupted. To be repaired by CS Chiltern		CS Chiltern		
3217	25/03/1903	Canso - Waterville	Repaired 13th inst	Repaired 13th inst by CS John Pender		CS John Pender		
3218	25/03/1903	Syra - Candia (Europe Azores Teleg Co)	Repaired 12th inst	Repaired 12th inst by CS Levant		CS Levant		
3219	25/03/1903	Fayal - St Miguel	Repaired 21st inst	Repaired 21st inst by CS Mirror		CS Mirror		
3220	25/03/1903	Aden - Bombay No 1	Interrupted	Interrupted. To be repaired by CS Electra		CS Electra		
3221	27/03/1903	Paramaribo - Cayenne	Interrupted 27th ulto				Interrupted 27th ulto	
3222	27/03/1903	Trinidad - Demerara	Repaired 20th inst				Repaired 20th inst	
3223	03/04/1903	Cap St Jacques - Haiphong	Repaired 31st ulto				Repaired 31st ulto	
3224	10/04/1903	Accra - Lagos	Interrupted 7th inst				Interrupted 7th inst	
3225	17/04/1903	Zanzibar - Mombassa	Repaired 15th inst				Repaired 15th inst	
3226	17/04/1903	New York - Hayti	Interrupted 13th inst				Interrupted 13th inst	
3227	22/04/1903	Gibraltar - Carcavellos No 1	Faults repaired 7th, 11th & 15th inst	Faults repaired 7th, 11th & 15th inst by CS John Pender		CS John Pender		
3228	22/04/1903	Porthcurno - Carcavellos No 2	Repaired 12th inst	Repaired 12th inst by CS John Pender		CS John Pender		
3229	22/04/1903	Porthcurno - Lisbon Direct	Interrupted	Interrupted. To be repaired by CS John Pender		CS John Pender		
3230	22/04/1903	Bona - Malta	Interrupted	Interrupted. To be repaired by CS Mirror		CS Mirror		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3231	22/04/1903	Sitia - Candia	Repaired 6th inst	Repaired 6th inst by CS Mirror		CS Mirror		
3232	22/04/1903	Aden - Bombay No 2	Interrupted	Interrupted 3nm from Aden. To be repaired by CS Citta di Milano		CS Citta di Milano		
3233	22/04/1903	Aden - Bombay No 1	Under repair	Under repair by CS Electra		CS Electra		
3234	22/04/1903	Aden - Bombay No 2	Faulty	Fault 90nm from Bombay. CS Electra to repair		CS Electra		
3235	22/04/1903	Mozambique - Laurenco Marques	Repaired 29th ulto	Repaired 29th ulto by CS Chiltern		CS Chiltern		
3236	22/04/1903	Mozambique - Zanzibar No 1	Fault repaired 3rd inst	Fault repaired 3rd inst by CS Chiltern		CS Chiltern		
3237	22/04/1903	Mozambique - Zanzibar No 1	Interruption repaired 5th inst	Interruption repaired 5th inst by CS Chiltern		CS Chiltern		
3238	22/04/1903	Zanzibar - Mombassa	Repaired 17th inst	Repaired 17th inst by CS Chiltern		CS Chiltern		
3239	22/04/1903	Accra - Lagos	Repaired 16th inst	Repaired 16th inst by CS Duplex		CS Duplex		
3240	24/04/1903	Accra - Lagos	Repaired 17th inst				Repaired 17th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3241	03/05/1903	Valentia - Hearts Content (1874)	Repairs		NMM TCM/8/90 CABLE ENGINEERS' LOGBOOKS. Valentia - Hearts Content (1874), BRITANNIA, 23 April - 3 May 1903; TCM/9/65 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Valentia - Hearts Content (1874), BRITANNIA, 23 April - 3 May 1903	CS Britannia		
3242	06/05/1903	Porthcurno - Lisbon Direct	Repaired 23rd ulto	Repaired 23rd ulto by CS John Pender		CS John Pender		
3243	06/05/1903	Sennen - Canso (Western Union)	Repaired 30th ulto	Repaired 30th ulto by CS John Pender		CS John Pender		
3244	06/05/1903	Bona - Malta No 2	Repaired 25th ulto	Repaired 25th ulto by CS Mirror		CS Mirror		
3245	06/05/1903	Alexandria - Port Said	Repaired 30th ulto	Repaired 30th ulto by CS Levant		CS Levant		
3246	06/05/1903	Aden - Bombay No 2	Repaired 23rd ulto	Repaired 23rd ulto by CS Electra		CS Electra		
3247	06/05/1903	Aden - Bombay No 1	Under repair	Under repair by CS Electra		CS Electra		
3248	08/05/1903	Guantanimo - Mole St Nicholas	Repaired 4th inst				Repaired 4th inst	
3249	08/05/1903	Jamaica - Colon	Repaired 5th inst				Repaired 5th inst	
3250	08/05/1903	Cap St Jacques - Haiphong	Repaired 5th inst				Repaired 5th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3251	15/05/1903	Borkum - Vigo	Repairs		NMM TCM/9/66 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Borkum - Vigo, BRITANNIA, 8 - 15 May 1903	CS Britannia		
3252	15/05/1903	St Vincent - Granada	Interrupted 9th inst				Interrupted 9th inst	
3253	15/05/1903	Falmouth - Bilbao	Interrupted 13th inst				Interrupted 13th inst	
3254	18/05/1903	Falmouth - Bilbao (Direct Spanish)	Repaired	Repaired by CS Mirror		CS Mirror		
3255	18/05/1903	Aden - Bombay No 1	IRREPAIRABLE	Discussed at Board meeting: Irrepairable, to be scrapped		CS Electra		
3256	18/05/1903	Aden - Bombay No 2	Faulty	Faulty but CS Electra unable to locate position		CS Electra		
3257	29/05/1903	Falmouth - Bilbao	Repaired 24th inst				Repaired 24th inst	
3258	18/05/1903	Laurenco Marques - Durban	Interrupted 16th inst	Interrupted 16th inst 60nm from Durban. To be repaired by CS Chiltern		CS Chiltern		
3259	05/06/1903	St Vincent - Granada	Repaired 3rd inst				Repaired 3rd inst	
3260	05/06/1903	Assab - Massowah	Interrupted 1st inst				Interrupted 1st inst	
3261	17/06/1903	Falmouth - Bilbao (Direct Spanish)	Repaired 23rd ulto	Repaired 23rd ulto by CS Mirror		CS Mirror		
3262	17/06/1903	Carcavellos - Madeira No 2	Repaired 28th ulto	Repaired 28th ulto by CS Amber		CS Amber		
3263	17/06/1903	Suakin - Perim No 2	Repaired 8th inst	Repaired 8th inst by CS Electra		CS Electra		
3264	17/06/1903	Perim - Aden No 2	Repaired 12th inst	Repaired 12th inst		CS Electra		
3265	17/06/1903	Bathurst - Sierra Leone	Repaired 16th inst	Repaired 16th inst by CS Duplex		CS Duplex		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3266	17/06/1903	Durban - Delgoa Bay	Repaired 28th ulto	Repaired 28th ulto by CS Chiltern		CS Chiltern		
3267	17/06/1903	Durban - Delgoa Bay	Repaired fault in Shore end 7th inst	Repaired fault in shore end by CS Chiltern		CS Chiltern		
3268	17/06/1903	Porthcurno - Gibraltar No 2	Repaired 12th inst	Repaired 12th inst by the tug Greencastle and CS Mirror crew		Tug Greencastle; CS Mirror		
3269	17/06/1903	Alexandria Shore ends	Shifted	Shifted 10th inst by CS Chiltern		CS Chiltern		
3270	19/06/1893	Trinidad - Demerara Nos 1& 2	Interrupted 13th inst				Interrupted 13th inst	
3271	01/07/1903	Porthcurno - Lisbon Direct	Repaired 23rd ulto	Repaired 23rd ulto by CS Amber		CS Amber		
3272	01/07/1903	Dardanelles cable	Under repair	Under repair by CS Levant		CS Levant		
3273	01/07/1903	Mossamedes - Cape Town	Interrupted	Interrupted 140nm from Cape Town. To be repaired by CS Duplex		CS Duplex		
3274	03/07/1903	Assab - Massawah	Repaired 30th ulto				Repaired 30th ulto	
3275	10/07/1903	Trinidad - Demerara Nos 1& 2	Repaired 1st inst				Repaired 1st inst	
3276	10/07/1903	Kwandang - Menado	Interrupted 1st inst				Interrupted 1st inst	
3277	10/07/1903	Sitoebondo - Bandjermasin	Interrupted 6th inst				Interrupted 6th inst	
3278	15/07/1903	Sennen - Canso Nos 1 & 2 (Western Union)	Repaired 4th inst	Repaired 4th inst by CS Mirror		CS Mirror		
3279	15/07/1903	Gibraltar - Carcavellos No 1	Repaired 10th inst	Repaired 10th inst by CS Amber		CS Amber		
3280	15/07/1903	Nagara - Kartel	Repaired 7th inst	Repaired 7th inst by CS Levant		CS Levant		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3281	15/07/1903	Syra - Athens	Repaired 13th inst	Repaired 13th inst by CS Levant		CS Levant		
3282	15/07/1903	Zanzibar - Mombassa	RENEWAL	Renewal by CS Chiltern		CS Chiltern		
3283	15/07/1903	Aden - Zanzibar	Under repair	Fault under repair by CS Sherard Osborn		CS Sherard Osborn		
3284	15/07/1903	Aden - Bombay No 1	TO BE REPLACED	To be replaced				
3285	15/07/1903	Borkum - Vigo	Repairs		NMM TCM/8/91 CABLE ENGINEERS' LOGBOOKS. Borkum - Vigo, BRITANNIA, 6 May - 15 July 1903	CS Britannia		
3286	24/07/1903	Zanzibar - Mombassa	Interrupted 16th inst				Interrupted 16th inst	
3287	29/07/1903	Emden - Vigo	Repaired 23rd inst	Repaired 23rd inst by CS Mirror		CS Mirror		
3288	29/07/1903	Sitia - Canso	Repaired 20th inst	Repaired 20th inst by CS Levant		CS Levant		
3289	29/07/1903	Sitia - Alexandria	Repaired 20th inst	Repaired 20th inst by CS Levant		CS Levant		
3290	29/07/1903	Gibraltar - Malta	Repaired 24th inst	Repaired 24th inst by CS Amber		CS Amber		
3291	29/07/1903	Gibraltar - Cadiz	Repaired 25th inst	Repaired 25th inst by CS Amber		CS Amber		
3292	29/07/1903	Gibraltar - Carcavellos	Interrupted	Interrupted to be repaired by CS Amber		CS Amber		
3293	29/07/1903	Perim - Assab (Italian Govt)	Interrupted	Interrupted to be repaired by CS Electra		CS Electra		
3294	29/07/1903	Mossamedes - Cape Town	RENEWAL southern section	Renewal of Souther section by CS Chiltern		CS Chiltern		
3295	29/07/1903	Aden - Zanzibar	Repaired 25th inst	Repaired 25th inst by CS Sherard Osborn		CS Sherard Osborn		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3296	07/08/1903	Sitoebondo - Bandjermasin	Repaired 1st inst				Repaired 1st inst	
3297	07/08/1903	Zanzibar - Mombassa	Repaired 31st ulto					
3298	07/08/1903	Fao - Bushire	Interrupted 28th ulto				Interrupted 28th ulto	
3299	07/08/1903	Boloma - Bissau	Interrupted 4th inst				Interrupted 4th inst	
3300	14/08/1903	Kwandang - Menado	Repaired 8th inst				Repaired 8th inst	
3301	14/08/1903	Antigua - Guadeloupe	Interrupted 11th inst				Interrupted 11th inst	
3302	21/08/1903	Mozambique - Majungo (Madagascar)	Interrupted 20th inst				Interrupted 20th inst	
3303	04/09/1903	Mozambique - Majungo (Madagascar)	Repaired 1st inst				Repaired 1st inst	
3304								

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3305	07/09/1903	Borkum - Lowestoft (1871)	Repairs		NMM TCM/8/92 CABLE ENGINEERS' LOGBOOKS. Borkum - Lowestoft (1871), BRITANNIA, 31 August - 7 September 1903; TCM/9/67 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Borkum - Lowestoft, BRITANNIA, 31 August - 7 September 1903	CS Britannia		
3306	11/09/1903	Fao - Bushire	Repaired 5th inst				Repaired 5th inst	
3307	18/09/1903	Trinidad - Demerara	Repaired 15th inst				Repaired 15th inst	
3308	23/09/1903	Suez - Aden No 3	Repaired 29th ulto	Repaired 29th ulto by CS Chiltern		CS Chiltern		
3309	23/09/1903	Messena Straits No 3 cable	Repaired 9th inst	Repaired 9th inst by CS Chiltern		CS Chiltern		
3310	23/09/1903	Lipari cable	Repaired 13th inst	Repaired 13th inst by CS Chiltern		CS Chiltern		
3311	23/09/1903	Suakin - Perim No 2	Fault repaired	Fault repaired by CS Electra, another remains		CS Electra		
3312	23/09/1903	Gibraltar - Carcavellos No 2	Repaired 23rd ulto	Repaired 3rd ulto by CS Amber		CS Amber		
3313	23/09/1903	Gibraltar - Carcavellos No 1	Repaired 7th ulto	Repaired 7th ulto by CS Amber		CS Amber		
3314	23/09/1903	Marseilles - Bona Nos 1 & 2	Repaired 19th and 22nd ulto	Repaired 19th and 22nd ulto by CS Amber		CS Amber		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3315	23/09/1903	Porthcurno Direct	Repaired 15th inst	Repaired 15th inst by CS Amber		CS Amber		
3316	23/09/1903	Mossamedes - Cape Town	Repaired 24th ulto	Repaired 24th ulto by CS Duplex		CS Duplex		
3317	23/09/1903	St Thome - Loanda	Repaired 9th inst	Repaired 9th inst by CS Duplex		CS Duplex		
3318	23/09/1903	Accra - Sierra Leone	Repaired 21st inst	Repair 21st inst by CS Duplex		CS Duplex		
3319	23/09/1903	Mombassa cable	N section RENEWAL completed 3rd ulto	N section RENEWAL completed 3rd ulto by CS Sherard Osborn		CS Sherard Osborn		
3320	23/09/1903	Mozambique - Majungo	Repaired 31st ulto	Repaired 31st ulto by CS Sherard Osborn		CS Sherard Osborn		
3321	23/09/1903	Aden - Bombay No 2	Faulty 14th inst	Faulty 14th inst but any repair delayed until after Monsoon				
3322	02/10/1903	Antigua - Guadaloupe	Repaired 25th ulto				Repaired 25th ulto	
3323	02/10/1903	Cape St James - Haiphong	Repaired 7th inst				Repaired 7th inst	
3324	07/10/1903	Vigo shore ends	Moved	Moved 29th ulto by CS Chiltern		CS Chiltern		
3325	07/10/1903	Bathurst - Sierra Leone	Repaired 1st inst	Repaired 1st inst by CS Duplex		CS Duplex		
3326	07/10/1903	Mozambique - Delgoa Bay	Repaired 4th inst	Repaired 4th inst by CS Sherard Osborn		CS Sherard Osborn		
3327	21/10/1903	Malta - Bona No 2	Interrupted 19th inst	Interrupted 19th inst CS Amber to repair		CS Amber		
3328	21/10/1903	Suez - Aden No 3	Repaired 13th inst	Repaired 13th inst by CS Electra		CS Electra		
3329	21/10/1903	Bissau - Balloma	Repaired 13th inst	Repaired 13th inst by CS Duplex		CS Duplex		
3330	21/10/1903	Bissau - Bathurst	Faulty	Fault on beach, CS Duplex to repair		CS Duplex		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3331	21/10/1903	Patras - Corinth	Fault repaired 14th inst	Fault repaired 14th inst by CS Levant		CS Levant		
3332	23/10/1903	Puerto Plata - Martinique	Repaired 19th inst				Repaired 19th inst	
3333	23/10/1903	Nagasaki - Fusan	Interrupted 19th inst				Interrupted 19th	
3334	25/10/1903	Borkum - Fayal (No 2)	Repairs		NMM TCM/8/93 CABLE ENGINEERS' LOGBOOKS. Borkum - Fayal (No 2), BRITANNIA, 7 - 25 October 1903	CS Britannia		
3335	30/10/1903	Nagasaki - Fusan	Repaired 26th inst				Repaired 26th inst	
3336		Trinidad - Demerara	Interrupted 23rd inst				Interrupted 23rd inst	
3337	04/11/1903	Sennen - Canso (Western Union)	Interrupted	Interrupted. To be repaired by CS Mirror		CS Mirror		
3338	04/11/1903	Emden - Vigo	Interrupted	Interrupted. To be repaired by CS Britannia		CS Britannia		
3339	04/11/1903	Bona - Malta No 2	Repaired 26th ulto	Repaired 26th ulto CS Amber		CS Amber		
3340	04/11/1903	Patras - Corinth No 3	Repaired 1st inst	Repaired 1st inst by CS Levant		CS Levant		
3341	04/11/1903	Bissuu Bathurst	Under repair	Under repair by CS Duplex. Many faults		CS Duplex		
3342	04/11/1903	Lagod - Brass	Interrupted	Interrupted. To be repaired by CS Duplex		CS Duplex		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3343	07/11/1903	Borkum - Vigo	Repairs		NMM TCM/9/68 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Borkum - Vigo, BRITANNIA, JOHN PINDER, 28 October - 7 November 1903; TCM/8/94 CABLE ENGINEERS' LOGBOOKS. Borkum - Vigo (1896), BRITANNIA, 29 October - 7 November 1903	CS Britannia		
3344	13/11/1903	Tourane - Amoy	Interrupted 10th inst				Interrupted 10th inst	
3345	18/11/1903	Aden - Bombay No 1	To be RENEWED	Renewal by CS John pender		CS John Pender		
3346	18/11/1903	Sennen - Canso No 1	Repaired 11th inst	Repaired 11th inst by CS Mirror		CS Mirror		
3347	18/11/1903	Sennen - Canso No 2	Under repair	Under repair by CS Mirror. Very bad weather		CS Mirror		
3348	18/11/1903	Malta - Bona No 1	Faulty	Faulty 170nm from Malta CS Amber to repair		CS Amber		
3349	18/11/1903	Jeddah cable (Turkish Govt)	Fault repaired 14th inst	Fault repaired 14th inst by CS Electra		CS Electra		
3350	18/11/1903	Porthcurno - Vigo	Repaired 11th inst	Repaired 11th inst by Station Staff				

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3351	20/11/1903	Guadeloupe - Martinique	Repaired 16th inst				Repaired 16th inst	
3352	20/11/1903	Trinidad - Demerara	Repaired 16th inst				Repaired 16th inst	
3353	20/11/1903	Accra - Lagos	Interrupted 14th inst				Interrupted 14th inst	
3354	20/11/1903	Lagos - Brass	Interrupted 14th inst				Interrupted 14th inst	
3355	27/11/1903	Accra - Lagos	Repaired 22nd inst				Repaired 22nd inst	
3356	27/11/1903	Tenedos - Chio	Interrupted 25th inst				Interrupted 25th inst	
3357	02/12/1903	Sennen - Canso	Repaired 23rd ulto	Repaired 23rd ulto by CS Mirror		CS Mirror		
3358	02/12/1903	Malta - Bona No 1	Fault under repair	Fault under repair by CS Amber		CS Amber		
3359	02/12/1903	Chios - Tenedos	Repaired 28th ulto	Repaired 28th ulto by CS Levant		CS Levant		
3360	02/12/1903	Lourim - Zea	Repaired 28th ulto	Repaired 28th ulto by CS Levant		CS Levant		
3361	02/12/1903	Suakim - Perim No 2	Under repair	Under repair by CS Electra		CS Electra		
3362	02/12/1903	Accra - Lagos	Repaired 21st ulto	Repaired 21st ulto by CS Duplex		CS Duplex		
3363	02/12/1903	Lagod - Brass	Interrupted	Shorend interrupted by ANCHOR. Under repair by CS Duplex		CS Duplex		
3364	04/12/1903	Lagos - Brass	Repaired 2nd inst				Repaired 2nd inst	
3365		Tenedos - Chio	Repaired 29th ulto				Repaired 29th ulto	
3366	16/12/1903	Lisbon - Vigo	Interrupted	Interrupted. To be repaired by CS Mirror		CS Mirror		
3367	16/12/1903	Malta - Bona No 1	Repaired 2nd inst	Repaired 2nd inst by CS Amber		CS Amber		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3368	16/12/1903	Gibraltar - Malta No 1	Repaired 13th inst	Repaired 13th inst by CS Amber		CS Amber		
3369	16/12/1903	Suakin - Perim No 2	Fault repaired 2nd inst	Repaired 2nd inst by CS Electra		CS Electra		
3370	16/12/1903	Mozambique - Zanzibar Nos 1 & 2	Repaired 13th inst	Repaired 13th inst by CS Sherard Osborn		CS Sherard Osborn		
3371	16/12/1903	Lagos - Brass	Repaired 7th inst	Repaired 7th inst by CS Duplex		CS Duplex		
3372	18/12/1903	Cap St Jaques - Haiphong	Interrupted 15th inst				Interrupted 15th inst	
3373	18/12/1903	Mole St Nicholas - Port au Prince	Interrupted 16th inst				Interrupted 16th inst	
3374	25/12/1903	St Kitts - St Thome	Interrupted 22nd inst				Interrupted 22nd inst	
3375	01/01/1904	St Vincent - Grenada	Interrupted 29th ulto				Interrupted 29th ulto	
3376	15/01/1904	Cap St Jaques - Haiphong	Repaired 11th inst				Repaired 11th inst	
3377	15/01/1904	St Kitts - St Thome	Repaired 8th inst				Repaired 8th inst	
3378	15/01/1904	Lisbon - Vigo	Repaired 27th ulto	Repaired 27th ulto by CS Mirror		CS Mirror		
3379	15/01/1904	Gibraltar - Cadiz	Repaired 7th inst	Repaired 7th inst by CS Amber		CS Amber		
3380	15/01/1904	Patras - Corinth No 1	Repaired 9th inst	Repaired 9th inst by CS Levant		CS Levant		
3381	15/01/1904	Aden - Bombay No 2	Repaired 25th ulto	Repaired 25th ulto by CS John Pender		CS John Pender		
3382	15/01/1904	Aden - Bombay No 1	START OF RENEWAL	Start of renewal by CS John Pender		CS John Pender		
3383	15/01/1904	Durban - Delgoa Bay	Repaired 28th ulto	Repaired 28th ulto by CS Sherard Osborn		CS Sherard Osborn		
3384	15/01/1904	Inyack Cable (Portuguese Govt)	Repaired 29th ulto	Repaired 29th ulto by CS Sherard Osborn		CS Sherard Osborn		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3385	22/01/1904	St Vincent - Grenada	Repaired 15th inst				Repaired 15th inst	
3386	22/01/1904	Gib - Tangier	Interrupted 18th inst				Interrupted 18th inst	
3387	22/01/1904	Tarifa - Tangier	Interrupted 18th inst				Interrupted 18th inst	
3388	29/01/1904	Tangier - Gibraltar	Repaired 18th inst	Repaired 18th inst by CS Amber		CS Amber		
3389	29/01/1904	Patras - Corinth	Repaired	Repaired CS Levant		CS Levant		
3390	29/01/1904	Perim - Obock	Repaired 15th inst	Repaired 15th inst by CS Electra		CS Electra		
3391	05/02/1904	Paramaribo - Cayenne	Repaired 28th ulto				Repaired 28th ulto	
3392	05/02/1904	Oran - Tangiers	Interrupted 3rd inst				Interrupted 3rd inst	
3393	10/02/1904	Gibraltar - Tangiers	Repaired 6th inst	Repaired 6th inst				
3394	10/02/1904	Vigo - Carcavelos	Interrupted	Interrupted				
3395	10/02/1904	Aden - Bombay No 1& 2	Interrupted	Interrupted CS Electra to repair		CS Electra		
3396	10/02/1904	Aden - Bombay No 1	RENEWAL complete	Renewal conpleted by CS John Pender		CS John Pender		
3397	10/02/1904	Suakim - Perim No 2	RENEWED	Renewal conpleted by CS John Pender		CS John Pender		
3398	12/02/1904	St Lucia - St Vincent	Repaired 9th inst				Repaired 9th inst	
3399		UK - Channel Islands	Interrupted				Interrupted	
3400	24/02/1904	Vigo - Carcavelos	Under repair	Under repair by CS Amber but bad weather		CS Amber		
3401	24/02/1904	Gibraltar - Malta No 1	Repaired 18th inst	Repaired 18th inst by CS Levant 2		CS Levant 2		
3402	24/02/1904	Malta - Tripoli	Interrupted	Interrupted, to be repaired by CS Levant 2		CS Levant 2		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3403	24/02/1904	Perim - Sheikh Seyd	Repaired 14th inst	Repaired 14th inst by CS John Pender		CS John Pender		
3404	24/02/1904	Suakin - Perim No 2	Under RENEWAL	Under renewal by CS John Pender		CS John Pender		
3405	24/02/1904	Aden - Bombay No 1	Repaired 17th inst	Repaired 17th inst by CS Electra		CS Electra		
3406	24/02/1904	Aden - Bombay No 2	Faulty	Faulty 370nm from Aden				
3407	24/02/1904	Mossamedes - Cape Town	Faulty	Faulty				
3408	24/02/1904	Mozambique - Delgoa Bay	Interrupted 22nd inst	Interrupted 22nd inst. To be repaired by CS Sherard Osborn		CS Sherard Osborn		
3409	01/03/1904	Brest - Cape Cod (French 1898)	Repairs		NMM TCM/8/95 CABLE ENGINEERS' LOGBOOKS. Brest - Cape Cod (French 1898), BRITANNIA, 24 December 1903 - 1 March 1904; TCM/9/69 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Brest - Cape Cod (1898), BRITANNIA, 24 December 1903 - 1 March 1904	CS Britannia		
3410	09/03/1904	Malta - Tripoli	Repaired 27th ulto	Repaired 27th ulto by CS Levant 2		CS Levant 2		
3411	09/03/1904	Suakin - Perim No 2	RENEWAL complete	Renewal completed by CS John Pender		CS John Pender		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3412	09/03/1904	Suakin - Perim	Fault repaired	Fault repaired by CS John Pender		CS John Pender		
3413	09/03/1904	Mossamedes - Cape Town	Under repair	Under repair by CS Duplex		CS Duplex		
3414	09/03/1904	Accra - Lagos	Interrupted	Interrupted. To be repaired by CS Duplex		CS Duplex		
3415	09/03/1904	Mozambique - Laurenco Marques	Fault repaired 29th ulto	Fault repaired 29th ulto by CS Sherard Osborn		CS Sherard Osborn		
3416	11/03/1904	Mole St Nicholas - Port au Prince	Repaired 3rd inst				Repaired 3rd inst	
3417	11/03/1904	Cape St James - Haiphong	Interrupted 7th inst				Interrupted 7th inst	
3418	18/03/1904	Oran - Tangiers	Repaired 11th inst				Repaired 11th inst	
3419	25/03/1904	Patros Narrows cable	Under repair	Under repair by CS Levant 1		CS Levant 1		
3420	25/03/1904	Vigo - Lisbon	Repaired 10th inst	Repaired 10th inst by CS Amber		CS Amber		
3421	25/03/1904	San Miguel - Fayal	Repaired 16th inst	Repaired 16th inst by CS Amber		CS Amber		
3422	25/03/1904	Gibraltar - Malta No 1	Interrupted 18th inst	Interrupted 18th inst. To be repaired by CS Amber		CS Amber		
3423	25/03/1904	Perim - Suakin	Repaired 18th inst	Repaired 18th inst by CS John Pender		CS John Pender		
3424	25/03/1904	Aden - Bombay No 1	Under repair	Under repair by CS Electra		CS Electra		
3425	25/03/1904	Aden - Bombay No 2	Fault repaired	Fault repaired by CS Electra		CS Electra		
3426	25/03/1904	St Thome - Loanda	Repaired	Repaired by CS Duplex		CS Duplex		
3427	25/03/1904	Accra - Lagos	Under repair	Under repairby CS Duplex		CS Duplex		
3428	25/03/1904	Camaroon cable	Interrupted.	Interrupted. To be repaired by CS Duplex		CS Duplex		
3429	25/03/1904	Mozambique - Delgoa Bay	Repaired 12th inst	Repaired 12th inst by CS Sherard Osborn		CS Sherard Osborn		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3430	25/03/1904	Zanzibar - Mozambique No 1	Interrupted	Interrupted. To be repaired by CS Sherard Osborn		CS Sherard Osborn		
3431	01/04/1904	Dakar - Conakry	Interrupted 24th ulto				Interrupted 24th ulto	
3432	08/04/1904	Cape St Jaques - Haiphong	Repaired 6th inst				Repaired 6th inst	
3433	08/04/1904	Dakar - Conakry	Repaired 24th ulto				Repaired 24th ulto	
3434	15/04/1904	Dakar - Conakry	Interrupted again 11th inst				Interrupted again 11th inst	
3435	20/04/1904	Gibraltar - Malta No 1	Repaired 26th ulto	Repaired 26th ulto by CS Amber		CS Amber		
3436	20/04/1904	Dakar - Conakry	Interrupted	Interrupted. To be repaired by CS Amber		CS Amber		
3437	20/04/1904	Bathurst - Sierra Leone	Interrupted	Interrupted. To be repaired by CS Amber		CS Amber		
3438	20/04/1904	Accra - Lagos	Repaired 25th ulto	Repaired 25th ulto by CS Duplex		CS Duplex		
3439	20/04/1904	Bonny - Brass	Interrupted and repaired 10th inst	Interrupted and repaired 10th inst by CS Duplex		CS Duplex		
3440	20/04/1904	Aden - Bombay No 1	Repaired 3rd inst	Repaired 3rd inst by CS Electra		CS Electra		
3441	20/04/1904	Aden - Bombay No 2	Repaired 11th inst	Repaired 11th inst by CS Electra		CS Electra		
3442	20/04/1904	Perim - Aden No 1	Repaired 16th inst	Repaired 16th inst by CS Electra		CS Electra		
3443	20/04/1904	Sitia - Rhodes	Repaired 6th inst	Repaired 6th inst by CS John Pender		CS John Pender		
3444	20/04/1904	Kartel - Nagara	Repaired 10th inst	Repaired 10th inst by CS John Pender		CS John Pender		
3445	20/04/1904	Zante - Canea	Under repair	Under repair by CS John Pender		CS John Pender		
3446	20/04/1904	Alexandria - Port Said	Repaired	Repaired by station staff at Alexandria with a tug		Tugboat		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3447	20/04/1904	Emden - Vigo	Repaired 28th ulto	Repaired 28th ulto by CS Mirror		CS Mirror		
3448	20/04/1904	Porthcurno - Carcavellos	Under repair	Under repair by CS Mirror		CS Mirror		
3449	20/04/1904	San Miguel - Fayal	Interrupted. To be repaired by CS Mirror			CS Mirror		
3450	20/04/1904	Patros Narrows cable	Repaired 5th inst	Repaired 5th inst by CS Levant 1		CS Levant 1		
3451	20/04/1904	Zante - Cephalonia	Repaired 12th inst	Repaired 12th inst by CS Levant 1		CS Levant 1		
3452	20/04/1904	Zanzibar-Mozambique	Repaired 3rd ulto	Repaired 3rd ulto by CS Sherard Osborn		CS Sherard Osborn		
3453	22/04/1904	New York - Haiti	Interrupted 14th inst				Interrupted 14th inst	
3454	22/04/1904	New York - Haiti	Repaired 15th inst				Repaired 15th inst	
3455	22/04/1904	Dakar - Conakry	Interrupted 11th inst				Interrupted 11th inst	
3456	29/04/1904	Tourane - Tangier	Interrupted 10th inst				Interrupted 10th inst	
3457	29/04/1904	Tourane - Tangier	Repaired 26th inst				Repaired 26th inst	
3458	04/05/1904	Porthcurno - Carcavellos	Under repair	Under repair by CS Mirror		CS Mirror		
3459	04/05/1904	Zantia - Cania	Repaired 20th ulto	Repaired 20th ulto by CS John Pender		CS John Pender		
3460	04/05/1904	Zante - Oranto	Repaired 22nd ulto	Repaired 22nd ulto by CS John Pender		CS John Pender		
3461	04/05/1904	San Miguel - Fayal	Under repair	Under repair by CS John Pender rather than CS Mirror		CS John Pender		
3462	04/05/1904	Candia - Rettino	Repaired 26th ulto	Repaired 26th ulto by CS Levant 1		CS Levant 1		
3463	04/05/1904	Aden beach ends of Red Sea cables	Repaired 25th ulto	Repaired 25th ulto by CS Electra		CS Electra		
3464	04/05/1904	Dakar - Conakry	Repaired 1st inst	Repaired 1st inst by CS Amber		CS Amber		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3465	04/05/1904	Bathurst - Sierra Leone	Repaired 3rd inst	Repaired 3rd inst by CS Amber		CS Amber		
3466	04/05/1904	Bonny - Camaroons	Repaired 22nd ulto	Repaired 22nd ulto by CS Duplex		CS Duplex		
3467	04/05/1904	Mossamedes - Cape Town	Under repair	Under repair by CS Duplex		CS Duplex		
3468	04/05/1904	Zanzibar harbour cables	Under repair	Under repair by CS Sharrard Osborn		CS Sherard Osborn		
3469	06/05/1904	Dakar - Conakry	Repaired 2nd inst				Repaired 2nd inst	
3470	18/05/1904	Dakar - Conakry	Interrupted again	Interrupted again. To be repaired by CS Amber		CS Amber		
3471	18/05/1904	Mossamedes - Cape Town	Under repair	Under repair by CS Duplex		CS Duplex		
3472	18/05/1904	Suakin - Perim	Under repair	Under repair by CS Electra		CS Electra		
3473	18/05/1904	San Miguel - Fayal	Repaired 7th inst	Repaired 7th inst by CS John Pender		CS John Pender		
3474	20/05/1904	Dakar - Conakry	Interrupted again 13th inst				Interrupted again 13th inst	
3475		Gibraltar - Tangier	Interrupted 17th inst				Interrupted 17th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3476	06/06/1904	Valentia - Hearts Content (1873)	Repairs		NMM TCM/8/96 CABLE ENGINEERS' LOGBOOKS. Valentia - Hearts Content (1873), SEINE, 28 MAy - 6 June 1904; TCM/9/70 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Valentia - Hearts Content (1873); St Pierre - Sydney, SEINE, 28 May - 18 June 1904	CS Seine		
3477	10/06/1904	Gibraltar - Tangier	Repaired 8th inst				Repaired 8th inst	
3478	10/06/1904	Accra - Lagos	Interrupted 1st inst				Interrupted 1st inst	
3479	10/06/1904	Nagasaki - Fusan	Interrupted 7th inst				Interrupted 7th inst	
3480	15/06/1904	Dakar - Conakry	Repaired 20th ulto	Repaired 20th ulto by CS Amber		CS Amber		
3481	15/06/1904	Gibraltar - Tangier	Repaired 7th inst	Repaired 7th inst by CS Amber		CS Amber		
3482	15/06/1904	Malta - Alexandria No 2	Under repair	Under repain by CS Amber		CS Amber		
3483	15/06/1904	Suakin - Perim	Repaired 25th ulto	Repaired 25th ulto by CS Electra		CS Electra		
3484	15/06/1904	Suakin Aden No 4	Repaired 2nd inst	Repaired 2nd inst by CS Electra		CS Electra		
3485	15/06/1904	Suez - Suakin No 2	Repaired 6th inst	Repaired 6th inst by CS Electra		CS Electra		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3486	15/06/1904	Syra - Candia (Europe Azores Teleg Co)	Repaired 8th inst	Repaired 8th inst by CS Levant 1		CS Levant 1		
3487	15/06/1904	Porthcurno - Vigo and Borkum - Fayal (Deutsch-Atlantische)	Repaired 3rd inst	Repaired 3rd inst by tug Greencastle with 1st Officer of CS John Pender aboard. However accidently interrupted Borkum - Fayal. Repaired with a piece of ETC cable		Tug Greencastle; (CS John Pender)		
3488	15/06/1904	Mossamedes - Cape Town	Repaired 6th inst	Repaired 6th inst by CS Duplex		CS Duplex		
3489	15/06/1904	Accra - Lagos	Interrupted.	Interrupted. To be repaired by CS Duplex		CS Duplex		
3490	15/06/1904	Mozambique - Delgoa Bay	Repaired 11th inst	Repaired 11th inst by CS Sherard Osborn		CS Sherard Osborn		
3491	19/06/1904	St Pierre - Sydney (1880 Tricore)	Repairs		NMM TCM/8/97 CABLE ENGINEERS' LOGBOOKS. St Pierre - Sydney (1880 Tricore), SEINE, 6 - 19 June 1904	CS Seine		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3492	24/06/1904	Duxbury - St Pierre (1869)	Repairs		NMM TCM/9/71 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Duxbury - St Pierre, SEINE, 18 - 24 June 1904; TCM/8/98 CABLE ENGINEERS' LOGBOOKS. St Pierre - Duxbury (1869), SEINE, 18 - 25 June 1904	CS Seine		
3493	24/06/1904	Chios - Tenedos	Interrupted 21st inst				Interrupted 21st inst	
3494	29/06/1904	Malta - Alexandria No 2	Repaired 18th inst	Repaired 18th inst by CS Amber		CS Amber		
3495	29/06/1904	Bona - Marseilles No 2	Repaired 27th inst	Repaired 27th inst by CS Amber		CS Amber		
3496	29/06/1904	Vigo - Gibraltar	Under repair	Under repair by CS Britannia		CS Brittania		
3497	29/06/1904	Accra - Lagos	45nm of cable laid in deep water to avoid the frequent repairs by anchor damage.	45nm of cable laid in deep water to avoid the frequent repairs by anchor damage by CS Duplex		CS Duplex		
3498	29/06/1904	Chios - Tenedos	Under repair	Under repair by CS Levant 1		CS Levant 1		
3499	29/06/1904	Malta - Alexandria No 2	Faulty repaired 25th inst	Fault repaired 25th inst by CS Levant 2		CS Levant 2		
3500	01/07/1904	Accra - Lagos	Repaired 23rd ulto				Repaired 23rd ulto	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3501	09/07/1904	Valentia - Hearts Content (1874)	Repairs		NMM TCM/8/99 CABLE ENGINEERS' LOGBOOKS. Valentia - Hearts Content (1874), SEINE, 25 June - 9 July 1904; TCM/9/72 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Valentia - Hearts Content (1874), SEINE, 25 June - 9 July 1904	CS Seine		
3502	13/07/1904	Gibraltar Shore ends	Shore ends Gib to Lisbon and Gib to Malta replaced	Shore ends Gib to Lisbon and Gib to Malta replaced by CS Amber		CS Amber		
3503	13/07/1904	Gibraltar - Vigo	Repaired 29th ulto	Repaired 29th ulto by CS Britannia		CS Brittania		
3504	13/07/1904	Porthcurno - Lisbon No 2	Repaired	Repaired by CS Britannia		CS Brittania		
3505	13/07/1904	Suakin - Perim	Fault repaired	Fault repaired by CS Electra		CS Electra		
3506	13/07/1904	Aden - Suez No 3	Fault repaired	Fault repaired by CS Electra		CS Electra		
3507	13/07/1904	Malta - Alexandria No 2	Faults repaired	Faults repaired by CS Levant 2		CS Levant 2		
3508	13/07/1904	Accra - Lagos	Repaired 4th inst	Repaired 4th inst by CS Duplex		CS Duplex		
3509	13/07/1904	Bonny - Camaroons	Under repair	Under repair by CS Duplex		CS Duplex		
3510	22/07/1904	Dakar - Conakry	Repaired 20th ulto				Repaired 20th ulto	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3511	22/07/1904	Chios - Tenedos	Repaired 27th ulto				Repaired 27th ulto	
3512	22/07/1904	Cayenne - Paramaribo	Interrupted 13th inst				Interrupted 13th inst	
3513	22/07/1904	Bombay - Camaroons	2nd fault repaired	2nd fault repaired by CS Duplex		CS Duplex		
3514	22/07/1904	Suez - Aden No 3	Repaired	Repaired by CS Electra		CS Electra		
3515	22/07/1904	Suez - Suakin	Repaired 21st inst	Repaired 21st inst by CS Electra		CS Electra		
3516	22/07/1904	Alexandria - Malta No 2	Repaired 13th inst	Repaired 13th inst by CS Levant 2		CS Levant 2		
3517	22/07/1904	Bathurst - Sierra Leone	Under repair	Under repair by CS Britannia		CS Britannia		
3518	29/07/1904	Assab - Massowah	Interrupted 26th inst				Interrupted 26th inst	
3519	05/08/1904	Assab - Massowah	Repaired 2nd inst				Repaired 2nd inst	
3520	19/08.1904	Marseilles - Barcelona	Interrupted 16th inst				Interrupted 16th inst	
3521	26/08/1904	Marseilles - Barcelona	Repaired 20th inst				Repaired 20th inst	
3522	26/08/1904	Cap Haiten - Mole St Nicholas	Interrupted 20th inst				Interrupted 20th inst	
3523	02/09/1904	Bunda berg - Gomen (New Caledonia)	Interrupted 30th ulto				Interrupted 30th ulto	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3524	07/09/1904	Valentia - Hearts Content (1873)	Repairs		NMM TCM/8/100 CABLE ENGINEERS' LOGBOOKS. Valentia - Hearts Content (1873), SEINE, 3 August - 7 September 1904; TCM/9/73 ROUGH DRAFTS OF CABLE ENGINEERS' BOOKS. Valentia - Hearts Content (1873), SEINE, 3 August - 7 September 1904	CS Seine		
3525	21/09/2004	Gibraltar - - Carcavellos No 2	Repaired 8th Aug	Repaired 8th Aug by CS Amber		CS Amber		
3526	21/09/1904	Gibraltar - Carcavellos No 1	Repaired 9th Aug	Repaired 9th Aug by CS Amber		CS Amber		
3527	21/09/1904	Marseilles - Bona No 2	Repaired 27th Aug	Repaired 27th Aug by CS Amber		CS Amber		
3528	21/09/1904	Carcavellos - Gibraltar No 2	Shore end repaired 8th inst	Shore end repaired 8th inst by CS Amber		CS Amber		
3529	21/09/1904	Carcavellos - Porthcurno No 1	Shore end repaired 9th inst	Shore end repaired 9th inst by CS Amber		CS Amber		
3530	21/09/1904	Carcavellos - Porthcurno No 2	Shore end repaired 10th inst	Shore end repaired 10th inst by CS Amber		CS Amber		
3531	21/09/1904	Carcavellos - Gibraltar No 1	Shore end repaired 12th inst	Shore end repaired 12th inst by CS Amber		CS Amber		
3532	21/09/1904	Carcavellos - Madeira No 1	Accidently cut whilst grappling for Gibraltar No 1 on 13th inst. Repaired same day	Accidently cut whilst grappling for Gibraltar No 1 on 13th inst. Repaired same day by CS Amber		CS Amber		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3533	21/09/1904	Porthcurno - Vigo No 1	Interrupted	Interrupted 115nm from Porthcurno. To be repaired by CS Amber		CS Amber		
3534	21/09/1904	Gibraltar - Carcavellos No 2	Interrupted again by French steamer. Repaired by Station Staff and tug 31 Aug	Interrupted again by French steamer. Repaired by Station Staff and tug 31 Aug				
3535	21/09/1904	Bathurst - Sierra Leone	Repaired 6th Aug	Repaired 6th Aug by CS Britannia		CS Britannia		
3536	21/09/1904	Loanda - St Thome	Repaired 29th Aug	Repaired 29th Aug by CS Britannia		CS Britannia		
3537	21/09/1904	Bonny - Brass	Repaired 6th Sept	Repaired 6th inst by CS Britannia		CS Britannia		
3538	21/09/1904	Bonny - Camaroons	Repaired 26th July	Repaired 26th July by CS Duplex		CS Duplex		
3539	21/09/1904	Perim - Assab (Italian Govt)	Repaired 1st Aug	Repaired 1st Aug by CS Duplex		CS Duplex		
3540	21/09/1904	Corfu - Oranto	Repaired 25th July	Repaired 25th July by CS Levant 2		CS Levant 2		
3541	21/09/1904	Tripoli - Malta	Repaired 8th Aug	Repaired 8th Aug by CS Levant 2		CS Levant 2		
3542	21/09/1904	Patros Narrows cable	Under repair	Under repair by CS Levant 1		CS Levant 1		
3543	21/09/1904	Aden - Zanzibar	Repaired 21st August	Repaired 21st Aug by CS Sherard Osborn		CS Sherard Osborn		
3544	21/09/1904	Bagamoyo - Dar es Salaam	Repaired 8th Sept	Repaired 8th Sept by CS Sherard Osborn		CS Sherard Osborn		
3545	30/09/1904	Cap Haiten - Puerto Plata	Interrupted 26th inst				Interrupted 26th inst	
3546	05/10/1904	Porthcurno - Vigo	Repaired 25th Oct	Repaired 25th Oct by CS Amber		CS Amber		
3547	05/10/1904	Perim - Aden No 1	Interrupted	Interrupted				
3548	05/10/1904	Patros Narrows cable	Repaired	Repaired by CS Levant 1		CS Levant 1		
3549	05/10/1904	Nagara - Kartel	Under repair	Under repair by CS levant 1		CS Levant 1		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3550	05/10/1904	Marseilles - Barcelona	Repaired 2nd inst	Repaired 2nd inst by CS Levant 2		CS Levant 2		
3551	07/10/1904	Marseilles - Barcelona	Repaired 2nd inst				Repaired 2nd inst	
3552	14/10/1904	Dominica - Martinique	Interrupted 1st inst				Interrupted 1st inst	
3553	14/10/1904	St Lucia - Martinique	Interrupted 1st inst				Interrupted 1st inst	
3554	14/10/1904	Trinidad - Demerara	Interrupted 11th inst				Interrupted 11th inst	
3555	19/10/1904	Carcavellos - Gibraltar No 1	Under repair	Under repair by CS Duplex		CS Duplex		
3556	19/10/1904	Perim - Aden No 1	New shore end 10th inst	New shore end 10th inst by CS Electra		CS Electra		
3557	19/10/1904	Nagara - Kartel	Repaired 16th inst	Repaired 16th inst by CS Levant 2		CS Levant 2		
3558	19/10/1904	Ubea - Skyres	Under repair	Under repair by CS Levant 2		CS Levant 2		
3559	19/10/1904	Mombassa - Cape Town	Repaired 15th inst	Repaired 15th inst by CS Britannia		CS Britannia		
3560	19/10/1904	Mombassa - Cape Town	Fault repaired	Fault repaierd by local station staff				
3561	21/10/1904	Boloma - Bissau	Interrupted 13th inst				Interrupted 13th inst	
3562	28/10/1904	Bunda berg - Gomen (New Caledonia)	Repaired 21st inst				Repaired 21st inst	
3563	28/10/1904	Jupiter Inlets (Florida) - Nassau (Bahamas	Interrupted 20th inst				Interrupted 20th inst	
3564	02/11/1904	Carcavellos - Gibraltar No 1	Interruption and 2 faults repaired 27th ulto	Interruption and 2 faults repaired 27th ulto by CS Duplex		CS Duplex		
3565	02/11/1904	Ubea - Skyres	Repaired 23rd ulto	Repaired 23rd ulto by CS Levant 2		CS Levant 2		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3566	02/11/1904	Sitia - Rhodes	Interrupted 30th ulto	Interrupted 30th ulto. To be repaired by CS Levant 2		CS Levant 2		
3567	02/11/1904	Boloma - Bissau	Interrupted	Interrupted. To be repaired by CS Britannia		CS Britannia		
3568	04/11/1904	Cap Haiten - Mole St Nicholas	Repaired 30th ulto				Repaired 30th ulto	
3569	04/11/1904	Rhodes - Sitia	Interrupted 1st inst				Interrupted 1st inst	
3570	11/11/1904	Cap Haiten - Mole St Nicholas	Repaired again 8th inst				Repaired again 8th inst	
3571	11/11/1904	Salonica - Lemnos	Interrupted 6th inst				Interrupted 6th inst	
3572	16/11/1904	Gibraltar - Carcavellos	Repaired 4th inst	Repaired 4th inst by CS Duplex		CS Duplex		
3573	16/11/1904	Marseilles - Barcleona	Interrupted	Interrupted. Complete repalacement under consideration				
3574	16/11/1904	Perim - Aden	Fault repaired 8th inst	Fault repaired 8th inst by CS Electra		CS Electra		
3575	16/11/1904	Salonica - Tenedos	Repaired 11th inst	Repaired 11th inst by CS Levant 2		CS Levant 2		
3576	16/11/1904	Boloma - Bissau	Repaired 14th inst	Repaired 14th inst by CS Britannia		CS Britannia		
3577	18/11/1904	Boloma - Bissau	Repaired 15th inst				Repaired 15th inst	
3578	18/11/1904	Salonica - Lemnos	Repaired 13th inst				Repaired 13th inst	
3579	18/11/1904	Marseilles - Barcelona	Interrupted 11th inst				Interrupted 11th inst	
3580	18/11/1904	Santa Cruz (Tenareffe) - Tejita (Tenareffe)	Interrupted 11th inst				Interrupted 11th inst	
3581	18/11/1904	Sitka - Valdez (Alaska)	Interrupted 11th inst				Interrupted 11th inst	
3582	18/11/1904	Mozambique - Majunga	Interrupted 15th inst				Interrupted 15th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3583	25/11/1904	Trinidad - Demerara	Repaired 21st inst				Repaired 21st inst	
3584	25/11/1904	Rhodes - Sitia	Repaired 22nd inst				Repaired 22nd inst	
3585	25/11/1904	Marseilles - Barcelona	Repaired 20th inst				Repaired 20th inst	
3586	25/11/1904	St Kitts - St Thome	Interrupted 22nd inst				Interrupted 22nd inst	
3587	30/11/1904	Emden - Vigo	Interrupted	Interrupted. To be repaired by CS John Pender		CS John Pender		
3588	30/11/1904	Waterville - Fayal	Repaired 27th inst	Repaired 27th inst by CS Norse		CS Norse		
3589	30/11/1904	Marseilles - Barcleona	Repaired 19th inst	Repaired 19th inst		CS Duplex		
3590	30/11/1904	Marseilles - Bona	Repaired 22nd inst	Repaired 22nd inst by CS Duplex		CS Duplex		
3591	30/11/1904	Porthcurno - Vigo	Interrupted	Interrupted. To be repaired by CS Duplex		CS Duplex		
3592	30/11/1904	Sitia - Rhodes	Repaired 18th inst	Repaired 18th inst by CS Levant 2		CS Levant 2		
3593	30/11/1904	Mozambique - Majunga (French Govt)	Repaired 29th inst	Repaired 29th inst by CS Sherard Osborn		CS Sherard Osborn		
3594	02/12/1904	St Kitts - St Thome	Repaired 28th ulto				Repaired 28th ulto	
3595	09/12/1904	Santa Cruz (Tenareffe) - Tejita (Tenareffe)	Repaired 2nd inst				Repaired 2nd inst	
3596	09/12/1904	Mozambique - Majunga	Repaired 2nd inst				Repaired 2nd inst	
3597	14/12/1904	Emden - Vigo	Repaired 2nd inst	Repaired 2nd inst by CS John Pender		CS John Pender		
3598	14/12/1904	Falmouth - Bilbao	Interrupted	Interrupted. To be repaired by CS John Pender		CS John Pender		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3599	14/12/1904	Porthcurno - Madiera	Interrupted	Interrupted. To be repaired by CS Norse. Bad weather		CS Norse		
3600	14/12/1904	Vigo - Gibraltar No 2	Repaired 8th inst	Repaired 8th inst by CS Duplex		CS Duplex		
3601	14/12/1904	Gibraltar - Carcavellos No 1	Under repair	Under repair by CS Duplex		CS Duplex		
3602	14/12/1904	Malta - Bona No 1	Under repair	Under repair by CS Levant 2 but bad weather		CS Levant 2		
3603	14/12/1904	Aden - Z anzibar	Repaired 3rd inst	Repaired 3rd inst by CS Electra		CS Electra		
3604	14/12/1904	Bathurst - Bissau	Repaired 7th inst	Repaired 7th inst by CS Britannia		CS Britannia		
3605	16/12/1904	Jupiter Inlets (Florida) - Nassau (Bahamas	Repaired 10th inst				Repaired 10th inst	
3606	16/12/1904	Falmouth - Bilbao	Interrupted 14th inst				Interrupted 14th inst	
3607	23/12/1904	Falmouth - Bilbao	Repaired 21th inst				Repaired 21st inst	
3608	23/12/1904	Trinidad - Demerara	Interrupted again 20th inst				Interrupted again 20th inst	
3609	30/12/1904	Assab - Perim	Interrupted 26th inst				Interrupted 26th inst	
3610	30/12/1904	St Vincent - San Thiago	Interrupted 27th inst				Interrupted 27th inst	
3611	30/12/1904	Bathurst - Sierra Leone	Interrupted 27th inst				Interrupted 27th inst	
3612	30/12/1904	Cap Haiten - Puerto Plata	Interrupted 27th inst				Interrupted 27th inst	
3613	30/12/1904	Gibraltar - Tangier	Interrupted 28th inst				Interrupted 28th inst	
3614	06/01/1905	St Vincent - San Thiago	Repaired 4th inst				Repaired 4th inst	
3615	06/01/1905	Bathurst - Sierra Leone	Repaired 30th ulto				Repaired 30th ulto	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3616	06/01/1905	Gibraltar - Tangier	Repaired 3rd inst				Repaired 3rd inst	
3617	11/01/1905	Falmouth - Bilbao	Repaired 20th ulto	Repaired 20th ulto		CS John Pender		
3618	11/01/1905	Madiera - St Vincent	Repaired 25th ulto	Repaired 25th ulto by CS John Pender		CS John Pender		
3619	11/01/1905	Borkum - Lowestoft (German Govt)	Interrupted	Interrupted. To be repaired by CS John Pender		CS John Pender		
3620	11/01/1905	Porthcurno - Madiera	Repaired 21st ulto	Repaired 21st ulto by CS Norse		CS Norse		
3621	11/01/1905	Lisbon - Gibraltar No 1	Repaired 14th ulto	Repaired 14th ulto by CS Duplex		CS Duplex		
3622	11/01/1905	Porthcurno - Vigo	Repaired 25th ulto	Repaired 25th ulto by CS Duplex		CS Duplex		
3623	11/01/1905	Gibraltar - Tangier	Repaired 2nd inst	Repaired 2nd inst by CS Duplex		CS Duplex		
3624	11/01/1905	Cadiz - Gibraltar	Fault repaired 6th inst	Fault repaired 6th inst by CS Duplex		CS Duplex		
3625	11/01/1905	Nagara - Kartal	Repaired 5th inst	Repaired 5th inst by CS Levant 1		CS Levant 1		
3626	11/01/1905	Chio - Chesme	Repaired 8th inst	Repaired 8th inst by CS Levant 1		CS Levant 1		
3627	11/01/1905	Mitylene - Aivaly (Turkish Govt)	Repaired 8th inst	Repaired 8th inst by CS Levant 1		CS Levant 1		
3628	11/01/1905	Canea - Rettimo	Interrupted	Interrupted. To be repaired by CS Levant 1		CS Levant 1		
3629	11/01/1905	Malta - Bona No 1	Repaired 23rd ulto	Repaired 23rd ulto by CS Levant 2		CS Levant 2		
3630	11/01/1905	Malta - Bona No 2	Repaired 5th inst	Repaired 5th inst by CS Levant 1		CS Levant 2		
3631	11/01/1905	Milaza - Lipari	Under repair	Under repair by CS Levant 2		CS Levant 2		
3632	11/01/1905	Pozallo cable	Under repair	Under repair by CS Levant 2		CS Levant 2		
3633	11/01/1905	Periim - Aden No 2	Repaired 18th ulto	Repaired 18th ulto by CS Electra		CS Electra		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3634	11/01/1905	Aden - Bombay No 1	Partial renewal 28th ulto	Partial renewal 28th ulto by CS Electra		CS Electra		
3635	11/01/1905	Suez - Aden No 3	Repaired 31st ulto	Repaired 31st ulto by CS Electra		CS Electra		
3636	11/01/1905	Aden - Zanzibar	Repaired 8th inst	Repaired 8th inst by CS Electra		CS Electra		
3637	11/01/1905	Perim - Assab	Interrupted. Under repair	Interupted, under repair by CS Electra		CS Electra		
3638	11/01/1905	Bathurst - Bissau	Repaired 19th ulto	Repaired 19th ulto by CS Britannia		CS Britannia		
3639	11/01/1905	Bathurst - Sierra Leone	Repaired 29th ulto	Repaired 29th ulto by CS Britannia		CS Britannia		
3640	11/01/1905	St Jago - St Vincent	Repaired 3rd inst	Repaired 3rd inst by CS Britannia		CS Britannia		
3641	11/01/1905	Laurenco Marques - Mozambique	Repaired 20th ulto	Repaired 20th ulto by CS Sherard Osborn		CS Sherard Osborn		
3642	11/01/1905	Laurenco Marques - Durban	Repaired 24th ulto	Repaired 24th ulto by CS Sherard Osborn		CS Sherard Osborn		
3643	11/01/1905	Laurebco Marques - Mozambique	Interrupted & repaired again 30th ulto	Interrupted & repaired again 30th ulto. bCS Sherard Osborn		CS Sherard Osborn		
3644	11/01/1905	Mozambique - Zanzibar	Repaired 1st inst	Repaired 1st inst by CS Sherard Osborn		CS Sherard Osborn		
3645	20/01/1905	Trinidad - Demerara	Repaired 19th inst				Repaired 19th inst	
3646	20/01/1905	Assab - Perim	Repaired 14th inst				Repaired 14th inst	
3647	25/01/1905	Borkum - Lowestoft (German Govt)	Under repair	Under repair by CS John Pender		CS John Pender		
3648	25/01/1905	Cadiz - Gibraltar	Under repair	Under repair by CS Duplex		CS Duplex		
3649	25/01/1905	Gibraltar - Malta No 1	Under repair	Under repair by CS Duplex		CS Duplex		
3650	25/01/1905	Zante - Cephalonia	Repaired 17th inst	Repaired 17th inst by CS Levant 1		CS Levant 1		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3651	25/01/1905	Milaza - Lipari	Repaired 12th inst	Repaired 12th inst by CS Levant 2		CS Levant 2		
3652	25/01/1905	Perim - Assab	Repaired 13th inst	Repaired 13th inst by CS Electra		CS Electra		
3653	25/01/1905	Perim - Aden No 2	Under repair	Under repair by CS Electra		CS Electra		
3654	25/01/1905	Seirra Leone - Accra	Repaired 22nd inst	Repaired 22nd inst by CS Britannia		CS Britannia		
3655	25/01/1905	Mozambique - Delagoa	Fault under repair	Fault under repair by CS Sherard Osborn		CS Sherard Osborn		
3656	03/02/1905	Sitka - Valdez (Alaska)	Repaired 28th ulto				Repaired 28th ulto	
3657	03/02/1905	Marnaritza - Rhodes	Interrupted 30th ulto				Interrupted 30th ulto	
3658	08/02/1905	Emden - Vigo	Repaired 31st ulto	Repaired 31st ulto by CS Norse		CS Norse		
3659	08/02/1905	Borkum - Lowestoft (German Govt)	Repaired 1st inst	Repaired 1st inst by CS John Pender		CS John Pender		
3660	08/02/1905	Marseilles - Barcleona	RENEWAL	Renewal by CS Amber		CS Amber		
3661	08/02/1905	Alexandria - Port Said	Interrupted	Interrupted. CS Amber to repair		CS Amber		
3662	08/02/1905	Gibraltar - Malta No 1	Repaired 25th ulto	Repaired 25th ulto by CS Duplex		CS Duplex		
3663	08/02/1905	Gibraltar - Tangier	Interrupted	Interrupted. To be repaired by CS Duplex		CS Duplex		
3664	08/02/1905	Mycory - Rhenia	Repaired 3rd inst	Repaired 3rd inst by CS Levant 1		CS Levant 1		
3665	08/02/1905	Channack - Kartal	Under repair	Under repair by CS Levant 2		CS Levant 2		
3666	08/02/1905	Suez - Perim No 1	Repaired 27th ulto	Repaired 27th ulto by CS Electra		CS Electra		
3667	08/02/1905	Seirra Leone - Bathurst	Repaired 1st inst	Repaired 1st inst by CS Britannia		CS Britannia		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3668	08/02/1905	Laurenco Marques - Mozambique	Repaired 4th inst	Repaired 4th inst by CS Sherard Osborn		CS Sherard Osborn		
3669	08/02/1905	Aden - Zanzibar	Interrupted 2nd inst	Interrupted 2nd inst. To be repaired by CS Sharrard Osborn		CS Sherard Osborn		
3670	10/02/1905	Jamaica - Colon	Interrupted 10th ulto				Interrupted 10th ulto	
3671	14/02/1905	Valentia - Hearts Content (1880)	Repairs		NMM TCM/9/74 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Valentia - Hearts Content (1880), SEINE, 31 January - 14 February 1905	CS Seine		
3672	17/02/1905	Cap Haiten - Puerto Plata	Repaired 29 December 1904				Repaired 29th December 1904	
3673	17/02/1905	Martinique - Paramaribo	Interrupted 14th inst				Interrupted 14th inst	
3674	22/02/1905	Alexandria - Port Said	Under repair	Under repair by CS Amber		CS Amber		
3675	22/02/1905	Gibraltar - Tangier	Repaired 16th inst	Repaired 16th inst by CS Duplex		CS Duplex		
3676	22/02/1905	Cadiz - Villa Real	Under repair	Under repair by CS Duplex		CS Duplex		
3677	22/02/1905	Canea - Rettimo	Under repair	Under repair by CS levant 1		CS Levant 1		
3678	22/02/1905	Channack - Kartal	Under repair	Under repair by CS levant 1		CS Levant 1		
3679	22/02/1905	Aden - Zanzibar	Under repair	Under repair by CS Sherard Osborn		CS Sherard Osborn		
3680	24/02/1905	Gibraltar - Tangiers	Interrupted 20th inst				Interrupted 20th inst	
3681	03/03/1905	Oran - Tangiers	Interrupted 24th ulto				Interrupted 24th ulto	
3682	03/03/1905	England - Channel Islands	Interrupted 28th ulto				Interrupted 28th ulto	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3683	08/03/1905	Havre - Waterville	Repaired 4th inst	Repaired 4th inst by CS Norse		CS Norse		
3684	08/03/1905	Porthcurno - Vigo	Under repair	Under repair by CS Norse		CS Norse		
3685	08/03/1905	Alexandria - Port Said	Repaired 1st inst	Repaired 1st inst by CS Amber		CS Amber		
3686	08/03/1905	Cadiz - Villa Real	Repaired 25th ulto	Repaired 25th ulto by CS Duplex		CS Duplex		
3687	08/03/1905	Gibraltar - Tangier	Repaired 4th inst	Repeared 4th inst by CS Duplex		CS Duplex		
3688	08/03/1905	Cadiz - Gibraltar	Under repair	Under repair by CS Duplex but weather bad		CS Duplex		
3689	08/03/1905	Rhodes - Mairmarico	Repaired 28th ulto	Repaired 28th ulto by CS Levant 1		CS Levant 1		
3690	08/03/1905	Canea - Rettimo	Repaired 27th ulto	Repaired 27th ulto by CS Levant 2		CS Levant 2		
3691	08/03/1905	Aden - Bombay No 2	Repaired 4th inst	Repaired 4th inst by CS Electra		CS Electra		
3692	08/03/1905	Aden - Bombay No 1	Fault under repair	Fault under repair by CS Electra		CS Electra		
3693	08/03/1905	Seirra Leone - Bathurst	Repaired 25th ulto	Repaired 25th ulto by CS Britannia		CS Britannia		
3694	08/03/1905	Bathurst - Bissau	Repaired 7th inst	Repaired 7th inst by CS Britannia		CS Britannia		
3695	08/03/1905	Aden - Zanzibar	Repaired 28th ulto	Repaired 28th ulto by CS Sherard Osborn		CS Sherard Osborn		
3696	08/03/1905	Rhodes - Laurenco Marques	Repaired 28th ulto	Repaired 28th ulto by CS Levant 1		CS Levant 1		
3697	10/03/1905	Gibraltar - Tangiers	Repaired 7th inst				Repaired 7th inst	
3698	10/03/1905	England - Channel Islands	Repaired 7th inst				Repaired 7th inst	
3699	10/03/1905	Suakin - Jeddah	Interrupted 3rd inst				Interrupted 3rd inst	
3700	17/03/1905	Oran - Tangiers	Repaired 13th inst				Repaired 13th inst	
3701	17/03/1905	Suakin - Jeddah	Repaired 9th inst				Repaired 9th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3702	22/03/2005	Porthcurno - Vigo	Interrupted	Interrupted. To be repaired by CS Norse. Very bad weather		CS Norse		
3703	22/03/2005	Vigo - Gibraltar	Interrupted	Interrupted. To be repaired by CS Norse. Very bad weather		CS Norse		
3704	22/03/2005	Marseilles - Barcelona	RENEWAL complete	Renewal conpleted by CS John Pender 11th inst		CS John Pender		
3705	22/03/2005	Carcavellos - Gibraltar	Under repair	Under repair by CS John Pender		CS John Pender		
3706	22/03/2005	Suez - Aden No 4	Repaired 15th inst	Repaired 15th inst by CS Amber		CS Amber		
3707	22/03/2005	Suakin - Perim	Interrupted	Interrupted. To be repaired by CS Amber		CS Amber		
3708	22/03/2005	Gibraltar - Cadiz	Repaired 9th inst	Repaired 9th inst by CS Duplex		CS Duplex		
3709	22/03/2005	Porthcurno - Carcavellos	Repaired 22inst	Repaired 22nd inst br CS Duplex despite bad weather		CS Duplex		
3710	22/03/2005	Trieste cable	Under repair	Under repair by CS Levant 2		CS Levant 2		
3711	22/03/2005	Aden - Bombay No 1	RENEWALS	Renewals by CS Electra		CS Electra		
3712	31/03/1905	Cyanne - Paramaribo	Repaired 23rd inst				Repaired 23rd inst	
3713	05/04/1905	Gibraltar - Vigo	Repaired 23rd ulto	Repaired 23rd ulto by CS Norse		CS Norse		
3714	05/04/1905	Porthcurno - Vigo	Repaired 27th ulto	Repaired 27th ulto by CS Norse		CS Norse		
3715	05/04/1905	Carcavellos - Gibraltar	Repaired 23rd ulto	Repaired 23rd ulto by CS John Pender		CS John Pender		
3716	05/04/1905	Vigo - Carcavelos	Repaired 28th ulto	Repaired 28th ulto by CS John Pender		CS John Pender		
3717	05/04/1905	Perim - Suakin No 2	Repaired 25th ulto	Repaired 25th ulto by CS Amber		CS Amber		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3718	05/04/1905	Aden - Bombay	Repaired 3rd inst	Repaired 3rd inst by CS Amber		CS Amber		
3719	05/04/1905	Porthcurno - Vigo	Repaired 31st ulto	Repaired 31st ulto by CS Duplex		CS Duplex		
3720	05/04/1905	Corfu - Trieste	Repaired 27th ulto	Repaired 27th ulto by CS Levant 2		CS Levant 2		
3721	05/04/1905	Valona - Oranto	Repaired 31st ulto	Repaired 31st ulto by CS Levant 2		CS Levant 2		
3722	05/04/1905	Perim - Aden No 1	Under repair	Under repair by CS Electra		CS Electra		
3723	07/04/1905	Fort de France - Paramaribo	Interrupted 2nd inst				Interrupted 2nd inst	
3724	07/04/1905	Pernambuco - Paramaribo	Interrupted 6th inst				Interrupted 6th inst	
3725	07/04/1905	Maranham - Ceara	Interrupted 6th inst				Interrupted 6th inst	
3726	14/04/1905	Medam - Olehleh	Interrupted 8th inst				Interrupted 8th inst	
3727	16/04/1905	Falmouth - Bilbao	Repaired 19th inst	Repaired 19th inst by CS Norse		CS Norse		
3728	16/04/1905	Perim - Aden No 1	Repaired 12th ulto	Repaired 12th ulto by CS Electra		CS Electra		
3729	16/04/1905	Assab - Massowah	Repaired 20th ulto	Repaired 20th ulto by CS Electra		CS Electra		
3730	16/04/1905	Lagos - Brass	RENEWAL	Renewal by CS Britannia		CS Britannia		
3731	16/04/1905	Bonny - Camaroons	Several faults repaired	Several faults repaired by CS Britannia		CS Britannia		
3732	21/04/1905	Fort de France - Paramaribo	Interrupted 2nd inst				Interrupted 2nd inst	
3733	21/04/1905	Pernambuco - Para	Interrupted 6th inst				Interrupted 6th inst	
3734	21/04/1905	Maranham - Ceara	Interrupted 6th inst				Interrupted 6th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3735	21/04/1905	Medam - Olehleh	Interrupted 8th inst. Repaired 14th inst				Interrupted 8th inst. Repaired 14th inst	
3736	21/04/1905	Massawah - Assab	Interrupted 17th inst				Interrupted 17th inst	
3737	28/04/1905	Pernasmbuco - Para	Repaired 22nd inst				Repaired 22nd inst	
3738	28/04/1905	Massawah - Assab	Repaired 17th inst				Repaired 17th inst	
3739	28/04/1905	Bathurst - Bissau	Interrupted 22nd inst				Interruptred 22nd inst	
3740	28/04/1905	Bonny - Duana	Interrupted 25th inst				Interrupted 25th inst	
3741	05/05/1905	Bonny - Duana	Repaired 27th ulto				Repaired 27th ulto	
3742	05/05/1905	Cape Haiten - Mole St Nicholas	Interrupted 28th ulto				Interrupted 28th ulto	
3743	12/05/1905	Fort de France - Paramaribo	Repaired 8th inst				Repaired 8th inst	
3744		Maranham - Ceara	Repaired 4th inst				Repaired 4th inst	
3745		San Dominique - Curacoa	Repaired 5th inst				Repaired 5th inst	
3746	17/05/1905	Porthcurno - Lisbon	Repaired 9th inst	Repaired 19th inst by CS Norse		CS Norse		
3747	17/05/1905	Patros - Corinth No 2	Repaired 12th inst	Repaired 12th inst by CS Levant 2		CS Levant 2		
3748	17/05/1905	Zante - Cephalonia	Under repair	Under repair by CS Levant 2		CS Levant 2		
3749	17/05/1905	Perim - Aden No 1	Repaired 14th inst	Repaired 14th inst by CS Electra		CS Electra		
3750	17/05/1905	Bonny - Camaroons	Repaired 4th inst	Repaired 4th inst by CS Britannia		CS Britannia		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3751	17/05/1905	Marseilles - Barcelona	Report on unsatisfactory repair	Repaort dated 9th May to the Board by the Chief Electrician. Unsatisfactory work done by CS Amber. Not enough slack laid. Capt Drake severely reprimanded and salary reduced to lowest point on scale		CS Amber		
3752	19/05/1905	Dakar - Conakry	Interrupted 11th inst				Interrupted 11th inst	
3753	19/05/1905	Bonny - Duana	Interrupted 12th inst				Interrupted 12th inst	
3754	19/05/1905	Trinidad - Demerara	Interrupted 13th inst				Interrupted 13th inst	
3755	26/05/1905	San Dominique - Curacoa	Repaired 19th inst				Repaired 19th inst	
3756	26/05/1905	Bonny - Duana	Repaired 20th inst				Repaired 20th inst	
3757	26/05/1905	Paramaribo - Cayenne	Interrupted 25th inst				Repaired 25th inst	
3758	31/05/1905	Zante - Cephalonia	Repaired 21st inst	Repaired 21st inst by CS Levant 2		CS Levant 2		
3759	31/05/1905	Zante - Trepito	Repaired 22nd inst	Repaired 22nd inst by CS Levant 2		CS Levant 2		
3760	31/05/1905	Aden - Zanzibar	Repaired 24th inst	Interrupted 466nm from Aden. Repaired 24th inst by CS Electra		CS Electra		
3761	31/05/1905	Bonny - Camaroons	Repaired 18th inst	Repaired 18th inst by CS Brittania		CS Britannia		
3762	02/06/1905	Cape Haiten - Mole St Nicholas	Repaired 25th ulto				Repaired 25th ulto	
3763	02/06/1905	Trinidad - Demerara	Repaired 29th ulto				Repaired 29th ulto	
3764	09/06/1905	Dakar - Conakry	Repaired 7th inst				Repaired 7th inst	
3765	16/06/1905	Bathurst - Bissau	Repaired 11th inst				Repaired 11th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3766	26/06/1905	Boloma - Fayal	Interrupted 21st inst				Interrupted 21st inst	
3767	28/06/1905	Weston - Waterville	Repaired 10th inst	Repaired 10th inst by CS Norse		CS Norse		
3768	28/06/1905	Emden - Vigo	Repaired 19th inst	Repaired 19th inst by CS Norse		CS Norse		
3769	28/06/1905	Madiera - St Vincent	Repaired 21st inst	Repaired 21st inst by CS John Pender		CS John Pender		
3770	28/06/1905	Madiera	Renewal of shore ends 23rd inst	Renewal of shore ends 23rd inst by CS John Pender		CS John Pender		
3771	28/06/1905	Malta - Bona No 2	Repaired 14th inst	Repaired 14th inst by CS Sherard Osborn		CS Sherard Osborn		
3772	28/06/1905	Syra - Piraeus No 2	Repaired 14th inst	Repaired 14th inst by Cs Levant 1		CS Levant 1		
3773	28/06/1905	Corfu - Oranto	Repaired 18th inst	Repaired 18th inst by CS Levant 1		CS Levant 1		
3774	28/06/1905	Spizzia - Moria	Fault repaired 26th inst	Fault repaired 26th inst by CS Levant 1		CS Levant 1		
3775	28/06/1905	Malta - Bona No 2	Fault repaired 26th inst	Fault repaired 26th inst by CS Levant 2		CS Levant 2		
3776	28/06/1905	Aden - Suez No 3	Repaired 21st inst	Repaired 21st inst by CS Electra		CS Electra		
3777	28/06/1905	Perim - Aden No 2	Repaired 25th inst	Repaired 25th inst by CS Electra		CS Electra		
3778	28/06/1905	Suez - Suakin	Repaired 27th inst	Repaired 27th inst by CS Electra		CS Electra		
3779	28/06/1905	Zanzibar	Zanzibar shoe ends overhauled	Zanzibar shore ends overhauled by CS Amber		CS Amber		
3780	28/06/1905	Mozambique - Zanzibar	Fault under repair	Fault under repair by CS Amber		CS Amber		
3781	28/06/1905	Dakar - Conakry	Repaired 6th inst	Repaired 6th inst by CS Britannia		CS Britannia		
3782	28/06/1905	Bissau - Bathurst	Repaired 10th inst	Repaired 10th inst by CS Britannia		CS Britannia		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3783	28/06/1905	St Thome - Loanda	Repaired 27th inst	Repaired 27th inst by CS Britannia		CS Britannia		
3784	30/06/1905	Cape St Jacques - Haiphong	Interrupted 26th inst				Interrupted 26th inst	
3785	07/07/1905	Cape St Jacques - Haiphong	Repaired 5th inst				Repaired 5th inst	
3786	07/07/1905	Trinidad - Demerara	Interrupted 3rd inst				Interrupted 3rd inst	
3787	07/07/1905	Sierra Leone - Accra	Interrupted 4th inst				Interrupted 4th inst	
3788	12/07/1905	Porthcurno - Carcavellos No 1	Interrupted	Interrupted. To be repaired by CS Norse		CS Norse		
3789	12/07/1905	Seirra Leone - Accra	Interrupted	Interrupted. To be repaired by CS John Pender		CS John Pender		
3790	12/07/1905	Bona - Malta No 2	Repaired 1st inst	Repaired 1st inst by CS Levant 2		CS Levant 2		
3791	12/07/1905	Bona - Malta No 1	Repaired 9th inst	Repaired 9th inst by CS Levant 2		CS Levant 2		
3792	12/07/1905	Mozambique - Tanzania No 1	Under repair	Under repair 30nm from Mozambique by CS Amber		CS Amber		
3793	12/07/1905	Cape Town - St Helana	Interrupted	Interrupted. To be repaired by CS Britannia but ship quarantined for 5/7 at Loanda due to smallpox amongst the native crew		CS Britannia		
3794	20/07/1905	Porthcurno - Carcavellos	Repaired 19th inst	Repaired 19th inst by CS Norse		CS Norse		
3795	20/07/1905	Accra - Sierra Leone	Repaired 19th inst	Repaired 19th inst by CS John Pender		CS John Pender		
3796	20/07/1905	Mozambique - Zanzibar No 1	Repaired 18th inst	Repaired 18th inst by CS Amber		CS Amber		
3797	20/09/1905	Gibraltar - Carcavellos No 1	Repaired 25th ulto	Repaired 25th ulto by CS Electra		CS Electra		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3798	20/09/1905	Weston - Waterville	Repaired 11th inst	Repaired 11th inst by CS Electra		CS Electra		
3799	20/09/1905	Havre - Waterville	Repaired 16th inst	Repaired 16th inst by CS Electra		CS Electra		
3800	20/09/1905	Madiera - Lisbon No 1	Repaired 9th ulto	Repaired 9th ulto by CS Norse		CS Norse		
3801	20/09/1905	St Thome - Loanda	Repaired 2nd ulto	Repaired 2nd ulto by CS John Pender		CS John Pender		
3802	20/09/1905	Lagos - Katoma	New shore ends 17th ulto	New shore ends 17th ulto by CS John Pender		CS John Pender		
3803	20/09/1905	Bissau - Balloma	Repaired 31st ulto	Repaired 31st ulto by CS John Pender		CS John Pender		
3804	20/09/1905	Accra - Sierra Leone	Repaired 10th inst	Repaired 10th inst by CS John Pender		CS John Pender		
3805	20/09/1905	Madiera - St Vincent	Under repair	Inder repair by CS John Pender		CS John Pender		
3806	20/09/1905	Lisbon - Madiera	Under repair	Inder repair by CS John Pender		CS John Pender		
3807	20/09/1905	Tynos - Mykoni	Repaired 2nd inst	Repaired 2nd inst by CS Levant 1		CS Levant 1		
3808	20/09/1905	Nio - Sikino	Repaired 2nd inst	Repaired 2nd inst by CS Levant 1		CS Levant 1		
3809	20/09/1905	Messana No 1 cable	Repaired 13th inst	Repaired 13th inst by CS Levant 2		CS Levant 2		
3810	20/09/1905	Milazo - Lipani	Repaired 13th inst	Repaired 13th inst by CS Levant 2		CS Levant 2		
3811	20/09/1905	Sitia - Alexandria	Repaired 23rd ulto	Repaired 23rd ulto by CS Duplex		CS Duplex		
3812	20/09/1905	St Helana cable	Repaired 19th ulto	Repaired 19th ulto by CS Britannia		CS Britannia		
3813	20/09/1905	Loanda beach lines	Overhauled 10th inst	Overhauled 10th inst by CS Britannia		CS Britannia		
3814	20/09/1905	Cape Town - Messam	Fault repaired 18th inst	Fault repaired 18th inst by CS Britannia		CS Britannia		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3815	20/09/1905	Zanzibar - Laurenco Marques	Under repair	Under repair by CS Amber. Bad weather		CS Amber		
3816	28/09/1905	Penzance - Canso (1881, 1882)	Repairs		NMM TCM/9/75 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Penzance - Canso (1881, 1882), CAMBRIA, 10 - 20 September 1905; TCM/8/101 CABLE ENGINEERS' LOGBOOKS. Penzance - Canso (1882), CAMBRIA, 21 - 28 September 1905	CS Cambria		
3817	21/07/1905	Trinidad - Demerara	Repaired 17th inst				Repaired 17th inst	
3818	28/07/1905	Cadiz - Tenariffe	Interrupted 20th inst				Interrupted 20th inst	
3819	28/07/1905	Iquique - Antofagasta	Interrupted 21st inst				Interrupted 21st inst	
3820	28/07/1905	Antofagasta - La Serena	Interrupted 21st inst				Interrupted 21st inst	
3821	04/08/1905	Antofagasta - La Serena	Repaired 29th ulto				Repaired 29th ulto	
3822	04/08/1905	Lagos - Katoma	Interrupted 29th ulto				Interupted 29th ulto	
3823	04/08/1905	Trinidad - Demerara	Interrupted 29th ulto				Interupted 29th ulto	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3824	11/08/1905	Martinique - Paramaribo	Interrupted 7th inst				Interrupted 7th inst	
3825	18/08/1905	Martinique - Paramaribo	Repaired 14th inst				Repaired 14th inst	
3826	25/08/1905	Paramaribo - Cayenne	Repaired 19th inst				Repaired 19th inst	
3827	25/08/1905	Lagos - Katoma	Repaired 19th inst				Repaired 19th inst	
3828	25/08/1905	Trinidad - Demerara	Repaired 21st inst				Repaired 21st inst	
3829	08/09/1905	Bolama - Bissau	Repaired 1st inst				Repaired 1st inst	
3830	08/09/1905	Shanghai - Nagasaki	Interrupted 2nd inst. Repaired 6th inst				Interrupted 2nd inst. Repaired 6th inst	
3831	15/09/1905	Iquique - Antofagasta	Repaired 8th inst				Repaired 8th inst	
3832	04/10/1905	Madiera - St Vincent No 2	Repaired 9th ulto	Repaired 9th ulto by CS John Pender		CS John Pender		
3833	04/10/1905	Lisbon - Madiera	Under repair	Under repair by CS John Pender		CS John Pender		
3834	04/10/1905	Bathurst - Sierra Leone	Under repair	Under repair by CS Britannia		CS Britannia		
3835	04/10/1905	Laurenco Marques - Durban	Repaired 25th ulto	Repaired 25th ulto by CS Amber		CS Amber		
3836	04/10/1905	Madiera - St Vincent	Repaired 9th inst	Repaired 9th inst by CS John Pender		CS John Pender		
3837	04/10/1905	Lisbon - Madiera No 1	Under repair	Under repair by CS John Pender		CS John Pender		
3838	04/10/1905	Bathurst - Sierra Leone No 1	Interrupted	Interrupted. CS Britannia to repair		CS Britannia		
3839	06/10/1905	Kotona - Grand Bassam	Interrupted 4th inst				Interrupted 4th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3840	20/10/1905	Borkum - Lowestoft	Repairs		NMM TCM/8/102 CABLE ENGINEERS' LOGBOOKS. Borkum - Lowestoft, CAMBRIA, 10 - 20 October 1905; TCM/9/76 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Borkum - Lowestoft (1871), CAMBRIA, 10 - 20 October 1905	CS Cambria		
3841	20/10 1905	Kotona - Grand Bassam	Interrupted 4th inst				Interrupted 4th inst	
3842	01/11/1905	Weston - Waterville	Interrupted	Interrupted. CS Sherard Osborn		CS Sherard Osborn		
3843	01/11/1905	Lisbon - Madiera No 1	Repaired 21st ulto	Repaired 21st ulto by CS John Pender		CS John Pender		
3844	01/11/1905	Direct Spanish Bilbao cable	Interrupted	Interrupted. CS John Pender to repair		CS John Pender		
3845	01/11/1905	Lemnos - Chios	Interrupted	Interrupted. CS Levant 1 to repair		CS Levant 1		
3846	01/11/1905	Suez - Suakin No 2	Repaired 21st inst	Repaired 21st inst by CS Duplex		CS Duplex		
3847	01/11/1905	Aden - Bombay No 2	Interrupted	Interrupted. CS Duplex to repair		CS Duplex		
3848	01/11/1905	Bathurst - Sierra Leone	Repaired 19th ulto	Repaired 19th ulto by CS Britannia		CS Britannia		
3849	01/11/1905	Lagos - Brass	Under repair	Under repair by CS Britannia		CS Britannia		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3850	03/11/1905	Medan - Plehleh	Interrupted 26th ulto				Interrupetd 26th ulto	
3851	03/11/1905	Oran - Tangiers	Interrupted 30th ulto				Interrupted 30th ulto	
3852	03/11/1905	Tangier - Cadiz	Interrupted				Interrupted	
3853	03/11/1905	Falmouth - Bilbao	Interrupted 31st ulto				Interrupted 31st ulto	
3854	03/11/1905	Borkum - Fayal (1903)	Repairs		NMM TCM/8/103 CABLE ENGINEERS' LOGBOOKS. Borkum - Fayal (1903) CAMBRIA, 20 October - 3 November 1905; TCM/9/77 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Borkum - Fayal (1903), CAMBRIA, 20 October - 3 November 1905	CS Cambria		
3855	10/11/1905	Falmouth - Bilbao	Repaired 31st ulto				Repaired 31st ulto	
3856	15/11/1905	Weston - Waterville	Repaired 5th inst	Repaired 5th inst by CS Sherard Osborn		CS Sherard Osborn		
3857	15/11/1905	Azores cable	Under repair	Under repair by CS Norse but bad weather		CS Norse		
3858	15/11/1905	Direct Spanish Bilbao cable	Repaired 9th inst	Repaired 9th inst by CS John Pender		CS John Pender		
3859	15/11/1905	Santorini cable	Interrupted	Interrupted. To be repaired by CS Levant 1		CS Levant 1		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3860	15/11/1905	Aden - Bombay No 2	Repaired 5th inst	Repaired 5th inst by CS Duplex		CS Duplex		
3861	15/11/1905	Aden - Bombay No 3	Under repair	Under repair by CS Duplex		CS Duplex		
3862	15/11/1905	Bonny - Brass	Repaired 7th inst	Repaired 7th inst by CS Britannia		CS Britannia		
3863	15/11/1905	Kotona - Grand Bassam	Fault repaired 14th inst	Fault repaired 14th inst by CS Britannia		CS Britannia		
3864	15/11/1905	Laurenco Marques - Durban	Fault under repair	Fault under repair by CS Amber		CS Amber		
3865	17/11/1905	Medan - Olehleh	Repaired 13th inst				Repaired 13th inst	
3866	22/11/1905	Penzance - Canso (1882)	Repairs		NMM TCM/8/104 CABLE ENGINEERS' LOGBOOKS. Penzance - Canso (1882), CAMBRIA, 8 - 22 November 1905	CS Cambria		
3867	24/11/1905	Kotona - Grand Bassam	Repaired 18th inst				Repaired 18th inst	
3868	24/11/1905	Oran - Tangiers	Repaired 22nd inst				Repaired 22nd inst	
3869	29/11/1905	Azores cable	Repaired 21st inst	Repaired 21st inst by CS Norse		CS Norse		
3870	29/11/1905	Porthcurno - Lisbon Direct	Repaired 23rd inst	Repaired 23rd inst by CS Norse		CS Norse		
3871	29/11/1905	Porthcurno - Lisbon No 1	Repaired 20th inst	Repaired 20th inst by CS John Pender		CS John Pender		
3872	29/11/1905	Kotona - Grand Bassam	Repaired 15th inst	Repaired 15th inst by CS Britannia		CS Britannia		
3873	29/11/1905	Ascension cable	Under repair	Under repair by CS Britannia		CS Britannia		
3874	29/11/1905	Laurenco Marques - Durban	Repaired 16th inst	Repaired 16th inst by CS Amber		CS Amber		

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1		Cable	Event	ETC Board Minute Books	Engineer's Reports (and other sources)	Ship	The Electrician	The Times
3875	29/11/1905	Zanzibar - Mozambique No 1	Under repair	Under repair by CS Amber		CS Amber		
3876	29/11/1905	Aden - Bombay No 1	Fault investigated	Fault investigated by CS Duplex		CS Duplex		
3877	29/11/1905	Kotona - Grand Bassam	Repaired 15th inst	Repaired 15th inst by CS Britannia		CS Britannia		
3878	29/11/1905	Anxension cable	Under repair	Under repair by CS Britannia		CS Britannia		
3879	29/11/1905	Laurenco Marques - Durban	Repaired 16th inst	Repaired 16th inst by CS Amber		CS Amber		
3880	29/11/1905	Zanzibar - Mozambique No 1	Repaired 27th inst	Repaired 27th inst by CS Amber		CS Amber		
3881	04/12/1905	Penzance - Canso (1882)	Repairs		NMM TCM/9/78 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Penzance - Canso (1882), CAMBRIA, 8 November - 4 December 1905	CS Cambria		
3882	06/12/1905	Penzance - Canso (1881)	Repairs		NMM TCM/8/105 CABLE ENGINEERS' LOGBOOKS. Penzance - Canso (1881), CAMBRIA, 25 November - 6 December 1905			
3883	08/12/1905	Tangier - Cadiz	Repaired 1st inst				Repaired 1st inst	
3884	13/12/1905	Porthcurno - Carcavellos Direct	Repaired 4th inst	Repaired 4th inst by CS Norse		CS Norse		
3885	13/12/1905	Carminha - Vigo	Repaired 12th inst	Repaired 12th inst by CS Norse. Deleyed by bad weather		CS Norse		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3886	13/12/1905	Bauvi	Cable end overhauled 4th inst	Cable ends overhauled 4th inst by CS Amber		CS Amber		
3887	13/12/1905	Zanzibar - Mozambique No 2	Repaired 9th inst	Repaifred 9th inst by CS Amber		CS Amber		
3888	13/12/1905	Aden and Seychelle	Cable end overhauled	Cable ends overhauled by CS Amber		CS Amber		
3889	22/12/1905	Puerto Plata - Martinique	Repaired 15th inst				Repaired 15th inst	
3890	05/01/1906	St Thomas - St Kitz	Interrupted 29th ulto				Interrupted 29th ulto	
3891	05/01/1906	Manilla - Iloilo	Interrupted 29th ulto				Interrupted 29th ulto	
3892	10/01/1906	Azores cables (Portugese Govt)	Interrupted	Interrupted. To be repaired by CS Electra		CS Electra		
3893	10/01/1906	Pico - Tereira	Under repair	Under repair by CS Norse		CS Norse		
3894	10/01/1906	St Jorge - Graciosa	Under repair	Under repair by CS Norse		CS Norse		
3895	10/01/1906	Spanish Direct Bilbao cable	Fault repaired 7th inst	Fault repaifred 7th inst by CS Norse		CS Norse		
3896	10/01/1906	Malta - Alexandria No 2	Repaired 22nd ulto	Repaired 22nd ulto by CS Sherard Osborn		CS Sherard Osborn		
3897	10/01/1906	Larnaca cable	Repaired 23rd ulto	Repaired 23rd ulto by CS Sherard Osborn		CS Sherard Osborn		
3898	10/01/1906	Messina Straits No 5	Repaired 19th ulto	Repaired 19th ulto by CS Levant 2		CS Levant 2		
3899	10/01/1906	Aleandria - Malta No 1	Faults repaired 25th ulto	Faults repaired 25th ulto by CS Levant 2		CS Levant 2		
3900	10/01/1906	Aden - Bombay No 1	Faults under repair	Faults under repair by CS Duplex		CS Duplex		
3901	10/01/1906	Perim - Suakin	Repaired 2nd inst	Repaired 2nd inst by CS Duplex		CS Duplex		
3902	10/01/1906	Zanzibar	Cable ends overhauled 14th ulto	Cable ends overhauled by CS Amber 14th ulto		CS Amber		
3903	10/01/1906	Massamedes - Cape Town	Repaired 22nd ulto	Repaired 22nd ulto by CS Britannia		CS Britannia		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3904	10/01/1906	Loanda - Benguella	Interrupted	Interrupted. To be repaired by CS Britannia		CS Britannia		
3905	22/01/1906	Valentia - Hearts Content (1874)	Repairs		NMM TCM/9/79 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Valentia - Hearts Content (1874), CAMBRIA, 20 December 1905 - 22 January 1906; TCM/8/106 CABLE ENGINEERS' LOGBOOKS. Atlantic (1874), CAMBRIA, 29 December 1905 - 22 January 1906	CS Cambria		
3906	24/01/1906	Tercura - Pico	Under repair	Under repair by CS Electra		CS Electra		
3907	24/01/1906	Gibraltar - Cadiz	Repaired 22nd inst	Repaired 22nd inst by CS Norse. Delayed by bad weather		CS Norse		
3908	24/01/1906	Cadiz - Villa Real	Under repair	Under repair by CS Norse		CS Norse		
3909	24/01/1906	Malta - Alexandria No 1	Repaired 13th inst	Repaired 13th inst by CS Levant 2		CS Levant 2		
3910	24/01/1906	Loanda - Benguella	Repaired 12th inst	Repaired 12th inst by CS Britannia		CS Britannia		
3911	24/01/1906	Accra - Lagos	Repaired 20th inst	Repaired 20th inst by CS Britannia		CS Britannia		
3912	26/01/1906	Manilla - Iloilo	Repaired 18th inst				Repaired 18th inst	
3913	26/01/1906	Boloma - Bissau	Interrupted 19th inst					

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3914	02/02/1906	St Thomas - St Kitz	Repaired 30th ulto				Repaired 30th ulto	
3915	07/02/1906	Tercura - Pico	Repaired 25th ulto	Repaired 25th ulto by CS Electra		CS Electra		
3916	07/02/1906	St Jorge - Graciosa	Under repair	Under repair by CS Electra but bad weather		CS Electra		
3917	07/02/1906	Cadiz - Villa Real	Renewed shore ends 25th ulto	Renewed shore ends 25th ulto by CS Norse		CS Norse		
3918	07/02/1906	Porthcurno - Vigo	Faulty	Faulty CS Norse to repair		CS Norse		
3919	07/02/1906	Alexandria - Malta No 2	Fault repaired 5th inst	Fault repaired 5th inst by CS Sherard Osborn		CS Sherard Osborn		
3920	07/02/1906	Spinosa - Milo	Repaired 1st inst	Repaired 1st inst by CS Levant 1		CS Levant 1		
3921	07/02/1906	Sierra Leone - Bathurst	Repaired 6th inst	Repaired 6th inst by CS Britannia		CS Britannia		
3922	07/02/1906	Bathurst - Bissau	Under repair	Under repair by CS Britannia		CS Britannia		
3923	09/02/1906	Vladivostock - Nagasaki	Interrupted 7th inst				Interrupted 7th inst	
3924	16/02/1906	Cap St Jaques - Haiphong	Interrupted 14th inst				Interrupted 14th inst	
3925		Jamaica - Porta Rico	Repaired 9th inst				Repaired 9th inst	
3926	21/02/1906	St Jorge - Graciosa	Repaired 9th inst	Repaired 9th inst by CS Electra		CS Electra		
3927	21/02/1906	Carcavellos - Gibraltar No 2	Repaired 17th inst	Repaired 17th inst by CS Electra		CS Electra		
3928	21/02/1906	Porthcurno - Vigo	Fault repaired 13th inst	Fault repaired 13th inst by CS Norse. Bad weather		CS Norse		
3929	21/02/1906	Suez - Suakin No 2	2 faultsa repaired	2 faults repaired by CS Sherard Osborn		CS Sherard Osborn		
3930	21/02/1906	Malta - Bona No 2	Interrupted	Interrupted. CS Levant 2 to repair		CS Levant		
3931	21/02/1906	Aden - Bombay No 1	Repaired 21st inst	Repaired 21st inst by CS Duplex		CS Duplex		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3932	21/02/1906	Bissau - Boloma	Repaired 10th inst	Repaired 10th inst by CS Britannia		CS Britannia		
3933	23/02/1906	Boloma - Bissau	Repaired 10th inst				Repaired 10th inst	
3934	23/02/1906	Vladivostock - Nagasaki	Repaired 21st inst				Repaired 21st inst	
3935	23/02/1906	Cap St Jaques - Haiphong	Repaired 21st inst				Repaired 21st inst	
3936	23/02/1906	Tangier - Cadiz	Interrupted 17th inst				Interrupted 17th inst	
3937	23/02/1906	Santa Lucia - St Vincent	Interrupted 19th inst				Interrupted 19th inst	
3938	23/02/1906	St Vincent - Grenada	Interrupted 19th inst				Interrupted 19th inst	
3939	03/03/1906	Granada - Trinidad	Interrupted 24th ulto				Interrupted 24th ulto	
3940	03/03/1906	Puerto Rico - St Thomas	Interrupted 26th ulto				Interrupted 24th ulto	
3941	03/03/1906	Puerto Rico - St Croix	Interrupted 26th ulto				Interrupted 24th ulto	
3942	03/03/1906	Alexandria - Larnaca	Interrupted 28th ulto				Interrupted 28th ulto	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3943	05/03/1906	Penzance - Canso (1882)	Repairs		NMM TCM/8/107 CABLE ENGINEERS' LOGBOOKS. Penzance - Canso (1882), CAMBRIA, 16 February - 5 March 1906; TCM/9/80 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Penzance - Canso (1882), CAMBRIA, 16 February - 5 March 1906	CS Cambria		
3944	07/03/1906	Gibraltar - Malta No 1	Repaired 27th ulto	Repaired 27th ulto by CS Electra		CS Electra		
3945	07/03/1906	Malta - Alexandria No 2	Under repair	Under repair by CS Electra		CS Electra		
3946	07/03/1906	Suez - Suakin No 2	Repaired 21st ulto	Repaired 21st ulto by CS Sherard Osborn		CS Sherard Osborn		
3947	07/03/1906	Aden - Bombay No 1	Interrupted	Interrupted. CS Sherard Osborn		CS Sherard Osborn		
3948	07/03/1906	Alexandria - Cyprus No 2	Under repair	Under repair by CS Levant 1 but bad weather		CS Levant 1		
3949	07/03/1906	Malta - Bona No 2	Fault repaired 2nd inst	Fault repaired 2nd inst by CS Levant 2		CS Levant 2		
3950	07/03/1906	Trieste cable	Interrupted	Interrupted. CS Levant 2 to repair		CS Levant 2		
3951	07/03/1906	Aden - Zanzibar	Repaired 5th inst	Repaire 5th inst by CS Amber		CS Amber		
3952	07/03/1906	St Jago - St Vincent	Shore ends renewed	Shore end renewed by CS Britannia		CS Britannia		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3953	07/03/1906	Bathurst - Bissau	Repaired 5th inst	Repaired 5th inst by CS Britannia		CS Britannia		
3954	09/03/1906	Porto Rico - St Thomas	Repaired 8th inst				Repaired 8th inst	
3955	09/03/1906	Guadeloupe - Dominica	Interrupted 8th inst				Interrupted 8th inst	
3956	16/03/1906	Granada - Trinidad	Repaired 12th inst				Repaired 12th inst	
3957	16/03/1906	Guadeloupe - Dominica	Repaired 8th inst				Repaired 8th inst	
3958	21/03/1906	Malta - Alexandria No 2	Repaired 8th inst	Repaired 8th inst by CS Electra		CS Electra		
3959	21/03/1906	Lisbon - Gibraltar No 1	Interrupted	Interrupted. CS Electra to repair		CS Electra		
3960	21/03/1906	Aden - Bombay No 1	Fault repaired 17th instant	Fault repaired 17th inst by CS Sherard Osborn		CS Sherard Osborn		
3961	21/03/1906	Alexandria - Cyprus	Repaired 20th inst	Repaired 20th inst by CS Levant 1		CS Levant 1		
3962	21/03/1906	Corfu - Trieste	Under repair	Under repair by CS Levant 2		CS Levant 2		
3963	21/03/1906	Conakary	Renewed cable ends 8th inst	Renewed Cable ends 8th inst by CS Britannia		CS Britannia		
3964	21/03/1906	Dakar - Conakry	Repaired 8th inst	Repaired 8th inst by CS Britannia		CS Britannia		
3965	23/03/1906	St Vincent - Grenada	Repaired 19th inst				Repaired 19th inst	
3966		Alexandria - Larnaca	Repaired 20th inst				Repaired 20th inst	
3967	04/04/1906	Carcavellos - Gibraltar No 1	Repaired 25th ulto	Repaired 25th ulto by CS Electra		CS Electra		
3968	04/04/1906	Suez - Perim No 4	Under repair	Under repair 213nm from Suez by CS Sherard Osborn		CS Sherard Osborn		
3969	04/04/1906	Trieste - Corfu	Under repair	Ubder repair by CS Levant 2. Bad weather		CS Levant 2		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3970	04/04/1906	Aden - Zanzibar	82nm renewal completed 27th ulto	82nm renewal combleted 27th ulto by CS Duplex		CS Duplex		
3971	06/04/1906	Puerto Plata - Martinique	Repaired 3rd inst				Repaired 3rd inst	
3972	07/04/1906	Ponce - Santa Cruz and West India - Panama	Repairs		NMM TCM/8/108 CABLE ENGINEERS' LOGBOOKS. Ponce - Santa Cruz, CAMBRIA, 10 March - 7 April 1906; TCM/9/81 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. West India and Panama, CAMBRIA, 10 March - 7 April 1906	CS Cambria		
3973	13/04/1906	Trinidad - Demerara	Interrupted 10th inst				Interrupted 10th inst	
3974	20/04/1906	St Lucia - St Vincent	Repaired 13th inst				Repaired 13th inst	
3975	20/04/1906	Porto Rico - St Croix	Repaired 13th inst				Repaired 13th inst	
3976	20/04/1906	Trinidad - Demerara	Interrupted 10th inst				Interrupted 10th inst	
3977	27/04/1906	Trinidad - Demerara	Repaired 20th inst				Repaired 20th inst	
3978	27/04/1906	Pernambuco - Cayenne	Interrupted 20th inst				Interrupted 20th inst	
3979	27/04/1906	Sydney - Nelson	Interrupted 26th inst				Interrupted 26th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3980	30/04/1906	San Juan - Jamaica	Repairs		NMM TCM/9/82 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. San Juan - Jamaica, CAMBRIA, 7 - 29 April 1906; TCM/8/109 CABLE ENGINEERS' LOGBOOKS. Jamaica - San Juan, CAMBRIA, 7 - 30 April 1906	CS Cambria		
3981	02/05/1906	Anglo-Amaerican Cable (1874)	Under repair	Under repair 60nm from Valentia by CS John Pender. Bad weather		CS John Pender		
3982	02/05/1906	Lisbon - Gibraltar No 2	Repaired 14th ulto	Repaired 14th ulto by CS Electra		CS Electra		
3983	02/05/1906	Malta - Alexandria No 2	Interrupted	Interrupted 130nm from Alexandria. CS Electra to repair		CS Electra		
3984	02/05/1906	Perim - Aden No 1	Repaired 1st inst	Repaired 1st inst by CS Sherard Osborn		CS Sherard Osborn		
3985	02/05/1906	Aden - Bombay No 1	Repaired 29th ulto	Repaired 29th ulto near Bombay by CS Duplex		CS Duplex		
3986	02/05/1906	Aden - Bombay No 3	Repaired 13th ulto	Repair of interruption and a fault completed 13th ulto by CS Patrick Stewart		CS Patrick Stewart		
3987	02/05/1906	Cape Town - Mossamedes	Interrupted	Interrupted. To be repaired by CS Britannia		CS Britannia		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3988	04/05/1906	Jamaica - Colon and Bull Bay (Jamaica) - Colon (1870)	Repairs		NMM TCM/8/110 CABLE ENGINEERS' LOGBOOKS. Jamaica - Colon, CAMBRIA, 29 April - 4 May 1906; TCM/9/83 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Bull Bay (Jamaica) - Colon (1870), CAMBRIA, 29 April - 4 May 1906	CS Cambria		
3989	04/05/1906	Cadiz I Tenariffe	Temporary repair 26th ulto				Temporary repair 26th ulto	
3990	11/05/1906	Jamaica - Colon	Repaired 5th inst				Repaired 5th inst	
3991	16/05/1906	Cape Bay 4-core cable	Repaired 6th inst	Repaired 6th inst by CS Britannia		CS Britannia		
3992	18/05/1906	Cape Haitien - Porto Plata	Interrupted 15th inst				Interrupted 15th inst	
3993	30/05/1906	Western Union Company's cable	Interrupted	Interrupted 200nm from Sennen. Under repair by CS John Pender		CS John Pender		
3994	30/05/1906	Sitia - Candia	Repaired 17th inst	Repaired 17th inst by CS Electra		CS Electra		
3995	30/05/1906	Zante - Corfu	Repaired 24th inst	Repaired 24th inst by CS Electra		CS Electra		
3996	30/05/1906	Syra - Paros	Repaired	Repaired by CS Levant 1		CS Levant 1		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
3997	31/05/1906	Holland Bay; Jamaica - Cuba	Repairs		NMM TCM/8/111 CABLE ENGINEERS' LOGBOOKS. Holland Bay, CAMBRIA, 4 - 31 May 1906; TCM/9/84 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Jamaica - Cuba, CAMBRIA, 4 - 31 May 1906	CS Cambria		
3998	01/06/1906	Sydney - Nelson	Repaired 28th ulto				Repaired 28th ulto (one cable repaired)	
3999	01/06/1906	Cap Haiten - Puerto Plata	Repaired 29th ulto				Repaired 29th ulto	
4000	08/06/1906	Tangier - Cadiz	Repaired 2nd inst				Repaired 2nd inst	
4001	10/06/1906	Atalantic (1873), Valentia - Hearts Content	Repairs		NMM TCM/8/112 CABLE ENGINEERS' LOGBOOKS. Atlantic (1873), CAMBRIA, 6 - 10 June 1906; TCM/9/85 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Valentia-Hearts Content (1873), CAMBRIA, 6-10 June 1906	CS Cambria		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4002	14/06/1906	Penzance - Canso (1881)	Repairs		NMM TCM/8/113 CABLE ENGINEERS' LOGBOOKS. Penzance - Canso (1881), CAMBRIA, 10 - 14 June 1906	CS Cambria		
4003	15/06/1906	Guadeloupe - Dominica	Interrupted 11th inst				Interrupted 11th inst	
4004	22/06/1906	Paramaribo - Cayenne	Repaired 18th inst				Repaired 18th inst	
4005	22/06/1906	Guadeloupe - Dominica	Repaired 16th inst				Repaired 16th inst	
4006	27/06/1906	Western Union's Sennen cable	Repaired 30th ulto	Repaired 30th ulto by CS John Pender		CS John Pender		
4007	27/06/1906	PQ company's Brest cable	Under repair	Under repair by CS John Pender		CS John Pender		
4008	27/06/1906	Alexandria - Malta No 2	Repaired 13th inst	Repaired 13th inst by CS Electra		CS Electra		
4009	27/06/1906	Carcavellos - Gibraltar No 1	Under repair	Under repair by CS Electra		CS Electra		
4010	27/06/1906	Zante	Shore ends under repair	Shore ends under repair By CS Levant 1		CS Levant 1		
4011	27/06/1906	Messena Straits cable	Repaired 13th inst	Repaired 13th inst by CS Levant 2		CS Levant 2		
4012	27/06/1906	Malta - Alexandria No 1	Repaired 25th inst	Repaired 25th inst by CS Levant 2		CS Levant 2		
4013	27/06/1906	Malta - Pozzalo	Repaired 26th inst	Repaired 26th inst by CS Levant 2		CS Levant 2		
4014	27/06/1906	Perim - Suakin No 2	Repaired 2nd inst	Repaired 2nd inst by CS Duplex		CS Duplex		
4015	27/06/1906	Suez	Shore ends repaired	Shore ends repaired by CS Duplex		CS Duplex		
4016	27/06/1906	Perim - Jeddah	Shore ends repaired	Shore ends repaired by CS Duplex		CS Duplex		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4017	27/06/1906	Suez - Suakin No 2	Under repair	Under repair by CS Duplex		CS Duplex		
4018	27/06/1906	Suez - Aden No 3	Repaired 11th inst	Repaired 11th inst CS Sherard Osborn		CS Sherard Osborn		
4019	27/06/1906	Obock - Djibouti (French Govt)	Repaired 23rd inst	Repaired 23rd inst by CS Sherard Osborn		CS Sherard Osborn		
4020	27/06/1906	Suez - Aden No 3	Repaired 26th inst	Repaired 26th inst by CS Sherard Osborn		CS Sherard Osborn		
4021	27/06/1906	Perim - Sheikh Seyd	Repaired 26th inst	Repaired 26th inst by CS Sherard Osborn		CS Sherard Osborn		
4022	11/07/1906	Suez - Suakin No 2	Repaired 28th ulto	Repaired 28th ulto by CS Duplex		CS Duplex		
4023	11/07/1906	Aden - Bombay No 2	Interrupted	Interrupted				
4024	11/07/1906	PQ company's Brest cable	Repaired 2nd inst	Repaired 2nd inst by CS John Pender		CS John Pender		
4025	11/07/1906	Lisbon - Gibraltar No 1	Repaired 4th inst	Repaired 4th inst by CS Electra		CS Electra		
4026	11/07/1906	Bathurst - Sierra Leone	Interrupted	Interrupted. CS Britannia to repair		CS Britannia		
4027	20/07/1906	Garachico (Tenafeffe) - Santa Cruz de la Palma	Interrupted 12th inst				Interrupted 12th inst	
4028	25/07/1906	Alexandria - Port Said	Repaired 20th inst	Repaired 20th inst by CS Levant 2		CS Levant 2		
4029	25/07/1906	Alexandria - Port Said	Faulty	Faulty. To be repaired by CS Levant 2		CS Levant 2		
4030	25/07/1906	Tangier cable	Under repair	Under repair by CS Electra		CS Levant 2		
4031	25/07/1906	Aden - Bombay No 2	Under repair	Under repair by CS Ahmadi but all grappling gear lost in overboard in storm when ship rolled heavily		CS Ahmadi		
4032	25/07/1906	Bathurst - Sierra Leone	Repaired 23rd inst	Repaired 23rd inst by CS Britannia		CS Britannia		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4033	27/07/1906	Boloma - Bissau	Interrupted 24th inst				Interrupted 24th ulto	
4034	10/08/1906	Boloma - Bissau	Repaired 3rd inst				Repaired 3rd inst	
4035	17/08/1906	Rhodes - Sitia	Interrupted 10th inst				Interrupted 10th inst	
4036	17/08/1906	Falmouth - Bilbao	Interrupted 14th inst				Interrupted 14th inst	
4037	24/08/1906	Rhodes - Sitia	Repaired 17th inst				Repaired 17th inst	
4038	24/08/1906	Mole St Nicholas - Port au Prince	Interrupted 16th inst				Interrupted 16th inst	
4039	31/08/1906	Falmouth - Bilbao	Repaired 30th inst				Repaired 30th inst	
4040	14/09/1906	Sierra Leone - Conakry	Interrupted 12th inst				Interrupted 12th inst	
4041	19/09/1906	Porthcurno - Lisbon	Repaired 31 ulto	Repaired 31st ulto by CS John Pender		CS John Pender		
4042	19/09/1906	Porthcurno - Vigo	Repaired 1st inst	Repaired 1st inst by CS John Pender		CS John Pender		
4043	19/09/1906	Vigo - Lisbon	Repaired 3rd inst	Repaired 3rd inst by CS John Pender		CS John Pender		
4044	19/09/1906	Carcavellos - Gibraltar No 1	Repaired 19th inst	Repaired 19th inst by CS John Pender		CS John Pender		
4045	19/09/1906	Sitia - Rhodes	Repaired 14th ulto	Repaired 14th ulto by CS Levant 1		CS Levant 1		
4046	19/09/1906	Jeddah Cable (Turkish Govt)	Repaired 12th inst	Repaired 12th inst by CS Electra		CS Electra		
4047	19/09/1906	Suez - Suakin No 2	Repaired 18th inst	Repaired 18th inst by CS Electra		CS Electra		
4048	19/09/1906	Suakin - Perim	Under repair	Under repair by CS Electra		CS Electra		
4049	19/09/1906	Aden - Bombay Nos 1 & 2	Interrupted	Interrupted. To be repaired by CS Electra		CS Electra		
4050	19/09/1906	Aden - Perim No 2	Repaired 6th ulto	Repaired 6th ulto by CS Sherard Osborn		CS Sherard Osborn		
4051	19/09/1906	Suez - Suakin No 2	Repaired 21st ulto	Repaired 21st ulto by CS Sherard Osborn		CS Sherard Osborn		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4052	19/09/1906	Mozambique - Laurenco Marques	Repaired 21st ulto	Repaired 21st ulto by CS Amber		CS Amber		
4053	19/09/1906	Mozambique - Zanzibar	Repaired 26th ulto	Repaired 26th ulto by CS Amber		CS Amber		
4054	19/09/1906	Boloma - Bissau	Repaired 29th ulto	Repaired 29th ulto by CS Britannia		CS Britannia		
4055	19/09/1906	Conakry - Sierra Leone	Repaired 13th inst	Repaired 13th inst by CS Britannia		CS Britannia		
4056	19/09/1906	Porthcurno - Lisbon No 2	Repaired 5th ulto	Repaired 5th ulto by CS Sentinel		CS Sentinel		
4057	19/09/1906	Falmouth - Bilbao (Direct Spanish Co)	Repaired 4th inst	Repaired 4th inst by CS Sentinel		CS Sentinel		
4058	19/09/1906	Porthcurno - Lisbon No 2	Repaired 8th inst	Repaired 8th inst by CS Sentinel		CS Sentinel		
4059	19/09/1906	Porthcurno - Vigo	Repaired 11th inst	Repaired 11th inst by CS Sentinel		CS Sentinel		
4060	19/09/1906	Aden - Bombay No 2	Failed repair	Failed repair by CS Ahmadi & charter terminated		CS Ahmadi		
4061	21/09/1906	Sierra Leone - Conakry	Repaired 14th inst				Repaired 14th inst	
4062	21/09/1906	Grand Carary - Lanzarotte	Interrupted 18th inst				Interrupted 18th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4063	30/09/1906	Atlantic (1873)	Repairs		NMM TCM/8/114 CABLE ENGINEERS' LOGBOOKS. Atlantic, (1873), CAMBRIA, 6 - 30 September 1906; TCM/9/86 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Heart Content-Valentia (1873), CAMBRIA, 12-30 September 1906	CS Cambria		
4064	03/10/1906	Gibraltar - Malta No 1	Repaired 21st ulto	Repaired 21st ulto by CS John Pender		CS John Pender		
4065	03/10/1906	Porthcurno - Carcavellos	Interrupted	Interrupted. CS John Pender to repair		CS John Pender		
4066	03/10/1906	Malta - Bona No 2	Under repair	Under repair by CS Duplex		CS Duplex		
4067	03/10/1906	Mozambique - Delagoa	Partial Renewal	Partial renewal by CS Amber		CS Amber		
4068	03/10/1906	Seychelles - Mauritius	Interrupted	Interrupted. CS Sherard Osborn to repair		CS Sherard Osborn		
4069	05/10/1906	Gibraltar - Tangier	Interrupted 3rd inst				Interrupted 3rd inst	
4070	17/10/1906	Malta - Bona No 2	Repaired 3rd inst	Repaired 3rd inst by CS Duplex		CS Duplex		
4071	17/10/1906	Aden - Bombay No 2	Repaired 4 breaks 4-8th inst	Repaired 4 breaks between 4th and 8th by CS Electra		CS Electra		
4072	17/10/1906	Aden - Bombay No 1	Fault repaired 9th inst	Repaired 9th inst by CS Electra		CS Electra		
4073	17/10/1906	Libreville Cable (French Govt)	Repaired 12th inst	Repaired 12th inst by CS Britannia		CS Britannia		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4074	17/10/1906	Seychelles - Mauritius	Repaired 8th inst	Repaired 8th inst by CS Sherard Osborn		CS Sherard Osborn		
4075	17/10/1906	Mozambique - Laurenco Marques	Partial renewal and repair	Partial renewal and repair by CS Amber		CS Amber		
4076	31/10/1906	St Vincent - Madiera Nos 2 & 3	Under repair	Under repair by CS John Pender		CS John Pender		
4077	31/10/1906	Pozzalo cable	Repaired 22nd inst	Repaired 22nd inst by CS levant 2		CS Levant 2		
4078	31/10/1906	Malta - Bona No 1	Repaired 26th inst	Repaired 26th inst by CS Levant 2		CS Levant 2		
4079	31/10/1906	Aden - Bombay No 2	Repaired 27th inst	Repaired 27th inst by CS Electra		CS Electra		
4080	31/10/1906	Mozambique - Laurenco Marques	Renewal	Renewal by CS Sherard Osborn		CS Sherard Osborn		
4081	14/11/1906	Madiera - St Vincent Nos 2 & 3	Repaired 10th inst	Repaired 10th inst by CS John Pender		CS John Pender		
4082	14/11/1906	Alexandria - Malta No 1	Repaired 9th inst	Repaired 10th inst by CS Duplex		CS Duplex		
4083	14/11/1906	Alexandria - Sitia	Under repair	Under repair by CS Duplex		CS Duplex		
4084	14/11/1906	Suez - Aden No 3	Under repair	Under repair by CS Electra		CS Electra		
4085	14/11/1906	Laurenco Marques cable	Renewal complete	Renewal complete by CS Amber		CS Amber		
4086	14/11/1906	Mozambique shore ends	Renewed 6th inst	Renewed 6th inst by CS Sherard Osborn		CS Sherard Osborn		
4087	14/11/1906	Aden - Zanzibar	Interrupted	Interrupted CS Sherard Osborn to repair		CS Sherard Osborn		
4088	28/11/1906	Alexandria - Sitia	Repaired 25th inst	Repaired 25th inst by CS Duplex		CS Duplex		
4089	28/11/1906	Suez - Aden No 3	Repaired 14th inst	Repaired 14th inst by CS Electra		CS Electra		
4090	28/11/1906	Perim - Aden No 2	Repaired 15th inst	Repaired 15th inst by CS Electra		CS Electra		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4091	28/11/1906	Perim - Aden No 1	Repaired 18th inst	Repaired 18th inst by CS Electra		CS Electra		
4092	28/11/1906	Aden - Zanzibar	Repaired 24th inst	Repaired 24th inst by CS Sherard Osborn		CS Sherard Osborn		
4093	28/11/1906	Mozambique No 1	Under repair	Under repair by CS Sherard Osborn		CS Sherard Osborn		
4094	28/11/1906	Mozambique shore ends	Renewed 17th inst	Renewed 17th inst by CS Amber		CS Amber		
4095	12/12/1906	Gibraltar - Tangier	Repaired 12th inst	Repaired 12th inst by CS Duplex		CS Duplex		
4096	12/12/1906	Malta - Bona No 2	Interrupted 4th inst	Interrupted 4th inst. To be repaired by Cs Levent 2		CS Levant 2		
4097	12/12/1906	Cape Town beach ends	Renewed 5th inst	Renewed 5th inst by CS Britannia		CS Britannia		
4098	12/12/1906	Zanzibar - Mozambique No 1	Repaired 4th inst	Repaired 4th inst by CS Sherard Osborn		CS Sherard Osborn		
4099	12/12/1906	Delegoa	New shore ends	Now shore end by CS Sherard Osborn		CS Sherard Osborn		
4100	14/12/1906	Gibraltar - Tangier	Repaired 12th inst				Repaired 12th inst	
4101	14/12/1906	Trinidad - Demerara	Repaired 7th inst				Repaired 7th inst	
4102	21/12/1906	Fort de France - Paramaribo	Interrupted 17th inst				Interrupted 17th inst	
4103	23/12/1906	Penzance - Canso (1881)	Repairs		TCM/8/115 CABLE ENGINEERS' LOGBOOKS. Penzance - Canso (1881), CAMBRIA, 9 - 23 December 1906	CS Cambria		
4104	04/01/1907	Gibraltar - Tangier	Interrupted 2nd inst				Interrupted 2nd inst	
4105	09/01/1907	Gibraltar - Malta No 1	Interrupted	Interrupted. CS Duplex to repair		CS Duplex		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4106	09/01/1907	Para - Odessa	Repaired 28th ulto	Repaired 28th ulto by CS Levant 1		CS Levant 1		
4107	09/01/1907	Patras Narrows	Renewed 5th inst	Renewed 5th inst by CS Levant 1		CS Levant 1		
4108	09/01/1907	Bona - Malta No 2	Repaired 19th ulto	Repaired 19th ulto by CS Levant 2		CS Levant 2		
4109	09/01/1907	Suez - Aden No 4	Repaired 21st ulto	Repaierd 21st ulto by CS Electra		CS Electra		
4110	09/01/1907	Suez - Suakin	Repaired 29th ulto	Repaired 29th ulto by CS Electra		CS Electra		
4111	09/01/1907	Seirra Leone - Accra	Repaired 20th ulto	Repaired 20th ulto by CS Sentinel		CS Sentinel		
4112	09/01/1907	Sierra Leone - Ascension	Renewed beach pieces 19th ulto	Renewed beach pieces 19th ulto by CS Sherard Osborn		CS Sherard Osborn		
4113	09/01/1907	Sierra Leone - Accra	Renewed beach pieces 19th ulto	Renewed beach pieces 19th ulto by CS Sherard Osborn		CS Sherard Osborn		
4114	09/01/1907	Laurenco Marques - Mozambiques	Fault repaired	Fault repaired by CS Amber		CS Amber		
4115	09/01/1907	Cape Town - Mossamedes	2 faults repaired 3rd inst	2 faults repaired 3rd inst by CS Britannia		CS Britannia		
4116	11/01/1907	New Brunswick - Prince Edward Islands	Interrupted 9th inst				Interrupted 9th inst	
4117	23/01/1907	Gibraltar - Malta No 1	Repaired 10th inst	Repaired 10th inst by CS Duplex		CS Duplex		
4118	23/01/1907	Gibraltar - Porthcurno No 3	Repaired 11th inst	Repaired 11th inst by CS Duplex		CS Duplex		
4119	23/01/1907	Lisbon - Gibraltar No 1	Repaired 19th inst	Repaired 19th inst by CS Duplex		CS Duplex		
4120	23/01/1907	Gibraltar - Tangier	Repaired 21st inst	Repaired 21st inst by CS Duplex		CD Duplex		
4121	23/01/1907	Lisbon - Gibraltar No 1	Interrupted again	Interrupted again. Under repair by CS Duplex		CS Duplex		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4122	23/01/1907	Laurence Marques shore ends	Renewed 13th inst	Renewed 13th inst by CS Amber		CS Amber		
4123	23/01/1907	Massamedes - Cape Town	Fault	Fault 54nm from Mossamedes				
4124	25/01/1907	Gibraltar - Tangier	Repaired 22ndinst				Repaired 22nd inst	
4125	25/01/1907	Dakar - Conakry (French Govt)	Interrupted 22nd inst				Interrupted 22nd inst	
4126	06/02/1907	Lisbon - Vigo	Repaired 28th ulto	Repaired 28th ulto by CS Duplex		CS Duplex		
4127	06/02/1907	Carcavellos - Gibraltar No 1	Repaired 2nd inst	Repaired 2nd inst by CS Duplex		CS Duplex		
4128	06/02/1907	Gibraltar - Malta No 1	Under repair	Under repair by CS Duplex		CS Duplex		
4129	06/02/1907	Bosphorus cables	All interrupted & temporarily repaired 4th inst	All interrupted and temporarily repaired 4th inst by CS Levant 1		CS Levant 1		
4130	06/02/1907	Suez - Perim No 1	Repaired 2nd inst	Repaired 2nd inst by CS Electra		CS Electra		
4131	06/02/1907	Suez - Suakin No 2	Repaired 5th inst	Repaired 5th inst by CS Electra		CS Electra		
4132	06/02/1907	Sierra Leone shore ends	Renewals	Renewals by CS Sentinel		CS Sentinel		
4133	06/02/1907	Zanzibar - Mombassa	Fault repaired 3rd inst but another to be repaired	Fault repaired 3rd inst but another to be repaired by CS Sherard Osborn		CS Sherard Osborn		
4134	06/02/1907	Mossamedes - Cape Town	Fault under repair	Fault under repair by CS Britannia		CS Britannia		
4135	08/02/1907	Mole St Nicholas - Port au Prince	Repaired 4th inst				Repaired 4th inst	
4136	08/02/1907	Dakar - Conakry (French Govt)	Repaired 6th inst				Repaired 6th inst	
4137	15/02/1907	Tenidos - Lemnos	Interrupted 7th inst				Interrupted 7th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4138	15/02/1907	Odessa - Kilia	Interrupted 9th inst				Interrupted 9th inst	
4139	15/02/1907	Tenedos - Chio	Interrupted 13th inst				Interrupted 13th inst	
4140	20/02/1907	Gibraltar - Malta No 1	Under repair	Under repair but bad weather. CS Duplex		CS Duplex		
4141	20/02/1907	Chios - Tenedos	Repaired 14th inst	Repaired 14th inst by CS Levant 1		CS Levant 1		
4142	20/02/1907	Accra	Shore ends overhauled	Shore ends overhauled 9th inst by CS Sentinel		CS Sentinel		
4143	20/02/1907	Zanzibar - Mombassa	Repaired 10th inst	Repaired 10th inst by CS Britannia		CS Britannia		
4144	20/02/1907	Benguela	Trench lines overhauled 10th inst	Trench lines overhauled 10th inst by CS Britannia		CS Britannia		
4145	22/02/1907	Tenedos - Lemnos	Repaired 18th inst				Repaired 18th inst	
4146	25/02/1907	Valentia - Hearts Content (1873)	Repairs		NMM TCM/9/87 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Valentia - Hearts Content (1873), CAMBRIA, 12 - 25 February 1907; TCM/8/116 CABLE ENGINEERS' LOGBOOKS. Atlantic (1874), CAMBRIA, 12 - 25 February 1907	CS Cambria		
4147	01/03/1907	Rhodes - Sitia	Interrupted 25th ulto				Interrupted 25th ulto	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4148	06/03/1907	Gibraltar - Malta No 1	Fault repaired 23rd ulto and a another fault 3rd inst	Fault repaired 23rd ulto by CS Duplex and a another fault on the 2nd inst		CS Duplex		
4149	06/03/1907	Vigo - Carcavellos	Under repair	Under repair by CS Duplex		CS Duplex		
4150	06/03/1907	Rhodes - Sitia	Repaired 5th inst	Repaired 5th inst by CS levant 1		CS Levant 1		
4151	06/03/1907	Malta - Alexandria No 2	Repaired 1st inst	Repaired 1st inst by CS Electra		CS Electra		
4152	06/03/1907	Principe Bay cable	Under repair	Under repair by CS Sentinel		CS Sentinel		
4153	06/03/1907	Zanzibar - Mozambique No 1	Interrupted	Interrupted. CS Sherard Osborn to repair		CS Sherard Osborn		
4154	08/03/1907	Panama - Buenaventura	Interrupted 28th ulto				Interrupted 28th ulto	
4155	08/03/1907	Buenoventura - Santa Elena	Interrupted 28th ulto				Interrupted 28th ulto	
4156	15/03/1907	Rhodes - Sitia	Repaired 3rd inst				Repaired 3rd inst	
4157	15/03/1907	Fort de France - Paramaribo	Repaired 11th inst				Repaired 11th inst	
4158	15/03/1907	Mozambique - Majunga	Interrupted 3rd inst				Interrupted 3rd inst	
4159	20/03/1907	Vigo - Carcavellos	Repaired 16th inst	Repaired 16th inst by CS Duplex		CS Duplex		
4160	20/03/1907	Vigo - Caminha	Repaired 19th inst	Repaired 19th inst by CS Duplex		CS Duplex		
4161	20/03/1907	St Maina - Corfu	Under repair	Under repair by CS Levant 1		CS Levant 1		
4162	20/03/1907	Principe Bay cable	Repaired	Repaired by CS Sentinel		CS Sentinel		
4163	20/03/1907	Kelia - Odessa	Interrupted 9th ulto	Interrupted 9th ulto. CS Levant 2 to repair		CS Levant 2		
4164	20/03/1907	Brass - Bonny	Faults repaired on 10th and 18th inst	Faults repaired on 10th and 18th by CS Sentinel		CS Sentinel		
4165	20/03/1907	St Thome - Loanda	Repaired 18th inst	Repaired 18th inst 298nm from St Thome by CS Amber		CS Amber		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4166	20/03/1907	Zanzibar - Mozambique No 1	Fault repaired 7th inst	Fault repaired 7th inst 170nm from Zanzibar by CS Sherard Osborn		CS Sherard Osborn		
4167	22/03/1907	Trinidad - Demerara	Interrupted 14th inst				Interrupted 14th inst	
4168	22/03/1907	Tangier - Cadiz	Interrupted 20th inst				Interrupted 20th inst	
4169	29/03/1907	Trinidad - Demerara	Repaired 20th inst				Repaired 20th inst	
4170	05/04/1907	Paramaribo - Cayenne	Repaired 30th ulto				Repaired 30th ulto	
4171	05/04/1907	Odessa - Kilia	Repaired 4th inst				Repaired 4th inst	
4172	05/04/1907	Mozambique - Majunga	Repaired 30th ulto				Repaired 30th ulto	
4173	12/04/1907	Cadiz - Tenariffe	Interrupted 10th inst				Interrupted 10th inst	
4174	17/04/1907	Gibraltar - Carcavellos	Repaired 24th ulto	Repaired 24th ulto by CS Duplex		CS Duplex		
4175	17/04/1907	Carcavellos - Azores	Fault repaired 14th inst	Fault repaired 14th inst by CS Duplex		CS Duplex		
4176	17/04/1907	St Miguel - Carcavellos	Under repair	Under repair by CS Duplex		CS Duplex		
4177	17/04/1907	Corfu - St Maura	Repaired 19th ulto	Repaired 19th ulto by CS Levant 1		CS Levant 1		
4178	17/04/1907	Pozzalo cable	Repaired 31st ulto	Repaired 31st ulto by CS Levant 1		CS Levant 1		
4179	17/04/1907	Katakolo - Zante	Repaired 10th inst	Repaired 10th inst by CS Levant 1		CS Levant 1		
4180	17/04/1907	Rio - Antirio	Under repair	Under repair by CS Levant 1		CS Levant 1		
4181	17/04/1907	Sitia - Alexandria	Repaired 28th ulto	Repaired 28th ulto by CS Electra		CS Electra		
4182	17/04/1907	Corfu - Oranto	Repaired 8th inst	Repaired 8th inst by CS Electra		CS Electra		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4183	17/04/1907	Dakar - Conakry (French Govt)	Interrupted	Interrupted. To be repaired by CS Sentinel		CS Sentinel		
4184	17/04/1907	Mossamedes - Benguella	Repaired 7th inst	Repaired 7th inst by CS Amber		CS Amber		
4185	17/04/1907	Mozambique - Majunga (French Govt)	Repaired 28th ulto	Repaired 28th ulto by CS Sherard Osborn		CS Sherard Osborn		
4186	28/04/1907	Tenedos - Chio	Repaired 22nd inst				Repaired 22nd inst	
4187	28/04/1907	Dakar - Conakry (French Govt)	Interrupted 24th inst				Interrupted 24th inst	
4188	01/05/1907	Azores cable	Repaired 20th ulto	Repaired 20th ulto by CS Duplex		CS Duplex		
4189	01/05/1907	Patras - Corinth Nos 1 & 3	Repaired 24th ulto	Repaired 24th ulto by CS Levant 1		CS Levant 1		
4190	01/05/1907	Cania - Rettino	Repaired 21st ulto	Repaired 21st ulto by CS Levant 2		CS Levant 2		
4191	01/05/1907	Dakar - Conakry (French Govt)	Under repair	Under repair by CS Sentinel		CS Sentinel		
4192	10/05/1907	Tangier - Tenedos	Repaired 6th inst				Repaired 6th inst	
4193	10/05/1907	Gibraltar - Tangier	Repaired 7th inst				Repaired 7th inst	
4194	15/05/1907	Cadiz - Tenariffe (Spanish Govt)	Repaired 7th inst	Repaired 7th inst by CS CS Duplex		CS Duplex		
4195	15/05/1907	Gibraltar - Tangier	Repaired 7th inst	Repaired 7th inst by CS Duplex		CS Duplex		
4196	15/05/1907	Melilla - Althaceinos (Spanish Govt)	Under repair	Under repair by CS Duplex		CS Duplex		
4197	15/05/1907	Zante - Canea	Under repair	Under repair by CS Levant 2		CS Levant 2		
4198	15/05/1907	Aden - Bombay No 2	Fault repaired & interrupted	Fault repaired & interrupted 11th inst by CS Electra		CS Electra		
4199	15/05/1907	Dakar - Conakry (French Govt)	Several faults repaired	Several faults repaired by CS Sentinel		CS Sentinel		
4200	15/05/1907	St Jago - Bathurst	Under repair	Under repair by CS Sentinel		CS Sentinel		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4201	15/05/1907	Rodriguez Station	Damaged by cyclone 10th inst	Damaged by cyclone 10th inst. CS Sherard Osborn to assist		CS Sherard Osborn		
4202	17/05/1907	New Brunswick - Prince Edward Islands	Repaired 17th inst				Repaired 17th inst	
4203	17/05/1907	Dakar - Conakry (French Govt)	Repaired 12th inst				Repaired 12th inst	
4204	12/06/1907	Malta - Alhucemas (Spanish Govt)	Repaired 7th ulto	Repaired 7th ulto by CS Duplex		CS Duplex		
4205	12/06/1907	Cadiz Bay line	Repaired 24th ulto	Repaired 24th ulto by CS Duplex		CS Duplex		
4206	12/06/1907	Gibraltar - Malta No 1	Repaired 27th ulto	Repaired 27th ulto by CS Levant 2		CS Levant 2		
4207	12/06/1907	Bona - Malta No 1	Interrupted	Interrupted. CS Levant 2 to repair		CS Levant 2		
4208	12/06/1907	Aden - Bombay No 2	Repaired 21st ulto	Repaired 21st ulto by CS Electra		CS Electra		
4209	12/06/1907	St Jago - Bathurst	Repaired 26th ulto	Repaired 26th ulto by CS Sentinel		CS Sentinel		
4210	12/06/1907	Dakar - Conakry (French Govt)	Repaired 6th inst	Repaired 6th inst by CS Sentinel		CS Sentinel		
4211	12/06/1907	Loanda - St Thome	Repaired 3rd inst	Repaired 3rd inst by CS Amber		CS Amber		
4212	12/06/1907	Rodriguez - Cocos	Repaired 1st inst	Repaired 1st inst by CS Sherard Osborne		CS Sherard Osborn		
4213	12/06/1907	Mozambique - Laurenco Marques	Interrupted	Interrupted. CS Sherard Osborn to repair		CS Sherard Osborn		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4214	17/06/1907	Penzance - Canso (1882)	Repairs		NMM TCM/9/88 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Penzance - Canso (1882), CAMBRIA, 13 - 17 June 1907	CS Cambria		
4215	21/06/1907	Trinidad - Demerara	Interrupted 18th inst				Interrupted 18th inst	
4216	26/06/1907	Porthcurno - Madiera	Repaired 23rd inst	Repaired 23rd inst by CS John Pender		CS John Pender		
4217	26/06/1907	Malta - Bona No2	Under repair	Under repair by CS Levant 2		CS Levant 2		
4218	26/06/1907	Perim - Suakin	Repaired 22nd inst	Repaired 21st inst by CS Electra		CS Electra		
4219	26/06/1907	Mozambique - Laurenco Marques No 1	Repaired 21st inst	Repaired 21st inst by CS Sherard Osborn		CS Sherard Osborn		
4220	26/06/1907	Zanzibar - Mozambique No 1	Fault under repair	Fault under repair by CS Sherard Osborn		CS Sherard Osborn		
4221	26/06/1907	Trinidad - Demerara	Repaired 24th inst				Repaired 24th inst	
4222	10/07/1907	Porthcurno - Vigo	Under repair	Under repair CS Britannia		CS Britannia		
4223	10/07/1907	Gibraltar - Malta No 1	Repaired 3rd inst	Repaired 242nm fro Malta 3rd inst by CS Duplex		CS Duplex		
4224	10/07/1907	Terceira cable	Interrupted.	Interrupted. CS Duplex to repair		CS Duplex		
4225	10/07/1907	Chios - Tenedos	Repaired 1st inst	Repaired 1st inst by CS Levant 1		CS Levant 1		
4226	10/07/1907	Patros - Zante No 2	Repaired 7th inst	Repaired 7th inst by CS Levant 1		CS Levant 1		
4227	10/07/1907	Alexandria - Malta No 2	Interrupted	Interrupted 18nm from Alexandria. CS Levant 2 to repair		CS Levant 2		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4228	10/07/1907	Mozambique - Delagoa	Under repair	Interrupted 201nm from Mozambique. Under repair by CS Sherard Osborn		CS Sherard Osborn		
4229	12/07/1907	Buenoventura - Santa Elena	Repaired 12th <u>March</u>				Repaired 12th <u>March</u>	
4230	12/07/1907	Panama - Buenaventura	Repaired 12th <u>March</u>				Repaired 12th <u>March</u>	
4231	12/07/1907	Faro Islands - Shetlands	Interrupted 8th inst				Interrupted 8th inst	
4232	12/07/1907	Trinidad - Demerara	Interrupted 9th inst				Interrupted 9th inst	
4233	19/07/1907	Faro Islands - Shetlands	Repaired 13th inst				Repaired 13th inst	
4234	19/07/1907	Trinidad - Demerara	Repaired 15th inst				Repaired 15th inst	
4235	27/07/1907	Porthcurno - Vigo	Repaired 10th inst	Repaired 10th inst by CS Britannia		CS Britannia		
4236	27/07/1907	Porthcurno - Vigo	Repaired 22nd inst	Repaired 22nd inst by CS John Pender		CS John Pender		
4237	27/07/1907	Porthcurno - Carcavellos	Under repair	Under repair by CS John Pender		CS John Pender		
4238	27/07/1907	Vigo - Caminha	Repaired 1st inst	Repaired 1st inst by CS Britannia		CS Britannia		
4239	27/07/1907	Pico - Terceira	Under repair	Under repair by CS Duplex		CS Duplex		
4240	27/07/1907	Trieste - Corfu	Repaired 19th inst	Repaired 19th inst by CS levant 2		CS Levant 2		
4241	27/07/1907	Mozambique - Laurenco Marques	Under repair	Under repair by CS Sherard Osborn but strong currents		CS Sherard Osborn		
4242	02/08/1907	Gib - Tangier	Interrupted 29th ulto				Interrupted 29th ulto	
4243	09/08/1907	Gib - Tangier	Repaired 5th inst				Repaired 5th inst	
4244	16/08/1907	Accra - Lagos	Interrupted 11th inst				Interrupted 11th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4245	23/08/1907	Para - Pernambuco	Interrupted 21st inst				Interrupted 21st inst	
4246	23/08/1907	Maranham - Ceara	Interrupted 21st inst				Interrupted 21st inst	
4247	30/08/1907	Accra - Lagos	Repaired 24th inst				Repaired 24th inst	
4248	30/08/1907	Para - Pernambuco	Repaired 22nd inst				Repaired 22nd inst	
4249	30/08/1907	Medam - Olehleh	Interrupted 21st inst				Interrupted 21st inst	
4250	06/09/1907	Maranham - Ceara	Repaired 2nd inst				Repaired 2nd inst	
4251	06/09/1907	Medam - Olehleh	Repaired 2nd inst				Repaired 2nd inst	
4252	13/09/1907	Kotonou - Libraville	Repaired 10th inst				Repaired 10th inst	
4253	18/09/1907	Porthcurno - Madiera No 3	Repaired 8th inst	Repaired 8th inst by CS John Pender		CS John Pender		
4254	18/09/1907	Gibraltar - Tangier	Repaired 4th ulto	Repaired 4th ulto by CS Britannia		CS Britannia		
4255	18/09/1907	Almeria - Melilla	Repaire d 9th ulto	Repaired 9th ulto by CS Britannia		CS Britannia		
4256	18/09/1907	Tunata - Centa	Repaired 22nd ulto	Repaired 22nd ulto BY CS Britannia		CS Britannia		
4257	18/09/1907	Vigo - Gibraltar	Repaired 2nd inst	Repaired 2nd inst by CS Britannia		CS Britannia		
4258	18/09/1907	Cadiz - Gibraltar	Repaired 4th inst	Trepaired 4th inst by CS Britannia		CS Britannia		
4259	18/09/1907	Carcavellos - Gibraltar No 1	Repaired 16th inst	Repaired 16th inst by CS Britannia		CS Britannia		
4260	18/09/1907	Cania cable	Repaired 30th July	Repaired 30th July by CS Levant 2		CS Levant 2		
4261	18/09/1907	Port Said - Alexandria	Repaired 6th Aug	Repaired 6th Aug by CS Levant 2		CS Levant 2		
4262	18/09/1907	Malta - Bona No 2	Repaired 18th Aug	Repaired 18th Aug by CS Levant 2		CS Levant 2		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4263	18/09/1907	Suez - Suakin	Repaired 16th Aug	Repaired 16th Aug by CS Electra		CS Electra		
4264	18/09/1907	Bonny - Lagos	Repaired and diverted 14th Aug	Repaired and diverted 14th Aug by CS Sentinel		CS Sentinel		
4265	18/09/1907	Accra - Lagos	Repaired 18th Aug	Repaired 18th Aug by CS Sentinel		CS Sentinel		
4266	18/09/1907	Gabon - Cotonou	Repaired 7th inst	Repaired 7th inst by CS Amber		CS Amber		
4267	18/09/1907	Laurenco Marques - Durban	Repaired 17th Aug	Repaired 17th Aug by CS Sherard Osborn		CS Sherard Osborn		
4268	18/09/1907	Mozambique - Laurenco Marques	Repaired 19th Aug	Repaired 19th Aug by CS Sherard Osborn		CS Sherard Osborn		
4269	18/09/1907	Zanzibar - Mozambique	2 faults repaired 15th inst	2 faults repaired 15th				
4270	20/09/1907	Dardanelles - Tenedos	Repaired 18th inst				Repaired 18th inst	

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4271	25/09/1907	Atlantic (1874, 1880)	Repairs		NMM TCM/8/117 CABLE ENGINEERS' LOGBOOKS. Atlantic (1874, 1880), CAMBRIA, 6 July - 31 August 1907;TCM/9/90 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Atlantic (1874), CAMBRIA, 13 July - 23 September 1907; TCM/9/89 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Valentia (1880), CAMBRIA, 13 July - 26 September 1907; TCM/9/91 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Valentia - Hearts Content (1874, 1880), CAMBRIA, 23 July - 13 September 1907; TCM/8/118 CABLE ENGINEERS'	CS Cambria		
4272	27/09/1907	Grand Carary - Lanzarotte	Interrupted 18th inst				Interrupted 18th inst	

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4273	27/09/1907	Midway Is - Guam	Interrupted 22nd inst				Interrupted 22nd inst	
4274	27/09/1907	Fort de France - Paramaribo	Interrupted 26th inst				Interrupted 26th inst	
4275	02/10/1907	Cania - Zante	Repaired 18th ulto	Repaired 18th ulto by CS Levant 1		CS Levant 1		
4276	02/10/1907	Black Sea cable	Interrupted	Interrupted				
4277	02/10/1907	Sierra Leone - Accra	Interrupted	Interrupted. CS Sentinel to repair		CS Sentinel		
4278	02/10/1907	Zanzibar - Mozambique No 1	Repaired 19th ulto	Repaired 19th ulto				
4279	02/10/1907	Durban - Delagoa Bay	Partial renewal	Partial renewal by CS Colonia		CS Colonia		
4280	02/10/1907	Aden - Zanzibar	Partial renewal	Partial renewal by CS Colonia		CS Colonia		
4281	02/10/1907	Aden - Bombay No 1	Partial renewal	Partial renewal by CS Colonia		CS Colonia		
4282	02/10/1907	San Thome - Loanda	Partial renewal	Partial renewal by CS Colonia		CS Colonia		
4283	11/10/1907	Fort de France - Paramaribo	Repaired 7th inst				Repaired 7th inst	
4284	11/10/1907	Pernambuco - Ceara	Interrupted 9th inst				Interrupted 9th inst	
4285	11/10/1907	Pernambuco - Para	Interrupted 9th inst				Interrupted 9th inst	
4286	16/10/1907	Weston - Waterville	Repaired 14th inst	Repaired 14th inst by CS John Pender		CS John Pender		
4287	16/10/1907	Porthcurno - Gibraltar No 3	Repaired 15th inst	Repaired 15th inst by CS John Pender		CS John Pender		
4288	16/10/1907	Black Sea cable	Repaired 9th inst	Repaired near Odessa 9th inst by CS Levant 1		CS levant 1		
4289	16/10/1907	Malta - Alexandria No 1	Repaired 13th inst	Repaired 13th inst by CS Electra		CS Electra		
4290	16/10/1907	Accra - Sierra Leone	Repaired 4th inst	Repaired 4th inst by CS Sentinel		CS Sentinel		

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4291	18/10/1907	Pernambuco - Ceara	Interrupted 9th inst				Interrupted 9th inst	
4292	18/10/1907	Pernambuco - Para	Interrupted 9th inst				Interrupted 9th inst	
4293	23/10/1907	Midway Is - Guam	Repaired 22nd inst				Repaired 22nd inst	
4294		Pernambuco - Para	Repaired 17th inst				Repaired 17th inst	
4295		Guernsey - Jersey	Interrupted 19th inst				Interrupted 19th inst	
4296	23/10/1907	San Thome - St Paul de Loanda (1886)	Repairs		NMM TCM/9/99 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. San Thome - Loanda, COLONIA, 25 September - 16 October 1907; TCM/8/120 CABLE ENGINEERS' LOGBOOKS. San Thome - St Paul de Loanda (1886), COLONIA, 25 September - 23 October 1907	CS Colonia		
4297	30/10/1907	Porthcurno - Carcavellos	Repaired 26th inst	Repaired 26th inst by CS Britannia and now repairing a second break on the same cable		CS Britannia		
4298	30/10/1907	Malta - Alexandria No 2	Repaired 26th inst	Repaired 26th inst by CS Electra		CS Electra		
4299	30/10/1907	Bathurst - Bissau	Under repair	Under repair by CS Sentinel		CS Sentinel		

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4300	30/10/1907	Zanzibar - Mozambique	Fault repaired 28th inst	Fault repaired 28th inst by CS Sherard Osborn		CS Sherard Osborn		
4301	01/11/1907	Pernambuco - Ceara	Repaired 30th ulto				Repaired 30th ulto	
4302	01/11/1907	Fao - Bushire	Interrupted 31st ulto				Interrupted 31sr ulto	
4303	08/11/1907	Guernsey - Jersey	Repaired 31st ulto				Repaired 31st ulto	
4304	13/11/1907	Porthcurno - Carcavellos	Repaired 10th inst	Repaired 10th inst by CS Britannia		CS Britannia		
4305	13/11/1907	Suez - Aden No 3	Under repair	Under repair by CS Electra		CS Electra		
4306	13/11/1907	Mozambique - Zanzibar Nos 1&2	Shore ends at Mozambique renewed 30th ulto	Shore ends at Mozambique renewed 30th ulto by CS Sherard Osborn		CS Sherard Osborn		
4307	27/11/1907	Porthcurno - Gibraltar No 3	Repaired 19th inst	Repaired 19th inst by CS John Pender		CS John Pender		
4308	27/11/1907	Suez - Aden No 3	Faults repaired 16th inst	Faults repaired 16th inst by CS Electra		CS Electra		
4309	27/11/1907	Aden - Perim No 2	New shore ends at Aden 20th inst	New shore ends at Aden 20th inst by CS Electra		CS Electra		
4310	27/11/1907	Perim - Suakin	Repaired 27th inst	Repaired 27th inst by CS Electra		CS Electra		
4311	27/11/1907	Bathurst - Bissau	Repaired 16th inst	Repaired 16th inst by CS Sentinel		CS Sentinel		
4312	27/11/1907	Kotonou - Lagos	Under repair	Fault inder repair by CS Sentinel		CS Sentinel		
4313	27/11/1907	Mozambique - Delagoa	Repairs		NMM TCM/9/101 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Mozambique - Delagoa, COLONIA, 23 March - 27 November 1907	CS Colonia		

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4314	29/11/1907	Fao - Bushire	Repaired 25th inst				November 25th inst	
4315		Trinidad - Demerara	Interrupted 25th inst				Interrupted 25th inst	
4316	30/11/1907	Brest - Dakar (1905), Borkum - Vigo (1896)			NMM TCM/8/119 CABLE ENGINEERS' LOGBOOKS. Brest - Dakar (1905), Borkum - Vigo (1896), CAMBRIA, 29 September - 30 November 1907; TCM/9/93 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Brest - Dakar, CAMBRIA, 29 September - 30 November 1907	CS Cambria		
4317	06/12/1907	Grand Carary - Lanzarotte	Repaired 29th ulto				Repaired 29th ulto	
4318	06/12/1907	Trinidad - Demerara	Repaired 3rd inst				Repaired 3rd inst	
4319	06/12/1907	Lagos - Kotonou	Interrupted 4th inst				Interrupted 4th inst	

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4320	06/12/1907	Delagoa - Mozambique (1879); Durban - Delagoa Bay (1879)			NMM TCM/8/121 CABLE ENGINEERS' LOGBOOKS. Delagoa - Mozambique (1879), COLONIA, 13 - 23 November 1907; TCM/9/100 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Mozambique - Delagoa, COLONIA, 13 - 23 November 1907; TCM/8/122 CABLE ENGINEERS' LOGBOOKS. Delagoa - Mozambique (1879), COLONIA, 23 - 29 November 1907; TCM/8/124 CABLE ENGINEERS' LOGBOOKS. Durban - Delagoa Bay (1879), COLONIA, 29 November - 6 December 1907; TCM/9/102 ROUGH DRAFTS OF CABLE	CS Colonia		
4321	11/12/1907	Falmouth - Bilbao (Direct Spanish Co)	Interrupted	Interrupted 21nm from Bilbao. CS John Pender to repair		CS John Pender		

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4322	11/12/1907	Kotonou - Lagos	Repaired 1st inst	Repaired 1st inst by CS Sentinel		CS Sentinel		
4323	11/12/1907	Laurenco Marques - Durban	Renewal complete 30th ulto	Renewal complete 30th ulto				
4324	13/12/1907	Cueta - Tangiers	Interrupted 7th inst				Interrupted 7th inst	
4325	13/12/1907	Falmouth - Bilbao (Direct Spanish Co)	Interrupted 9th inst				Interrupted 9th inst	
4326	13/12/1907	Sierra Leone - Accra	Interrupted 11th inst				Interrupted 11th inst	
4327	13/12/1907	Lagos - Brass - Bonny	Interrupted 11th inst				Interrupted 11th inst	
4328	20/12/1907	Garachico (Tenafeffe) - Santa Cruz de la Palma	Repaired 17th inst				Repaired 17th inst	
4329	20/12/1907	Falmouth - Bilbao	Repaired 18th inst				Repaired 18th inst	
4330	20/12/1907	Sierra Leone - Accra	Repaired 12th inst				Repaired 12th inst	
4331	20/12/1907	Lagos - Brass - Bonny	Repaired 12th inst				Repaired 12th inst	

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4332	23/12/1907	Delagoa - Mozambique (1879); Durban - Delagoa Bay (1879)	Repairs		NMM TCM/8/123 CABLE ENGINEERS' LOGBOOKS. Delagoa - Mozambique (1879), COLONIA, 6 - 23 December 1907; TCM/9/103 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Beira - Mozambique, COLONIA, 6 - 23 December 1907	CS Colonia		
4333	03/01/1908	Bathurst - Bissau	Interrupted 25th ulto				Interrupted 25th ulto	
4334	08/01/1908	Falmouth - Bilbao (Direct Spanish Co)	Repaired 17th ulto	Repaired 17th ulto by CS John Pender		CS John Pender		
4335	08/01/1908	Vigo - Carcavellos	Repaired 3rd inst	Repaired 3rd inst by CS Duplex		CS Duplex		
4336	08/01/1908	Corfu cable	Repaired 20th ulto	Repaired 20th ulto by CS Levant 1		CS Levant 1		
4337	08/01/1908	Malta - Alexandria No 2	Repaired 23rd ulto	Repaired 23rd ulto by CS Levant 2		CS Levant 2		
4338	08/01/1908	Malta - Alexandria No 1	Repaired 26th ulto	Repaired 26th ulto by CS Levant 2		CS Levant 2		
4339	08/01/1908	Mozambique - Beira	Repaired 6th inst	Repaired 6th inst by CS Sherard Osborn		CS Sherard Osborn		
4340	08/01/1908	Delagoa - Beira	Under repair	Under repair by CS Sherard Osborn		CS Sherard Osborn		
4341	08/01/1908	Accra - Sierra Leone	Repaired 20th ulto	Repaired 20th ulto by CS Britannia		CS Britannia		

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4342	08/01/1908	Perim - Aden No 1	Repaired 18th ulto	Repaired 18th ulto by CS Electra		CS Electra		
4343	08/01/1908	Suez - Aden No 3	Small renewal and repair	Small renewal and repair 173nm from Suez by CS Electra		CS Electra		
4344	08/01/1908	Aden - Zanzibar	Partial renewal 3rd inst	Partial renewal off Obbia completed 3rd inst by CS Colonia		CS Colonia		
4345	10/01/1908	Ceuta - Tangiers	Repaired 3rd inst				Repaired 3rd inst	
4346	17/01/1908	Paramaribo - Cayenne	Interrupted 11th inst				Interrupted 11th inst	
4347		Cayenne - Selina	Interrupted 14th inst				Interrupted 14th inst	

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4348	18/01/1908	Aden - Zanzibar	Repairs		NMM TCM/9/104 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Aden - Zanzibar, COLONIA, 26 December 1907 - 18 January 1908; TCM/8/128 CABLE ENGINEERS' LOGBOOKS. Aden - Zanzibar (1877, No 2), COLONIA, 18 - 27 January 1908; TCM/8/127 CABLE ENGINEERS' LOGBOOKS. Aden - Zanzibar (1879), COLONIA, 26 December 1907 - 18 January 1908	CS Colonia		

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4349	21/01/1908	Brest - Dakar (1905)	Repairs		NMM TCM/9/94 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Brest - Dakar, CAMBRIA, 30 November 1907 - 21 January 1908; TCM/8/125 CABLE ENGINEERS' LOGBOOKS. Brest - Dakar (1905), CAMBRIA, 10 December 1907 - 22 January 1908	CS Cambria		
4350	22/01/1908	Havre - Waterville	Repaired 14th inst	Repaired 14th inst by CS John Pender		CS John Pender		
4351	22/01/1908	San Miguel - Fayal	Repaired 17th inst	Repaired 17th inst by CS Duplex		CS Duplex		
4352	22/01/1908	Delagoa - Beira	Under repair	Under repair by CS Sherard Osborn		CS Sherard Osborn		
4353	22/01/1908	Suakin - Perim	Repaired 14th inst	Repaired 14th inst by CS Electra		CS Electra		
4354	22/01/1908	Aden - Zanzibar	Fault repaired 20th inst	Fault repaired 20th inst by CS Electra		CS Electra		
4355	22/01/1908	Aden - Zanzibar	Partial renewals compete	Partial renewals completed by CS Colonia		CS Colonia		
4356	24/01/1908	Brest - Dakar	Repaired 17th inst				Repaired 17th inst	
4357	24/01/1908	Lagos - Kotonou	Repaired 18th inst				Repaired 18th inst	
4358	24/01/1908	Trinidad - Demerara	Repaired 17th inst				Repaired 17th inst	
4359	24/01/1908	Tenariffe - St Louis, Senegal	Interrupted 16th inst				Interrupted 16th inst	
4360	22/01/1908	Aden - Bombay No 2	Faulty	Faulty. CS Colonia to repair		CS Colonia		

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4361	27/01/1908	Aden - Bombay No 2	Repairs		NMM TCM/9/105 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Aden - Bombay (No2), COLONIA, 8 - 27 January 1908	CS Colonia		
4362	31/01/1908	Paramaribo - Cayenne	Repaired 24th inst				Repaired 24th inst	
4363	31/01/1908	Tenariffe - St Louis, Senegal	Repaired 28th inst				Repaired 28th inst	
4364	31/01/1908	Alexandria - Larnaca	Interrupted 28th inst				Repaired 28th inst	
4365	05/02/1908	Havre - Waterville	Repaired 4th inst	Repaired 4th inst by CS John Pender		CS John Pender		
4366	05/02/1908	Alexandria - Port Said	Repaired 4th inst	Repaired 4th inst by CS Levant 2		CS Levant 2		
4367	05/02/1908	Alexandria - Larnaca	Repaired 4th inst	Repaired 4th inst by CS Levant 2		CS Levant 2		
4368	05/02/1908	Perim - Aden No 5	Fault repaired 23rd ulto	Fault repaired 3rd ulto by CS Electra		CS Electra		
4369	05/02/1908	Perim - Obock	Repaired 29th ulto	Repaired 29th ulto by CS Electra		CS Electra		
4370	05/02/1908	Sierra Leone - Accra	Repaired 30th ulto	Repaired 30th ulto by CS Sentinel		CS Sentinel		
4371	05/02/1908	Bathurst - Bissau	Interrupted	Interrupted. CS Sentinel to repair		CS Sentinel		
4372	05/02/1908	St Thome - Loanda	Repaired 28th ulto	Repaired 28th ulto by CS Britannia		CS Britannia		
4373	05/02/1908	Delagoa - Beira	Repaired 4 faults	Repaired 4 faults by CS Sherard Osborne		CS Sherard Osborn		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4374	05/02/1908	Aden - Bombay No 2	Fault repaired 26th ulto	Fault repaired 26th ulto by CS Colonia. Also replaced Bombay shore ends o Nos 2 & 3 cables		CS Colonia		
4375	07/02/1908	Alexandria - Larnaca	Repaired 4th inst				Repaired 4th inst	
4376	07/02/1908	Trinidad - Demerara	Interrupted 5th inst				Interrupted 4th inst	
4377	14/02/1908	Bathurst - Bissau	Repaired 10th inst				Repaired 10th inst	
4378	19/02/1908	Carcavellos - Gibraltar No 1	Gibraltar shore ends replaced 9th inst	Gibraltar shore ends replaced 9th inst by CS Duplex		CS Duplex		
4379	19/02/1908	Gibraltar - Malta No 1	Gibraltar shore ends retrenched 9th inst	Gibraltar shore ends retrenched 9th inst by CS Duplex		CS Duplex		
4380	19/02/1908	Porthcurno - Carcavellos No 1	Repaired 14th inst	Repaired 14th inst by CS Duplex		CS Duplex		
4381	19/02/1908	Vigo - Gibraltar	Replaced Vigo shore ends with heavier cable	Replaced Vigo shore ends with heavier cable. CS Duplex		CS Duplex		
4382	19/02/1908	Vigo - Carmina	Replaced Vigo shore ends with heavier cable	Replaced Vigo shore ends with heavier cable. CS Duplex		CS Duplex		
4383	19/02/1908	Alexandria - Port Said	2 breaks under repair	2 breaks under repair by CS Levant 2		CS Levant 2		
4384	19/02/1908	Suez - Perim No 1	Repaired 10th inst	Repaired 10th inst by CS Electra		CS Electra		
4385	19/02/1908	Perim - Aden No 5	Interrupted	Interrupted. CS Electra to repair but weather bad		CS Electra		
4386	19/02/1908	Bathurst - Bissau	Repaired 8th inst	Repaired 8th inst by CS Sentinel		CS Sentinel		
4387	19/02/1908	Reunion - Tamalove	Under repair	Under repair by CS Sherard Osborn		CS Sherard Osborn		
4388	28/02/1908	Cayenne - Selina	Repaired 24th inst				Repaired 24th inst	
4389	28/02/1908	Trinidad - Demerara	Repaired 5th inst				Repaired 5th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4390	04/03/1908	Aden - Bombay No 1	Partial renewal completed	Partial renewal completed				
4391	04/03/1908	Gibraltar - Carcavellos	Shore end renewed at Gibraltar 2nd inst	Shore end renewed at Gibraltar 2nd inst by CS Duplex		CS Duplex		
4392	04/03/1908	Vigo - Carcavellos	Repaired 3rd inst	Repaired 3rd inst 59nm from Carcavellos by CS Duplex		CS Duplex		
4393	04/03/1908	Chios - Tenedos	Interrupted	Interrupted 38nm from Chio. CS Levant 1 to repair		CS Levant 1		
4394	04/03/1908	Port Said - Alexandria	Repaired 19th ulto	Repaired 19th ulto by CS Levant 2		CS Levant 2		
4395	04/03/1908	Perim - Aden No 5	Repaired 24th ulto	Repaired 24th ulto by CS Electra		CS Electra		
4396	04/03/1908	Obock	Repair of trench lines 27 ulto	Repair of trench lines 27th ulto by CS Electra		CS Electra		
4397	04/03/1908	Aden - Zanzibar	Interrupted	Interrupted 440nm from Zanzibar. CS Electra to repair		CS Electra		
4398	04/03/1908	Madiera - St Vincent Nos 2 & 3	Interrupted	Interrupted. CS Sentinel to repair		CS Sentinel		
4399	04/03/1908	Tamatave cable (French Govt)	Interrupted	Interrupted. CS Sherard Osborn to repair, but delayed by cyclone		CS Sherard Osborn		
4400	06/03/1908	Chios - Tenedos	Interrupted 28th ulto				Interrupted 28th ulto	
4401	13/03/1908	Chios - Tenedos	Repaired 5th inst				Repaired 5th inst	
4402	18/03/1908	Vigo - Carcavellos	Repaired 8th inst	Repaired 8th inst by CS Duplex		CS Duplex		
4403	18/03/1908	Chios - Tenedos	Repaired 5th inst	Repaired 5th inst by CS levant 1		CS Levant 1		
4404	18/03/1908	Patros - Corinth No 3	Repaired 9th inst	Repaired 9th inst by CS Levant 1		CS Levant 1		
4405	18/03/1908	Patros - Corinth No 1	Fault repaired 11th instant	Fault repaired 11th inst by CS Levant 1		CS Levant 1		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4406	18/03/1908	Aden - Zanzibar	Repaired 8th inst	Repaired 8th inst by CS Electra		CS Electra		
4407	18/03/1908	Madiera - St Vincent No 2	Repaired 14th inst	Repaired 14th inst by CS Sentinel		CS Sentinel		
4408	18/03/1908	St Vincent - St Jago	Fault repaired 17th	Fault repaired 17th by CS Sentinel		CS Sentinel		
4409	18/03/1908	Sierra Leone - Accra	Interrupted	Interrupted 810nm from Sierra Leone. CS Sentinel to repair		CS Sentinel		
4410	18/03/1908	Tamatave cable (French Govt)	Repaired 7th inst	Repaired 7th inst bt CS Sherard Osborn		CS Sherard Osborn		
4411	18/03/1908	Aden - Bombay No 1	Renewal completed 12th inst	Renewal completed 12th inst by CS Levant 2		CS Levant 2		
4412	20/03/1908	Paramaribo - Cayenne	Interrupted 15th inst				Interrupted 15th inst	
4413	01/04/1908	Lisbon - Madiera No 1	Repaired 29th ulto	Repaired 29th ulto by CS Duplex		CS Duplex		
4414	01/04/1908	Gibraltar - Malta No 1	Interrupted	Interrupted 522nm from Gib. CS Duplex to repair		CS Duplex		
4415	01/04/1908	Cania - Rettino	Repaired 26th ulto	Repaired 26th ulto by CS Levant 1		CS Levant 1		
4416	01/04/1908	Tripoli cable	Faults	Faults to be repaired by CS Levant 2 but weather too rough at present		CS Levant 2		
4417	01/04/1908	Aden - Suez No 3	Repaired 25th ulto	Repaired 25th ulto by CS Electra		CS Electra		
4418	01/04/1908	Aden - Zanzibar	Faults under repair	Faults under repair by CS Electra		CS Electra		
4419	01/04/1908	Sierra Leone - Accra	Repaired 31st ulto	Repaired 31st ulto		CS Sentinel		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4420	12/04/1908	Atlantic (1874, 1880, 1894)	Repairs		NMM TCM/8/126 CABLE ENGINEERS' LOGBOOKS. Atlantic (1874, 1880, 1894), CAMBRIA, 5 February - 12 April 1908	CS Cambria		
4421	13/04/1908	Aden - Bonmbay Nos 1&3	Repairs		NMM TCM/8/129 CABLE ENGINEERS' LOGBOOKS. Aden - Bombay (Nos 1-3), COLONIA, 27 January - 13 April 1908;TCM/9/106 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Aden - Bombay (Nos 1-3), COLONIA, 27 January - 13 April 1908	CS Colonia		
4422	20/04/1908	Penzance - Canso (1882)	Repairs		NMM TCM/8/130 CABLE ENGINEERS' LOGBOOKS. Penzance - Canso (1882), CAMBRIA, 28 April - 20 May 1908	CS Cambria		
4423	24/04/1908	Paramaribo - Cayenne	Repaired 20th inst				Repaired 20th inst	
4424	24/04/1908	Cadiz - Tenariffe	Interrupted 22nd inst				Interrupted 22nd inst	

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4425	29/04/1908	Canso - Waterville	Repaired 20th inst	Repaired 20th inst by CS John Pender		CS John Pender		
4426	29/04/1908	Canso - Waterville (1884)	Under repair	Under repair by CS John Pender		CS John Pender		
4427	29/04/1908	Gibraltar - Malta No 1	Repaired 9th inst	Repaired 9th inst by CS Duplex		CS Duplex		
4428	29/04/1908	Cadiz - Tenariffe (Spanish Govt)	Under repair	Under repair by CS Duplex		CS Duplex		
4429	29/04/1908	Malta - Tripoli	Repaired 5th inst	Repaired 5th inst by CS Levant 2		CS Levant 2		
4430	29/04/1908	Aden - Zanzibar	Repaired 3rd inst	Repaired 3rd inst by CS Electra		CS Electra		
4431	29/04/1908	Aden - Perim No 1	Repaired 6th inst	Repaired 6th inst by CS Electra		CS Electra		
4432	29/04/1908	Perim - Suakin No 2	Repaired 26th inst	Repaired 26th inst by CS Electra		CS Electra		
4433	29/04/1908	Suez - Aden No 4	Under repair	Under repair by CS Electra		CS Electra		

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4434	30/04/1908	Atlantic (1874, 1880); Penzance - Canso (1882); Penzance - Canso (1882)			NMM TCM/9/95 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Atlantic (1874, 1880), CAMBRIA, 28 April - 30 May 1908; TCM/9/96 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Penzance - Canso (1882), CAMBRIA, 28 April - 30 May 1908; TCM/8/131 CABLE ENGINEERS' LOGBOOKS. Sennen Cove - Canso (1881), CAMBRIA, 21 - 26 May 1908; TCM/9/97 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Penzance - Canso (1881), CAMBRIA, 21 - 28 May 1908; TCM/8/132 CABLE ENGINEERS' LOGBOOKS.	CS Cambria		

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4435	12/05/1908	Canso - Waterville (1884)	Repaired 6th inst	Repaired 6th inst by CS John Pender. Further repairs to be carried out when weather improves.		CS John Pender		
4436	01/05/1908	Alexandria - Larnaca	Interrupted 29th ulto				Interrupted 29th ulto	
4437	08/05/1908	Cadiz - Tenariffe	Repaired 5th inst				Repaired 5th inst	
4438	12/05/1908	Cadiz - Tenariffe (Spanish Govt)	Repaired 4th inst	Repaired 4th inst by CS Duplex		CS Duplex		
4439	12/05/1908	Lisbon - Gibraltar No 2	Repaired 7th inst	Repaired 7th inst by CS Duplex		CS Duplex		
4440	12/05/1908	Alexandria - Larnaca	Repaired 6th inst	Repaired 6th inst by CS Levant 2		CS Levant 2		
4441	12/05/1908	Suez - Aden No 4	Repaired 8th inst	Repaired 8th inst by CS Electra		CS Electra		
4442	12/05/1908	Seychelles - Mauritius	Repaired 3rd inst	Repaired 3rd inst by CS Sherard Osborn		CS Sherard Osborn		
4443	15/05/1908	Alexandria - Larnaca	Repaired 7th inst				Repaired 7th inst	
4444	15/05/1908	Cayenne - Selina	Interrupted 12th inst				Interrupted 12th inst	
4445	22/05/1908	Las Palmas - Arrecife	Interrupted 18th inst				Interrupted 18th inst	
4446	22/05/1908	Angleterre - Guernsey	Interrupted 20th inst				Interrupted 20th inst	
4447	27/05/1908	Waterville - Canso	Repaired 16th inst	Repaired 16th inst by CS John Pender		CS John Pender		
4448	27/05/1908	Waterville - Canso	Repaired again 22nd inst	Repaired again 22nd inst by CS John Pender		CS John Pender		
4449	27/05/1908	Gibraltar - Tangier	Repaired 25th inst	Repaired 25th inst by CS Duplex		CS Duplex		
4450	27/05/1908	Chios - Tenedos	Repaired 11th inst	Repaired 11th inst by CS Levant 1		CS Levant 1		
4451	27/05/1908	Nagara - Kartal	Under repair	Under repair by CS Levant 1		CS Levant 1		

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4452	27/05/1908	Gibraltar - Malta No 2	Repaired 19th inst	Repaired 19th inst by CS levant 2		CS levant 2		
4453	27/05/1908	Malta - Bona No 2	Repaired 21st inst	Repaired 21st inst by CS Levant 2		CS Levant 2		
4454	27/05/1908	Perim - Aden No 1	Renewal completed 13th inst	Renewal completed 13th inst by CS Electra		CS Electra		
4455	27/05/1908	Aden - Perim No 4	Repaired 19th inst	Repaired 19th inst close to Perim by CS Electra		CS Electra		
4456	27/05/1908	Perim	New shore ends at Aden 21st inst	New shore ends at Aden 21st inst by CS Electra		CS Electra		
4457	27/05/1908	Aden - Bombay No 2	Shore ends replaced 25th inst	Shore ends at Bombay replaced 25th inst by CS Electra		CS Electra		
4458	27/05/1908	Sierra Leone - Accra	Under repair	Under repair by CS Sentinel		CS Sentinel		
4459	29/05/1908	Angleterre - Guernsey	Repaired 25th inst				Repaired 25th inst	
4460	01/07/1908	Porthcurno - Lisbon No1	Repaired 2nd ulto	Repaired 2nd ulto by CS Amber		CS Amber		
4461	05/06/1908	Trinidad - Demerara	Interrupted 1st inst				Interrupted 1st inst	
4462	05/06/1908	Dardanelles - Constintinople	Interrupted 1st inst				Interrupted 1st inst	
4463	12/06/1908	Jeddah - Suakin	Interrupted 9th inst				Interrupted 9th inst	
4464	19/06/1908	Trinidad - Demerara	Repaired 15th inst				Repaired 15th inst	
4465	19/06/1908	Dardanelles - Constintinople	Repaired 10th inst				Repaired 10th inst	
4466	19/06/1908	Jeddah - Suakin	Repaired 11th inst				Repaired 11th inst	
4467	01/07/1908	Brest - St Pierre (PQ Co)	Repaired 7th ulto	Repaired 7th ulto having been broken by ship repairing Porthcurno - Lisbon cable		CS Amber		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4468	01/07/1908	Porthcurno - Lisbon No 1	Repaired again 14th ulto	Repaired again 14th ulto by CS Amber		CS Amber		
4469	01/07/1908	Vigo - Caminha	Repaired 18th ulto	Repaired 18th ulto by CS Amber		CS Amber		
4470	01/07/1908	Waterville - Canso	Repaired 5th ulto	Repaired 5th ulto by CS John Pender		CS John Pender		
4471	01/07/1908	Carcavellos - Gibraltar No 1	Repaired 30th May	Repaired 30th May by CS Duplex		CS Duplex		
4472	01/07/1908	Madiera - St Vincent No 1	Repaired 9th June	Repaired 9th June by CS Duplex		CS Duplex		
4473	01/07/1908	Nagara - Kartal	Repaired 9th ulto	Repaired 9th ulto by CS Levant 1		CS Levant 1		
4474	01/07/1908	Corinth - Patras No 3	Repaired 15th ulto	Repaired 15th ulto by CS Levant 1		CS Levant 1		
4475	01/07/1908	Andros - Tinos	Under repair	Under repair by CS Levant 1		CS Levant1		
4476	01/07/1908	Perim - Suakin	Repaired 4th ulto	Repaired 4th ulto by CS Electra		CS Electra		
4477	01/07/1908	Suez - Suakin No 2	Under repair	Under repair by CS Electra		CS Electra		
4478	01/07/1908	Zanzibar - Seychelles	Repaired 27th ulto	Repaired 27th ulto by CS Sherard Osborn		CS Sherard Osborn		
4479	01/07/1908	Accra - Sierra Leone	Repaired 30th May	Repaired 30th May by CS Sentinel		CS Sentinel		
4480	01/07/1908	Accra - Lagos	Repaired 2nd ulto	Repaired 2nd ulto by CS Sentinel		CS Sentinel		
4481	01/07/1908	Madiera - St Vincent	Under repair	Under repair by CS Sentinel		CS Sentinel		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4482	07/07/1908	Ballinskellig - Halifax (1874)	Repairs		NMM TCM/9/98 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Ballinskellig - Halifax (1874), CAMBRIA, 18 June - 4 July 1908; TCM/8/134 CABLE ENGINEERS' LOGBOOKS. Ballinskellig - Halifax (1874), CAMBRIA, 18 June - 7 July 1908	CS Cambria		
4483	15/07/1908	Suakin - Perim	Repaired 9th inst	Repaired 9th inst by CS Electra but another interruption 100nm from Suakin		CS Electra		
4484	15/07/1908	Madiera - St Vincent No 2	Repaired 12th inst	Repaired 12th inst by CS Sentinel. Very bad weather		CS Sentinel		
4485	17/07/1908	Kwandang - Manado	Interrupted 9th inst				Interrupted 9th inst	
4486	24/07/1908	Kotonou - Grand Bassam	Interrupted 20th inst				Interrupted 20th inst	
4487	29/07/1908	Vigo - Carcavellos	Repaired 21st inst	Repaired 21st inst by CS Duplex		CS Duplex		
4488	29/07/1908	Suez - Suakin	Repaired 18th inst	Repaired 18th inst by CS Electra		CS Electra		
4489	29/07/1908	St Vincent - St Jago	Repaired 17th inst	Repaired 17th inst by CS Sentinel		CS Sentinel		
4490	29/07/1908	Kotonou - Grand Bassam	Under repair	Under repair by CS Britannia		CS Britannia		
4491	31/07/1908	Cayenne - Selina	Repaired 24th inst				Repaired 24th inst	

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4492	31/07/1908	Kwandang - Manado	Repaired 22nd inst				Repaired 22nd inst	
4493	31/07/1908	Jeddah - Suakin	Interrupted 27th inst				Interrupted 27th inst	
4494	31/07/1908	Assab - Massowah (Italian Govt)	Interrupted 28th inst				Interrupted 28th ulto	
4495	07/08/1908	Kotonou - Grand Bassam	Repaired 4th inst				Repaired 4th inst	
4496	07/08/1908	Trinidad - Demerara	Interrupted 1st inst				Interrupted 1st inst	
4497	07/08/1908	Kwandang - Manado	Interrupted 5th inst				Interrupted 5th inst	
4498	14/08/1908	Trinidad - Demerara	Repaired 10th inst				Repaired 10th inst	
4499	21/08/1908	Cadiz - Teneriffe	Interrupted 17th inst				Interrupted 17th inst	
4500	04/09/1908	Lagos- Kotonou	Interrupted 29th ulto				Interrupted 29th ulto	
4501	10/09/1908	Cadiz - Tenerife (1883)	Repairs		NMM TCM/8/135 CABLE ENGINEERS' LOGBOOKS. Cadiz - Tenerife (1883), CAMBRIA, 11 August - 10 September 1908; TCM/9/107 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Cadiz - Tenerife, CAMBRIA, 11 August - 10 September 1908	CS Cambria		

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4502	11/09/1908	Kwandang - Manado	Repaired 8th inst				Repaired 8th inst	
4503	11/09/1908	Paramaribo - Cayenne	Interrupted 3rd inst				Interrupted 3rd inst	
4504	18/09/1908	Assab - Massowah (Italian Govt)	Repaired 15th inst				Repaired 15th inst	
4505	18/09/1908	Cadiz - Teneriffe	Repaired 10th inst				Repaired 10th inst	
4506	18/09/1908	Lagos - Kotonou	Repaired 15th inst				Repaired 15th inst	
4507	18/09/1908	Pontianack - Saigon	Interrupted 16th inst				Interrupted 16th inst	
4508	18/09/1908	St Vincent - Barbados	Interrupted 16th inst				Interrupted 16th inst	
4509	25/09/1908	St Vincent - Barbados	Repaired 17th inst				Repaired 17th inst	
4510	25/09/1908	Sitia - Rhodes	Interrupted 17th inst				Interrupted 17th inst	
4511	25/09/1908	Dardanelles - Constintinople	Interrupted 20th inst				Interrupted 20th inst	
4512	25/09/1908	Las Palmas - Lanzarotte (1884)	Repairs		NMM TCM/8/136 CABLE ENGINEERS' LOGBOOKS. Las PAlmas - Lanzarotte (1884), CAMBRIA, 23 - 24 September 1908; TCM/9/108 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Las Palmas - Lanzarote, CAMBRIA, 23 - 25 September 1908	CS Cambria		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4513	30/09/1908	Carcavellos - Gibraltar No 1	Repaired 2nd inst	Repaired 2nd inst by CS Duplex		CS Duplex		
4514	30/09/1908	Malta - Alexandria No 2	Repaired 25th inst	Repaired 25th inst by CS Duplex		CS Duplex		
4515	30/09/1908	Sitia	Local repair 27th inst	Local repair 27th inst with help from CS Duplex		CS Duplex		
4516	30/09/1908	Syra - Piraeus Nos 1& 2	Repaired 17th Aug	Repaired 17th Aug by CS Levant 1		CS Levant 1		
4517	30/09/1908	Nagara - Kartal	Repaired 25th inst	Repaired 25th inst by CS Levant 1		CS Levant 1		
4518	30/09/1908	Bosphorus cable No 3	Repaired 28th inst	Repaired 28th inst by CS Levant 1		CS Levant 1		
4519	30/09/1908	Orevus - Starvo	Under repair	Under repair by CS Levant 1		CS Levant 1		
4520	30/09/1908	Malta - Bona No 1	Repaired 15th Aug	Repaired 15th Aug by CS Levant 2		CS Levant 2		
4521	30/09/1908	Gibraltar - Malta No 1	Repaired 20th inst	Repaired 20th inst by CS Levant 2		CS Levant 2		
4522	30/09/1908	Rhodes - Sitia	Under repair	Under repair by CS Levant 2		CS Levant 2		
4523	30/09/1908	Suakin - Perim	Repaired 29th ulto	Repaired 29th ulto by CS Electra		CS Electra		
4524	30/09/1908	Aden - Bombay No 2	Repaired 3rd inst	Repaired 3rd inst by CS Electra		CS Electra		
4525	30/09/1908	Assab - Massowah (Italian Govt)	Repaired 13th inst	Repaired 13th inst be CS Electra		CS Electra		
4526	30/09/1908	Suakin - Jeddah (Turkish Govt)	Repaired 22nd inst	Repaired 22nd inst by CS Electra		CS Electra		
4527	30/09/1908	Suez - Suakin	Under repair	Under repair by CS Electra		CS Electra		
4528	30/09/1908	Bathurst - Sierra Leone	Repaired 19th ulto	Repaired 19th ulto by CS Sentinel		CS Sentinel		
4529	30/09/1908	Lagos - Bonny	Repaired 10th inst	Repaired 10th inst by CS Sentinel		CS Sentinel		
4530	30/09/1908	Kotonou	Repaired 14th inst	Repaired 14th inst by local staff with help of CS Sentinel		CS Sentinel		

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4531	30/09/1908	Kotonou - Grand Bassam	Repaired 5th Aug	Repaired 5th Aug by CS Britannia		CS Britannia		
4532	30/09/1908	St Thome - Loanda	Repaired 22nd inst	Repaired 22nd inst off Congo River by CS Britannia		CS Britannia		
4533	30/09/1908	Zanzibar - Mozambique No 2	Repaired 7th Aug	Repaired 7th Aug by CS Sherard Osborn		CS Sherard Osborn		
4534	30/09/1908	Zanzibar - Mozambique No 1	Repaired 10th Aug	Repaired 10th Aug by CS Sherard Osborn		CS Sherard Osborn		
4535	02/10/1908	Las Palmas - Arrecife	Repaired 26th ulto				Repaired 26th ulto	
4536	02/10/1908	Jeddah - Suakin	Repaired 28th inst				Repaired 28th inst	
4537	02/10/1908	Dardanelles - Constintinople	repaired 25th inst				Repaired 25th inst	
4538	14/10/1908	Malta - Alexandria No 1	Under repair	Under repair by CS Duplex		CS Duplex		
4539	14/10/1908	Orevus - Starvo	Repaired 3rd inst	Repaired 3rd inst by CS Levant 1		CS Levant 1		
4540	14/10/1908	Sitia - Rhodes	Repaired 5th inst	Repaired 5th inst by CS Levant 2		CS Levant 2		
4541	14/10/1908	Suez - Suakin	Repaired 13th inst	Repaired 13th inst by CS Electra		CS Electra		
4542	14/10/1908	Delagoa - Durban	Interrupted	Interrupted. CS Sherard Osborn to repair		CS Sherard Osborn		

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4543	18/10/1908	Penzance - Canzo (1881)	Repairs		NMM TCM/8/137 CABLE ENGINEERS' LOGBOOKS. Penzance - Canzo (1881), CAMBRIA, 3 - 18 October 1908; TCM/9/109 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Penzance - Canso (1881), CAMBRIA, 3 - 18 October 1908	CS Cambria		
4544	23/10/1908	Paramaribo - Cayenne	Repaired 20th ulto				Repaired 20th ulto	
4545	28/10/1908	Malta - Alexandria No 1	Repaired 19th inst	Repaired 19th inst by CS Duplex		CS Duplex		
4546	28/10/1908	Carcavellos - Gibraltar No 1	Interrupted	Interrupted. To be repaired by CS Duplex		CS Duplex		
4547	28/10/1908	Suakin - Jeddah (Turkish Govt)	Repaired 24th inst	Repaired 24th inst by CS Electra		CS Electra		
4548	28/10/1908	Perim - Suakin	Repaired 27th inst	Repaired 27th inst by CS Electra		CS Electra		
4549	28/10/1908	Laurenco Marques - Durban	Repaired 20th inst	Repaired 20th inst by CS Sherard Osborn		CS Sherard Osborn		
4550	30/10/1908	Sitia - Rhodes	Repaired 10th inst				Repaired 10th inst	
4551	06/11/1908	Kotonou - Grand Bassam	Interrupted 29th ulto				Interrupted 29th ulto	
4552	11/11/1908	Carcavellos - Gibraltar No 1	Repaired 30th ulto	Repaired 30th ulto by CSDuplex		CS Duplex		
4553	11/11/1908	Perim - Aden No 1	Repaired 3rd inst	Repaired 3rd inst by CS Electra		CS Electra		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4554	11/11/1908	Sierra Leone - Conakry	Under repair	Under repair by CS Sentinel		CS Sentinel		
4555	11/11/1908	Zanzibar - Mombassa	Under repair	Under repair by CS Sherard Osborn		CS Sherard Osborn		
4556	13/11/1908	Dakar - Conakry	Interrupted 8th inst				Interrupted 8th inst	
4557	25/11/1908	Malta - Alexandria No 2	Interrupted	Interrupted 200nm from Alexandria. CS Duplex to repair		CS Duplex		
4558	25/11/1908	Obock - Djibuti (French Govt)	Repaired 24th inst	Repaired 24th inst by CS Electra		CS Electra		
4559	25/11/1908	Sierra Leone - Conakry	Repaired 11th inst	Repaired 11th inst by CS Sentinel		CS Sentinel		
4560	25/11/1908	Zanzibar - Mombassa	Under repair	Under repair and new shore ends by CS Sherard Osborn		CS Sherard Osborn		
4561	09/12/1908	Malta - Alexandria No2	Repaired 6th inst	Repaired 6th inst by CS Duplex		CS Duplex		
4562	09/12/1908	Andros - Cuboea	Interrupted	Interrupted; CS Levant 1 to repair		CS Levant 1		
4563	09/12/1908	Lipari - Salina (Italian Govt)	Repaired 6th inst	Repaired 6th inst by CS Levant 2		CS Levant 2		
4564	09/12/1908	Grand Bassam cable	Repaired 3rd inst	repaired 3rd inst by CS Sentinel		CS Sentinel		
4565	09/12/1908	Dakar - Conakry (French Govt)	Under repair	Under repair by CS Sentinel		CS Sentinel		
4566	09/12/1908	Zanzibar - Mombassa	Repaired 25th ulto	Repaired 25th ulto by CS Sherard Osborn		CS Sherard Osborn		
4567	11/12/1908	Kotonou - Grand Bassam	Repaired 5th inst				Repaired 5th inst	

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4568	14/12/1908	Atlantic (1874, 1894)	Repairs		NMM TCM/9/110 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Valentia - Hearts Content (1894); Hearts Content - Valentia (1874), CAMBRIA, 30 October - 2 December 1908; TCM/8/138 CABLE ENGINEERS' LOGBOOKS. Atlantic (1874, 1894), CAMBRIA, 30 October - 4 December 1908; TCM/8/139 CABLE ENGINEERS' LOGBOOKS. Atlantic (1874, 1894), CAMBRIA, 4 - 14 December 1908	CS Cambria		
4569	18/12/1908	Dakar - Conakry	Repaired 16th inst				Repaired 16th inst	
4570	01/01/1909	Malta - Zante	Interrupted 29th ulto				Interrupted 29th ulto	
4571	06/01/1909	Porthcurno - Carcavellos No 1	Repaired 23rd ulto	Repaired 23rd ulto by CS Amber		CS Amber		
4572	06/01/1909	Porthcurno - Vigo	Repaired 1st inst	Repaired 1st inst by CS Amber. Delayed by bad weather		CS Amber		

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4573	06/01/1909	Porthcurno - Carcavellos No 1	Repaired 2th inst again	Repaired 6th inst again by CS Amber		CS Amber		
4574	06/01/1909	Carcavellos - Gibraltar Nos 1 & 2	Faults under repair	Faults under repair by CS Amber		CS Amber		
4575	06/01/1909	Patros - Zante No 2	Repaired 26th ulto	Repaired 26th ulto by CS Levant 1		CS Levant 1		
4576	06/01/1909	Cougo - Vatica	Under repair	Under repair by CS Levant 1		CS Levant 1		
4577	06/01/1909	Alexandria - Port Said	Repaired 12th ulto	Repaired 12th ulto by CS Duplex		CS Duplex		
4578	06/01/1909	Malta - Zante	Interrupted	Interrupted 91nm fromMalta. CS Duplex to repair		CS Duplex		
4579	06/01/1909	Malta - Pozallo	Repaired 25th ulto	Repaired 25th ulto by CSLevant 2		CS Levant 2		
4580	06/01/1909	Aden - Bombay No 1	Under repair	Under repair by CS Electra		CS Electra		
4581	06/01/1909	Dakar - Conakry (French Govt)	Repaired 12th ulto	Repaired 12th ulto by CS Sentinel		CS Sentinal		
4582	06/01/1909	Beira - Laurenco Marques	Repaired 22nd ulto	Repaired 22nd ulto by CS Sherard Osborn		CS Sherard Osborn		
4583	06/01/1909	Aden - Zanzibar	Interrupted	Interrupted 480 nm from Zanzibar; CS Sherard Osborn to repair		CS Sherard Osborn		
4584	15/01/1909	Jamaica - Colon	Interrupted 9th inst				Interrupted 9th inst	
4585	15/01/1909	Seattle - Sitka	Interrupted 13th inst				Interrupted 13th inst	
4586	20/01/1909	Gibraltar - Carcavellos No 2	Repaired 15th inst	Repaired 15th inst by CS Amber		CS Amber		
4587	20/01/1909	Malta - Zante	Under repair	Under repair by CS Duplex. Very bad weather		CS Duplex		
4588	20/01/1909	Cinqo - Vatiga	Repaired 9th inst	Repaired 9th inst by CS Levant 1		CS Levant 1		

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4589	20/01/1909	Milazzo - Lipari	Under repair	Under repair by CS Levant 2 but vaey bad weather		CS Levant 2		
4590	20/01/1909	Aden - Bombay No 1	Repaired 14th inst	Repaired 14th inst by CS Electra		CS Electra		
4591	20/01/1909	Aden - Zanzibar	Repaired 13th inst	Repaired 13th inst by CS Sherard Osborn		CS Sherard Osborn		
4592	22/01/1909	Seattle - Sitka	Repaired 19th inst				Repaired 19th inst	
4593	22/01/1909	Jamaica - Colon	Repaired 19th inst				Repaired 19th inst	
4594	22/01/1909	Port de France - Paramaribo	Interrupted 14th inst				Interrupted 14th inst	
4595	22/01/1909	Falmouth - Bilbao	Interrupted 19th inst				Interrupted 19th inst	
4596	22/01/1909	Tourane - Amoy	Interrupted 19th inst				Interrupted 19th inst	
4597	29/01/1909	Zanzibar - Mombassa	Interrupted 27th inst				Interrupted 27th inst	
4598	03/02/1909	Porthcurno - Madiera	Repaired 31st ulto	Repaired 31st ulti by CS John Pender		CS John Pender		
4599	03/02/1909	Gibraltar - Carcavellos No 1	Repaired 21st ulto	Repaired 21st ulto by CS Amber		CS Amber		
4600	03/02/1909	Ivisa - Malorica; Allucinus - Gomera (Spanish Govt)	Under repair	Under repair by CS Amber		CS Amber		
4601	03/02/1909	Malta - Zante	Under repair	Under repair by CS Duplex		CS Duplex		
4602	03/02/1909	Raffina - Figonda	Under repair	Under repair by CS Levant 1		CS Levant 1		
4603	03/02/1909	Milazzo - Lipari	Repaired 23rd ulto	Repaired 23rd ulto by CS Levant 2		CS Levant 2		
4604	03/02/1909	Messina Straits Nos 2, 3 & 5	Repaired 26th ulto	Repaired 26th ulto by CS Levant 2		CS Levant 2		
4605	03/02/1909	Malta - Alexandria No 2	Under repair	Under repair 3o3nm from Alexandria by CS Levant 2		CS Levant 2		
4606	03/02/1909	Suez - Aden No 3	Repaired 23rd ulto	Repaired 23rd ulto by CS Electra		CS Electra		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4607	03/02/1909	Suez - Suakin	Repaired 29th ulto	Repaired 29th ulto by CS Electra		CS Electra		
4608	03/02/1909	Monbassa - Zanzibar	Repaired 29th ulto	Repaired 3nm from Mombassa 29th ulto by CS Sherard Osborn		CS Sherard Osborn		
4609	05/02/1909	Port de France - Paramaribo	Repaired 30th ulto				Repaired 30th ulto	
4610	05/02/1909	Falmouth - Bilbao	Repaired 2nd inst				Repaired 2nd inst	
4611	05/02/1909	Zanzibar - Mombassa	Repaired 29th ulto				Repaired 29th ulto	
4612	17/02/1909	"Spanish Govt Cables"	Repaired 4th inst	Repaired 4th inst by CS Amber		CS Amber		
4613	17/02/1909	Gib - Tangier	Repaired 10th inst	Repaired 10th inst by CS Amber		CS Amber		
4614	17/02/1909	Malta - Zante	Under repair	Under repair by CS Amber & Cs Duplex		CS Amber & CS Duplex		
4615	17/02/1909	Raffina - Figonda	Repaired	Repaired by CS Levant 1		CS Levant 1		
4616	17/02/1909	Malta - Alexandria No 2	Under repair	Under repair by CS Levant 2		CS Levant 2		
4617	26/02/1909	Malta - Zante	Repaired 24th inst				Repaired 24th inst	
4618	26/02/1909	Oran - Tangiers	Interrupted 20th inst				Interrupted 20th inst	
4619	26/02/1909	Seattle - Sitka	Interrupted 23rd inst				Interrupted 23rd inst	
4620	03/03/1909	Malta - Zante	Repaired 24th ulto	Repaired 24th ulto by CS Amber		CS Amber		
4621	03/03/1909	Malta - Alexandria No 2	Repaired 25th ulto	Repaired 25th ulto by CS Duplex		CS Duplex		
4622	03/03/1909	Carcavellos - Vigo	Interrupted	Interrupted; to be repaired by CS Duplex		CS Duplex		
4623	03/03/1909	Aden - Bombay No 2	Interrupted	Interrupted 20nm from Aden. CS Electra to repair		CS Electra		
4624	03/03/1909	Zanzibar - Seychelles	Repaired 24th ulto	Repaired 24th ulto by CS Sherard Osborn		CS Sherard Osborn		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4625	03/03/1909	Baive	Renewed shore ends	Renewed shore ends by CS Sherard Osborn		CS Sherard Osborn		
4626	05/03/1909	Seattle - Sitka	Repaired 26th ulto				Repaired 26th ulto	
4627	05/03/1909	Cayanne - Salinas	Interrupted 27th ulto				Interrupted 27th ulto	
4628	12/03/1909	Jersey - Guernsey	Interrupted 10th inst				Interrupted 10th inst	
4629	17/03/1909	Malta - Zante	Fault repaired 7th inst	Fault repaired 7th inst by CS Amber		CS Amber		
4630	17/03/1909	Malta - Zante	Another fault but bad weather	Another fault but bad weather. To be repaired by CS Amber		CS Amber		
4631	17/03/1909	Carcavellos - Vigo	Repaired 13th inst	Repaired 13th inst by CS Duplex		CS Duplex		
4632	17/03/1909	Gib - Malta No 1	Repaired 12th inst	Repaired 12th inst by CS Levant 2		CS Levant 2		
4633	17/03/1909	Aden - Bombay No 2	Repaired 9th inst	Repaired 9th inst by CS Electra		CS Electra		
4634	19/03/1909	Oran - Tangiers	Repaired 13th inst				Repaired 13th inst	
4635	19/03/1909	Jersey - Guernsey	Repaired 15th inst				Repaired 15th inst	
4636	31/03/1909	Malta - Zante	Under repair	Under repair by CS Amber		CS Amber		
4637	31/03/1909	Aden - Bombay No 2	Fault	Fault to be repaired by CS Electra		CS Electra		
4638	31/03/1909	Aden - Bombay No 3	Temporay repair 30th inst	Temporary repair by station staff 4.5nm from Bombay. CS Patrick Stewart to make paermanent repair		CS Patrick Stewart		
4639	02/04/1909	Cayanne - Salinas	Repaired 29th ulto				Repaired 29th ulto	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4640	07/04/1909	Borkum - Fayal (1903, No2)	Repairs		NMM TCM/8/140 CABLE ENGINEERS' LOGBOOKS. Borkum - Fayal (1903, No2), CAMBRIA, 27 March - 7 April 1909	CS Cambria		
4641	09/04/1909	Malta - Zante	Interrupted 6th inst				Interrupted 6th inst	
4642	16/04/1909	Malta - Zante	Repaired 11th inst				Repaired 11th inst	
4643	16/04/1909	Hong Kong - Macao	Interrupted 13th inst				Interrupted 13th inst	
4644	23/04/1909	Pontianack - Saigon	Repaired 16th inst				Repaired 16th inst	
4645	23/04/1909	Tourane - Amoy	Repaired 19th inst				Repaired 19th inst	
4646	23/04/1909	Obock - Djibuti (French Govt)	Interrupted 15th inst				Interrupted 15th inst	
4647	28/04/1909	Porthcurno - Gibraltar No 3	Repaired 18th inst	Repaired 18th inst by CS Duplex		CS Duplex		
4648	28/04/1909	Porthcurno - Carcavellos No 2	Under repair	Under repair but bad weather. CS Duplex		CS Duplex		
4649	28/04/1909	Malta - Zante	Repaired 11th inst	Repaired 11th inst by CS Amber		CS Amber		
4650	28/04/1909	Malta - Alexandria No 1	Under repaired but cable in very poor condition	Under reapair but cable in very poor condition over about 24nm length. CS Amber		CS Amber		
4651	28/04/1909	Milazzo - Lipari	Repaired 9th inst	Repaired 9th inst by CS Levant 2		CS Levant 2		
4652	28/04/1909	Gib - Malta No 1	Repaired 24th inst	Repaired 24th inst by CS Levant 2		CS Levant 2		
4653	28/04/1909	Cadiz - Gibraltar	Under repair	Under repair by CS Levant 2		CS levant 2		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4654	28/04/1909	Aden - Perim No 2	Repaired 2nd inst	Repaired 2nd inst by CS Electra		CS Electra		
4655	28/04/1909	Suez - Aden No 4	Under repair	Under repair by CS Electra		CS Electra		
4656	28/04/1909	Aden - Bombay No 3	Repaired 6th inst	Repaired 6th inst by CS Patrick Stewart (Indo European Telegraph Dept)		CS Patrick Stewart (Indo European Telegraph Dept)		
4657	30/04/1909	Hong Kong - Macao	Repaired 23rd inst				Repaired 23rd inst	
4658	28/04/1909	Lagos - Accra	Under repair	Under repair by CS Sentinel		CS Sentinel		
4659	12/05/1909	Emden - Vigo	Repaired 9th inst	Repaired 9th inst by CS John Pender		CS John Pender		
4660	12/05/1909	Porthcurno - Carcavellos No 2	Repaired 28th ulto	Repaired 28th ulto by CS Duplex		DS Duplex		
4661	12/05/1909	Vigo Carcavellos	Repaired 3rd inst	Repaired 3rd inst by CS Duplex		CS Duplex		
4662	12/05/1909	Malta - Alexandria No 2	Repaired 11th inst	Repaired 11th inst by CS Amber		CS Amber		
4663	12/05/1909	Patros - Zante No 2	Repaired 28th ulto	Repaired 28th ulto by CS Levant 1		CS Levant 1		
4664	12/05/1909	Gib - Cadiz	Repaired 30th ulto	Repaired 30th ulto by CS Levant 2		CS Levant 2		
4665	12/05/1909	Malta - Alexandria No 2	Under repair	Under repair by CS Levant 2. Very bad weather		CS Levant 2		
4666	12/05/1909	Suez - Aden No 4	Repaired 2nd inst	Repaired 2nd inst by CS Electra		CS Electra		
4667	12/05/1909	Suakin - Perim	Repaired 8th inst	Repaired 8th inst by CS Electra		CS Electra		
4668	12/05/1909	Djibuti cable (French Govt)	Under repair	Under repair by CS Electra		CS Electra		
4669	12/05/1909	Accra - Lagos	Repaired 12th inst	Repaired 12th inst by CS Sentinel		CS Sentinel		
4670	14/05/1909	Jamaica - Colon	Interrupted 6th inst				Interrupted 6th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4671	21/05/1909	Obock - Djibuti (French Govt)	Repaired 15th inst				Repaired 15th inst	
4672	21/05/1909	Dakar - Conakry	Interrupted 13th inst				Interrupted 13th inst	
4673	21/05/1909	Tangier - Cadiz	Interrupted 19th inst				Interrupted 19th inst	
4674	09/06/1909	Porthcurno - Carcavellos No 2	Repaired 8th inst	Repaired 8th inst by CS John Pender		CS John Pender		
4675	09/06/1909	Vigo - Carcavellos	interrupted	Interrupted. CS John Pender to repair.		CS John Pender		
4676	09/06/1909	Madiera - St Vincent No 1	Under repair	Under repair by CS Duplex		CS Duplex		
4677	09/06/1909	Malta - Alexandria No 1	Shore ends overhauled at Alexandria 16th ulto	Shore ends at Alexandria overhauled 16th ulto by CSAmber		CS Amber		
4678	09/06/1909	Malta - Alexandria No 2	Repaired 3rd inst	Repaired 3rd inst by CS Amber		CS Amber		
4679	09/06/1909	Malta - Zante	Interrupted	Interrupted, CS Amber to repair		CS Amber		
4680	09/06/1909	Syra - Chios No 2	Fault repaired 27th ulto	Fault repaired 27th ulto by CS Levant 1		CS Levant 1		
4681	09/06/1909	Coriinth - Patros No 1	Interrupted	Interrupted. CS Levant 1 to repair		CS Levant 1		
4682	09/06/1909	Bonny - Lagos	Repaired 7th inst	Repaired 7th inst by CS Sentinel		CS Sentinel		
4683	09/06/1909	Kotonou - Grand Bassam	Repaired	Repaired by CS Sentinel		CS Sentinel		
4684	09/06/1909	Dakar - Conakry (French Govt)	Repaired	Repaired by CS Sentinel		CS Sentinel		
4685	09/06/1909	Obock - Djibuti (French Govt)	Repaired 14th ulto	Repaired 14th ulto BY CS Electra		CS Electra		
4686	09/06/1909	Suez -Perim No 4	Repaired 30th ulto	Repaired 30th ulto by CS Electra		CS Electra		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4687	09/06/1909	Zanzibar - Mozambique	Repaired 23rd ulto	Repaired 23rd ulto by CS Sherard Osborn		CS Sherard Osborn		
4688	11/06/1909	Jamaica - Colon	Repaired 3rd inst				Repaired 3rd inst	
4689	11/06/1909	Cayenne - Selina	Interrupted 7th inst				Interrupted 7th inst	
4690	11/06/1909	Paramaribo - Cayenne	Interrupted 8th inst				Interrupted 8th inst	
4691	23/06/1909	Atlantic (1874,1894)	Repairs		NMM TCM/9/111 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Atlantic (1874,1894), CAMBRIA, 16 April - 18 May 1909; TCM/9/112 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Valentia - Hearts Content (1874), CAMBRIA, 18 May - 23 June 1909	CS Cambria		
4692	23/06/1909	Madiera - St Vincent No 1	Repaired 14th inst	Repaired 14th inst by CS Duplex		CS Duplex		
4693	23/06/1909	Malta - Zante	Repaired 14th inst	Repaired 14th inst by CS Amber		CS Amber		
4694	23/06/1909	Malta - Gib No 2	Interrupted	Interrupted. CS Amber to repair		CS Amber		
4695	23/06/1909	Patras - Corinth No 1	Repaired 10th inst	Repaired 10th inst by CS Levant 1		CS Levant 1		
4696	23/06/1909	Oranto - Corfu	Repaired 13th inst	Repaired 13th inst by CS Levant 1		CS Levant 1		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4697	23/06/1909	Partas Corinth No 2	Under repair	Under repair by CS Levant 1		CS Levant 1		
4698	23/06/1909	Zante - Canea	Under repair	Under repair by CS Levant 2		CS Levant 2		
4699	23/06/1909	Suez - Suakin	Under repair	Under repair by CS Electra		CS Electra		
4700	23/06/1909	Suakin - Perim	Repaired 23rd inst	Repaired 23rd inst by Suakim staff 400 yds out				
4701	23/06/1909	Bonny cable end	Renewed	Renewed by CS Sentinel		CS Sentinel		
4702	23/06/1909	Kotonou - Grand Bassam	Faults under repair	Faults under repair by CS Sentimel		CS Sentinel		
4703	23/06/1909	Mozambique - Beira	Under repair	Under repair by CS Sherard Osborn		CS Sherard Osborn		
4704	17/06/1909	Tourane - Amoy	Interrupted 17th inst				Interrupted 17th inst	
4705	17/06/1909	Trinidad - Demerara	Interrupted 21st inst				Interrupted 21st inst	
4706	02/07/1909	Cayenne - Selina	Repaired 28th ulto				Repaired 28th ulto	
4707	02/07/1909	Paramaribo - Cayenne	Repaired 27th ulto				Repaired 27th ulto	
4708	02/07/1909	Fort de France - Paramaribo	Interrupted 28th ulto				Interrupted 28th ulto	
4709	07/07/1909	Gib - Malta No 2	Repaired 26th ulto	Repaired 26th ulto by CS Amber		CS Amber		
4710	07/07/1909	Zante - Canea	Repaired 26th ulto	Repaired 26th ulto by CS Levant 2		CS Levant 2		
4711	07/07/1909	Suez - Suakin	Repaired 25th ulto	Repaired 25th ulto by CS Electra		CS Electra		
4712	07/07/1909	Suez - Aden No 3	Repaired 3rd inst	Repaired 3rd inst by CS Electra		CS Electra		
4713	07/07/1909	Lagos - Kotonou	Repaired 30th ulto	Repaired 30th ulto by CS Sentinel		CS Sentinel		
4714	07/07/1909	Dakar - Conakry (French Govt)	Under repair	Under repair by CS Sentinel		CS Sentinel		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4715	07/07/1909	Mozambique - Beira	Fault repaired 24th inst	Fault repaired 24th inst by CS Sherard Osborn		CS Sherard Osborn		
4716	09/07/1909	Fort de France - Paramaribo	Repaired 2nd inst				Repaired 2nd inst	
4717	16/07/1909	Trinidad - Demerara	Repaired 12th inst				Repaired 12th inst	
4718	21/07/1909	Penom - Gomera	Repaired 18th inst	Repaired 18th inst by CS Amber		CS Amber		
4719	21/07/1909	Patras - Corinth No 2	Repaired 11th inst	Repaired 1th inst by CS Levant 1		CS Levant 1		
4720	21/07/1909	Dakar - Conakry	Repaired 17th inst	Repaired 17th inst br CS Sentinel		CS Sentinel		
4721	21/07/1909	Zanzibar	Harbour lines renewed at Bawi	Harbour lines renewed at Bawi by CS Sherard Osborn		CS Sherard Osborn		
4722	21/07/1909	Perim - Sheikh Seyd	Under repair at Perim	Under repair at Perim by the station Supt				
4723	22/07/1909	Dakar - Conakry	Repaired 18th inst				Repaired 18th inst	
4724	13/08/1909	Gibraltar - Tangier	Interrupted 7th inst				Interrupted 7th inst	
4725	13/08/1909	Cueta - Tangiers	Interrupted 7th inst				Interrupted 7th inst	
4726	13/08/1909	Melilla - Chafrinas	Interrupted 7th inst				Interrupted 7th inst	
4727	20/08/1909	Corfu - Trieste	Interrupted 16th inst				Interrupted 16th inst	
4728	26/08/1909	Coney Island - Guantanamo (1907)	Repairs		NMM TCM/9/113 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Coney Island - Guantanamo (1907), CAMBRIA, 16 July - 23 August 1909	CS Cambria		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4729	27/08/1909	Corfu - Trieste	Repaired 23rd inst				Repaired 23rd inst	
4730	27/08/1909	Dakar - Conakry	Interruped again 19th inst				Interrupted again 19th inst	
4731	31/08/1909	Tangier - Cueta	Repairs		NMM TCM/8/143 CABLE ENGINEERS' LOGBOOKS. Tangier - Cueta, TELCONIA, 13 - 31 August 1909	CS Telconia		
4732	03/09/1909	Cueta - Tangiers	Repaired 27th ulto				Repaired 27th ulto	
4733	03/09/1909	Melilla - Chafrinas	Repaired 30th ulto				Repaired 30th ulto	
4734	08/09/1909	Canos - Flemish Cape; Waterville - Canso (1884)	Repairs		NMM TCM/8/142 CABLE ENGINEERS' LOGBOOKS. Canos - Flemish Cape, COLUMBIA, 8 August - 8 September 1909; TCM/9/114 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Waterville - Canso (1884), COLONIA, 8 August - 8 September 1909	CS Colonia & CS Columbia		
4735	10/09/1909	Balik Papan - Kwandang	Interrupted 2nd inst				Interrupted 2nd inst	
4736	17/09/1909	Gib - Tangier	Repaired 10th inst				Repaired 10th inst	
4737	17/09/1909	Balik Papan - Kwandang	Repaired 14th inst				Repaired 14th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4738	17/09/1909	Sheik Seyd - Perim	Interrupted 15th inst				Interrupted 15th inst	
4739	24/09/1909	Atlantic (1874)	Repairs		NMM TCM/8/146 CABLE ENGINEERS' LOGBOOKS. Atlantic (1874), CAMBRIA, 18 - 24 September 1909	CS Cambria		
4740	24/09/1909	Tangier - Cadiz	Repaired 21st inst				Repaired 21st inst	
4741	29/09/1909	Marsielles - Algiers No 2 (French Govt)	Repaired 18th ulto	Repaired 18th ulto by CS Amber		CS Amber		
4742	29/09/1909	Marsielles - Bona No 2	Repaired 30th ulto	Repaired 30th ulto by CS Amber		CS Amber		
4743	29/09/1909	Gib - Tangier	Repaired 9th inst	Repaired 9th inst by CS Amber		CS Amber		
4744	29/09/1909	Gib - Cadiz	Repaired 12th inst	Repaired 12th inst by CS Amber		CS Amber		
4745	29/09/1909	Carcavellos - Gibraltar	Repaired 16th inst	Repaired 16th inst by CS Amber		CS Amber		
4746	29/09/1909	Cadiz - Tangier (French Govt)	Reoaired 20th inst	Repaired 20th inst by CS Amber		CS Amber		
4747	29/09/1909	Carcavellos - Gib No 2	Interrupted	Interrupted. CS Amber to repair		CS Amber		
4748	29/09/1909	Hydra - Metoche	Repaired 5th ulto	Repaired 5th ulto by CS Levant 1		CS Levant 1		
4749	29/09/1909	Chio - Chesme No 2	Repaired 14th ulto	Repaired 14th ulto by CS Levant 1		CS Levant 1		
4750	29/09/1909	Anaphi - Santoun	Repaired 27th ulto	Repaired 27th ulto by CS Levant 1		CS Levant 1		
4751	29/09/1909	Syphno - Serpho	Repaired 29th ulto	Repaired 29th ulto by CS Levant 1		CS Levant 1		
4752	29/09/1909	Patras - Corinth	Repaired 4th inst	Repaired 4th inst by CS Levant 1		CS Levant 1		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4753	29/09/1909	Malta - Bona	Repaired 2nd ulto	Repaired 2nd ulto by CS Levant 2		CS Levant 2		
4754	29/09/1909	Trieste - Corfu	Repaired 21st ulto	Repaired 21st ulto by CS Levant 2		CS Levant 2		
4755	29/09/1909	Malta - Alexandria No 2	Repaired 8th inst	Repaired 8th inst by CS Levant 2		CS Levant 2		
4756	29/09/1909	Aden - Suex No 1	New shore end 6th inst	New shore end 6th inst by CS Electra		CS Electra		
4757	29/09/1909	Perim - Sheikh Seyd	Repaired 14th inst	Repaired 14th inst by CS Electra		CS Electra		
4758	29/09/1909	Aden - Bombay No 1	Under repair	Under repair 465nm from Aden and 64nm renewal so far. CS Electra. Bad weather		CS Electra		
4759	29/09/1909	Bathurst - Sierra Leone		Repaired 25th July by CS Sentinel		CS Sentinel		
4760	29/09/1909	Dakar - Conakry	Repaired 14th Aug	Repaired 14th Aug by CS Sentinel		CS Sentinel		
4761	29/09/1909	St Vincent - Madiera No 3	Repaired 29th Aug	Repaired 29th Aug by CS Sentinel		CS Sentinel		
4762	29/09/1909	Accra - Sierra Leone	Repaired 14th inst	Repaired 14th inst by CS Sentinel		CS Sentinel		
4763	29/09/1909	Accra - Lagos - Interrupted	Interrupted	Interrupted. CS Sentinel to repair		CS Sentinel		
4764	29/09/1909	Swakopmund T-piece	Rep[aired 21st Aug	Repaired 21st Aug by CS Britannia		CS Britannia		
4765	29/09/1909	Zanzibar - Mozambique No 1	Repaired 5th inst	Repaired 5th inst by CS Sherard Osborn		CS Sherard Osborn		
4766	01/10/1909	Hong Kong - Macao	Interrupted 25th ulto				Interupted 25th ulto	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4767	03/10/1909	Madeira - St Vincent	Repairs		NMM TCM/8/144 CABLE ENGINEERS' LOGBOOKS. Madeira - St Vincent, TELCONIA, 31 August - 3 October 1909	CS Telconia		
4768	08/10/1909	Hong Kong - Macao	Repaired 1st inst				Repaired 1st inst	
4769	13/10/1909	Gib - Carcavellos No 2	Repaired 4th inst	Repaired 4th inst by CS Amber		CS Amber		
4770	13/10/1909	Syra - Pyreus No 2	Repaired 3rd inst	Repaired 3rd inst by CS Levant 1		CS Levant 1		
4771	13/10/1909	Aden - Bombay No 1	Repaired 4th inst	Repaired 4th inst by CS Electra		CS Electra		
4772	13/10/1909	Accra - Lagos	Repaired 3rd inst	Repaired 3rd inst by CS Sentinel		CS Sentinel		
4773	13/10/1909	St Jago - Bissau	Interrupted	Interrupted. CS Sentinel to repair		CS Sentinel		
4774	14/10/1909	San Jorge - Graciosa (1893)	Repairs		NMM TCM/8/145 CABLE ENGINEERS' LOGBOOKS. San Jorge - Graciosa (1893), TELCONIA, 27 September - 14 October 1909	CS Telconia		
4775	22/10/1909	Sheik Seyd - Perim	Repaired 16th ulto				Repaired 16th ulto	
4776	22/10/1909	Mozambique - Majunga	Interrupetd 11th inst				Interrupted 11th inst	
4777	22/10/1909	Madagascar - Reunion	Interrupted 20th inst				Interrupted 20th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4778	27/10/1909	Weston - Waterville	Repaired 19th inst	Repaired 19th inst 30nm from Weston by CS Duplex		CS Duplex		
4779	27/10/1909	Carcavellos - Madiera No 1	Repaired 26th inst	Repaired 26th inst by CS Amber		CS Amber		
4780	27/10/1909	Porthcurno - Carcavellos	Interrupted	Interrupted 494nm from Porthcurno. CS Amber to repair		CS Amber		
4781	27/10/1909	Marsielles - Bona No 1	Repaired 18th inst	Repaired 18th inst by CS Levant 2		CS Levant 2		
4782	27/10/1909	Bona - Malta No 2	Faulty	Faulty 22nm from Malta. CS Levant 2 to repair		CS Levant 2		
4783	27/10/1909	Bathurst - St Jago	Interrupted	Interruptted, CS Sentinel to repair		CS Sentinel		
4784	27/10/1909	Bathurst - Bissau	Interrupted	Interruptted, CS Sentinel to repair		CS Sentinel		
4785	27/10/1909	Bagamoyo cable	Repaired 17th inst	Repaired 17th inst by CS Sherard Osborn		CS Sherard Osborn		
4786	29/10/1909	Madagascar - Reunion	Repaired 21st inst				Repaired 21st inst	
4787	29/10/1909	Paramaribo - Cayenne	Interrupted 21st inst				Interrupted 21st inst	
4788	29/10/1909	Sitka - Valdez	Interrupted 27th inst				Interrupted 27th inst	
4789	05/11/1909	Balik Papan - Kwandang	Interrupted 1st inst				Interrupted 1st inst	
4790	05/11/1909	Reunion - Mauritious	Interrupted 3rd inst				Interrupted 3rd inst	
4791	05/11/1909	Cayenne - Selina	Interrupted 3rd inst				Interrupted 3rd inst	
4792	10/11/1909	Falmouth - Bilbao (Direct Spanish Co)	Repaired 6th inst	Repaired 6th inst by CS Duplex		CS Duplex		
4793	10/11/1909	Porthcurno - Carcavellos No 1	Fault repaired	Fault repaired off Corunna by CS Amber		CS Amber		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4794	10/11/1909	Vigo - Carcavellos	Repaired 8th inst	Repaired 8th inst by CS Amber		CS Amber		
4795	10/11/1909	Malta - Bona No 2	Repaired 3rd inst	Repaired 3rd inst by CS Levant 2		CS Levant 2		
4796	10/11/1909	Perim - Aden No 1	Fault repaired 2nd inst	Fault repaired 2nd inst near Aden by CS Electra		CS Electra		
4797	10/11/1909	Jago - Bathurst	Repaired 29th ulto	Repaired 29th ulto by CS Sentinel		CS Sentinel		
4798	10/11/1909	Bathurst - Bissau	2 faults repaired 9th inst	2 faults repaired 9th inst by CS Sentinel		CS Sentinel		
4799	10/11/1909	Bissau - Boloma	Under repair	Under repair by CS Sentinel		CS Sentinel		
4800	10/11/1909	Mossamedes - Cape Town	Interrupted	Interrupted 180nm from Robben Island. CS Britannia to repair		CS Britannia		
4801	12/11/1909	Tourane - Amoy	Repaired 9th inst (Interrupted 17th July 1909)				Repaired 9th inst	
4802	19/11/1909	Sitka - Valdez	Repaired 11th inst				Repaired 11th inst	
4803	19/11/1909	Jamaica - Porta Rico	Interrupted 11th inst				Interrupted 11th inst	
4804	19/11/1909	Puerto Plata - Martinique	Interrupted 12th inst				Interrupted 12th inst	
4805	22/11/1909	Harve - Waterville (1885)	Repairs		NMM TCM/8/147 CABLE ENGINEERS' LOGBOOKS. Harve - Waterville (1885), TELCONIA, 11 - 22 November 1909	CS Telconia		
4806	24/11/1909	Porthcurno - Carcavellos No 1 & 2	Repaired 24th inst	Repaired 24th inst by CS Duplex		CS Duplex		
4807	24/11/1909	Porthcurno - Vigo	Under repair	Under repair by Very bad weather. CS Amber		CS Amber		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4808	24/11/1909	Syra - Piraeus No 1	Repaired 21st inst	Repaired 21st inst by CS Levant 1		CS Levant 1		
4809	24/11/1909	Perim - Aden No 2	Repaired 21st inst	Repaired 21st inst by CS Electra		CS Electra		
4810	24/11/1909	Bissau - Boloma	Repaired 12th inst	Repaired 12th inst by CS Sentinel		CS Sentinel		
4811	24/11/1909	Bathurst - Bissau	Fault repaired 18th inst	Fault repaired 18th by CS Sentinel		CS Sentinel		
4812	24/11/1909	Cape Town - Mossamedes	Under repair	Under repair by CS Britannia		CS Britannia		
4813	03/12/1909	Paramaribo - Cayenne	Repaired 29th ulto				Repaired 29th ulto	
4814	03/12/1909	Cayenne - Selina	Repaired 29th ulto				Repaired 29th ulto	
4815	03/12/1909	Jamaica - Porto Rico	Repaired 25th ulto				Repaired 25th ulto	
4816	08/12/1909	Porthcurno - Vigo	Repaired 26th ulto	Repaired 26th ulto by CS Amber		CS Amber		
4817	08/12/1909	Carcavellos - Gib No 1	Repaired 30th ulto	Repaired 30th ulto by CS Amber		CS Amber		
4818	08/12/1909	Porthcurno - Carcavellos No 1	Under repair but very bad weather	Under repair but very bad weather. CS Duplex		CS Duplex		
4819	08/12/1909	Porthcurno - Gibraltar No 3	Interrupted	Interrupted off Porthcurno. CS Duplex to repair		CS Duplex		
4820	08/12/1909	Nagara - Kartal	Repaired 7th inst	Repaired 7th inst by CS Levant 1		CS Levant 1		
4821	08/12/1909	Malta - Bona No 2	Repaired 27th ulto	Repaired 27th ulto by CS Levant 2		CS Levant 2		
4822	08/12/1909	Sierra Leone - Bathurst	Under repair	Under repair by CS Sentinel		CS Sentinel		
4823	08/12/1909	Cape Town - Mossamedes	Repaired 25th ulto	Repaired 25th ulto by CS Britannia		CS Britannia		
4824	08/12/1909	Mozambique - Majunga	Under repair	Under repair by CS Sherard Osborn		CS Sherard Osborn		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4825	09/01/1910	Waterville - Canso (1884)	Repairs		NMM TCM/9/115 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Waterville - Canso (1884), COLONIA, 19 December 1909 - 9 January 1910; TCM/8/149 CABLE ENGINEERS' LOGBOOKS. Waterville - Canso (1884), COLONIA, 19 December 1909 - 9 January 1910	CS Colonia		
4826	10/12/1909	Paramaribo - Cayenne	Interrupted 7th inst				Interrupted 7th inst	
4827	17/12/1909	Mozambique - Majunga	Repaired 14th inst				Repaired 14th inst	
4828	17/12/1909	Puerto Plata - Martinique	Repaired 12th inst				Repaired 12th inst	
4829	17/12/1909	Bathurst - Bissau	Interrupted 9th inst				Interrupted 9th inst	
4830	24/12/1909	Obock - Djibuti (French Govt)	Interrupted 20th inst				Interrupted 20th inst	
4831	25/12/1909	Atlantic (1873)	Repairs		NMM TCM/8/148 CABLE ENGINEERS' LOGBOOKS. Atlantic (1873), TELCONIA, 23 November - 25 December 1909	CS Telconia		
4832	31/12/1909	Reunion - Mautitious	Repaired 29th inst				Repaired 29th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4833	31/12/1909	Obock - Djibuti (French Govt)	Repaired 28th inst				Repaired 28th inst	
4834	31/12/1909	Tourane - Amoy	Interrupted 27th inst				Interrupted 27th inst	
4835	07/01/1910	Bathurst - Bissau	Repaired 3rd inst				Repaired 3rd inst	
4836	07/01/1910	Paramaribo - Cayenne	Repaired 4th inst				Repaired 4th inst	
4837	07/01/1910	Lagos - Kotonou	Interrupted 3rd inst				Interrupted 3rd inst	
4838	15/01/1910	Emden - Fayal (German)	Repaired 18th ulto	Repaired 18th ulto after delay because of bad weather by CS John Pender		CS John Pender		
4839	15/01/1910	Porthcurno - Carcavellos	Repaired 10th ulto	Repaired 10th ulto by CS Amber		CS Amber		
4840	15/01/1910	Madiera - St Vincent No 2	Repaired 13th ulto	Repaired 13th ulto by CS Amber		CS Amber		
4841	15/01/1910	St Vincent - Pernambuco	Repaired 22nd ulto	Repaired 22nd ulto by CS Amber		CS Amber		
4842	15/01/1910	Madiera - St Vincent No 1	Repaired 30th ulto	Repaired 30th ulto by CS Amber		CS Amber		
4843	15/01/1910	Carcavellos - Gib No 2	Interrupted	Interrupted. CS Amber to repair		CS Amber		
4844	15/01/1910	Perim - Aden No 5	Repaired 14th ulto	Repaired 14th ulto by CS Electra		CS Electra		
4845	15/01/1910	Aden - Bombay No 2	Repaired 19th ulto	Repaired 19th ulto by CS Electra		CS Electra		
4846	15/01/1910	Obock - Djibuti (French Govt)	Repaired 27th ulto	Repaired 27th ulto by CS Electra		CS Electra		
4847	15/01/1910	Suakin - Perim No 2	Repaired 2nd inst	Repaired 2nd inst by CS Electra		CS Electra		
4848	15/01/1910	Malta - Bona No 1	To be renewed	To be renewed by CS Levant 2		CS Levant 2		
4849	15/01/1910	Marsielles - Bona No 2	Repaired 4th inst	Repaired 4th inst by CS Levant 2		CS Levant 2		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4850	15/01/1910	Porthcurno - Gibraltar No 3	Repaired 8th ulto	Repaired 8th ulto by CS Duplex		CS Duplex		
4851	15/01/1910	Porthcurno - Carcavellos No 1	Further repairs	Further repairs. Bad weather. CS Duplex		CS Duplex		
4852	15/01/1910	Porthcurno - Vigo	Fault	Fault to be repaired by CS Duplex		CS Duplex		
4853	15/01/1910	Sierra Leone - Bathurst	Repaired 27th ulto	Repaired 27th ulto by CS Sentinel		CS Sentinel		
4854	15/01/1910	Bathurst - Bissau	Under repair	Under repair by CS Sentinel		CS Sentinel		
4855	15/01/1910	Mozambique - Majunga	Repaired 12th ulto	Repaired 12th ulto by CS Sherard Osborn		CS Sherard Osborn		
4856	15/01/1910	Mauritious - Reunion	Repaired 30th ulto	Repaired 30th ulto by CS Sharad Osborn		CS Sherard Osborn		
4857	15/01/1910	Reunion - Tamalove	Repaired 30th ulto	Repaired 30th ulto by CS Sharad Osborn		CS Sherard Osborn		
4858	19/01/1910	Western Union Telegraph Company (No2 1882)	Repairs		NMM TCM/8/150 CABLE ENGINEERS' LOGBOOKS. Western Union Telegraph Company (No2 1882), CAMBRIA, 24 September 1909 - 19 January 1910	CS Cambria		
4859	19/01/1910	Weston - Waterville	Under repair	Under repair by CS John Pender		CS John Pender		
4860	19/01/1910	Porthcurno - Vigo	Fault repaired 8th inst	Fault near Vigo repaired 8th inst by CS Duplex		CS Duplex		
4861	19/01/1910	Porthcurno - Vigo	Interrupted	Break 160nm from Porthcurno under repair by CS Duplex. Bad weather		CS Duplex		
4862	19/01/1910	Carcavellos - Gib No 2	Repaired 9th inst	Repaired 9th inst by CS Amber		CS Amber		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4863	19/01/1910	Gib - Cadiz	Repaired 11th inst	Repaired 11th inst by CS Amber		CS Amber		
4864	19/01/1910	Malta - Bona No 1	Repaired 12th inst	Repaired 12th inst by CS Levant 2		CS Levant 2		
4865	19/01/1910	Suez - Suakin	Repaired 9th inst	Repaired 9th inst by CS Electra		CS Electra		
4866	19/01/1910	Reunion - Tamalove	Interrupted	Interrupted. CS Sherard Osborn to repair		CS Sherard Osborn		
4867	21/01/1910	Fantaradja - Macassar	Interrupted 19th inst			Interrupted 19th inst		
4868	21/01/1910	Penzance - Canso (1882)	Repairs		NMM TCM/9/116 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Penzance - Canso (1882), CAMBRIA, 24 September 1909 - 21 January 1910	CS Cambria		
4869	02/02/1910	Weston - Waterville	Repaired 21st ulto	Repaired 21st ulto by CS John Pender		CS John Pender		
4870	02/02/1910	Porthcurno - Vigo	Under repair	Under repair by CS Duplex		CS Duplex		
4871	02/02/1910	Vigo - Gibraltar	Repaired 23rd ulto	Repaired 23rd ulto by CS Amber		CS Amber		
4872	02/02/1910	Villa Real - Cadiz	Interrupted	Interrupted CS Amber to repair		CS Amber		
4873	02/02/1910	Zante - Cephalonia	Interrupted	Interrupted. CS Levant 1 to repair		CS Levant1		
4874	02/02/1910	Lagos	New land lines 20th ulto	New land lines 20th ulto by CS Sentinel		CS Sentinel		
4875	02/02/1910	Reunion - Tamalove	Repaired 27th ulto	Repaired 27th ulto by CS Sherard Osborn		CS Sherard Osborn		
4876	11/02/1910	Swakopmund - Mossamedes	Interrupted 5th inst				Interrupted 5th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4877	11/02/1910	Accra - Lagos	Interrupted 9th inst				Interrupted 9th inst	
4878	16/02/1910	Porthcurno - Vigo	Repaired 9th inst	Repaired 9th inst by CS Duplex		CS Duplex		
4879	16/02/1910	Villa Real - Cadiz	Repaired 5th inst	Repaired 5th inst by CS Amber		CS Amber		
4880	16/02/1910	Zante - Cephalonia	Repaired 8th inst	Repaired 8th inst by CS Levant 1		CS Levant 1		
4881	16/02/1910	Messina Straits cable	Repaired 13th inst	Repaired 13th inst by CS Levant 2		CS Levant 2		
4882	16/02/1910	Malta - Gib No 1	Interrupted	Interrupted. CS Levant 2 to repair		CS Levant 2		
4883	16/02/1910	Mossamedes - Cape Town	Under repair	Under repair CS Britannia		CS Britannia		
4884	18/02/1910	Accra - Lagos	Repaired 11th inst				Repaired 11th inst	
4885	25/02/1910	Swakopmund - Mossamedes	Repaired 17th inst				Repaired 17th inst	
4886	02/03/1910	Gib - Malta No 1	Repaired 20th ulto	Repaired 20th ulto by CS Amber & CS Levant 2		CS Amber; CS Levant 2		
4887	02/03/1910	Malta - Bona No 1	Under repair	Under repair by CS Levant 2		CS Levant 2		
4888	02/03/1910	Suez - Aden No 3	Repaired 27th ulto	Repaired 27th ulto		CS Electra		
4889	02/03/1910	Perim - Obock	Under repair	Under repair CS Electra		CS Electra		
4890	02/03/1910	Lagos	Cable diversion work completed 15th ulto	Cable diversion work completed 15th ulto by CS Sentinel		CS Sentinel		
4891	02/03/1910	Mossamedes - Cape Town	Repaired 17th ulto	Repaired 17th ulto by CS Britannia		CS Britannia		
4892	04/03/1910	Lagos - Kotonou	Repaired 16th ulto				Repaired 16th ulto	
4893	04/03/1910	Perim - Obock	Interrupted 22nd ulto				Interrupted 22nd ulto	
4894	04/03/1910	Paramaribo - Cayenne	Interrupted 28th ulto				Interrupted 28th ulto	
4895	11/03/1910	Perim - Obock	Repaired 7th inst				Repaired 7th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4896	16/03/1910	Gib - Carcavellos No 2	Repaired 9th inst	Repaired 9th inst by CS Amber		CS Amber		
4897	16/03/1910	Vigo - Caminha	Interrupted	Interrupted. CS Amber to repair		CS Amber		
4898	16/03/1910	Zante - Malta	Shore end repaired (Zante) 9th inst	Shore end repaired (Zante) 9th inst by CS Levant 1		CS Levant 1		
4899	16/03/1910	Rio - Antirio	Under repair	Under repair by CS Levant 1		CS Levant 1		
4900	16/03/1910	Malta - Bona No 1	Repaired 3rd inst	Repaired 3rd inst by CS Levant 2		CS Levant 2		
4901	16/03/1910	Perim - Obock	Repaired 6th inst	Repaired 6th inst by CS Electra		CS Electra		
4902	16/03/1910	Perim - Aden No 1	Renewed trench line at Perim	Renewed trench line at Perim. CS Electra		CS Electra		
4903	18/03/1910	Tourane - Amoy	Repaired 15th inst				Repaired 15th inst	
4904	18/03/1910	Perim - Obock	Repaired 7th inst				Repaired 7th inst	
4905	18/03/1910	Para - Maranham	Interrupted 16th inst				Interrupted 16th inst	
4906	18/03/1910	Pernambuco - Ceara	Interrupted 16th inst				Interrupted 16th inst	
4907	25/03/1910	Pernambuco - Ceara	Repaired 23rd inst				Repaired 23rd inst	
4908	25/03/1910	Para - Maranham	Interrupred 16th inst				Interrupted 16th inst	
4909	25/03/1910	Ceara - Pernambuco	Repaired 18th inst				Repaired 18th inst	
4910	08/04/1910	Dakar - Conakry	Repaired 31st ulto				Repaired 31st ulto	
4911	13/04/1910	Vigo - Caminha	Repaired 18th ulto	Repaired 18th ulto by CS Amber		CS Amber		
4912	13/04/1910	Porthcurno - Vigo	Under repair	Under repair by CS Amber but bad weather		CS Amber		
4913	13/04/1910	Chalkus - Cuboea	Repaired 28th ulto	Repaired 28th ulto by CS Levant 1		CS Levant 1		
4914	13/04/1910	Zante - Corfu	Under repair	Under repair by CS Levant 1		CS Levant 1		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4915	13/04/1910	Port Said - Alexandria	Under repair	Under repair by CS Electra		CS Electra		
4916	13/04/1910	Dakar - Conakry	Repaired 26th ulto	Repaired 26th ulto by CS Sentinel		CS Sentinel		
4917	13/04/1910	Bathurst - Bissau	Under repair	Under repair by CS Sentinel		CS Sentinel		
4918	13/04/1910	Zanzibar - Mozambique	Interrupted	Interrupted. Cs Sherard Osborn to repair		CS Sherard Osborn		
4919	22/04/1910	Malta - Tripoli	Interrupted 20th inst				Interrupted 20th inst	
4920	27/04/1910	Porthcurno - Vigo	Under repair	Under repair by CS Amber. Bad weather		CS Amber		
4921	27/04/1910	Perim - Aden No 2	Repaired 20th inst	Repaired 20th inst by CS Electra		CS Electra		
4922	27/04/1910	Bathurst - Bissau	Fault repaired 14th inst	Fault repaired 14th inst by CS Sentinel		CS Sentinel		
4923	27/04/1910	Bathurst - St Jago	Repaired 26th inst	Repaired 26th inst by CS Sentinel		CS Sentinel		
4924	27/04/1910	Zanzibar - Mozambique No 1	Repaired 18th inst	Repaired 18th inst by CS Sherard Osborn		CS Sherard Osborn		
4925	29/04/1910	Para - Pernambuco	Interrupted 25th inst				Interrupted 28th inst	
4926	06/05/1910	Para - Maranham	Repaired 23rd ulto				Repaired 23rd ulto	
4927	06/05/1910	Mozambique - Majunga	Interrupted 3rd inst				Interrupted 3rd inst	
4928	06/05/1910	Madagascar - La Reunion	Interrupted 3rd inst				Interrupted 3rd inst	
4929	11/05/1910	Porthcurno - Vigo	Reopaired 28th ulto	Repaired 28th ulto by CS Amber		CS Amber		
4930	11/05/1910	Falmouth - Bilbao (Direct Spanish Co)	Under repair	Under repair by CS Electra but bad weather		CS Electra		
4931	11/05/1910	Patras - Corinth No 2	Repaired 9th inst	Repaired 9th inst by CS Levant 1		CS Levant 1		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4932	11/05/1910	Gib - Malta No 1	Repaired 9th inst	Repaired 9th inst by CS Levant 2		CS levant 2		
4933	11/05/1910	Suez - Aden No 3	Repaired 9th inst	Repaired 9th inst by CS Duplex		CS Duplex		
4934	11/05/1910	Accra - Sierra Leone	Under repair	Under repair by CS Sentinel		CS Sentinel		
4935	13/05/1910	Madagascar - La Reunion	Repaired 10th inst				Repaired 10th inst	
4936	13/05/1910	Suakin - Jeddah	Interrupted 6th inst				Interrupted 6th inst	
4937	13/05/1910	Bonny - Duala	Interrupted 6th inst				Interrupted 6th inst	
4938	20/05/1910	Madagascar - La Reunion	Interrupted 12th inst				Interrupted 12th inst	
4939	03/06/1910	Para - Pernambuco	Repaired 1st inst				Repaired 1st inst	
4940	03/06/1910	Bonny - Duala	Repaired 30th ulto				Repaired 30th ulto	
4941	03/06/1910	Lattaquie - Talura	Interrupted 26th ulto				Interrupted 26th ulto	
4942	08/06/1910	Harvre - Waterville	Repaired 20th ulto	Repaired 20th ulto off the Scilly Isles by CS John Pender		CS John Pender		
4943	08/06/1910	Falmouth - Bilbao (Direct Spanish Co)	Repaired 15th ulto	Repaired 15th ulto by CS Electra		CS Electra		
4944	08/06/1910	Gib - Carcavellos No 1	Repaired 18th ulto	Repaired 18th ulto by CS Amber		CS Amber		
4945	08/06/1910	Gib - Carcavellos No 2	Repaired 29th ulto	Repaired 29th ulto by CS Amber		CS Amber		
4946	08/06/1910	Patras - Zante	Repaired 21st ulto	Repaired 21st ulto by CS Levant 1		CS Levant 1		
4947	08/06/1910	Suez - Aden No 3	Repaired 16th ulto	Repaired 16th ulto by CS Duplex		CS Duplex		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4948	08/06/1910	Accra - Sierra Leone	Repaired 13th ulto	Repaired 13th ulto by CS Sentinel		CS Sentinel		
4949	08/06/1910	Bonny - Camaroons	Repaired 28th ulto	Repaired 28th ulto by CS Sentinel		CS Sentinel		
4950	08/06/1910	Mozambique - Majunga	Repaired 4th inst	Repaired 4th inst by CS Sherard Osborn		CS Sherard Osborn		
4951	10/06/1910	Mozambique - Majunga	Repaired 5th inst				Repaired 5th inst	
4952	16/06/1910	Western-Super-Mare - Waterville (1885)	Repairs		NMM TCM/8/151 CABLE ENGINEERS' LOGBOOKS. Western-Super-Mare - Waterville (1885), TELCONIA, 13-16 June 1910	CS Telconia		
4953	22/06/1910	Gib - Tangier	Repaired 14th inst	Repaired 14th inst by CS Amber		CS Amber		
4954	22/06/1910	Syra - Chio No 1	Fault repaired 13th inst	Fault repaired 13th inst by CS Levant 1		CS Levant 1		
4955	22/06/1910	Malta - Bona No 1	Repaired 11th inst	Repaired 11th inst by CS Levant 2		CS Levant 2		
4956	22/06/1910	Malta - Gib No 1	Faulty	Faulty, to be repaired ny CS Levant 2		CS Levant 2		
4957	22/06/1910	Suakin - Jeddah (Turkish Govt)	Repaired 17th inst	Repaired 17th inst by CS Duplex		CS Duplex		
4958	22/06/1910	Suez - Suakin	Under repair	Under repair by CS Duplex		CS Duplex		
4959	22/06/1910	Accra - Sierra Leone	Repaired 20th inst	Repaired 20th inst by CS Sentinel		CS Sentinel		
4960	22/06/1910	Zanzibar - Mozambique No 2	Repaired 20th inst	Repaired 20th inst by CS Sherard Osborn		CS Sherard Osborn		
4961	24/06/1910	Suakin - Jeddah	Repaired 18th inst				Repaired 18th inst	
4962	01/07/1910	Obock - Djibuti	Interrupted 24th ulto				Interrupted 24th ulto	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4963	01/07/1910	Fort de France - Paramarabo	Interrupted 25th ulto				Interrupted 25th ulto	
4964	01/07/1910	Gibraltar - Tangier	Interrupted 30th ulto				Interrupted 30th ulto	
4965	05/07/1910	Waterville - St John's (1884)	Repairs		NMM TCM/8/152 CABLE ENGINEERS' LOGBOOKS. Waterville - St John's (1884), COLONIA, TELCONIA, 17 June - 5 July 1910; TCM/9/117 ROUGH DRAFTS OF CABLE ENGINEERS' LOGBOOKS. Waterville - St Johns (1884), COLONIA, 17 June - 5 July 1910	CS Telconia & CS Colonia		
4966	06/07/1910	Falmouth - Bilbao (Direct Spanish Co)	Under repair	Under repair by CS John Pender but thick Fog		CS John Pender		
4967	06/07/1910	Gib - Malta No 1	Repaired 30th ulto	Repaired 30th ulto by CS Amber		CS Amber		
4968	06/07/1910	Carcavellos - Gib No 1	Repaired 5th inst	Repaired 5th inst by CS Norseman		CS Norseman (Western Teleg Co)		
4969	06/07/1910	Gib - Malta	Repaired 22nd ulto	Repaired 22nd ulto by CS Levant 2		CS Levant 2		
4970	06/07/1910	Suez - Suakin	Repaired 24th ulto	Repaired 24th ulto by CS Duplex		CS Duplex		
4971	06/07/1910	Zanzibar - Mombassa	Repaired fault 5th inst	Repaired fault 5th inst by CS Sherard Osborn		CS Sherard Osborn		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4972	08/07/1910	Fort de France - Paramarabo	Repaired 4th inst				Repaired 4th inst	
4973	08/07/1910	Gibraltar - Tangier	Repaired 4th inst				Repaired 4th inst	
4974	08/07/1910	Falmouth - Bilbao (Direct Spanish Co)	Interrupted 4th inst				Interrupted 4th inst	
4975	08/07/1910	Zanzibar - Mombassa	Repaired 7th inst				Repaired 7th inst	
4976	11/07/1910	Waterville - Harve (1885,1888)	Repairs		NMM TCM/8/154 CABLE ENGINEERS' LOGBOOKS. Waterville - Harve (1885,1888), TELCONIA, 21 June - 11 July 1910	CS Telconia		
4977	15/07/1910	Falmouth - Bilbao (Direct Spanish Co)	Repaired 11th inst				Repaired 11th inst	
4978	22/07/1910	Madagascar - La Reunion	Repaired 18th inst				Repaired 18th inst	
4979	26/07/1910	Hong Kong - Macao	Repaired 22nd inst				Repaired 22nd inst	
4980	26/07/1910	Cape St James - Doson	Interrupted 23rd inst				Interrupted 23rd inst	
4981	27/07/1910	Falmouth - Bilbao (Direct Spanish Co)	Repaired 10th inst	Repaired 10th inst by CS John Pender		CS John Pender		
4982	27/07/1910	Porthcurno - Vigo	Repaired 13th inst	Repaired 13th inst by CS John Pender		CS John Pender		
4983	27/07/1910	Porthcurno - Carcavellos No 2	Repaired 19th inst	Repaired 19th inst 32nm from Porthcurno by CS John Pender		CS John Pender		
4984	27/07/1910	Porthcurno - Carcavellos No 1	Repaired 24th inst	Repaired 24th inst by CS John Pender		CS John Pender		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4985	27/07/1910	Gib - Carcavellos No 1	Repaired 13th inst	Repaired 13th inst by CS Amber		CS Amber		
4986	27/07/1910	Nagara - Kartal	Repaired 21st inst	Repaired 21st inst by CS Duplex		CS Duplex		
4987	27/07/1910	Zanzibar - Mozambique	Repaired 13th inst	Repaired 13th inst by CS Sherard Osborn		CS Sherard Osborn		
4988	04/08/1910	Sennen Cove - Conception Bay - Coney Island	Repairs		NMM TCM/8/155 CABLE ENGINEERS' LOGBOOKS. SennTCM/8/155 CABLE ENGINEERS' LOGBOOKS. Sennen Cove - Conception Bay - Coney Island, TELCONIA, 14 July - 4 August 1910 en Cove - Conception Bay - Coney Island, TELCONIA, 14 July - 4 August 1910	CS Telconia		
4989	05/08/1910	Bonny - Duala	Interrupted 3rd inst				Interrupted 3rd inst	
4990	19/08/1910	Hong Kong - Macao	Interrupted 15th inst				Interrupted 15th inst	
4991	23/08/1910	Ballinskellig - Halifax	Repairs		NMM TCM/8/156 CABLE ENGINEERS' LOGBOOKS. , TELCONIA, 2-23 August 1910	CS Telconia		
4992	09/09/1910	Bonny - Duala	Repaired 3rd inst				Repaired 3rd inst	
4993	09/09/1910	Cape St James - Doson	Repaired 5th inst				Repaired 5th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
4994	16/09/1910	Cape St James - Doson	Interrupted again 9th inst				Interrupted again 9th inst	
4995	23/09/1910	Cape St James - Doson	Repaired 14th inst				Repaired 14th inst	
4996	30/09/1910	Tourane - Amoy	Interrupted 25th inst				Repaired 25th inst	
4997	30/09/1910	Lowestoft - Borkum	Repairs		NMM TCM/8/157 CABLE ENGINEERS' LOGBOOKS. Lowestoft - Borkum, TELCONIA, 15 - 30 September 1910	CS Telconia		
4998	04/10/1910	Suez - Aden No 4	Repaired 26th Sept	Repaired 26 Sept by CS Electra		CS Electra		
4999	04/10/1910	Suez - Perim No 1	Under repair	Under repair by CS Electra		CS Electra		
5000	04/10/1910	Carcavellos - Madiera No 2	Repaired 22nd Aug	Reoaired 22nd Aug by CS Amber		CS Amber		
5001	04/10/1910	Bona - Marsielles	Repaired 10th Sept	Repaired 10th Sept by CS Amber		CS Amber		
5002	04/10/1910	Gib - Cadiz	Repaired 17th Sept	Repaired 17th Sept by CS Amber		CS Amber		
5003	04/10/1910	Alexandria - Sitia	Under repair	Under repair by CS Amber		CS Amber		
5004	04/10/1910	Vigo - Gibraltar	Repaired 10th Sept	Repaired 10th Sept by Vigo Station staff				
5005	04/10/1910	Cape Town - Mossamedes	Repaired 10th Sept	Repaired 10th Sept by local staff at Grainger Bay				
5006	04/10/1910	Chio - Tenedos	Repaired 22nd Aug	Repaired 22nd Aug by CS Levant 1		CS Levant 1		
5007	04/10/1910	Chio - Syra	Repaired 23rd Aug	Repaired 23rd Aug by CS Levant 1		CS Levant 1		
5008	04/10/1910	Syra - Piraus	Repaired 4th Sept	Repaired 4th Sept by CS Levant 1		CS Levant 1		
5009	04/10/1910	Patras - Corinth No 3	Under repair	Under repair by CS Levant 1		CS Levant 1		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
5010	04/10/1910	Lipari - Salina (Italian Govt)	Repaired 29th Aug	Repaired 29th Aug by CS Levant 2		CS Levant 2		
5011	04/10/1910	Malta - Bona No 2	Repaired 8th Sept	Repaired 8th Sept by CS Levant 2		CS Levant 2		
5012	04/10/1910	Corfu - Trieste	Repaired 2nd inst	Repaired 2nd inst		CS Levant 2		
5013	04/10/1910	Suez - Perim No 4	Perim shore end renewed 7th Aug	Perim shore end renewed 7th Aug by CS Duplex		CS Duplex		
5014	04/10/1910	Perim - Aden	Repaired 14th Aug	Repaired 14th Aug by CS Duplex		CS Duplex		
5015	04/10/1910	Zanzibar - Mozambique No 1	New shore end 30th Aug	New shore end 30th Aug by CS Sherard Osborn		CS Sherard Osborn		
5016	04/10/1910	Zanzibar - Mozambique No 1	Repaired 3rd Sept	Repaired 3rd Sept by CS Sherard Osborn		CS Sherard Osborn		
5017	04/10/1910	Zanzibar - Mombassa	Repaired 19th Sept	Repaired 19th Sept by CS Sherard Osborn		CS Sherard Osborn		
5018	04/10/1910	Reunion - Tamalove	Under repair	Under repair bt CS Sherard Osborn		CS Sherard Osborn		
5019	04/10/1910	St Vincent - St Jago	Repaired 31st Aug	Repaired 31st Aug by CS Britannia		CS Britannia		
5020	04/10/1910	St Vincent - Pernambuco No 2	Repaired 6th Sept	Repaired 6th Sept by CS Britannia		CS Britannia		
5021	04/10/1910	Bonny - Camaroon	Repaired 2nd Sept	Repaired 2nd Sept by CS Sentinel		CS Sentinel		
5022	04/10/1910	Bathurst - Sierra Leone	Interrupted	Interrupted. CS Sentinel to repair		CS Sentinel		
5023	07/10/1910	Paramaribo - Cayenne	Interrupted 1st inst				Interrupted 1st inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
5024	09/10/1910	Sennen Cove - Canso (1881)	Repairs		NMM TCM/8/158 CABLE ENGINEERS' LOGBOOKS. Sennen Cove - Canso (1881), COLONIA, 27 September - 9 October 1910	CS Colonia		
5025	14/10/1910	Paramaribo - Cayenne	Interrupted 1st inst				Interrupted 1st inst	
5026	21/10/1910	Reunion - Mauritious	Repaired 17th inst				Repaired 17th inst	
5027	21/10/1910	Bonny - Duala	Interrupted 18th inst				Interrupted 18th inst	
5028	26/10/1910	Porthcurno - Carcavellos No 1	Repaired 17th inst	Repaired 17th inst by CS John Pender		CS John Pender		
5029	26/10/1910	Vigo - Carcavellos	Repaired 5th inst	Repaired 5th inst by CS Norseman		CS Norseman		
5030	26/10/1910	Patras - Corinth No 3	Repaired 27th Sept	Repaired 27th Sept by CS Levant 1		CS Levant 1		
5031	26/10/1910	Patras - Corinth No 1	Repaired 6th inst	Repaired 6th inst by CS Levant 1		CS Levant 1		
5032	26/10/1910	Zante - Canea	Repaired 9th inst	Repaired 9th inst by CS Levant 2		CS Levant 2		
5033	26/10/1910	Malta - Alexandria No 2	Repaired 25th inst	Repaired 25th inst by CS Levant 2		CS Levant 2		
5034	26/10/1910	Alexandria - Sitia	Repaired 23rd inst	Repaired 23rd inst by CS Amber. Bad weather		CS Amber		
5035	26/10/1910	Suez - Perim No 1	Repaired 5th inst	Repaired 5th inst by CS Electra		CS Electra		
5036	26/10/1910	Suez - Suakin	Repaired 6th inst	Repaired 6th inst by CS Electra		CS Electra		
5037	26/10/1910	Suez - Aden No 1	Repaired 9th inst	Repaired 9th inst by CS Electra		CS Electra		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
5038	26/10/1910	Suakim shore ends	Repaired 25th inst	Repaired 25th inst by CS Electra		CS Electra		
5039	26/10/1910	Aden shore ends	Separated to reduce interference	Separated to reduce interference by CS Duplex		CS Duplex		
5040	26/10/1910	Mauritious - Reunion (French Govt)	Repaired 18th inst	Repaired 18th inst by CS Sherard Osborn		CS Sherard Osborn		
5041	26/10/1910	Bathurst - Sierra Leone	Repaired 6th inst	Repaired 6th inst by CS Sentinel		CS Sentinel		
5042	28/10/1910	Tangier - Cadiz	Interrupted 23rd inst				Interrupted 23rd inst	
5043	04/11/1910	Teneriffe - St Louis	Interrupted 27th ulto				Interrupted 27th ulto	
5044	04/11/1910	Marsielles - Barcelona	Interrupted 2nd inst				Interrupted 2nd inst	
5045	09/11/1910	Porthcurno - Lisbon No1	Renewal	Renewal by CS John Pender as soon as weather moderates		CS John Pender		
5046	09/11/1910	Sitia - Alexandria	Repaired 4th inst	Repaired 4th inst by CS Levant 1		CS Levant 1		
5047	09/11/1910	Marsielles - Barcelona	Tempory repair	Tempory repair of beach lines by CS Levant 2		CS Levant 2		
5048	09/11/1910	Alexandria shore ends	Overhauled	Overhauled by CS Amber		CS Amber		
5049	09/11/1910	Mozambique - Zanzibar No 1	Repaired 1st inst	Repaired 1st inst by CS Sherard Osborn		CS Sherard Osborn		
5050	09/11/1910	Bonny - Camaroon	Under repair	Under repair by CS Sentinel		CS Sentinel		

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
5051	15/11/1910	Sennen Cove - Canso (1881, 1882)	Repairs		NMM TCM/8/159 CABLE ENGINEERS' LOGBOOKS. Sennen Cove - Canso (1881, 1882), TELCONIA, 13 October - 15 November 1910	CS Telconia		
5052	18/11/1910	Tangier - Cadiz	Repaired 23rd ulto				Repaired 23rd ulto	
5053	23/11/1910	Porthcurno - Lisbon No1	Renewals under way	Renewals under wat by CS John Pender		CS John Pender		
5054	23/11/1910	Suez - Aden No 3	Repaired 14th inst	Repaired 14th inst by CS Electra		CS Electra		
5055	23/11/1910	Malta - Alexandria No 2	Renewal	Renewal by CS Amber		CS Amber		
5056	23/11/1910	Aden - Bombay No 1	Part renewal	Part renewal under way by CS Duplex		CS Duplex		
5057	23/11/1910	Zanzibar - Mozambique No 1	Renewals complete 11th inst	Renewals complete 11th inst by CS Sherard Osborn		CS Sherard Osborn		
5058	23/11/1910	Bonny - Camaroon	Repaired 10th inst	Repaired 10th inst by CS Sentinel		CS Sentinel		
5059	23/11/1910	Accra - Lagos	Repaired 15th inst	Repaired 15th inst by CS Sentinel		CS Sentinel		
5060	25/11/1910	Tangier - Cadiz	Repaired 19th inst				Repaired 19th inst	
5061	25/11/1910	Marsielles - Barcelona	Repaired 4/11/1910				Repaired 4/11/1910	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
5062			**From the beginning of December 1910, "Repairing Ships" which was always a major section of the ETC Board Meeting Minutes ceased to be recorded. Instead, the entry "Ships Diaries" was listed as one of the "Books on the Table". Unfortunately these have not survived in any known archive.**					
5063	02/12/1910	Obock - Djibuti	Repaired 3rd ulto. (originaly interrupted 24 June 1910)				Repaired 3rd ulto	
5064	02/12/1910	Tangier - Oran	Repaired 26th ulto				Repaired 26th ulto	
5065	05/12/1910	Sennen Cove - Canso (1881, 1882)	Repairs		NMM TCM/8/160 CABLE ENGINEERS' LOGBOOKS. Sennen Cove - Canso (1881, 1882), TELCONIA, 16 November - 5 December 1910	CS Telconia		
5066	23/12/1910	Falmouth - Bilbao (Direct Spanish Co)	Interrupted 21st inst				Interrupted 21st inst	
5067	06/01/1911	Falmouth - Bilbao (Direct Spanish Co)	Repaired 31st inst				Repaired 31st inst	
5068	13/01/1911	Jeddah - Suakin	Interrupted 30th ulto				Interrupted 30th ulto	
5069	13/01/1911	Cap Haitien - Porto Plata	Interrupted 3rd inst				Interrupted 3rd inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
5070	13/01/1911	Port de France - Paramaribo	Interrupted 7th inst				Interrupted 7th inst	
5071	20/01/1911	Paramaribo - Cayenne	Repaired 16th inst				Repaired 16th inst	
5072	20/01/1911	Port de France - Paramaribo	Repaired 17th inst				Repaired 17th inst	
5073	20/01/1911	Dakar - Conakry	Interrupted 17th inst				Interrupted 17th inst	
5074	20/01/1911	Hong Kong - Macao	Interrupted 18th inst				Interrupted 18th inst	
5075	27/01/1911	Dakar - Conakry	Repaired 24th inst				Repaired 24th inst	
5076	27/01/1911	Hong Kong - Macao	Repaired 21st inst				Repaired 21st inst	
5077								
5078	03/02/1911	Cap Haitien - Porto Plata	Repaired 27th ulto				Repaired 27th ulto	
5079	10/02/1911	Cap Haitien - Porto Plata	Interrupted 8th inst				Interrupted 8th inst	
5080	17/02/1911	Cap Haitien - Porto Plata	Repaired 13th inst				Repaired 13th inst	
5081	17/02/1911	Constantinople - Odessa	Interrupted 14th inst				Interrupted 14th inst	
5082	24/02/1911	Australia - New Caledonia	Interrupted 18th inst				Interrupted 18th inst	
5083	24/02/1911	Madagascar - La Reunion	Interrupted 19th inst				Interrupted 19th inst	
5084	24/02/1911	La Reunion - Mauritius	Interrupted 19th inst				Interrupted 19th inst	
5085	03/03/1911	Dante - Corfu	Interrupted 26th ulto				Interrupted 26th ulto	
5086	10/03/1911	Jeddah - Suakin	Repaired 8th inst				Repaired 8th inst	
5087	17/03/1911	Australia - New Caledonia	Repaired 13th inst				Repaired 13th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
5088	17/03/1911	Cayenne - Salinas	Interrupted 13th inst				Interrupted 13th inst	
5089	24/03/1911	Madagascar - La Reunion	Repaired 16th inst				Repaired 16th inst	
5090	24/03/1911	La Reunion - Mauritius	Repaired 17th inst				Repaired 17th inst	
5091	24/03/1911	Bathurst - Bissau	Interrupted 22nd inst				Interrupted 22nd inst	
5092	31/03/1911	Constantinople - Odessa	Repaired 27th inst				Repaired 27th inst	
5093	31/03/1911	Zante - Corfu	Repaired 21st inst				Repaired 21st inst	
5094	07/04/1911	Teneriffe - St Louis	Repaired 4th inst (Interrupted 27 Oct 1910)				Repaired 4th inst	
5095	07/04/1911	Bathurst - Bissau	Repaired 31st ulto				Repaired 31st ulto	
5096	07/04/1911	Bonny - Duala	Interrupted 30th ulto				Interrupted 30th ulto	
5097	14/04/1911	Cayenne - Salinas	Repaired 7th inst				Repaired 7th inst	
5098	14/04/1911	Port de France - Paramaribo	Interrupted 10th inst				Interrupted 10th inst	
5099	21/04/1911	Zanzibar - Mombassa	Interrupted 19th inst				Interrupted 19th inst	
5100	21/04/1911	Ile Chausey - Pointe de Gronin (1865), Ile de Moleux - Ile d'Ouessant (1897)	Repairs		NMM TCM/8/161 CABLE ENGINEERS' LOGBOOKS. Ile Chausey - Pointe de Gronin (1865), Ile de Moleux - Ile d'Ouessant (1897) TELCONIA, 5 - 21 April 1911	CS Telconia		
5101	28/04/1911	Kwandang - Menado	Interrupted 25th inst				Interrupted 25th inst	
5102	05/05/1911	Port de France - Paramaribo	Repaired 27th ulto				Repaired 27th ulto	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
5103	05/05/1911	Zanzibar - Mombassa	Repaired 2nd inst				Repaired 2nd inst	
5104	08/05/1911	Abbotts Cliff - Gris Nez (1859)	Repairs		NMM TCM/8/162 CABLE ENGINEERS' LOGBOOKS. Abbotts Cliff - Gris Nez (1859), TELCONIA, 27 April - 8 May 1911	CS Telconia		
5105	02/06/1911	Tourane - Amoy	Repaired 29th May (interrupted 25th Sept 1910)				Repaired 29th May	
5106	06/07/1911	Ballinskellig - Harbour Grace	Repairs		NMM TCM/8/163 CABLE ENGINEERS' LOGBOOKS. Ballinskellig - Harbour Grace, TELCONIA, 27 June - 6 July 1911	CS Telconia		
5107	14/07/1911	Zanzibar - Mombassa	Interrupted 11th inst				Interruped 11th inst	
5108	14/07/1911	Bathurst - Bissau	Interrupted 11th inst				Interruped 11th inst	
5109	14/07/1911	Guam - Manila	Interrupted 12th inst				Interrupted 12th inst	
5110	21/07/1911	Malta - Tripoli	Repaired 18th inst				Repaired 18th inst	
5111	28/07/1911	Bathurst - Bissau	Repaired 22nd inst				Repaired 22nd inst	
5112	04/08/1911	Cayenne - Salinas	Interrupted 29th ulto				Repaired 29th ulto	
5113	11/08/1911	Guam - Manila	Repaired 4th inst				Repaired 4th inst	
5114	11/08/1911	Cayenne - Salinas	Repaired 5th inst				Repaired 5th inst	
5115	25/08/1911	Kotonou - Grand Bassam	Interrupted 23rd inst				Interrupted 12th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
5116	25/08/1911	Sabang - Koetaradja	Interrupted 18th inst				Interrupted 18th inst	
5117	25/08/1911	Saigon - Pontianak	Interrupted 23rd inst				Interrupted 12th inst	
5118	01/09/1911	Saigon - Pontianak	Repaired 24th ulto				Repaired 24th ulto	
5119	04/09/1911	Brest - St Pierre (1879 No 3)	Repairs		NMM TCM/8/164 CABLE ENGINEERS' LOGBOOKS. Brest - St Pierre (1879 No 3), TELCONIA, 23 August - 4 September 1911	CS Telconia		
5120	08/09/1911	San Thiago - Bathurst	Interrupted 4th inst				Interrupted 4th inst	
5121	08/09/1911	Bathurst - Sierra Leone	Interrupted 4th inst				Interrupted 4th inst	
5122	22/09/1911	Sabang - Koetaradja	Repaired 5th inst				Repaired 5th inst	
5123	29/09/1911	Zanzibar - Mombassa	Repaired 21st inst				Repaired 21st inst	
5124	29/09/1911	San Thiago - Bathurst	Repaired 23rd inst				Repaired 23rd inst	
5125	29/09/1911	Bissau - Baloma	Interrupted 26th inst				Interrupted 26th inst	
5126	06/10/1911	Malta - Tripoli	Interrupted 2nd inst				Interrupted 2nd inst	
5127	13/10/1911	Bathurst - Sierra Leone	Repaired 9th inst				Repaired 9th inst	
5128	13/10/1911	Malta - Tripoli	Repaired 10th inst				Repaired 10th inst	
5129	03/11/1911	Kotonou - Grand Bassam	Repaired 27th ulto				Repaired 27th ulto	
5130	17/11/1911	Jamaique - Colon	Interrupted 14th inst				Interrupted 14th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
5131	24/11/1911	New York - Cape Haitien	Interrupted 16th inst				Interrupted 16th inst	
5132	24/11/1911	Fort de France - Paramaribo	Inbterrupted 17th inst				Interrupted 17th inst	
5133	24/11/1911	Cape St James - Dosan	Interrupted 18th inst				Interrupted 18th inst	
5134	24/11/1911	Paramaribo - Cayenne	Interrupted 18th inst				Interrupted 18th inst	
5135	01/12/1911	Jamaique - Colon	Repaired 24th ulto				Repaired 24th ulto	
5136	01/12/1911	New York - Cape Haitien	Repaired 24th ulto				Repaired 24th ulto	
5137	01/12/1911	Fort de France - Paramaribo	Repaired 25th ulto				Repaired 25th ulto	
5138	01/12/1911	Saigon - Pontianak	Interrupted 24th ulto				Interrupted 24th ulto	
5139	08/12/1911	Bissau - Baloma	Repaired 6th inst				Repaired 6th inst	
5140	08/12/1911	Cape St James - Dosan	Repaired 6th inst				Repaired 6th inst	
5141	15/12/1911	Paramaribo - Cayenne	Repaired 11th inst				Repaired 11th inst	
5142	05/01/1912	Paramaribo - Cayenne	Interrupted 1st inst				Interrupted 1st inst	
5143	05/01/1912	Tenedos - Bessika	Interrupted 1st inst				Interrupted 1st inst	
5144	12/01/1912	Tenedos - Bessika	Repaired 8th inst				Repaired 8th inst	
5145	12/01/1912	Cairo - Chio	Interrupted 9th inst				Interrupted 9th inst	
5146	12/01/1912	Candia - Sitia	Interrupted 9th inst				Interrupted 9th inst	
5147	12/01/1912	Alexandria - Larnica	Interrupted 10th inst				Interrupted 10th inst	
5148	19/01/1912	Syra - Chio	Repaired 17th inst				Repaired 17th inst	

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
5149	26/01/1912	Cayenne - Salinas	Interrupted 18th inst				Interrupted 18th inst	
5150	26/01/1912	Sitoebondo - Macassar	Interrupted 22nd inst				Interrupted 22nd inst	
5151	02/02/1912	Bissau - Baloma	Interrupted 29th ulto				Interrupted 29th ulto	
5152	09/02/1912	Sitoebondo - Macassar	Repaired 29th ulto				Repaired 29th ulto	
5153	09/02/1912	Gib - Tangier	Interrupted 4th inst				Interrupted 4th inst	
5154	16/02/1912	Saigon - Pontianak	Repaired 12th inst				Repaired 12th inst	
5155	16/02/1912	Paramaribo - Cayenne	Repaired 11th inst				Repaired 11th inst	
5156	16/02/1912	Alexandria - Larnica	Repaired 8th inst				Repaired 8th inst	
5157	16/02/1912	Midway - Guam	Interrupted 9th inst				Interrupted 9th inst	
5158								
5159	23/02/1912	Cayenne - Salinas	Repaired 17th inst				Repaired 17th inst	
5160	23/02/1912	Gib - Tangier	Repaired 19th inst				Repaired 19th inst	
5161	01/03/1912	Espagnol - Tangier	Interrupted 27th ulto				Interrupted 27th ulto	
5162	01/03/1912	Alhucemas - Penon de la Gomora	Interrupted 28th ulto				Interrupted 28th ulto	
5163	01/03/1912	Ceuta - Estepone	Interrupted 28th ulto				Interrupted 28th ulto	
5164	01/03/1912	Melilla - Chafarinas	Interrupted 28th ulto				Interrupted 28th ulto	
5165	08/03/1912	Cadiz - Tenerife	Interrupted 29th ulto				Interrupted 29th ulto	
5166	15/03/1912	Midway - Guam	Repaired 10th inst				Repaired 10th inst	
5167	15/03/1912	Jeddah - Suakin	Interrupted 4th inst				Interrupted 4th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
5168	15/03/1912	Sitia - Rhodes	Interrupted 5th inst				Interrupted 5th inst	
5169	22/03/1912	Sitia - Rhodes	Repaired 20th inst				Repaired 20th inst	
5170	22/03/1912	Cape St James - Dosan	Interrupted 14th inst				Interrupted 14th inst	
5171	29/03/1912	Bissau - Baloma	Repaired 23rd inst				Repaired 23rd inst	
5172	29/03/1912	Pernambuco - Para	Interupted 28th inst				Interrupted 28th inst	
5173	29/03/1912	Pernambuco - Ceara	Interupted 28th inst				Interrupted 28th inst	
5174	05/04/1912	Pernambuco - Ceara	Repaired 1st inst				Repaired 1st inst	
5175	05/04/1912	Cap Haitien - Puerto Plata	Interrupted 1st inst				Interrupted 1st inst	
5176	12/04/1912	Jeddah - Suakin	Interrupted 4th inst				Interrupted 4th inst	
5177	12/04/1912	Para - Pernambuco	Repaired 9th inst (Interrupted 28th March 1912)				Repaired 9th inst (Interrupted 28th March 1912)	
5178	12/04/1912	Cap Haitien - Puerto Plata	Repaired 19th inst				Repaired 19th inst	
5179	12/04/1912	Chafarinas - Nemours	Interrupted 10th inst				Interrupted 10th inst	
5180	12/04/1912	Seattle - Sitka	Interrupted 10th inst				Interrupted 10th inst	
5181	26/04/1912	Seattle - Sitka	Repaired 20th inst				Repaired 20th inst	
5182	26/04/1912	Salonika - Lemnos	Interrupted 18th inst				Interrupted 18th inst	
5183	26/04/1912	Chio - Tenedos	Interrupted 20th inst				Interrupted 20th inst	
5184	26/04/1912	Syra - Chio Nos 1 & 2	Interrupted 20th inst				Interrupted 20th inst	
5185	26/04/1912	Scalonova - Samos	Interrupted 21st inst				Interrupted 21st inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
5186	26/04/1912	Marmariza - Rhodes	Interrupted 21st inst				Interrupted 21st inst	
5187	26/04/1912	Bessica - Tenedos	Interrupted 24th inst				Interrupted 24th inst	
5188	10/05/1912	Cape St James - Dosan	Repaired 2nd inst				Repaired 2nd inst	
5189	10/05/1912	Sitia - Rhodes	Interrupted 2nd inst				Interrupted 2nd inst	
5190	10/05/1912	Perim - Djibuti	Interrupted 7th inst				Interrupted 7th inst	
5191	24/05/1912	Perim - Djibuti	Repaired 14th inst				Repaired 14th inst	
5192	14/06/1912	Fort de France - Paramaribo	Interrupted 6th inst				Interrupted 6th inst	
5193	14/06/1912	Kotonou - Libreville	Interrupted 12th inst				Interrupted 12th inst	
5194	21/06/1912	Bonny - Duala	Interrupted 16th inst				Interrupted 16th inst	
5195	21/06/1912	Oran - Tangier	Interrupted 16th inst				Interrupted 16th inst	
5196	28/06/1912	Oran - Tangier	Repaired 23rd inst				Repaired 23rd inst	
5197	05/07/1912	Fort de France - Paramaribo	Repaired 2nd inst				Repaired 2nd inst	
5198	05/07/1912	Bonny - Duala	Repaired 29th ulto				Repaired 29th ulto	
5199	12/07/1912	Sitia - Rhodes	Repaired 6th inst				Repaired 6th inst	
5200	12/07/1912	Poulocoudore - Pontianic	Interrupted 5th inst				Interrupted 5th inst	
5201	09/08/1912	Kotonou - Libreville	Repaired 4th inst				Repaired 4th inst	
5202	16/08/1912	Kartal - Nagara	Interrupted 12th inst				Interrupted 12th inst	
5203	30/08/1912	Cap St James - Doson	Interrupted 23rd inst				Interrupted 23rd inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
5204	06/09/1912	Cadiz - Tangier	Repaired 2nd inst (interrupted 27/02/1912)				Repaired 2nd inst (interrupted 27/02/1912)	
5205	06/09/1912	Ceuta - Estepone	Repaired 2nd inst (Interrupted 28/12/1911)				Repaired 2nd inst (Interrupted 28/12/1911)	
5206	06/09/1912	Kartal - Nagara	Repaired 28th ulto				Repaired 28th ulto	
5207	13/09/1912	Kwandang - Medado	Interrupted 4th inst				Interrupted 4th inst	
5208	13/09/1912	Sharp - Peak - Formosa	Interrupted 6th inst				Interrupted 6th inst	
5209	13/09/1912	Tokyo - Guam	Interrupted 10th inst				Interrupted 10th inst	
5210	13/09/1912	Cape St James - Dosan	Interrupted 11th inst				Interrupted 11th inst	
5211	20/09/1912	Kwandang - Medado	Repaired 13th inst				Repaired 13th inst	
5212	20/09/1912	Seattle - Sitka	Interrupted 12th inst				Repaired 12th inst	
5213	27/09/1912	Cape St James - Dosan	Repaired 11th inst				Repaired 11th inst	
5214	27/09/1912	Oran - Tangier	Repaired 22nd inst				Repaired 22nd inst	
5215	27/09/1912	Seattle - Sitka	Repaired 15th inst				Repaired 15th inst	
5216	04/10/1912	Cadiz - Tenerife	Repaired 27th ulto (Interrupted 29/02/1912)				Repaired 27th ulto (Interrupted 29/02/1912)	
5217	04/10/1912	Sharp Peak - Formosa	Repaired 24th ulto				Repaired 24th ulto	
5218	04/10/1912	Tangier - Cadiz	Interrupted 2nd inst				Interrupted 2nd inst	
5219	11/10/1912	Cayenne - Salinas	Interrupted 9th inst				Interrupted 9th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
5220	25/10/1912	Peurto Plata - Martinique	Interrupted 21st inst				Interrupted 21st inst	
5221	01/11/1912	Tangier - Cadiz	Repaired 26th ulto				Repaired 26th ulto	
5222	08/11/1912	Melilla - Chafarinas	Repaired 6th inst (Interrupted 28/02/1912				Repaired 6th inst (Interrupted 28/02/1912	
5223	08/11/1912	Chafarinas - Nemours	Repaired 6th inst (Interrupted 10/04/12)				Repaired 6th inst (Interrupted 10/04/12)	
5224	08/11/1912	Peurto Plata - Martinique	Repaired 3rd inst				Repaired 3rd inst	
5225	15/11/1912	Alhucemas - Penon de la Gomora	Repaired 7th inst (Interrupted 28/02/1912)				Repaired 7th inst (Interrupted 28/02/1912)	
5226	22/11/1912	Cayenne - Salinas	Repaired 18th inst				Repaired 18th inst	
5227	22/11/1912	Bonny - Duala	Interrupted 19th inst				Interrupted 19th inst	
5228	13/12/1912	Djedda - Suakim	Repaired 5th inst (Interrupted 04/04/1912				Repaired 5th inst (Interrupted 04/04/1912	
5229	13/12/1912	Bonny - Duala	Repaired 5th inst				Repaired 5th inst	
5230	13/12/1912	Bissau - Baloma	Interrupted 7th inst				Interrupted 7th inst	
5231	27/12/1912	Madras - Penang Nos 1 & 2	Interrupted 17th inst				Interrupted 17th inst	
5232	03/01/1913	Bonny - Duala	Interrupted 24th ulto				Interrupted 24th ulto	
5233	03/01/1913	Cayenne - Salinas	Interrupted 24th ulto				Interrupted 24th ulto	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
5234	05/01/1913	Valentia - Hearts Content (1874)	Repairs		NMM TCM/8/165 CABLE ENGINEERS' LOGBOOKS. Valentia - Hearts Content (1874), TELCONIA, 22 December 1912 - 5 January 1913	CS Telconia		
5235	10/01/1013	Paramaribo - Cayenne	Interrupted 2nd inst				Interrupted 2nd inst	
5236	17/01/1913	Bonny - Duala	Repaired 9th inst				Repaired 9th inst	
5237	24/01/1913	Cayenne - Salinas	Repaired 17th inst				Repaired 17th inst	
5238	24/01/1913	Paramaribo - Cayenne	Repaired 20th inst				Repaired 20th inst	
5239	31/01/1913	Dartmouth - Guernsey	Interrupted 29th inst				Interrupted 29th inst	
5240	07/02/1913	Cape St James - Dosan	Interrupted 5th inst				Interrupted 5th inst	
5241	14/02/1913	Bissau - Baloma	Repaired 8th inst				Repaired 8th inst	
5242	14/02/1913	Dartmouth - Guernsey	Repaired 6th inst				Repaired 6th inst	
5243	14/02/1913	Bathurst - Bissau	Interrupted 11th inst				Interrupted 11th inst	
5244	18/02/1913	Waterville - Weston-Super-Mare, (1885)	Repairs		NMM TCM/8/166 CABLE ENGINEERS' LOGBOOKS. Waterville - Weston-Super-Mare, (1885)TELCONIA, 6 January - 18 February 1913	CS Telconia		
5245	21/02/1913	Cape St James - Dosan	Repaired 19th inst				Repaired 19th inst	

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
5246	28/02/1913	Bathurst - Bissau	Repaired 27th inst				Repaired 27th inst	
5247	28/02/1913	Lemnon - Salonika	Interrupted 25th inst				Interrupted 25th inst	
5248	28/02/1913	Zante - Patras No 1 & 2	Interrupted 25th inst				Interrupted 25th inst	
5249	07/03/1913	Zante - Patras No 1 & 2	Repaired 28th ulto				Repaired 28th ulto	
5250	14/03/1913	Lemnon - Salonika	Repaired 8th inst				Repaired 8th inst	
5251	14/03/1913	Zante - Canea	Repaired 12th inst				Repaired 12th inst	
5252	14/03/1913	Madagascar - Reunion	Interrupted 11th inst				Interrupted 11th inst	
5253	14/03/1913	Reunion - Mauritius	Interrupted 11th inst				Interrupted 11th inst	
5254	21/03/1913	Reunion - Mauritius	Repaired 15th inst				Repaired 15th inst	
5255	28/03/1913	Seattle - Sitka	Interrupted 26th inst				Interrupted 26th inst	
5256	04/04/1913	Seattle - Sitka	Repaired 27th ulto				Repaired 27th ulto	
5257	04/04/1913	Djeddah - Suakin	Interrupted 28th ulto				Interrupted 28th ulto	
5258	04/04/1913	Chio - Tenedos	Interrupted 1st inst				Interrupted 1st inst	
5259	05/04/1913	Aden - Bombay (1877 No2, 1891 No 3)	Repairs		NMM TCM/8/168 CABLE ENGINEERS' LOGBOOKS. Aden - Bombay (1877 No2, 1891 No 3), COLONIA, 14 March - 5 April 1913	CS Colonia		
5260	11/04/1913	Djeddah - Suakin	Repaired 7th inst				Repaired 7th inst	
5261	11/04/1913	Chio - Tenedos	Repaired 5th inst				Repaired 5th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
5262	18/04/1913	Tokyo - Guam	Repaired 13th inst (interrupted 10 Sept 1912)				Repaired 13th inst	
5263	18/04/1913	Paramaribo - Cayenne	Interrupted 11th inst				Interrupted 11th inst	
5264	25/04/1913	Paramaribo - Cayenne	Repaired 22nd inst				Repaired 22nd inst	
5265	25/04/1913	Perim - Cayenne	Interrupted 21st inst				Interrupted 21st inst	
5266	25/04/1913	Oran - Tangier	Repaired 18th inst				Repaired 18th inst	
5267	02/05/1913	Seattle - Sitka	Interrupted 24th ulto				Interrupted 24th ulto	
5268	09/05/1913	Seattle - Sitka	Repaired 6th inst				Repaired 6th inst	
5269	12/05/1913	Suez - Aden (No 3)	Repairs		NMM TCM/8/169 CABLE ENGINEERS' LOGBOOKS. Suez - Aden (No 3), COLONIA, 4-12 May 1913	CS Colonia		
5270	20/05/1913	Valentia - Hearts Content (1880, 1894)	Repairs		NMM TCM/8/167 CABLE ENGINEERS' LOGBOOKS. Valentia - Hearts Content (1880, 1894) TELCONIA, 30 April - 20 May 1913	CS Telconia		
5271	23/05/1913	Madagascar - Reunion	Repaired 16th inst				Repaired 16th inst	
5272	06/06/1913	Paramaribo - Cayenne	Interrupted 28th ulto				Interrupted 28th ulto	
5273	06/06/1913	Fort de France - Paramaribo	Interrupted 30th ulto				Interrupted 30th ulto	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
5274	12/06/1913	Penzance - Brignogan (1879)	Repairs		NMM TCM/8/170 CABLE ENGINEERS' LOGBOOKS. Penzance - Brignogan (1879), TELCONIA, 2 - 12 June 1913	CS Telconia		
5275	13/06/1913	Jamaica - Colon	Interrupted 9th inst				Interrupted 9th inst	
5276	04/07/1913	Paramaribo - Cayenne	Repaired 19th ulto				Repaired 19th ulto	
5277	04/07/1913	Fort de France - Paramaribo	Repaired 27th ulto				Repaired 27th ulto	
5278	04/07/1913	Sitia - Rhodes	Interrupted 2nd inst				Interrupted 2nd inst	
5279	11/07/1913	Sitia - Rhodes	Repaired 5th inst				Repaired 5th inst	
5280	01/08/1913	Cjorillon - Molendo (Peru)	Interrupted 29th ulto				Interrupted 29th ulto	
5281	08/08/1913	Chorillon - Iqueique	Interrupted 31st ulto				Interrupted 31st ulto	
5282	15/08/1913	Chorillon - Iqueique	Repaired 8th inst				Repaired 8th inst	
5283	15/08/1913	Cape St James - Dosan	Interrupted 5th inst				Interrupted 5th inst	
5284	15/08/1913	Cadiz - Tenerife (1883)	Repairs		NMM TCM/8/171 CABLE ENGINEERS' LOGBOOKS. Cadiz - Tenerife (1883), TELCONIA, 13 June - 15 August 1913	CS Telconia		
5285	29/08/1913	Cape St James - Dosan	Repaired 27th inst				Repaired 27th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
5286	29/08/1913	Sasebo - Dairen	Interrupted 21st inst				Interrupted 21st inst	
5287	01/09/1913	Valentia - Hearts Content (1873)	Repairs		NMM TCM/8/172 CABLE ENGINEERS' LOGBOOKS. Valentia - Hearts Content (1873), TELCONIA, 21 August - 1 September 1913	CS Telconia		
5288	12/09/1913	Sasebo - Dairen	Repaired 3rd inst				Repaired 3rd inst	
5289	26/09/1913	Valentia - Hearts Content (1873)	Repairs		NMM TCM/8/173 CABLE ENGINEERS' LOGBOOKS. Valentia - Hearts Content (1873), TELCONIA, 11 September - 26 September 1913	CS Telconia		
5290	03/10/1913	Chorillon - Molendo	Repaired 24th ulto				Repaired 24th ulto	
5291	10/10/1913	Falmouth - Bilbao	Interrupted 3rd inst				Interrupted 3rd inst	
5292	10/10/1913	Oran - Tangier	Interrupted 6th inst				Interrupted 6th inst	
5293	10/10/1913	Singaradja - Ampenan	Interrupted 5th inst				Interrupted 5th inst	
5294	10/10/1913	Bissau - Baloma	Interrupted 8th inst				Interrupted 8th inst	
5295	17/10/1913	Falmouth - Bilbao	Repaired 14th inst				Repaired 14th inst	
5296	17/10/1913	Bissau - Baloma	Repaired 10th inst				Repaired 10th inst	
5297	24/10/1913	Chio - Tenedos	Interrupted 17th inst				Interrupted 17th inst	

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1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
5298	24/10/1913	Pernambuco - Ceara	Interrupted 20th inst				Interrupted 20th inst	
5299	24/10/1913	Ceara - Maranham	Interrupted 20th inst				Interrupted 20th inst	
5300	31/10/1913	Besika - Tenedos	Repaired 24th inst (interrupted 24th April)				Repaired 24th inst	
5301	31/10/1913	Chio - Tenedos	Repaired 29th inst				Repaired 29th inst	
5302	31/10/1913	Mole St Nicholas - Port au Prince	Interrupted 27th inst				Interrupted 27th inst	
5303	07/11/1913	Pernambuco - Ceara	Repaired 1st inst				Repaired 1st inst	
5304	07/11/1913	Cayenne - Salinas	Interrupted 30th ulto				Interrupted 30th ulto	
5305	07/11/1913	Puerto Plata - Martinique	Interrupted 3rd inst				Interrupted 3rd inst	
5306	07/11/1913	Chio - Smyrna	Repaired 1st inst				Repaired 1st inst	
5307	14/11/1913	Oran - Tangier	Repaired 11th inst				Repaired 11th inst	
5308	14/11/1913	Ceara - Maranham	Repaired 10th inst				Repaired 10th inst	
5309	14/11/1913	Fort de France - Paramaribo	Interrupted 12th inst				Interrupted 12th inst	
5310	21/11/1913	Kartel - Nagara	Interrupted 15th ulto				Interrupted 15th ulto	
5311	05/12/1913	Sitka - Valdez	Interrupted 3rd inst				Interrupted 3rd inst	
5312	05/12/1913	Puerto Plata - Martinique	Repaired 2nd inst				Repaired 2nd inst	

	A	B	C	D	E	F	G	H
1		Cable	Event	ETC Board Minute Books	Engineer's Reports (and other sources)	Ship	The Electrician	The Times
5313	07/12/2013	Brest - St Pierre (1879)	Repairs		NMM TCM/8/174 CABLE ENGINEERS' LOGBOOKS. Brest - St Pierre (1879), TELCONIA, 3 November - 7 December 1913	CS Telconia		
5314	12/12/1913	Cape St James - Pontianac	Interrupted 7th inst				Interrupted 7th inst	
5315	19/12/1913	Mole St Nicholas - Port au Prince	Repaired 11th inst				Repaired 11th inst	
5316	19/12/1913	Sitka - Valdez	Repaired 18th inst				Repaired 18th inst	
5317	19/12/1913	Paramaribo - Cayenne	Interrupted again 16th inst				Interrupted 16th inst	
5318	19/12/1913	Chios - Tenedos	Interrupted 15th inst				Interrupted 15th inst	
5319	26/12/1913	Chios - Tenedos	Repaired 21st inst				Repaired 21st inst	
5320	02/01/1914	Tenedos - Chios	Interrupted 26th ulto				Interrupted 26th ulto	
5321	02/01/1914	Tenedos - Lemnos	Interrupted 26th ulto				Interrupted 26th ulto	
5322	09/01/1914	Tenedos - Chios	Repaired 6th inst				Repaired 6th inst	
5323	09/01/1914	Aden - Bombay (No2)	Repairs		NMM TCM/8/175 CABLE ENGINEERS' LOGBOOKS. Aden - Bombay (No2), COLONIA, 10 December 1913 - 9 January 1914	CS Colonia		
5324	23/01/1914	Carcavellos - San Miguel	Interrupted 20th inst				Interrupted 20th inst	

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
5325	23/01/1914	Fayal - San Miguel	Interrupted 20th inst				Interrupted 20th inst	
5326	23/01/1914	Oran - Tangier	Interrupted 20th inst				Interrupted 20th inst	
5327	23/01/1914	Tangier - Cadiz	Interrupted 20th inst				Interrupted 20th inst	
5328	07/02/1914	Penzance - Brignogan (1879)	Repairs		NMM TCM/8/177 CABLE ENGINEERS' LOGBOOKS. Penzance - Brignogan (1879), TELCONIA, 28 January - 7 February 1914; TCM/8/176 CABLE ENGINEERS' LOGBOOKS. Penzance-Brignogan (1879), TELCONIA, 28 January - 7 February 1914	CS Telconia		
5329	13/02/1914	Zanzibar - Mombassa	Repaired 6th inst				Repaired 6th inst	
5330	13/02/1914	Paramaribo - Cayenne	Interrupted 11th inst				Interrupted 11th inst	
5331	06/02/1914	Fort de France - Paramaribo	Repaired 30th ulto				Repaired 30th ulto	
5332	06/02/1914	Paramaribo - Cayenne	Repaired 30th ulto				Repaired 30th ulto	
5333	06/02/1914	Carcavellos - San Miguel	Repaired 28th ulto				Repaired 28th ulto	
5334	20/02/1914	Tangier - Cueta	Interrupted 15th inst				Interrupted 15th inst	

	A	B	C	D	E	F	G	H
1		Cable	Event	ETC Board Minute Books	Engineer's Reports (and other sources)	Ship	The Electrician	The Times
5335	20/02/1914	Fayal - San Miguel	Repaired 18th inst				Repaired 18th inst	
5336	27/02/1914	Oran - Tangier	Repaired 20th inst				Repaired 20th inst	
5337	27/02/1914	Oran - Tangier	Interrupted (again) 25th inst				Interrupted 25th inst	
5338	06/03/1914	Paramaribo - Cayenne	Repaired 2nd inst				Repaired 2nd inst	
5339	13/03/1914	Tangier - Cadiz	Repaired 6th inst				Repaired 6th inst	
5340	13/03/1914	Oran - Tangier	Repaired 8th inst				Repaired 8th inst	
5341	13/03/1914	Perim - Djibouti	Repaired 10th inst				Repaired 10th inst	
5342	27/03/1914	Zanzibar - Mombassa	Repaired 20th inst				Repaired 20th inst	
5343	17/04/1914	Cayenne - Salinas	Repaired 9th inst				Repaired 9th inst	
5344	24/04/1914	Cayenne - Salinas	Interrupted (again) 22st inst				Interrupted 22st inst	
5345	01/05/1914	Cayenne - Salinas	Repaired 24th ulto				Repaired 24th ulto	
5346	29/05/1914	Cayenne - Salinas	Interrupted (again) 26th inst				Interrupted 26th inst	
5347	12/06/1914	Seattle - Sitka	Interrupted 9th inst				Interrupted 9th inst	
5348	19/06/1914	Seattle - Sitka	Repaired 16th inst				Repaired 16th inst	
5349	26/06/1914	Madagascar - Reunion	Interrupted 23rd inst				Interrupted 23rd inst	
5350	26/06/1914	Mauritius - Reunion	Interrupted 23rd inst				Interrupted 23rd inst	
5351	03/07/1914	Nagasaki - Tamsui	Interrupted 26th ulto				Interrupted 26th ulto	
5352	03/07/1914	Cayenne - Salinas	Repaired 29th ulto				Repaired 29th ulto	
5353	17/07/1914	Nagasaki - Tamsui	Repaired 9th inst				Repaired 9th inst	
5354	24/07/1914	Cape St James - Doson	Interrupted 17th inst				Interrupted 27th inst	

	A	B	C	D	E	F	G	H
1		**Cable**	**Event**	**ETC Board Minute Books**	**Engineer's Reports (and other sources)**	Ship	**The Electrician**	**The Times**
5355	31/07/1914	Mauritius - Reunion	Repaired 29th inst				Repaired 29th inst	
5356							**From July there were no futher routine reports of Cable interruepions and repairs in *The Electrician* presum ably at the request of the UK Govt.**	