25th April to 1st October 2006

> **Telegraphy Without Wires.**
>
> -Last night, at Myddleton-hall, Upper-street, Islington, Mr. W.H. Preece delivered a lecture on "Telegraphy without Wires." The proceeds of the lecture are to be devoted to the funds of the Islington Wesleyan Circuit. There was a large attendance, and Mr. Watson Surr occupied the chair. Among those present on the platform was Mr. Marconi, the inventor of the new system of telegraphy. The lecturer recapitulated the facts and details of the discovery as recorded in The Times of Monday last. He had, he said, spent 47 years of his life in the study of electricity. Not a day passed that he did not come across something new and interesting, but he ventured to say that the system of telegraphy he was there to explain was the greatest and most important discovery that had yet been made in this branch of science. They knew that the universe was filled with a homogeneous, continuous, elastic medium which transmitted heat, light, electricity, and other forms of energy from one point of space to another. This medium was ether, not air; and the discovery of its real existence was one of the greatest scientific events of the Victorian era. What ether was they did not know. But this agency was utilized in the new means of telegraphy. Mr. Marconi had produced an instrument which he had no hesitation in describing as the most delicate electrical instrument they possessed. The distance to which signals could be sent by Mr. Marconi's system was remarkable. On Salisbury Plain a distance of four miles had been covered. In the Bristol Channel the distance had been extended to over eight miles. The system was now to be put in operation officially between Sark and the other Channel Islands, and in a short time a telegraph office would be opened there and messages would be received and transmitted without the aid of any communicating wires. He believed that this new system would in the near future prove of great commercial and naval and military value. Even if it turned out that it was impossible to communicate over very long distances, could they estimate the value of the system as a means of communication between ship and ship, or ship and shore? Mr. Marconi briefly addressed the audience.

Mr. Marconi had produced an instrument which he had no hesitation in describing as the most delicate electrical instrument they possessed.

The Times, Friday 11 June 1897

Marconi Arrives

Marconi began his research on radio waves while at home in Bologna, inspired by the possibilities he saw in the work of early pioneers such as Heinrich Hertz, Augusto Righi and Oliver Lodge. He brought his vision and his enthusiasm to England in 1896, in search of support and commercial application, and in the same year applied for a patent for a system of wireless telegraphy.

Having demonstrated his system to the Navy, Army and representatives of the Post Office in trials on Salisbury Plain, Marconi arranged a demonstration to accompany a public lecture on telegraphy by William Preece, chief engineer to the General Post Office. This was held in Toynbee Hall, the educational and charitable institution in London's East End, in December 1896. Preece operated the transmitter and whenever he created an electric spark, a bell rang on a box Marconi took to any part of the lecture room. There was no visible connection between the two. The demonstration caused a sensation and made Marconi a celebrity.

The parabolic transmitter and receiver used by Marconi for his demonstration on Salisbury Plain in 1896.

Coherer Receiver, by Guglielmo Marconi, 1896. A coherer was linked to a device such as a recorder or a bell to register the signal and to a 'tapper'. A mechanical tap to the coherer released its metal filings, making it non-conductive and ready to receive the next signal. This example was used by Marconi in his famous public demonstration of wireless in London's Toynbee Hall in 1896.

Righi Oscillator or Spark-Gap, 1895. An instrument for generating radio waves invented by Augusto Righi of Bologna, who was influential in directing Marconi's scientific interests. In 1896 Marconi brought this example to England, where he used it in demonstrations for the Post Office.

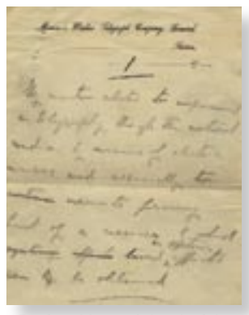
7777

Marconi's method of separating signals through 'tuning' was granted a patent in April 1900 and by good fortune happened to be allocated a striking and memorable number: 7777. This helped to establish the fame of the 'Four Sevens' patent.

Marconi had hired the electrical engineer and Professor at University College London, John Ambrose Fleming. His subsequent work on thermionic valves would be crucial to the further development of radio.

Experimental Valve, by J.A. Fleming, c.1889. This appears to be one of some 14 valves Fleming used for his experiments on the Edison effect in 1889-90.

Magnetic Detector, by Marconi's Wireless Telegraph Co. Ltd., Early 20th Century. First patented in 1902, Marconi's magnetic detector was more sensitive than the coherer and became the standard device for receiving spark telegraphic signals between 1903 and 1918 in both ships and shore stations.



Draft, in Marconi's hand, of the specification for the patent relating to tuning, 7777/1900.

Patent 7777/1900, 'Improvements in Apparatus for Wireless Telegraphy'.

BROAD SHEET communicates the work of the Museum of the History of Science, Oxford.

It is posted on the Museum's website, sold in the shop, and distributed to members of the mailing list, see www.mhs.ox.ac.uk.

£1.00

BROAD SHEET

No. 1

Museum of the History of Science

Wireless World

In 2004 the Marconi Collection was presented to the University of Oxford by the Marconi Corporation. This large and unrivalled archive of objects and documents records the work of Guglielmo Marconi and the wireless telegraph company he founded. The documents are kept in the Bodleian Library and the objects in the Museum of the History of Science. This exhibition of material from the collection presents the first decades of the history of radio (or 'wireless'), from Marconi's pioneering experiments and demonstrations at the end of the 19th century to the beginning of public radio broadcasting in the 1920s.

Wireless transformed the modern world. At first it was a means of individual communication, for sending telegraphic messages in Morse code without the need for connecting cables, hence the name 'wire-less'. Two decades later radio signals were also being 'broadcast'. Radio was entering the home, bringing information and entertainment, and anyone could 'listen in'. The commonly used expression 'listening in' perfectly captured the shift from private and individual communication to public broadcasting accessible to everyone.

Seaside Trials

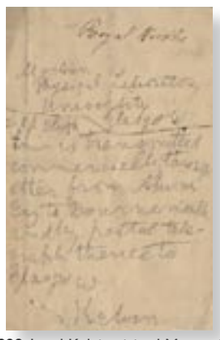
In the final years of the 19th century Marconi worked to extend the range of his radio signals and to demonstrate their practical value. He established stations on the south coast and the Isle of Wight, successfully exchanged signals with ships at sea and in March 1899 transmitted the first wireless message across the English Channel. He had not neglected the commercial side, establishing a factory in Chelmsford in December 1898.

Once he went beyond simple demonstrations of radio transmission and reception, Marconi had to tackle the problem of interference between signals. The answer was 'tuning' – the ability to transmit waves of a particular frequency and to adjust the receiver to accept one frequency at a time.

Tuned Transmitter, by Guglielmo Marconi, 1899. Marconi's first tuned transmitter, completed at the Haven Hotel, Poole. The square wooden frame carries two windings, one linked to the Leyden jar and the brass balls that form a spark-gap. The single turn of the second winding was connected between an aerial and earth.

Tuned Transmitter, by Marconi's Wireless Telegraph Co. Ltd., c.1900. A commercial version of the experimental tuned transmitter.

Morse Key, c.1900. This key was used by Marconi during his experiments on tuned circuits at the Haven Hotel, Poole in c.1900. It was the first type of key designed specifically for wireless work.



In June 1898, Lord Kelvin visited Marconi on the Isle of Wight and insisted on paying for the sending of messages by wireless telegraphy and onward by cable, thus challenging the General Post Office's monopoly on telegraphy. Here he records the 'ether' or wireless message he sent.

Atlantic Crossing

Marconi's most audacious early ambition was to send a radio signal across the Atlantic. It was generally believed that the curvature of the earth made this impossible, because the waves were expected to travel in straight lines and could not pass through the earth.

Two wireless stations were set up in 1901: a transmitter of unprecedented power at Poldhu in Cornwall and a receiving station at St John's in Newfoundland, where the aerial was to be raised by a balloon or a kite. Marconi and his assistants George Kemp and Percy Paget arrived in Newfoundland in December and, although the balloons failed and one of the kites was blown away, after an anxious wait they finally detected the pre-arranged signal from Poldhu. On 12 December they heard the three dots – the letter 'S' in Morse – on a telephone wired in series with a sensitive detector.

The signal had been too weak to be printed on tape in the way telegraphic messages were usually recorded, which led to problems in convincing everyone that the trial had succeeded. Two month's later, however, signals were successfully transmitted over 2,000 miles to Marconi on board the Philadelphia, leaving no room for doubt.

Kite, by G.C. Spencer & Sons, Balloon Makers, Holloway, London, c.1901. One of the large linen kites, with bamboo poles, Marconi and his assistants took to Newfoundland to raise the aerial wires of his receiver at Signal Hill.

Telephone Receiver, by Collier-Marr Telephone & Electrical Manufacturing Co. Ltd., Manchester, 1901. This was used to receive the first transatlantic signal, the three dots of Morse code for the letter 'S'. After struggling either to record or recognise a signal, Marconi famously handed this receiver to his assistant with the words, 'Can you hear anything, Mr Kemp?'

Applications

The first decade of the 20th century saw the beginnings of the serious practical uses of wireless telegraphy. Early success came in areas where the value of speedy communication was already appreciated, such as in the military and especially at sea. The advantages of wireless for maritime use were obvious and had been appreciated by Marconi from a very early stage. His ambitions in this direction are evident from the formation of a subsidiary company, the Marconi International Marine Communication Company, in 1900.

Portable Lifeboat Transmitter Receiver, by Marconi's Wireless Telegraph Co. Ltd, Early 20th Century. This is a unique early example of a fully self-contained portable transmitter and receiver. The robust design was intended for use on lifeboats.

Tuned Field Transmitter, by Marconi's Wireless Telegraph Co. Ltd, 1907. This was one of the first portable wireless transmitters for use by the Army. It was tuned by a bank of Leyden-jar capacitors.

The earliest surviving 'Marconigram' - a telegraph message sent using an official form produced by one of Marconi's companies, to the operator on the S.S. Lake Champlain, June 1901.

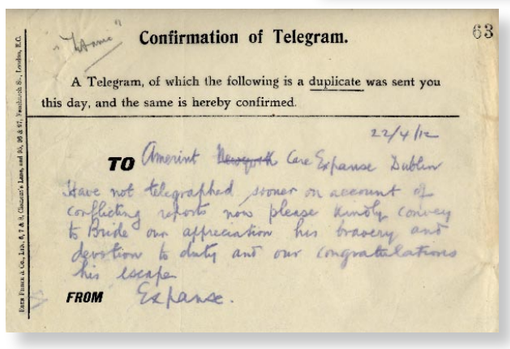
Titanic aftermath

The two Marconi operators on board Titanic were Jack Phillips and Harold Bride. Their first distress message was sent out at 00.05 hours (ship's time) on 15 April (about 25 minutes after the ship struck the iceberg), after which they were continuously occupied in emergency communications until loss of power to their equipment meant they could do no more. Both then abandoned ship, shortly before it foundered at 02.20 hours.

Phillips, the senior operator, was lost, but Bride was picked up by Carpathia, where he assisted the sole radio operator in dealing with a constant exchange of messages in the following hours. The Carpathia finally docked at New York on 18 April and Marconi visited his exhausted operators on board. He had recently arrived there himself on the Lusitania, having at a late stage changed his original plan to cross the Atlantic on Titanic.

Jack Phillips, the radio operator who was drowned in the disaster.

Telegram from George Phillips, father of Jack Phillips, seeking news of his son.



Message conveying the Company's appreciation of the bravery and devotion to duty of Harold Bride, the surviving radio operator from the Titanic.

World War One

It was obvious from the outbreak of World War I in 1914 that wireless had become a technology of great strategic importance. The British government immediately took control of parts of the Marconi company, such as its latest transatlantic stations in Wales and its factory in Chelmsford, and the company established an ambitious training programme for wireless operators. While government restrictions meant that public developments were suspended, the demands of war – from land, sea and airborne services – meant that other technical developments were accelerated.

Wartime priorities emphasised the potential for counter-offensive inherent in wireless communication – signals could be intercepted, for example, and direction-finding techniques could locate the positions of enemy transmitters. Once it was possible to locate trench wireless sets, enemy troop positions could also be known, as well as Zeppelins and other hostile aircraft. It was detection of wireless traffic that alerted the British navy to the movements of the German fleet and precipitated the Battle of Jutland in May 1916.

Map of Zeppelin routes tracked by Marconi Direction Finding equipment on 27-28 November 1916. Zeppelins (German airships) were used for reconnaissance and for bombing raids over the east coast of Britain. This map shows that two of the airships were shot down at the places marked.

Marconi Bellini-Tosi Direction Finder, by Marconi's Wireless Telegraph Co. Ltd, c.1916. Designed for detecting the positions of enemy wireless stations, it was used by the Royal Navy and British Army to trace the position of German submarines, surface naval vessels, and Zeppelins.

Forward Spark 'B' Wavemeter, c.1918. This set has been marked by the Signals section of the Flying Corps under the command of the War Department and can be dated to before April 1918 and the formation of the Royal Air Force.

Wireless at sea

Wireless services became increasingly sophisticated as technology developed. Ocean newspapers originated as early as 1899, when Marconi, sailing from the United States on the liner St Paul, produced a single sheet of news derived from wireless messages, for the benefit of passengers as the liner neared Britain. In subsequent years, with increasing range, news was conveyed to ships at more distant positions and incorporated into pre-printed newspapers containing more general articles.

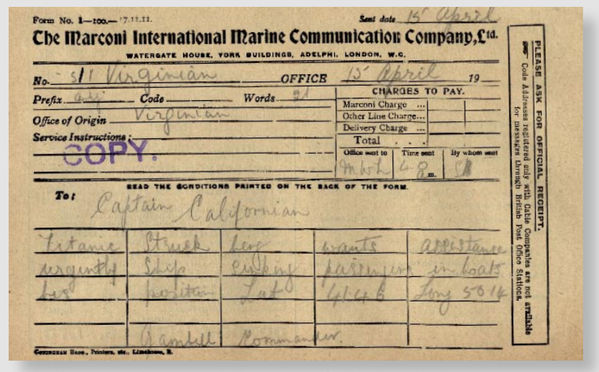
The Transatlantic Times: ocean newspaper produced on the St Paul, 1899.

Marine Auto-Alarm set, by the Marconi International Marine Communication Co. Ltd., c. 1920. This system was one outcome of the Titanic disaster. If a ship had only one wireless operator, he could sleep without fear of missing an emergency message.

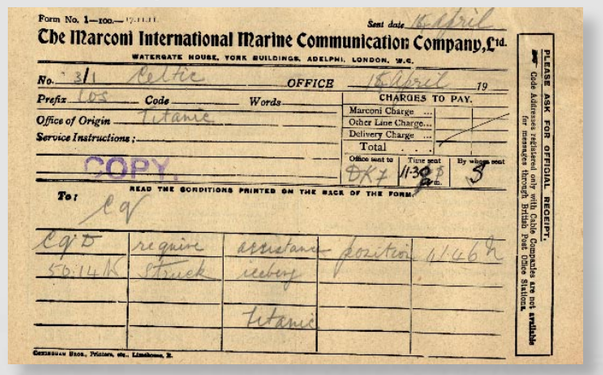
Titanic

The value of wireless communication at sea was dramatically demonstrated by the Titanic disaster in April 1912. Large ships were now being fitted with wireless sets and at least one operator was included among the crew. Titanic had two operators and the latest and most powerful equipment from the Marconi company. After she struck an iceberg and was holed below the water and sinking, the operators were able to send out distress calls to nearby ships and to receive word of their plans to assist. Marconi was celebrated as the saviour of the 700 people who were rescued from Titanic.

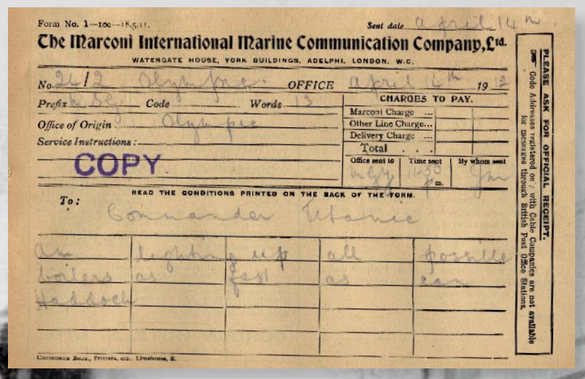
Some of the most remarkable and compelling material in the Marconi archive is the original documentary record of this influential and memorable episode in the history of wireless telegraphy. Much of the material in the two showcases on Titanic is being shown in public for the first time.



A message from the Virginian to the Californian: 'Titanic struck berg wants assistance urgently ship sinking passengers in boats her position Lat 41.46 Long 50.14'.



Message sent from Titanic, as received by Celtic: 'CQD require assistance position 41.46 N 50.14 W struck iceberg Titanic'. 'CQD' was the international help signal used before the introduction of 'SOS'.



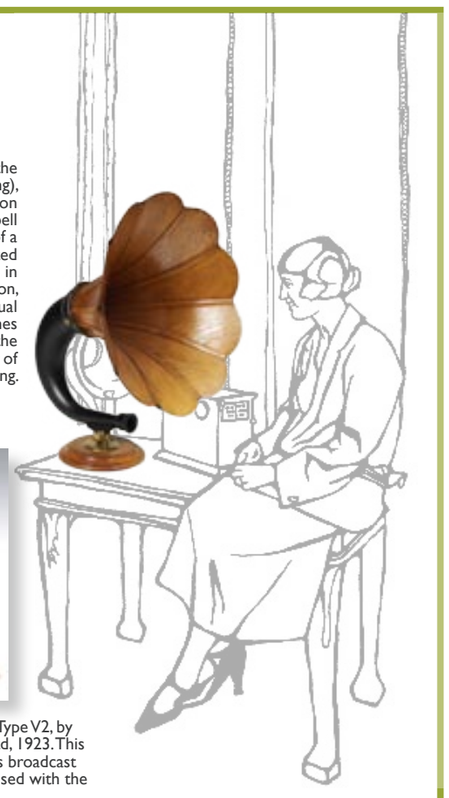
From Olympic to her sister ship Titanic: 'Am lighting up all possible boilers as fast as can'.

Radio Room on Titanic

Broadcasting

Techniques for using wireless technology to transmit speech, instead of Morse signals, began to be developed before World War I but it was after the war that amateur radio became increasingly popular and simple radio receiver sets were developed for a rapidly expanding market. This meant that wireless could be used for 'broadcasting' as well as for sending targeted messages.

Marconi's company pioneered regular broadcasts of information and entertainment in Britain. It organised the first ever broadcast of live public entertainment, by the famous Australian soprano Dame Nellie Melba from the company's Chelmsford works in 1920. Subsequently it set up broadcasting stations at Writtle in Chelmsford and at Marconi House in London in 1922. Strict regulation was enforced by the Post Office, as the licensing authority for broadcasting. But the increasing clamour for licenses from several organisations resulted in their coming together as the British Broadcasting Company (later 'Corporation') in December 1922. The era of popular broadcasting for the home – first by radio, later by television – had begun.



Horn Loudspeaker (the drive unit is missing), c.1923, of the Amplion pattern, with oak bell and base. The idea of a loudspeaker illustrated the new emphasis in wireless communication, away from the individual use of headphones and towards the social character of broadcasting.

Marconiphone Two-Valve Receiver Type V2, by Marconi's Wireless Telegraph Co. Ltd, 1923. This is one of the first domestic wireless broadcast receivers. A loudspeaker could be used with the addition of a two-stage amplifier.

The microphone used on 15 June 1920 by Dame Nellie Melba for her famous broadcast from Chelmsford, the first live public entertainment broadcast. She has signed it 'Nellie Melba 1920'.

BROAD SHEET

Broad Sheet is produced by the **Museum of the History of Science, Oxford**
Broad Street, Oxford OX1 3AZ
Tel +44(0)1865 277280 Fax +44(0)1865 277288
Web: www.mhs.ox.ac.uk
Email: museum@mhs.ox.ac.uk

Arts & Humanities Research Council
RENAISSANCE SOUTH EAST museums for changing lives
Bodleian Library UNIVERSITY OF OXFORD
The Wireless Preservation Society founded by Douglas Byrne