A Joint Exhibit
Celebrating Sir Oliver Lodge

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Presented At:
Radio Club of America
Annual Banquet & Technical Symposium
November 19, 2010
New York City

Antique Wireless Association
50th Annual Conference
August 19, 2011
Rochester, NY
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The Exhibit’s Origins at AWA and RCA
Origins of the exhibit:

• AWA’s first joint exhibit with RCA was displayed at the RCA Centennial in 2009
  • It featured original Edwin H. Armstrong artifacts from AWA, The Franklin Institute and personal collections, including:
    • Armstrong’s First AM and FM experimental receivers
    • Armstrong’s original medal citations from the Radio Club of America and the Institute of Radio Engineers
  • It also included:
    • Original Lee Deforest patent models used in patent litigation
    • Original documents establishing the IEEE Edison Medal in 1909
    • Examples of other radio achievements:
      • First transistor radio
      • First Motorola cell phone

• AWA and RCA jointly prepared a second exhibit that was displayed at RCA in 2010 and at AWA’s Library and 50th Anniversary Conference in 2011
Description of this compendium:

• The exhibit on Sir Oliver Lodge was displayed in 2010 and 2011:
  • *Radio Club of America -- Annual Banquet & Technical Symposium*
    New York City, November 19, 2010
  • *Antique Wireless Association -- Max Bodmer Library & Conference Center*
    *2010-2011 and 50th Annual Conference*, Rochester, NY, August 19, 2011

• The following pages provide an overview of the exhibit, including:
  • Brief biographical information about Sir Oliver Lodge
  • Artifacts and descriptions from the exhibits
  • Additional items not previously shown
  • Articles from *Scientific American* and *Nature* that describe the 1903
    Lodge-Muirhead System of Wireless Telegraphy

• This exhibit introduces Sir Oliver Lodge by featuring artifacts held in private
  collections and in the AWA Museum. The exhibit is not intended to provide a
  comprehensive treatment of Lodge’s life or his many interests and fields of
  study.
The Exhibit
THE EXHIBIT AT AWA & RCA

Exhibit Tables at AWA
Exhibit Tables at RCA
Exhibit at AWA’s Max Bodmer Library & Conference Center
Oliver Lodge contributed many innovations to early radio technology. He coined the term "coherer" in his Royal Institution lectures ("The Work of Hertz and Some of His Successors"). He received the "syntonic" (or tuning) patent from the U.S Patent Office in 1898. He was also credited by Lorentz with the first published description of the Length Contraction hypothesis, in 1893. Five years later, he invented a "bellowing telephone" loudspeaker which is very similar to the modern, paper cone speaker.
Lodge became assistant professor of applied mathematics at University College, London in 1879 and was appointed to the chair of physics at University College, Liverpool in 1881. His principal scientific contributions were concerned with the transmission of electromagnetic waves. His earliest experiments with electricity started in the late 1870s. Lodge first transmitted radio signals on August 14, 1894, at a meeting of the British Association for the Advancement of Science, one year before Marconi, but one year after Tesla. He improved Branly’s detector and also worked with Alexander Muirhead on the development of wireless telegraphy, selling the patents to Marconi in 1912.
SIR OLIVER LODGE’S LANDMARK LECTURE
“ON THE WORK OF HERTZ”

On June 1, 1894, Sir Oliver Lodge delivered his historic memorial lecture and demonstrations “On the Work Of Hertz” at the Royal Institution in London. This landmark lecture ignited the study of wireless telegraphy and the search for a practical commercial means of radio communication. Lodge’s lecture was initially reprinted in 1894 in pamphlet form. The Electrician published it in 1894 with its original title “On the Work Of Hertz”. It was subsequently republished in four editions beginning in 1896 as “Signalling Across Space Without Wires: Being a Description of the Work of Hertz And His Successors”.

Lodge’s 1894 lecture was the first time Hertzian waves were publicly demonstrated. He used William Thomson’s (Lord Kelvin’s) mirror galvanometer to show that his research confirmed Hertz’s independent findings validating Maxwell’s theories. Lodge demonstrated the refraction, reflection and polarization of electric waves, and their passage through stone walls from room to room. These experiments, with some variations, were repeated on August 1, 1894 at meetings of the British Association in Oxford. This was the first widely heralded public demonstration of Morse code signals sent by radio. Although the intended purpose of the lectures was to expound on the theory of electric waves, they created a sensation by showing the capabilities of wireless telegraphy. The lectures are credited with focusing the interests of many notable engineers and scientists on wireless telegraphy including: Dr. A. Muirhead and Captain Henry B. Jackson (R.N.) in Great Britain, Professor A.S. Popoff in Russia, Nikola Tesla in the U.S., and Augusto Righi (Guillermo Marconi’s mentor) in Bologna, Italy. Yet, Lodge did not pursue his discoveries, and the commercial development of wireless telegraphy ultimately occurred only after Marconi and others found ways to make it feasible. Even so, it was through his now famous lecture that Sir Oliver Lodge is credited with initiating the age of wireless telegraphy and the birth of radio.
Following Lodge’s presentation and demonstration at the weekly evening meeting of the Royal Institution of Great Britain on June 1, 1894, an abstract of his speech was reprinted as a pamphlet for the Royal Institution by William Clowes & Sons, Ltd. in London. These original pamphlets are extremely scarce today. Lodge’s illustrations from the presentation were reproduced for The Electrician in its printing of the books “The Work of Hertz” and “Signalling Across Space Without Wires”. These same illustrations were also included in the Royal Institute’s pamphlet.
Illustrations From Sir Oliver Lodge's June 1, 1894 Presentation To the Royal Institution of Great Britain.
First Edition of Sir Oliver Lodge’s 1894 Presentation
"The Work of Hertz and Some of His Successors".

The First Edition was published in 1894 by The Electrician Printing and Publishing Company, Ltd. in London, reproducing the original pamphlet notes, as edited by Lodge, with illustrations.

The Fourth Edition was published in 1909 by The Electrician Printing and Publishing Company, Ltd. in London and was presented by Lodge to the Author’s Club in London. The club was founded in 1891 and was the premier gathering place for well known British authors.

The Fourth Edition includes the original presentation plus Lodge’s later remarks concerning the development of wireless telegraphy. The rest of the volume discusses the work of Branley, Popoff, Slaby, Marconi and Thompson and concentrates on the development and use of the coherer principle and photo-electric phenomenon.
Title page & bookplate.
In 1894, Lodge greatly improved the means of detecting “Hertzian” waves (radio waves) by developing the “coherer”. His work was based on French physicist, Édouard Branly’s 1890 discovery that electrical discharges in certain metallic powders, caused by radio waves, resulted in a drop in electrical resistance. Branly called this device a “radio-conductor”, but it was Lodge who coined the name “coherer” based upon his hypothesis that metal filings ‘cohere’ in the presence of the electromagnetic waves. He used a coherer to detect the radio waves and demonstrated that these waves could be used for signaling. His coherer became the standard detector used in many early wireless telegraph receivers.

A coherer consists of a small quantity of metal filings lying loosely between metallic electrodes in a non-conducting glass tube. If an electromagnetic wave was generated nearby, the metal particles became fused together, until the tube was tapped and the fused particles returned to their original, separated condition. Lodge called the fusing of the metal produced by the electromagnetic wave, the “coherer effect”. Similarly, he called any detector of electromagnetic waves based on this effect, a “coherer”. Lodge later added a “trembler”, a device that shook the filings loose between waves. The improved coherer was connected to a receiving circuit and could reliably detect Morse code signals transmitted by radio waves, enabling them to be transcribed on paper by an inker.

Lodge demonstrated his device at the Royal Institute in 1894 and on August 16, 1898 he received U.S. Patent No. 609,154. The patent showed an adjustable induction coil used in the open or antenna circuit of a wireless transmitter and in a receiver. This made it possible to put the transmitter and receiver in tune with each other on the same frequency.
“In conjunction with the key and automatic transmitting machine a "buzzer" is included in the local circuit...the object of this device is to open and close the primary circuit of the induction coil so that a definite frequency is obtained in the local circuit; the buzzer consists of two sounders connected with each other so that they operate alternately. To a copper rod is fastened an arm of aluminum and connects with the armature of one of the sounders; the copper rod has a pointed end dipping into a cup of mercury which makes or breaks contact as the lever is drawn up or down; this arrangement interrupts the current about 600 times per minute, so that a similar frequency is set up in the secondary and electric waves are emitted at small but definite periods of time.” --- (Collins, 1905)
Complete Lodge-Muirhead Wireless Apparatus, 1903.

(L to R) Battery, Receiver, Spark Gap, Induction Coil, Signaling Key, Buzzer (at back), Automatic Transmitter, Perforator

(Erskine-Murray, 1911)
Lodge-Muirhead Key & Perforator, 1903.

(L to R) Signaling Key, Perforator, Automatic Transmitter

(Collins, 1905)
Lodge-Muirhead Receptor, 1903.

A-Recorder; B-Coherer; C-Clock Work; D-Changeover Switch; E-Potentiometer; F-Transformer.
(Collins, 1905)
Lodge-Muirhead Buzzer, 1903.

(Erskine-Murray, 1911)
Lodge-Muirhead Buzzer (1903)

(AWA Museum)
The public’s knowledge of wireless and its potential to save lives was slowly taking hold in 1912. Just three years earlier, the heroic wireless operator Jack Binns helped save the passengers and crew onboard the Republic by guiding rescue ships to the scene after a collision at sea. The Titanic disaster however, would have a monumental impact on the public’s awareness. Newspapers heralded the latest news received by “Wireless”. Press releases quoting wireless transmissions kept the public informed of the latest developments as the ship sank and survivors were picked up and brought to New York.
A bronze relief medallion, engraved in 1912 following the HMS Titanic disaster, paid homage to the heroes of wireless telegraphy. The medallion was produced by Eugene De Bremaecker for the Society of Friends in Holland and Belgium as a Medal of Art. Bremaecker was an award winning Belgian artist whose sculptures and artwork are displayed in Paris and Brussels.

This is the only Titanic medallion from the period which names the scientists who made wireless possible. It is also the only medal that identifies the early rescues at sea made possible by wireless.

The front (obverse) shows a woman using her hands to help her listen and to project her voice. She is seated atop a wireless antenna onboard a ship looking toward a radio station on the distant shore.

An inscription on the back (reverse) identifies the scientists who made wireless possible, including: Maxwell, Hertz, Branly, Popoff, Sir Oliver Lodge, Marconi and Braun. It also identifies major shipping disasters where heroic wireless operators helped save hundreds of lives, including: Jack Binns--SS Republic 1908; (George C.) Eccles--SS Ohio 1908; (‘Jack’) Philips--SS Titanic 1912 and Harold Bride--SS Titanic.
Titanic Memorial Medallion, 1912.

Obverse

Reverse
Lodge was a prolific writer, publishing more than 40 books and hundreds of articles. He was also a popular lecturer who attracted huge audiences, as well as a popular radio broadcaster. Three of his more popular scientific books are:

- **Talks About Wireless: With Some Pioneering History And Some Hints And Calculations For Wireless Amateurs.** Cassell & Co. Ltd., New York, 1925.
- **Pioneers of Science With Portraits and Other Illustrations.** Macmillan & Co., London, 1893.
Press Photos

Lodge was a favorite image in the press. Descriptions on the back of press photos gave details about the subject of the image for use in newspaper articles.

Lodge and his scientific contributions to wireless telegraphy, radio, physics and education were widely respected. He was often quoted and featured in both scientific journals and popular magazines.

Scientific American, Dec. 26, 1903.  
As President of the Radio Society of Great Britain, Lodge’s opinions were highly regarded by the amateur radio community. Lodge credited amateur contributions to science and radio as he traced the historical roots of the Radio Society of Great Britain beginning with its earliest days as the London Wireless Club. The Radio Society of Great Britain, founded in 1913, is the UK’s recognized national society for amateur radio operators.
Lodge was famous for his attempts to study life after death. He first began to study psychic phenomena (chiefly telepathy) in the late 1880s. Lodge based his knowledge of this subject on his studies of radio waves. After their son Raymond was killed in World War I, Lodge and his wife visited notable mediums and became frequent lecturers about communicating with the dead.

Press Photo of Lodge & His Wife, Jan. 16, 1925.

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ATOMIC FORCE,
THE POWER OF THE FUTURE

"In an address before the Midland Institute of Birmingham, England, Sir Oliver Lodge declared that if the atomic energy in an ounce of matter could be utilized, it would be sufficient to raise the German ships sunk in the Scapa Flow and pile them on top of the Scottish mountains! The great scientist said that he hoped that the human race would not discover this energy until it had brains and morality enough to use it properly, because if the discovery were made before its time, and by the wrong people, this planet would be unsafe. Had the secret been known to the Germans they could have annihilated every opposing army and conquered the world. The speculative possibilities of the release of atomic energy, he added, are simply beyond imagination. A force utterly disproportionate to the present sources of power would be put at the disposal of the world.

"In commenting on Sir Oliver Lodge's remarks, George R. Pogram, dean of the School of Engineering of Columbia University, said that the eminent scientist had by no means exaggerated the dangers that would result if the secret of applying atomic energy were ever discovered and fell into improper hands.

"Imagine, if you can, a band of criminals with the secret of making TNT, while society remained ignorant of its existence. The consequences would be appalling. Another comparison would be that of an army which had developed the use of explosives and artillery moving against a people among whom all knowledge of explosives was unknown. The effect would be comparable if a sudden force of energy were released in the world and fell into the hands of unscrupulous persons. That is what Sir Oliver Lodge referred to when he made the assertion that this world would not be a safe place to live in if the secret of applying atomic energy were discovered by the wrong people." -- New York Sun.
Lodge became very wealthy by selling his patents for wireless telegraphy to the Marconi Company. He also earned considerable royalties from his many popular books on spiritualism and other subjects. He invested in a number of different ventures. In this letter (written from Mariemont, Edgbaston in Birmingham, England where Lodge was associated with the University of Birmingham), Lodge asks for 200-300 GBP worth of shares to support the City of London during World War I.
L.J. Binns (no relation to the wireless hero Jack Binns) was a prominent turn of the century British caricature artist who specialized in English celebrities. He was also renowned for his portraits. His drawings, watercolors, engravings and caricatures are now in the collections of the New York Public Library and Harvard University. This portrait of Lodge is a pen drawing with watercolor.

Lodge’s inscription reads: “At Mr. Binn’s request, I sign this fierce edition of myself – Oliver Lodge 8-5-15”
Cigarette and tobacco cards were invented by their manufacturers in the late 1870’s to stiffen cigarette packaging. The cards later became a popular advertising vehicle that enticed buyers to purchase cigarettes and tobacco in order to collect the entire series of cards. The cards were discontinued during World War II because of paper rationing, after which they faded from favor, evolving into the baseball and sports cards that we see today.

This tobacco trading card by Carreras Tobacco Company depicts a portrait of Lodge. His image also appeared on a card by Godfrey Phillips Cigarettes and one by John Player & Sons for Players’ Cigarettes.
Vanity Fair Caricature, 1904.

The British magazine Vanity Fair commissioned a series of caricatures of famous scientists, politicians, generals, industrial magnates and other leaders of the era. The series captured the life and characteristics of its subjects. Lodge was a prominent, and sometimes controversial, scientist who was one of the founding fathers of the University of Birmingham.

Oliver Lodge (1851-1940) British physicist, 'Spy' (Leslie Ward) cartoon from Vanity Fair, 1904, when he was first Principal of Birmingham University.
OTHER MEMENTOS OF SIR OLIVER LODGE

Personal Calling Card, 1923.

Undated Autographed Portrait Photo.
Undated Three-Dimensional Portrait Relief
Mounted on a Picture Stand
Autographed Note & Photo, Jan. 22, 1930.

To Mr. Marshall

Thanks for copy I will send you write
Several people have mentioned it can
I said it was the last report yet.
I felt sure it would be.

NY, 22 Feb 1930

Olive Lodge
Appendix

English physicist Sir Oliver Joseph Lodge contributed to many fields—radio, electron research, the ether (at one time believed to be a medium that filled all space), chemistry, and even spiritualism and the study of life after death.

Lodge’s eclectic and rich life began on 12 June 1851, in Penkhull, England. The eldest son of Oliver and Grace Lodge, young Oliver was educated at Newport Grammar School and then at University College, London, where he received his degree in 1872. In 1877 he obtained a doctorate at London University. That same year he married and began a family which eventually grew to 12 children (six sons, six daughters). During these years, Lodge held a series of university level teaching jobs and in 1881 was appointed professor of physics and mathematics at the University College, Liverpool. He remained there until 1900 and then moved on to Birmingham University.

Although active in many areas, Lodge made a particularly strong mark in the field of wireless telegraphy (radio). In 1894 he perfected the “coherer,” an electrical device used to detect radio waves. Lodge’s version of the coherer greatly improved the detection of radio waves and made reception clearer. It became an integral part of early radio.

In 1898 Lodge was granted a patent for “syntonic” tuning. In essence, he claimed that making the antenna coil or inductance variable made tuning of the antenna circuits in a system of wireless communication possible. This “syntonic” or tuning patent won him a high place in the history of wireless, for it established him as a pioneer in experiments that recognized the necessity of tuning in order to select a desired station. The Marconi Company acquired this patent in 1912.
Throughout his career Lodge was a prolific author and published many works. One of the most influential was the book Modern Views of Electricity, written in 1889. In it he compared the ether, of which he was one of the most persuasive believers, to an elastic jelly filling all space; he compared magnetism to whirlpools in that jelly, or to interlocking wheels. Although his theories were later proven incorrect, at the time Lodge's work included one of the most advanced theories of physics and electricity. It stimulated research that would later prove his theories wrong.

In recognition of his scientific contributions, Lodge received many awards. In 1898 he was awarded the Rumford Medal of the Royal Society, and was knighted by King Edward VII in 1902. As one of the pioneers in wireless telegraphy, he was presented with the Albert Medal of the Royal Society of Arts in 1919.

After 1910 Lodge became increasingly prominent as a spiritualist leader and a strong believer in the possibility of communicating with the dead. In 1916 he published Raymond or Life and Death: With Examples of the Evidence for Survival of Memory and Affection After Death. In it, Lodge wrote about post-mortem communication with his son Raymond, who had been killed in World War I. Later, he announced that he himself would try to communicate with the world after his death. He placed a sealed document in the custody of the English Society of Psychical Research, saying that his message from the beyond would correspond with what he had recorded in the document. Lodge died on 22 August 1940. One year later members of the English Society of Psychical Research convened to contact him via séance. Although the society claimed success it was never able to prove it as the document disappeared shortly afterwards. Lodge hasn’t been heard from since.

Source: IEEE Global History Network
THE LODGE-MUIRHEAD SYSTEM OF WIRELESS TELEGRAPHY.

By R. C. PEPW, LONDON.

Through the courtesy of Sir Oliver Lodge and Dr. Alexander Muirhead I was enabled the other day to inspect the working of the Elmer’s End to Downe wireless telegraph installation in Kent. For some years past experiments have been carried out quietly in a shed at Elmer’s End, adjoining the works of Messrs. Muirhead & Co., and also in another shed situated at Downe, some eight miles away.

Between these two stations signals have been exchanged for a considerable period, but it was only quite recently that the inventors were sufficiently satisfied with their system to bring it before the notice of the cable companies. After a searching trial of the Eastern Extension Australasia and China Telegraph Company reported favorably on the new method, and as a result, Lodge-Muirhead wireless telegraph installations have been sent out on the two new cable ships “Restorer” and “Patrol,” belonging to the above-mentioned company, which have recently been dispatched to lay the new cable ordered by the Dutch government for use between Batavia, in Borneo, and Medan in the Celebes.

This it may be noted, is the first commercial application of the new system which we propose now to describe.

The Lodge-Muirhead receiver consists of a small fine-edged steel disk which is kept rotating by clockwork on a globule of mercury, from which it is separated by a thin film of oil. The construction of the receiver may be better understood by reference to the detail views, in which the disk is designated by the letter a. The mercury, b, is contained in a cup, d. Electrical connection is made therewith through binding screw, h, and the platinum wire, c. A copper brush which bears on the shaft, h, communicates current to the disk, a. A small cushion of felt, k, held in a spring support, f, serves to keep the edge of the disk clean. The disk is coupled to a clock mechanism by the ebonite clutch, g. The film of oil which covers the mercury acts as an insulator and prevents the passing of the current in the local circuit. The ef-
Sir Oliver Lodge.

Dr. Muirhead Adjusting the Delicate Coherer.
The Receiving Set and Spark Gap.

The "Buzzer."

The Automatic Transmitter with Perforator.

Complete Station, Comprising Transmitting and Receiving Sets.

THE LODGE-MUIRHEAD SYSTEM OF WIRELESS TELEGRAPHY.
effect of the oscillations sent out from the transmitting station is to break down the film of oil which covers the mercury and to establish contact between the disk and the mercury, thus completing the circuit of the receiving instrument. No tapper is required, as the coherer automatically decodes, and no relay is needed, as the current is quite strong enough to work the Muirhead siphon recorder; the clockwork draws the slip on which the signals are pivoted, as well as driving the disk.

The plan of the receiving station can be seen in one of our diagrams. The vertical wire used at the Elmer's End station is 80 feet high, and on it is hung a light wire cage or capacity; an increase in the size of the capacity is necessary when larger distances require to be bridged for wireless communication. The cage is made up of four copper wires strung on wooden loops with a copper ball above. One end of the wire is led through a capacity and inductance, and is connected up to the shed itself instead of being earthed. The other is led through the secondary coil of the transformer to the coherer.

The current passing through the coherer is led through an adjustable capacity to the Muirhead siphon recorder. The remaining apparatus at the receiving station comprises a local battery, and a potentiometer to regulate the potential of the coherer. The employment of a transformer in the receiving circuit was one of Sir Oliver Lodge's earliest improvements and one which is made use of by Marconi in all his long distance work.

The apparatus employed in the transmitting set consists of a local battery of 10 volts, a sending key and an interrupter for the local circuit. The sending battery may have a voltage of from 14 to 20. A novel feature is the use of a "buzzmer," viz., a couple of telegraphic sounders acting reciprocally, which operate a mercury make and break for the 10-inch spark coil. To one of the sounders is attached an aluminum needle dipping into the mercury. This forms a uniform and easily adjustable interrupter for the induction coil, allows the operator to have perfect control of the sparking frequency, and also does away with the possibility of his receiving shocks, which are liable to occur when the primary of the induction coil is directly broken by the key. After passing through the coil the current is led to two small brass rods between the ends of which sparking takes place.

Sir Oliver Lodge, F.R.S., the principal of Birmingham University, has been experimenting with Hertzian waves for a great many years past. On February 24, 1899, he delivered a lecture on coherers at the Royal Institution. A coherer was defined as an instrument which responds to electric waves somewhat in the same manner as a microphone responds to sound waves. Many different forms of coherer were shown, but no mention was made of the steel disk rotating on mercury, as this had not been discovered at the time. On June 1, 1894, Dr. Lodge delivered a lecture at the Royal Institution on "The Work of Hertz," and showed for the first time in England that electric Hertzian waves could be detected by means of suitable receivers through walls and closed doors, when set up by a transmitting or exciting apparatus some hundreds of yards away. In 1897 Mr. Marconi arrived in England with his system, and though Sir Oliver Lodge has kept his results secret until now, he has been working on the subject ever since his lecture in 1899. His first trials were over distances of 40 yards, and now the Lodge-Muirhead system has been operated perfectly at distances of 60 miles. The system was temporarily installed between Holyhead, in the Isle of Anglesea, and Howth, in Ireland.

"God save the King" was the message that passed hundreds of times between the transmitting and receiving stations.

It may be noted that the Cunard liners using the Marconi apparatus often intercepted the signals. The inventors are now working on the question of tuning or syntonization, and they have succeeded in tuning the oscillations passing between two stations so that only the properly tuned receiver shall respond to its own special transmitter.

They are of opinion that their devices, which I am not at present at liberty to make public, will neutralize the interference from any station not less than 10 miles distant, and will also prevent their signals from being read by any other station the same distance away.

The 8-mile Elmer's End to Downe circuit is a very difficult one, owing to the intervening hills, and it would correspond to a sea circuit of quite 60 miles.

During a voyage of the Liverpool steamship "Vedatmore" across the Atlantic, signals were exchanged between the ships and the shore over considerable distances, and the system was also tried with success between Washington and Baltimore, a distance of 45 miles. The actual distance which can be covered is of course mainly a question of electric power.

The fact that the cable companies, which have never one of them adopted the Marconi system, have approved the Lodge-Muirhead system and are installing it on their cable ships is a splendid testimonial for the new method.

The telegraphic experts have not been satisfied with the filing-tube coherer used by Mr. Marconi. At every Marconi station it is customary to have on hand some thirty or forty of these tubes, as they have a mysterious habit of getting out of order, and it is impossible often to get them to receive signals at all. Possibly the continuous tapping has something to do with the lack of reliability of the filing-tube coherer; we have seen that in the Lodge-Muirhead receiver no tapping action is necessary.

Sir Oliver Lodge and Dr. Muirhead believe that they have got a system which will work regularly and without a hitch in all weathers; the coherer employed is regular and simple in action and quite easy to adjust, for it can be taken to pieces in a few seconds and any defects can be easily removed.

It may be mentioned that the disk coherer prefers long and slow oscillations to the sharp discharges which other coherers require, and the former are more convenient to work, especially in long-distance transmission. It is so sensitive that a long stroke or dash of the Morse code reveals the actual rate of sparking by the slight quivering of the line. The record on the tape is strong and clear and quite equal to the best submarine cable working.

Among other new features in the Lodge-Muirhead system, mention should be made of an automatic device for short-circuiting the coherer when the vertical wire is switched on to the transmitter, which obviates the necessity of burying it in a sealed metal case. Another new feature is the application of an ordinary automatic signaling machine to the sender, so that the message can be delivered perfectly spaced from a perforated tape, as in the British post-office machines.

50
THE LODGE-MUIRHEAD SYSTEM OF WIRELESS TELEGRAPHY.

The system of wireless telegraphy which Sir Oliver Lodge and Dr. A. Muirhead have been developing for some years has, within the past few months, been brought to a degree of perfection which justifies the inventors in the belief that it is now of practical commercial value. Thanks to the courtesy of Messrs. Muirhead and Co., we have had an opportunity of seeing the system at work at a small experimental installation which has been put up in a field adjoining Messrs. Muirhead's works at Elmers End, Kent. At this station signals were being transmitted to and received from a similar installation at Downe. The distance between the two stations is only six or seven miles, but the chalky nature of the Kentish soil and the fact that the station at Elmers End lies in a hollow make this distance equivalent to eight or nine times as much over water. Experiments which have been made under the conditions which would obtain in the practical application of the system for maritime work and also over the Admiralty sixty-mile range have shown that, with the same power and the same adjustments as are required between Elmers End and Downe, thoroughly satisfactory communication can be maintained across sixty miles of ocean. Considerations of distance are, however, of secondary importance in estimating the merits of wireless telegraphy systems, for the recent work of Mr. Marconi and others has made it clear enough that, given sufficient power, almost any range can be attained. Trustworthiness, clearness, the design of circuits and apparatus, and the possibility of successful syntonisation are factors of greater importance. Looked at from this point of view, the Lodge-Muirhead system presents several novel and interesting features which show that, though it may be one of the latest to come into the field of practical wireless telegraphy, it is likely to prove one of the most efficient. Most noteworthy feature of all is the remarkably delicate coherer which has been finally evolved from numerous experiments, a coherer which not only promises to be accurate and trustworthy in practical work, but also possesses several advantages from an experimental point of view, a characteristic of no small importance in a piece of apparatus which has to be employed in an art in which there is so much to be learnt.

In general outline the Lodge-Muirhead system does not differ materially from other wireless telegraph systems, a fact which is not remarkable when it is recalled how much other systems owe to the pioneering work which Sir Oliver Lodge has carried on ever since the earliest days of Hertzian waves. In fact, if we retrace the development of Hertzian telegraphy from Maxwell's theory of light, the name of Sir Oliver Lodge is singularly prominent, and must be associated with all the more important advances. The connection begins in 1888, when he read a paper on the velocity of electromagnetic waves along wires at the meeting of the British Association, at which Prof. Fitzgerald directed attention to the work that Hertz had accomplished; a little later he discovered, in its simplest
form, coherer action, and it is interesting to note that after long trial of the filings coherers derived from the discoveries of Branly, there seems to be a tendency on all sides to return to simpler designs much more closely resembling Lodge's original single contact coherer. To Lodge also belongs the credit of having been the first to insist upon the importance of tuning, and of having pointed out how this might be possibly attained by the proper use of self-induction and capacity. Moreover, he was, we believe, who suggested using a transformer in the aerial circuit at both transmitting and sending stations instead of connecting the spark gap or coherer direct to the aerial; this device is now in general use for tuned systems. It will readily be realised, therefore, that a system which has been designed by Sir Oliver Lodge is likely to be one of the most promising of wireless telegraph systems, and that this is all the more likely to be the case in the present instance, as Sir Oliver has had the cooperation of Dr. Muirhead.

We do not propose to give a general description of the system, for, as we have said, other systems are similar in general outline, and with these most people are by now familiar. In the installation working between Elmers End and Downe there is no earth connection. The precise utility of an earth connection has been often in dispute, most people maintaining that it merely serves to introduce the earth as the second plate in a large condenser, the first plate being represented by the aerial wire and any capacity connected to it. In the system under consideration, a second capacity is provided which lies upon but is insulated from the earth; in the Elmers End station the capacity was beneath the floor of the instrument shed, and was connected to one terminal of the spark gap (or transformer), the other terminal being connected to the aerial, which has an open wire cage serving as a suitable capacity at its upper end. We need not enter here into the various ways in which the circuits can be connected up; the relative positions of coherer, spark gap, capacity and self-induction, the employment or not of the transformer, &c., offer a number of solutions to the problem of designing a complete station each of which has its special merits for particular purposes. In principle, all result in the same thing—a very large Hertz radiator transmitting into space a succession of untuned or carefully tuned electromagnetic waves. The two questions of primal importance are how to produce those waves, and how to detect them at the receiving end.

The production of the Hertzian waves presents several difficulties. Even for moderate ranges of transmission fairly powerful sparks have to be used; these are obtained from a special induction coil and spark gap (Fig. 1). Here again one notices in the simple spark gap between two rods a return to less complicated apparatus; in the early days of wireless telegraphy a spark gap between polished balls in oil or vaseline used to be regarded almost as essential. In using this apparatus for synchonic work a very great deal depends upon the spark. It is necessary, in the first place, to obtain a regular succession of sparks for every depression of the signalling key. The ordinary forms of make-and-break used with induction coils have not been found satisfactory, and a special form of interrupter or "buzzer," as it is called, has been designed. This is seen at the back on the right of Fig. 1. It consists of an ordinary mercury break operated by two cross-connected telegraphic sounders. The first of these sounders works in the same manner as an ordinary electric bell, the arm vibrating to and fro when the signalling key is de-
Fig. 1.—Complete Lodge-Muirhead Apparatus.
From left to right as follows:—Battery, receiver, spark gap, induction coil, signalling key, buzzer (at the back), automatic transmitter, and perforator.
pressed and the circuit closed; the vibrating arm opens and closes the circuit of the second sounder, to which is attached the dipping rod of the mercury break. It is said that this arrangement gives a more regular succession of sparks than is obtained with one sounder only. An automatic transmitting apparatus has also been worked out by Messrs. Lodge and Muirhead. This is shown at the right of Fig. 1, in front of the buzzer, and consists of two pieces of apparatus, a perforator and a transmitter, which are used in conjunction with the buzzer, &c., in place of the ordinary signalling key.

A regular succession of sparks having been thus obtained, still only part, and that the simpler part, of the difficulty has been overcome, for it is not the period of the sparks but the period of the oscillations in the spark which has to be synchronised. When one considers how short is the train of waves from each individual spark and how long comparatively the interval between two successive sparks, it is easy to see the importance of getting the best results possible from each spark. Herein, indeed, seems to lie one of the chief unsolved problems of wireless telegraphy—the problem of obtaining a really continuous series of undamped oscillations. It seems doubtful whether, even with the best possible design and arrangement of apparatus, a satisfactory solution will ever be found by means of disruptive sparks. Perhaps we must look to some quite different method of setting up the oscillations. The method that gives most promise of ultimate success is some application of the principle of Mr. Duddell’s musical arc, as suggested by Mr. Duddell at the Royal Institution last year (see also the Electrician, May 1, vol. li. p. 84). It certainly seems that from this discovery may be developed a means of producing a continuous series of undamped oscillations of high frequency, and if this should prove to be possible a change amounting almost to a revolution would be effected in the practice of syntonie wireless telegraphy.

We may pass now to a consideration of the receiving instruments which are shown in Fig. 1, and in more detail in Figs. 2 and 3. Fig. 2 represents the complete receiving instrument. The instrument looks at first sight much like a Morse recorder; the coherer is mounted behind the box which contains the clockwork for feeding forward the tape and rotating the coherer wheel. Its construction can be seen from Fig. 3, which shows a coherer by itself. It consists of a small steel disc with a fine razor edge which dips into a little pool of mercury in an ebonite cup. The mercury is covered by a thin film of oil, and the disc is adjusted so that under normal conditions the oil serves just to insulate it from the mercury. When oscillations are set up in the coherer circuit, this thin layer of insulation is broken down, and connection established between the disc and the mercury. The disc is slowly rotated by means of the notched wheel seen clearly in the illustration, which gears with a similar wheel at the back of the clockwork box. Connection is thus no sooner established between the disc and mercury than it is broken again by a fresh oily portion of the edge coming round; there is consequently only connection during the time the oscillations are actually arriving and the coherer is self-decohering and requires no tapping back. In some respects the device recalls a suggestion made by Rupp five or six years ago, who proposed mounting a filings coherer so that it was rotated slowly by the Morse tape. The Lodge coherer is, however, a far more mechanical contrivance than a filings tube however the latter may be decohered. In order to keep the edge of the disc clean a pad of felt is pressed lightly against it; this can just be seen on the left near the top of the disc; contact is made by a spring pressing against the shaft on which the disc is mounted. The coherer will only work with a very small potential difference—a fraction of a volt—between mercury and disc; it is therefore connected in series with a potentiometer, which reduces the voltage from the cell.

Another feature of the receiving circuit is the absence of any relay; the coherer and potentiometer are directly in series with the recording instrument, which takes the form of a simple syphon recorder. This is seen on the right of the clockwork in Fig. 2; the pen consists of a fine glass syphon tube suspended from the galvanometer coil, one end dipping in a cup of ink
Fig. 2.—Receiving Apparatus.

Fig. 3.—The Coherer.
and the other resting on the tape. When no signals are being received the pen draws a fine line on the paper, but when a signal arrives it is deflected. The result can be seen from the specimen of tape in Fig. 4. There is an arrangement by which the amplitude of the deflection can be controlled by making the syphon come up against a stop. It is obvious that the tops of the humps in the line representing dots and dashes are not needed for reading the message, since it is easy to see from the length of the break in the base line whether the signal is a dot or a dash. The tops of these humps have, however, a special interest. It will be noticed, on examining them closely, that they are not smooth, but are slightly irregular. These irregularities represent the sparks, and it is possible therefore to see from the form of the humps whether the sparking at the transmitting end is good or bad. A particularly bad spark is seen at the beginning of the third signal (the second dot) in the letter l, and a careful examination, of the dashes more especially, shows quite clearly the nature of the sparking at the transmitting station seven miles off. This not only points to the great sensitiveness of the coherer, but shows that it should prove particularly useful in research, since by its use one can obviously much better investigate the conditions necessary for good signal-

ling. In spite of this delicacy, it is remarkable how easy the coherer is to adjust. A milled head screw allows the mercury to be raised or lowered at will, and it is quite easy to get proper adjustment in a few seconds, even though one starts with the disc either in permanent contact or right out of contact with the mercury; in fact, the whole coherer can be dismantled and set up again in a few minutes. This coherer seems to us one of the most promising features of the system; it is a device at once quite simple and thoroughly mechanical, easy to reproduce, and easy to adjust, and, judging by the results which have been obtained, is both sensitive and trustworthy in practical work. So far as one can judge without lengthy experiment, it is more promising than any other form of receiving apparatus yet devised.

We may add that the system has been adopted by the Eastern Extension Telegraph Company on its two new cable ships, and is reported to be giving every satisfaction. In conclusion, we should like to express thanks to Messrs. Muirhead and Co. for showing us the system at work, and for lending the photographs from which the illustrations to this article have been made.

Maurice Solomon.
Sources & References
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Exhibit Artifacts & Descriptions:

David & Julia Bart
James & Felicia Kreuzer
Antique Wireless Association

References:


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