great. All of them make use of Marconi’s antenna in some form both at the transmitting and at the receiving end, all of them make use of an earth connexion, or its equivalent in the form of a balancing capacity or large surface having capacity with respect to the earth, which merely means that they insert a condenser of large capacity in the earth connexion. All of them couple the transmitting antenna directly or inductively to a capacity-inductive circuit serving as a storage of energy, and all of them create thereby electric waves of the same type moving over the earth’s surface with the magnetic force of the wave parallel to it. At the receiving station the differences in these systems depend chiefly upon varia­tions in the actual form of the oscillation detector used, whether it be a loose contact or a thermal, electrolytic or magnetic detector.

In July and August 1899 the Marconi system of wireless telegraphy was tried for the first time during British naval manoeuvres, and the two cruisers, “ Juno ” and “ Europa,” were fitted with the new means of communication. The important results obtained showed that a weapon of great power had been provided for assisting naval warfare. From and after that time the British Admiralty and the navies of other countries began to give great attention to the development of electric wave telegraphy.

*Transatlantic Wireless Telegraphy.—*Having found that the principles of resonance could be successfully applied so as to isolate wireless telegraph receivers, Marconi turned his attention to the accomplishment of his great ambition, viz. Transatlantic wireless telegraphy. In January 1901 he telegraphed without difficulty by electric waves from the Isle of Wight to the Lizard, viz. 200 m., and he considered that the time had come for a serious attempt to be made to communicate across the Atlantic. A site for a first Transatlantic electric wave power station was secured at Poldhu, near Mullion in south Cornwall, by the Marconi Company, and plans arranged for an installa­tion. Up to that time an induction coil known as a 10-inch coil had sufficed for spark production, but it was evident that much more power would be required to send electric waves across the Atlantic. Transformers were therefore employed taking alternating electric current from an alternator driven by an oil or steam engine, and these high tension transformers were used to charge condensers and set up powerful oscilla­tions in a multiple antenna. The special electrical engineering arrangements employed at the outset for this first electric wave power station required to create the oscillations of the desired power were designed for Marconi by J. A. Fleming, but the arrangements were subsequently altered and improved by Marconi, one of the most important additions being a form of high-speed rotating disk discharger devised by Marconi by which he was able to immensely increase the speed of signalling. The first antenna employed consisted of 50 bare copper wires 200 ft. long, arranged in fan-shape and upheld between two masts. Subsequently this antenna was enlarged, and four wooden lattice towers were built, 215 ft. high and 200 ft. apart, sustaining a conical antenna comprised of 400 wires (see G. Marconi, *Proc. Roy. Inst.,* 1902, 17, p. 208). This transmitting plant was completed in December 1901, and Marconi then crossed the Atlantic to Newfoundland and began to make experiments to ascertain if he could detect the waves emitted by it. At St John’s in Newfoundland he erected a temporary receiving antenna consisting of a wire 400 ft. long upheld by a box kite, and, employing a sensitive coherer and telephone as a receiver, he was able, on December 12, 1901, to hear “ S" signals on the Morse code, consisting of three dots, which he had arranged should be sent out from Poldhu at stated hours, according to a preconcerted programme, so as to leave no doubt they were electric wave signals sent across the Atlantic and not accidental atmospheric electric disturbances. This result created a great sensation, and proved that Transatlantic electric wave telegraphy was quite feasible and not inhibited by distance, or by the earth’s curvature even over an arc of a great circle 3000 m. in length. In a repetition of this experi­ment at the end of February 1902 Marconi, on board the s.s. “ Philadelphia,” received wireless messages printed on the ordi­nary' Morse tape at a distance of 1557 m. from the sending station at Poldhu, and also received the letter “ S ” at a distance of 2099 m. from the same place. In the course of this voyage he noticed that the signals were received better during the night than the daytime, legible messages being received on a Morse printer only 700 m. by day but 1500 by night.

The appliances in the Poldhu station were subsequently enlarged and improved by Marconi, and corresponding power stations erected at Cape Cod, Massachusetts, U.S.A., and at Cape Breton in Nova Scotia. In 1902 Marconi was able to transmit a Large number of messages across the Atlantic, receiving them by means of his magnetic detector. In the same year numerous experiments were tried with the assistance of an Italian battleship, the “ Carlo Alberto,” lent by the Italian government, and messages were transmitted from Poldhu to Kronstadt, to Spezia, and also to Sydney in Nova Scotia. Doubts having been raised whether the powerful electric waves sent out from these stations would not interfere with the ordinary ship to shore communication, special demonstrations were made by Marconi before the writer, and later before British naval officers, to demonstrate that this was not the case.@@@1 In 1904 a regular system of communication of press news and private messages from the Poldhu and Cape Breton stations to Atlantic liners in mid-Atlantic was inaugurated, and daily newspapers were thenceforth printed on board these vessels, news being supplied to them daily by electric wave telegraphy. By the middle of 1905 a very large number of vessels had been equipped with the Marconi short distance and long distance wireless telegraph apparatus for intercom­munication and reception of messages from power stations on both sides of the Atlantic, and the chief navies of the world had adopted the apparatus. In 1904, during the Russo- Japanese war, war news was transmitted for *The Times* by wireless telegraphy, the enormous importance of which in naval strategy was abundantly demonstrated.

As the power station at Poldhu was then fully occupied with the business of long distance transmission to ships, the Marconi Company began to erect another large power station to Mar­coni’s designs at Clifden in Connemara on the west coast of Ireland. This station was intended for the Transatlantic service in correspondence with a similar station at Glace Bay in Nova Scotia. It was completed in the summer of 1907, and on the 17th of October 1907 press messages and private messages were sent across the Atlantic in both directions. The station was opened shortly afterwards for public service, the rates being greatly below that then current for the cable service.

The service was, however, interrupted in August 1909 by a fire, which destroyed part of the Glace Bay station, but was re-established in April 1910.

Meanwhile other competitors were not idle. The inventions of Slaby, Braun and others were put into practice by a German wireless telegraph company, and very much work done in erecting land stations and equipping ships. In France the scientific study of the subject was advanced by the work of Blondel, Tissot, Ducretet and others, and systems called tue Ducretet and Rochefort set in operation. In the United States the most active workers and patentees at this period were R. A. Fessenden, Lee de Forest, . S. Stone, H. Shoemaker and a few others. In England, in addition to the Marconi Company, the Lodge-Muirhead Syndicate was formed to operate the inventions of Sir Oliver Lodge and Dr Muirhead.

*Directive Telegraphy.—*A problem of great importance in connexion with electric wave telegraphy is that of limiting the radiation to certain directions. A vertical transmitting antenna sends out its waves equally in all directions, and these can be equally detected by a suitable syntonic 01 other receiver at all points on the circumference of a circle described round the transmitter. This, however, is a disadvantage. What is required is some means for localizing and directing a beam of radiation. The first attempts involved the use of mirrors. Hertz had shown that the electric radiation from an oscillator

@@@1 See J. A. Fleming, *The Principles of Electric Wave Telegraphy* (London, 1906), chap. vii.; also Cantor Lectures on Hertzian wave telegraphy, Lecture iv., *Journ. Soc. Arts,* 1903, or letter to *The Times,* April 14, 1903.