it is an 'undulating railway,' its stations are all set on the crest of gradients rising from either side, illustrating the plan proposed in Robert Stephenson's day by Badnall with the published approval of that great engineer.* This arrangement is perfectly feasible whereas here, the stops are all made at precisely the same points and with practically similar intermediate speed of trains. It insures gain in operation by the utilization of the stored energy of the train at a stop, instead of its waste by the use of the brake. Leaving the station, the descent is utilized in securing the required acceleration, thus again saving power. The gradients are 1.66 to 2.33 per cent., and the latter is equivalent to 74 pounds per ton on the draw-bar. One hundred horse-power minutes are thus gained at each stop and at each start.

The electric locomotives were supplied by the General Electric Co., the converters by the Thompson-Houston Co., the electric 'lifts' at the stations, dropping the passenger 60 to 90 feet at the start and raising him to the surface at his destination, were furnished by the Sprague Electric Co. The tunnel is double-barreled, each tube being 11 feet 6 inches in diameter. There are 13 stations and the running speed ranges from 14 to a maximum of 25 miles an hour between stations. Twenty-eight locomotives are employed; each hauling a train of seven carriages, conveying at most 336 passengers, the train weighing, empty, 105 tons, exclusive of the locomotive. The latter weighs about 50 short tons. Power is supplied also by an American firm, the E. P. Allis Co., who furnish six cross-compound engines, designed by Reynolds, of 1,300 to 1,900 horse-power each, and these are supplied with steam by 16 Babcock & Wilcox water-tube boilers—another American invention. The generators are three-phase, alternating current, with revolving fields. The armatures weigh 48,000 pounds. The output is 850 kilowatts, each, at 5,000 volts, 25 periods per second. Four six-pole exciters, driven, each, by a compound engine at 450 r. p. m., direct, supply to each generator 50 kilowatts at 125 volts. The switchboard is of marble. There are 19 miles of cable, weighing 78.4 tons. The engineers of the line are Messrs. Benjamin Baker and Basil Mott.

R. H. Thurston.

* Treatise on 'Railway Improvements,' by R. Badnall; London, Sherwood, Gilbert and Piper, 1833.

WIRELESS TELEGRAPHY.

Professor J. A. Fleming writes to the London *Times* the following letter on recent advances in wireless telegraphy:

As the subject of wireless telegraphy has not yet apparently lost interest for the general reader, I venture to ask a little space to make known for the first time some recent achievements by Mr. Marconi which have astonished those who have been allowed to examine them. Every one is aware that in his system of electric wave telegraphy an important feature is the employment of an elevated conductor, which generally takes the form of a wire suspended from a mast. When Mr. Marconi attracted attention by his feat of establishing communication across the Channel without wires, critics raised a not altogether valid argument against its commercial utility, that a wave or signal sent out from one transmitter would affect equally all receivers within its sphere of influence and hence the privacy of the communication would be destroyed. No one felt the force of this objection more strongly than the distinguished inventor himself, whose original work has caused so many others to attempt to follow in his steps. For the last two years he has not ceased to grapple with the problem of isolating the lines of communication, and success has now rewarded his skill and industry. Technical details must be left to be described by him later on, but meanwhile I may say that he has modified his receiving and transmitting appliances so that they will only respond to each other when properly tuned to sympathy. I am well aware that other inventors have claimed to be able to do the same thing, but I do not fear refutation in saying that no one has given practical proof of possessing a solution of this problem which for a moment can compare with that Mr. Marconi is now in a position to furnish.

These experiments have been conducted between two stations 30 miles apart, one near Poole in Dorset and the other near St. Catharine's in the Isle of Wight. At the present

moment there are established at these places Mr. Marconi's latest appliances, so adjusted that each receiver at one station responds only to its corresponding transmitter at the other. During a three days' visit to Poole, Mr. Marconi invited me to apply any test I pleased to satisfy myself of the complete independence of the circuits, and the following are two out of many such tests: Two operators at St. Catharine's were instructed to send simultaneously two different wireless messages to Poole, and without delay or mistake the two were correctly recorded and printed down at the same time in Morse signals on the tapes of the two corresponding receivers at Poole.

In this first demonstration each receiver was connected to its own independent aërial wire hung from the same mast. But greater wonders followed. Mr. Marconi placed the receivers at Poole one on the top of the other, and connected them both to one and the same wire about 40 ft. in length, attached to a mast. I then asked to have two messages sent at the same moment by the operators at St. Catherine's, one in English and one in French. Without failure each receiver at Poole rolled out its paper tape, the message in English perfect on one and that in French on the other. When it is realized that these visible dots and dashes are the results of trains of intermingled electric waves rushing with the speed of light across the intervening 30 miles, caught on one and the same short aërial wire and disentangled and sorted out automatically by the two machines into intelligible messages in different languages, the wonder of it all cannot but strike the mind.

Your space is too valuable to be encroached upon by further details, or else I might mention some marvellous results, exhibited by Mr. Marconi during the same demonstrations, of messages received from a transmitter 30 miles away and recorded by an instrument in a closed room merely by the aid of a zinc cylinder, four feet high, placed on a chair. More surprising is it to learn that, whilst these experiments have been proceeding between Poole and St. Catherine's, others have been taking place for the Admiralty between Portsmouth and Portland, these lines of communication intersecting each other; yet so perfect is the independence that nothing done on one circuit now affects the other, unless desired. A corollary of these latest improvements is that the necessity for very high masts is abolished. Mr. Marconi now has established perfect independent wireless telegraphic communication between Poole and St. Catherine's, a distance of 30 miles, by means of a pair of metal cylinders elevated 25 or 30 feet above the ground at each place.

I need not enlarge on the possibilities thus opened out for naval and military purposes. The importance of this practical solution of the problem of independent electric wave telegraphy, in which each wireless circuit is as private as one with a wire, is obvious without comment. My desire is solely to mention the above facts for the benefit of general readers, whose minds will thus perhaps be eased of any doubts lest this brilliant application of electrical discoveries should, like some others, fall short of satisfying the requirements of practical use and be relegated to the region of imperfect inventions or unfulfilled hopes.

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*SPECIES OF MOSQUITOES COLLECTED FOR THE BRITISH MUSEUM.**

AT the latter end of 1898 a committee was appointed jointly by Mr. Chamberlain and the Royal Society to exercise a general supervision over a scientific investigation of malaria, and it was then suggested that, in view of the connection of malaria with mosquitoes, it would be desirable to obtain exact knowledge of the different species of mosquitoes and allied insects in the various tropical colonies. Acting on this suggestion, Mr. Chamberlain at once issued a circular despatch to the Governors of all the Crown colonies, requesting them to take the necessary steps to have such collections made and sent to the Natural History Museum for examination and classification of the specimens. For the guidance of those who might be employed on the work, directions for collecting, mounting and preserving the insects were drawn up by the museum and distributed in the colonies. As a result of these measures considerably over 3,000 specimens of mosquitoes have, we learn, been received at Cromwell-road up to

* From the London *Times*.