Apparatus used in Transatlantic Reception.

By Paul F. Godley.

A GREAT deal of interest will no doubt be displayed in the equipment used at Ardrossan. A brief description of the antenna follows. It consisted of a wire suspended on poles 12 ft. high, the wire being so arranged that it could be adjusted to a length equivalent to one wavelength for any wave between 190 and 325 metres. The wire is grounded on the far end through a non-inductive resistance of between 300 and 400 ohms and at the "home" station through an inductance which had a reactance of about 400 ohms for the frequency at which reception was being effected. No attempt will be made here to touch upon the theory of this antenna other than to say that its functions by virtue of those component parts of the electromagnetic wave which travel in a vertical direction rather than those which travel horizontally. Its use and proper adjustment enables the elimination of considerable atmospherics and interference due to its decidedly directional characteristics, and data gathered by engineers of the Radio Corporation of America, which Corporation uses this type of aerial in connection with all the trans-atlantic traffic, shows that potentials developed in the antenna are equivalent to those which would be developed in a vertical antenna whose height is equivalent to 1/10th of the length of the horizontal wire. In other words, assuming that it is desired to receive on 200 metres the length of wire to be out would be approximately 650 ft. and the strength of signals received in this length of wire at this wavelength would be equal to the strength of signal received on a vertical antenna 65 ft. in height.

The receiver used was the well-known super heterodyne or autodyne receiver, wherein oscillations from a local oscillator are caused to produce beats with the incoming signal, the frequency of the beats being of the order of 50 to 100,000 cycles per second. Forming a part of the anode circuit of the detector valve is a circuit tuned to the beat frequency this circuit being coupled to the first valve of a multistage amplifier set to amplify frequencies of the order of 50,000 cycles. In the Ardrossan outfit amplification was effected at a frequency of about 100,000 cycles. In addition to the detector and oscillator valves 5 radio frequency amplifiers and one note magnifier was used. The various radio frequency valves being coupled with 100 000 ohm resistances of the "Lavite" type, while the radio frequency amplifier and the note magnifier were transformer coupled. In the detector valve advantage was also taken of regeneration at the initial frequency which enabled the building up of the signal to three or four times its initial value.

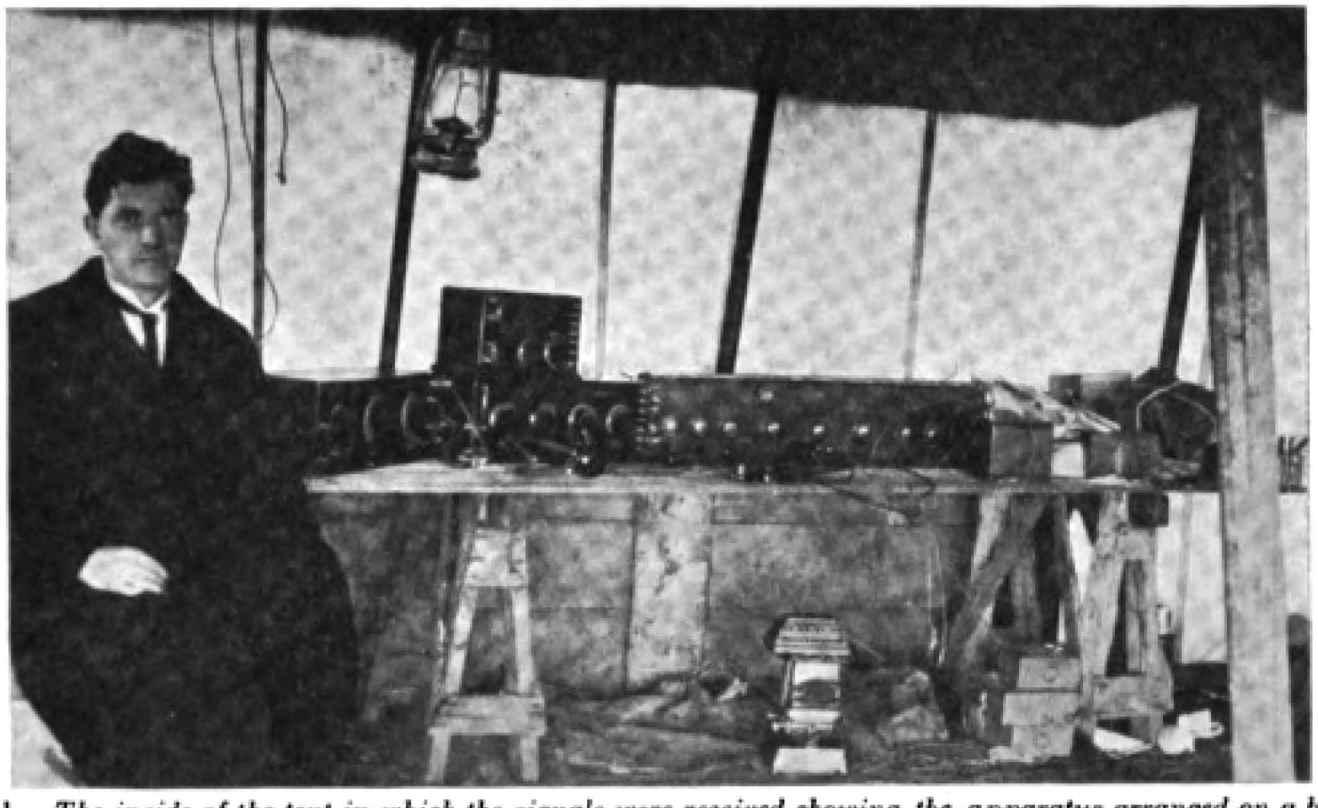

Fig. 1. The inside of the tent in which the signals were received showing the apparatus arranged on a bench. On the left is Inspector Pearson who assisted Mr. Godley.

In the photograph, Fig. 1, the instrument on the extreme left is the closed circuit which is coupled to the Beverage wire and tuned to that frequency which it is desired to receive, the case also containing a variometer for regenerative action at this same frequency. The second case (lower) includes an auxiliary condenser for use on the initial frequency, coupling between the circuit of initial frequency and

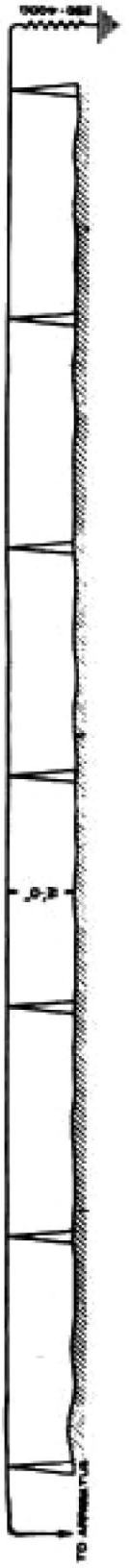

Fig. 2. The Beverage Antenna.

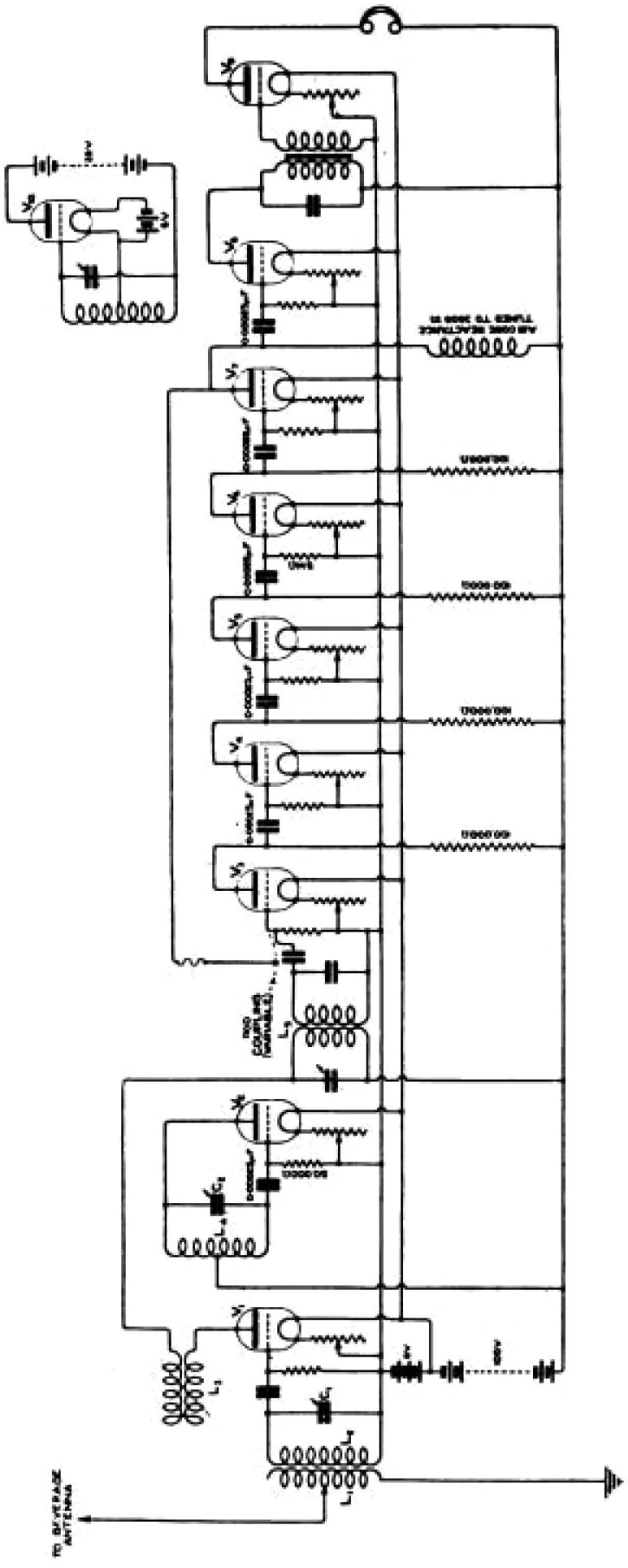

Fig. 3. Circuit diagram of the apparatus used.

L_1 = Inductance to give impedance of 400 ohms at the working wavelength ; L_2, C_1 secondary circuit with tuning range of 180 to 600 metres ; V_1 = first detector valve ; V_2 = short wave heterodyne valve (tuning range 180 to 600 metres) ; V_3 to V_7 = long wave amplifying valves (resistance-capacity coupled) ; V_8 = long wave detector valve ; V_9 = note magnifying valve ; V_{10} long wave separate heterodyne (range 2,000 to 6,000 metres).

the oscillator, condenser which controls the frequency of the oscillator, and a second condenser which controls the beat-note circuit in the anode circuit of the detector valve. The detector valve is inductively coupled to the amplifier and the cabinet last mentioned, also contains a transtormer for this purpose whose secondary is tuned to a fixed frequency of about 75,000 cycles. The third cabinet holds in all nine valves, the first of which is the detector, the second oscillator, the third to eighth inclusive radio frequency amplifiers and the ninth note magnifier. The cases of all these units are lined throughout with copper sheet 2 ins. thick, and where necessary all external leads including those of the headphones (where necessary) are covered by a flexible copper sheathing. Common battery is employed both for filament and anode of all valves, and a capacitative coupling (variable) is provided which enables one to take advantage of the regenerative action of the amplifier as a whole at the amplification frequency. For reception of C.W. the amplifier may either be caused to produce oscillations or an external oscillator may be set up in the vicinity of the apparatus and adjusted for a proper note. Such an oscillator produces energies far larger than necessary when it is set near the wavelength on which amplification is taking place. Therefore it is usually desirable to set the oscillator in such a way that its third harmonic falls at the frequency of amplification.

The unit which sits on top of the second cabinet mentioned is a combination detector and two-stage note magnifier also in a shielded copper-lined case. This unit is a companion for the left-hand unit and is a widely advertised combination of American equipment carrying the name "Paragon." To those British amateurs who may consider the construction of such an outfit as this, it might be well to caution them to use the greatest care in the selection of grid resistances, coupling resistances and grid condensers. Poor leaks, resistances or condensers oftentimes produce excessive loss and frequently give rise to troublesome noises. It will also be noted that the last radio frequency amplifier is coupled to the final detector by the use of an air coil reactance. This reactance is so chosen that its period is approximately that at which amplification is taking place. Its use tends toward the greatest possible quiescence and the elimination of many otherwise bothersome transients. Further attention is called to the fact that a condenser of approximately 500 micro microfarads is placed in shunt to the primary of the note magnification transformer. This to a large extent bipasses any radio frequency currents which might otherwise tend to get through to the note magnifier and ensures additional stability of the whole. Using this condenser it is usually unnecessary to shield the cords of the head telephones.

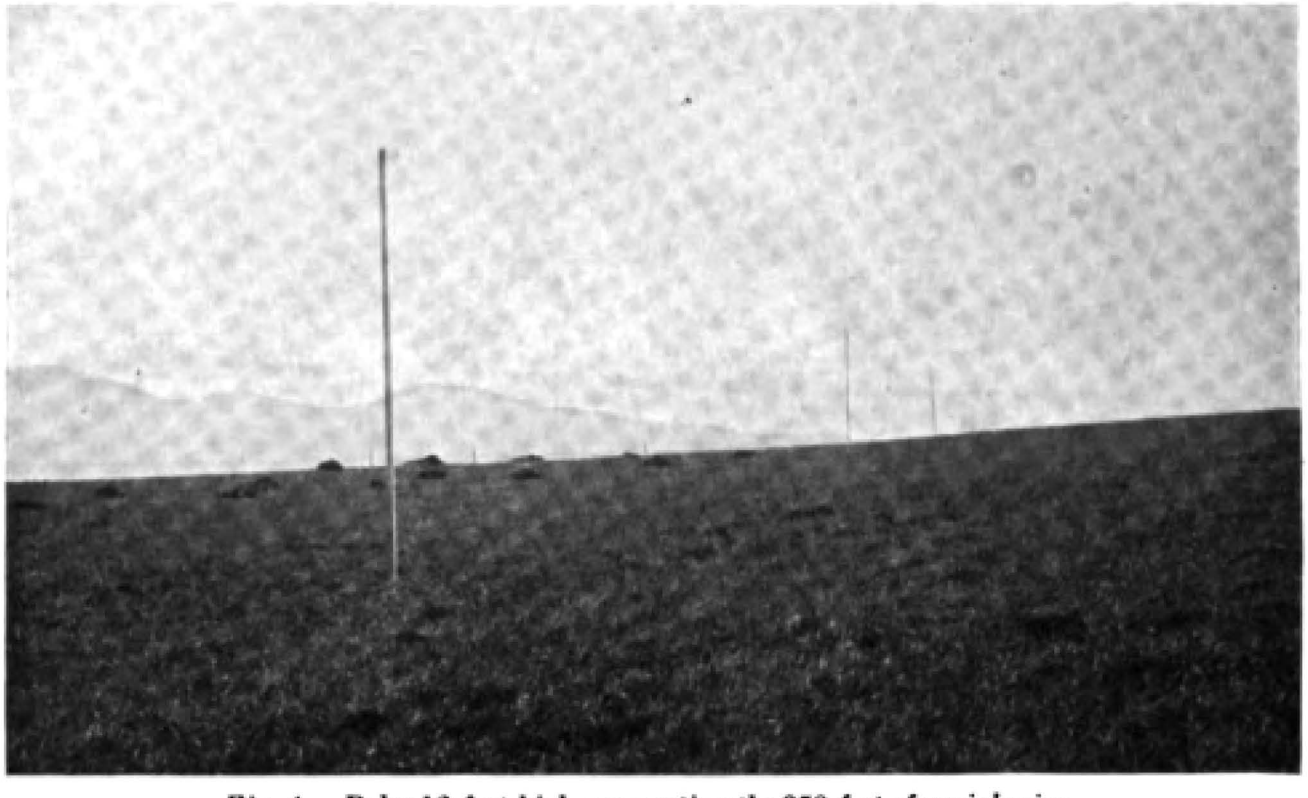

Fig. 4. Poles 12 feet high supporting the 850 feet of aerial wire.

Obviously an amplifier of this type is considerably more flexible than one which amplifies radio frequencies directly. The writer has used this amplifier in his own station during the past two years on wavelengths ranging between 75 and 1,600 metres. It is equally sensitive on all of these and it is a far simpler matter to adapt such an arrangement to all the shorter wavelengths than it would be to adapt a strictly radio frequency amplifier to such a wide band. After reaching 1,600 metres it is possible to shift to amplifier direct and work on up to 20,000 metres. Without

doubt, however, for amateurs, some advantage would be gained by the placing of one or two stages of amplification (radio frequency) between the antenna and the first valve shown in the diagram. Additional complications encountered would in many cases be entirely compensated for. Inasmuch as quite complete descriptions of this type of apparatus have been published some time since in both British and American radio journals no attempt is being made at this time to go into any details. The tubes chosen for this work are those known as "Moorehead," and are very similar to that valve which the British amateur knows as the "R" valve.

Baldwin's headphones were used throughout being extremely rugged in all respects and having a sensitivity at least equal to anything the writer has ever worn. H.T. batteries were of the "Burgess" type which are put up in 22½ volt units, each cell being carefully wrapped in paraffin paper sealed off from its neighbours and the whole cast *en bloc* in a resin wax. The performance of these batteries was excellent. During the whole test the batteries were on wet ground and a greater portion of the time were covered with a film of water. No difficulty of any sort developed from this direction.

The note magnifier valve was used very little during the test. It was either out entirely or had the filament brilliancy reduced to a minimum. (Each valve was separately controlled by a 6-ohm circular rheostat). On one or two occasions the note magnifier was used to the fullest extent and signals resulted which forced one to remove the headphones.

During one of the watches at Ardrossan Inspector Pearson dozed off. The static was rolling in by the buckets full. After making several entries in his log Godley also fell asleep face down on the table but awakened shortly afterwards with wild thoughts of fire chasing around in his head. In coming to with a start Pearson was awakened and gazed at Godley with a ghastly expression.

Godley: "What's the matter. Did I startle you?"

Pearson (large eyes and ghastly expression on his face): "What's the matter with your face it's as black as ink."

The oil stove which was under the table had started to smoke. By virtue of cracks in the table everything had been fairly smoked up including Godley's face.

A great deal of trouble was experienced in keeping the pole line at the Ardrossan installation in shape.

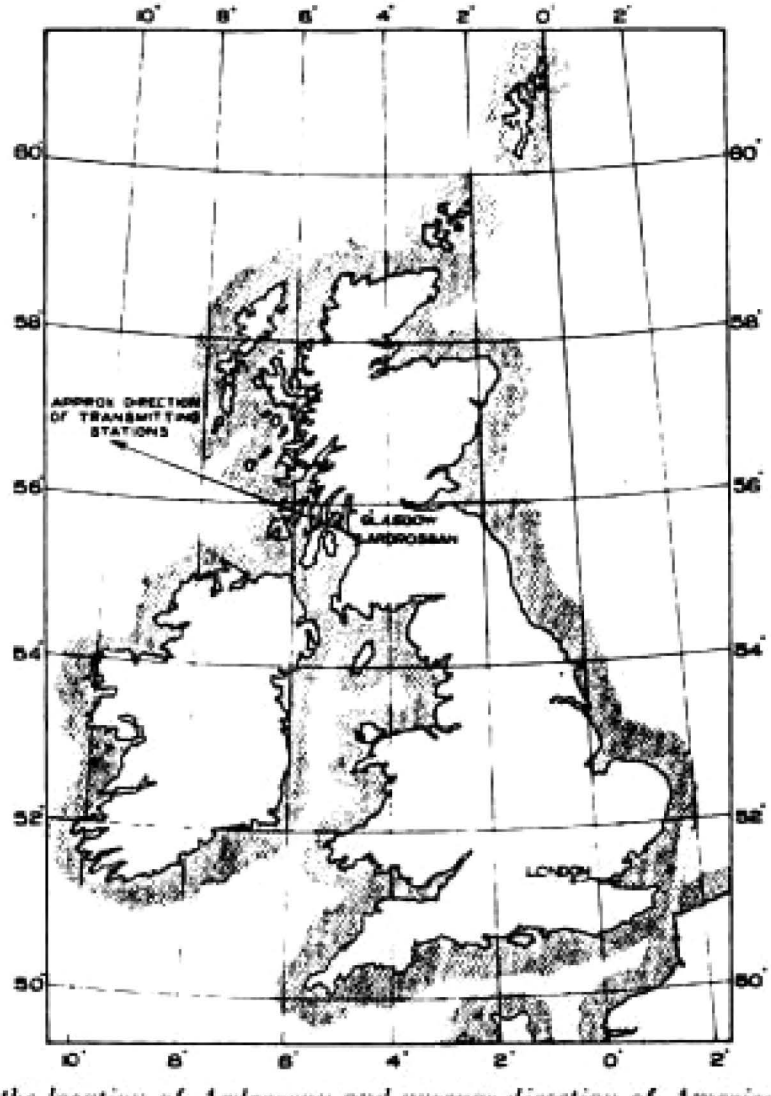

Fig. 5. Map showing the location of Ardrossan and average direction of American Transmitting Stations.

Fig. 6. The Receiving Station tent and the first pole.

The field in which the tests were made was used to pasture several horses all of which developed an appetite for the poles supporting the Beverage wire. These poles were gnawed freely and in several cases broken off short, as though the horses had tired leaning against the poles.

The seaweed which had been spread over the field in Ardrossan to act as a fertilizer made traveling up and down the line through the blackness of the rainy Scotch night a very difficult procedure. It was an easy matter to stray entirely away from the line, to fall down or to tangle oneself up un-

Fig. 7. Another view of the tent. The first three poles can be seen.

expectedly with the stay wires which were placed on some of the poles.

Several of the townspeople of Ardrossan visited the test station during the period and one gentleman who seemed to be proud of his ability to consume large quantities of Scotch liquor listened in during a period of 30 or 40 minutes to various H.P. stations picked up, having been told in each case "That's Berlin," "Here's New York," etc.

On account of the excellent signals of Friday, Saturday and Sunday nights violent efforts were made to get hold of a dictaphone in order that records might be taken of the Transatlantic Transmissions. A dictaphone arrived on the scene in due time but was never used. The dictaphone idea on the other hand may prove useful inasmuch as it is intended to take several dictaphone records of American signals on his return to the States, same to be forwarded to London for the information of members of the Wireless Societies of London.

Tremendous interest in the results of the American tests was created in engineering circles in America. Cables from various ones indicate that there may be some consideration on the part of various commercial firms to carry out a further test in order that more complete datum on short wave transmission may be available.

A cable from Greenwich, Connecticut, states that station 1BCG had an input of 1 kW having a total of 600 watts in the antenna. The transmitter consists of a master oscillator and three amplifiers, the whole being supplied from a direct current source. This particular transmitter is now being displayed in one of New York City's large show-windows and large crowds evidence considerable interest in the equipment.

Through error in coding the first station heard, 1AAW, was broadcasted as being 1AAY. A cable was received immediately to the effect that 1AAY was a spark coil station and that the transmitter was not in operation. Immediately correction was sent by cable to the effect that 1AAW was correct. A second reply came saying that 1AAW had no transmitter. The location of this first station heard is still undetermined at the time this is written.

Fig. 8. Enlarged Map of Ardrossan.
The approximate position of the station is shown at (×).

Waves and Wireless

Professor J. A. Fleming's Lectures at the Royal Institution.

Professor Fleming recently completed a series of six lectures on "Electric Waves and Wireless Telephony" primarily intended for a juvenile audience, at the Royal Institution. The lectures were throughout crowded with fascinating experiments calculated to raise enthusiasm for the subject in the hearts of even the youngest members of his audience. Professor Fleming commenced the series of lectures with an explanation of waves in other and more readily appreciated mediums such as air and water, before going on to the less tangible explanation of aether waves.

During the last of the series of lectures a demonstration of wireless telephony was given. Music, transmitted from Marconi House, being made to operate a Stentorphone.

In a later issue we hope to give a resumé of these lectures with an account of some of the experiments.