26th August 1854 there appeared in *L'Illustration* (Paris) an interesting article by Charles Bourseul on the electric transmission of speech.@@1 The writer recommended the use of a flexible plate at the source of sound, which would vibrate in response to the varying pressure of the air, and thus open and close an electric circuit, and of a similar plate at the receiving station, which would be acted on electromagnetically and thus give out as many pulsations as there are breaks in the current. These suggestions were to some extent an anticipation of the work of Reis ; but the conditions to be fulfilled before the sounds given out at the receiving station can be similar in pitch, quality, and relative intensity to those produced at the transmitting station are not stated, and do not seem to have been appreciated.

In Reis’s lecture an apparatus was described which has given rise to much discussion as to priority in the invention of the telephone. The instrument was described in over fifty publications @@2 in various countries, and was well known to physicists previous to Bell’s introduction of the electric telephone as a competitor with the electric telegraph. Reis caused a membrane to open and close an electric circuit at each vibration, thus transmitting as many electric pulses through the circuit as there were vibrations in the sound. These electric pulses were made to act on an electromagnet at the receiving station, which, in accord­ance with Page’s discovery, gave out a sound of a pitch corresponding to the number of times it was magnetized or demagnetized per second. Reis’s object was to re­produce at a distance not only music but also human speech ; but that he did not wholly succeed is clear from the following extract from his lecture : “ Hitherto it has not been possible to reproduce human speech with sufficient distinctness. The consonants are for the most part repro­duced pretty distinctly, but not the vowels as yet in an equal degree.” Considering the time at which he wrote, Reis seems to have understood very well the nature of the vibrations he had to reproduce, but he failed to compre­hend how they could be reproduced by electricity. His fundamental idea—the interruption of the current—was a fatal mistake, which was not at the time properly under­stood. The suggestion of Bourseul and the experiments of Reis are founded on the idea that a succession of currents, corresponding in number to the successive undulations of the pressure on the membrane of the transmitting in­strument, could reproduce at the receiving station sounds of the same character as those produced at the sending station. Neither of them seemed to recognize anything as important except pitch and amplitude, and Reis thought the amplitude was to some extent obtained by the varying length of contact in the transmitting instrument. This might possibly be to a small extent true ; but, considering the small capacity of the circuits he used and the nature of his receiving instrument, it is hardly probable that dura­tion of contact sensibly influenced the result. The quality of the sounds was to some extent also reproduced ; but, judging from the results of recent telephone investigation, it is highly probable that this was due, not to the varying duration, but to the varying firmness of the contact. Since the effect of the degree of contact has, through the re­searches of Bell, Berliner, Edison, Hughes, Elisha Gray, and others, become generally understood, it has become easy to make instruments very similar to those of Reis ;

and even his instruments, with slight modification, can be made to speak fairly well. The accidental transmission of words by Reis, the occasional recognition of the voice of a singer, and other instances of the transmission of quality were no doubt due to this element, the existence of or the necessity for which was never, so far as the present writer knows, hinted at by Reis.

The next worker at the telephone, and the one to whom the present great commercial importance of the instrument is due, was Bell. His aim was the production, by means of the undulations of pressure on a membrane caused by sound, of an electric current the strength of which should at every instant vary directly as the pressure varied.@@3 His first idea seems to have been to employ the vibrations of the current in an electric circuit, produced by moving the armature of an electromagnet included in the circuit nearer to or farther from the poles of the magnet. He proposed to make the armature partake of the vibrations of the atmosphere either by converting it into a suitable vibrator or by controlling its vibrations by a stretched membrane of parchment. In the early trials the armature had the form of a hinged lever of iron carrying a stud at one end, which pressed against the centre of a stretched membrane. The experiments with this form were not successful, and, with the view of making the moving parts as light as possible, he substituted for the comparatively heavy lever armature a small piece of clock spring, about the size of a sixpence, glued to the centre of the diaphragm. The magnet was mounted with its end carrying the coil op­posite, and very close to, the centre of the piece of clock spring. This answered sufficiently well to prove the feasibility of the plan, and subsequent experiments were directed to the discovery of the best form and arrange­ment of the parts. An increase in the size of the iron disk attached to the membrane augmented both the loud­ness and the distinctness of the sounds, and this finally led to the adoption of the thin iron disk now in use, which is supported round its edge, and acts as both membrane and armature. Again, the form of the opening or mouth­piece in front of the membrane exercised considerable influence on the efficiency of the instrument, and it was ultimately ascertained that a small central opening, with a thin air space extending across the face of the membrane, was best. It was also found that comparatively small magnets were sufficient, and that there was no particular virtue in the closed circuit and electromagnet, but that a small permanent magnet having one pole in contact with the end of the core of a short electromagnet, the coil of which was in circuit with the line, but which had no per­manent current flowing through it, answered the purpose quite as well.@@4 In fact the effect of keeping a permanent current flowing through the line and the coils of the electromagnet was to keep the core of the electro-magnet magnetized. This seems to have been almost simul­taneously pointed out by Bell and others who were work­ing in conjunction with him and by Professor Dolbear. Many experiments were made for ascertaining the best length of wire to use in the coil of the transmitting and the receiving instrument ; but this is clearly a question dependent to a large extent on the nature of the line and the system of working adopted.

After Bell’s success a large number of experimenters entered the field, and an almost endless variety of modi­fications have been described. But few possess any real merit, and almost none have any essentially new principle.@@5

@@@1 See also *Didaskalia : Blätter für Geist, Gemüth, u. Publicität,* Frank­fort, No. 232, 28th September 1854 ; Du Moncel, *Expose des Appli­cations de l'Electricité,* Paris, vol. ii. p. 25, ed. 1854, vol. iii. p. 110, ed. 1856, and *Comp. Rend.,* 26th November 1877.

@@@2 The English reader may consult—*Journ. Soc. Tel. Eng.,* March 1883 ; *British Assoc. Rep.,* 1863 ; *Civ. Eng. and Arch. Journ.,* vol. xxvi. p. 307 ; R. Μ. Ferguson, *Electricity,* London, 1866, p. 257 ; S. P. Thompson, *Philip Reis, the Inventor of the Telephone,* London, 1883.

@@@3 See A. G. Bell, “ Telephone Researches, in *Journ. Soc. Tel. Eng.,* 31st October 1877.

@@@4 The extreme smallness of the magnets which might be successfully employed was first demonstrated by Professor Peirce of Brown Uni­versity, Providence, R.I.

@@@5 For a detailed description, in a collected form, of a large number