That is the question," he humourously soliloquised. Brazil was charmed and said so. The Commissioners left off scoffing and the telephone became the prize hit of the great Exhibition.

One of the clauses of Bell's wonderful patent is as follows :, " The method of the apparatus for transmitting vocal sounds telegraphically, as herein described by causing electric undulations, similar in form to the vibrations of the air accompanying the said vocal and other sounds substantially as set forth."

This was the notice to the public that the instrument they were invited to use for ordinary communication would transmit every inflection of their voices one to another. But when the first exchange was established in 1877, it was found that the magnet transmitter was not sufficient for business needs, and the Bell Company sought to apply battery power. Edison here flashed into the field and, with his carbon transmitter added, led the world for some time. The foundation of his success was the discovery of the French physicist, Count de Moncey, that " when two ends of a severed circuit are brought into contact, the resistance of the contact is variable with and proportionate to the pressure between them. The next step forward was made by Edison and Berliner who acting separately combined the induction coil with the transmitter. In 1878, Professor Hughes of London proved, with his microphone that to obtain the best results with resistance changes due to changes of pressure, it is necessary to have a light contact. From that time all transmitters have been on the light contact plan.

Before this, iron had been substituted for the parchment of the first diaphragms, and the thickness fixed at one hundredth of an inch ; experience having proved that thinner sheets were shrill, and thicker confused.

The Blake transmitter followed the discovery of the microphone, but sensitive as was that transmitter at short distances it was found to be useless as the distances increased. A ruck of inventors at this juncture jostled one another for the discovery of some expedient to get over that difficulty. The lucky one proved to be a clergyman quite unversed in electricity. The Rev. H. Hunnings, using granulated carbon, gave clear talking at long distances and his transmitter could stand high battery power. But very soon the granules were found to be liable to pack, thus stopping the passage of sound. Investigation revealed the fact that the electric current heated the transmitters. More space was given and the packing ceased. The best transmitter, the White solid back transmitter, followed, in which the packing is avoided by the insertion of a mica disc, the carbon granules occupying only part of the space between the electrodes.

The receiver has a simpler story of development. The essential parts of the present receiver consist of magnet, air chamber, diaphragm, ear-piece and case ; the air-chamber giving increased distinctness to the voice speaking through the transmitter.

But the new telephone was not complete with the perfection of the transmitter. There remained the problem of long distance. In the beginning the Bell company guaranteed communication up to twenty miles. To-day men talk freely 1700 miles apart with as much ease as across an office table. The first difficulty was the attenuation of the very weak currents used. After much experimenting and the granting of many patents, Professor Pupin, of Colombia University, demonstrated that " inductances distributed at certain intervals along a telephone wire strengthened the current greatly." Accordingly slight coils of wire (copper with iron core) ten inches in diameter, were fastened, four miles apart to the line, and these receiving the electric current were found to send it on undiminished. That cured the trouble of attenuation. These rings treble the capacity of telephone lines.

As distances of telephony grew longer it was found that iron wire could not be used profitably. Copper being tried could not be tightened sufficiently, and the invention of Doolottle, who succeeded in hardening copper wire, so as to enable it to stand almost the same strain as iron, simplified matters.

Interference was the last of the troubles, and this was got over by twisting the wires. Professor Bell discovered that if two wires of a circuit be wound about each other, interference (induction) cannot occur, as outside currents passing into the twisted wires are neutralised. Thus the first and the last of the inventions of the first thirty years of the telephone are Bell's

Of the multiplication of exchanges and the improvements in the handling of their multitudinous wires it would be tedious to speak at length. Of the thousands of patents taken out for the betterment of various details of telephones and circuits it is impossible to speak at all. The chief aspiration is still unfulfilled. It is for the complete removal of the attenuation which has been partially got rid of so far as the establishment of the 1700 mile limit of long distance telegraphy. When complete success is attained men will be able to talk from Paris to Pekin and from Pekin back to Paris by the other side of the globe.

A few figures are interesting. There are in the United States alone in use some six millions of telephones, and what may be the number in the world may be imagined from the fact that the telephone has spread over Europe, Canada, all the Americas the British Empire not forgetting India, Burmah, China, Abyssinia, Persia, Turkey, Siberia, and other countries too numerous to mention. Of these the United States, as becomes the birthplace and cradle of the invention, stands pre-eminent. Berlin has one telephone to every seventeen families: Paris one to 22: London one to 58 : New York one to 12 : Boston one to 6 : and San Francisco (before the earthquake of 1906) one to 4.

The rise and progress of the telephone compressed as it is into the limits of a single generation make one of the most fascinating stories in the history of human achievement. But for the initial discovery of Graham Bell that story would have been impossible.

Successful Engineers.

[By Peter Ellis, Wellington.]

Successful engineering is the outcome of a happy combination of science and practical experience ; each is essential to the other. The man who is all science fails, because he carries formulas and exactitude to the verge of absurdity in real practical work, while the practical rule-of-thumb engineer fails because he depends too much on his judgment as a sufficient guide ; the balance ensuring success lies beyond the junction of the two principles each merged in the other. It is hard to say whether the workshop or the College training is the more important. Certainly a long workshop experience is an immense advantage to an engineer, and a man having such a training is less likely to develop " that superior air " the *bete noire* of the mere collegiate which stands so much in the way of success to many really clever men, and renders them unpopular among the fraternity. Mathematics will never teach design ; a lively imagination is essential to that end, and imagination springs from observation and experience, for what can a man imagine but from what he knows ? If he imagines wheels, he has seen wheels ; if levers, he has seen levers ; and some men have a positive gift amounting almost to genius for combining these things in original design which have no mathematical origin whatever. It does not help practical engineering much to apply the precision of a Geneva watch to the damming of a river, and we always find the most successful of the world's engineers among those who know how to brush aside unimportant petty details and give prominence to broad practical principles.

Honours for the Inventor.

An American Tribute. During the formal opening of the building of the United Engineering Society of America in April last, the John Fritz Gold Medal was presented to Alexander Graham Bell for the invention and introduction of the telephone. This is the third medal of the kind awarded. The first was given to Lord Kelvin for his work in cable laying, and the second to George Westinghouse for perfecting the air brake.

The Building of the United Engineering Society.

The dedicatory exercises of the new building of the United Engineering Society, at 25 West Thirty-ninth Street, New York city, to which Andrew Carnegie gave $1,500,000 for construction and still more when it came to raising an endowment fund were held on April 17th, 1907. The exercises were in the assembly hall of the new building which is one of the finest auditoriums of its kind in the city.

Mr. Carnegie shared attention with the venerable Dr. Edward Everett Hale, President Arthur T. Hadley, of Yale, Ambassador Creel, of Mexico ; Sir William H. Preece, president of the institute of Electrical Engineers of England, and John Fritz, of the building committee, who received the most prolonged applause of any of those present.

Charles Wallace Hunt, who presided, had as a gavel the setting maul which Mrs. Carnegie used when she laid the cornerstone of the building. T; C. Martin, president of the Engineers' Club, read this telegram of congratulation from President Roosevelt :

The White House, Washington,
April 13, 1907.

My Dear Sir : I heartily congratulate you on the opening of the building of the Engineering Societies. The building will be the largest engineering centre of its kind in the world. It is, indeed, the first of its kind, and its erection in New York serves to mark and emphasise the supremacy which this country is steadily achieving through her proficiency in applied science. The whole country is interested in the erection of such a building, and particularly of course, all of those who follow either the profession of engineering or any kindred profession, and in no branch of work have Americans shown to greater advantage what we like to think of as typically American characteristics.

With all good wishes, believe me, sincerely yours, Theodore Roosevelt.

Mr. T. C. Martin, 114 Liberty Street.

President Hadley delivered the principal address and declared that a combination of ethical and technical standards would produce the best professional service.