length of 78·6 kilometres of telegraph wire. The return was estimated approximately at 25 per cent.

It must not be believed that the affair proceeded with the convenient rapidity which this brief account might lead the reader to suppose. Many obstacles were encountered, but not those which had been announced. We are not speaking here of M. Deprez and his friends, who knew approximately what might be expected. But, in the electrical world, it was said on all sides that this would never work. Each one had his reason. At the first trial the machines, it was said, were to melt, burn, and be destroyed by the heat. Not only did nothing of the kind occur, but no machine had ever been so cool. The most ordinary light machines heated incomparably more than these. The real difficulties encountered lay, as was known to those who had studied the question, in the novel use of high tensions. It was necessary to employ great care in insulation ; to arrange commutators of new forms to prevent the origination of voltaic arcs, very difficult to extinguish at the moment of interrupting the current. It was even needful to employ especial methods for effecting the interruption, as any sudden break was seriously injurious. Thus, as we advanced, difficulties presented themselves, inherent in the use of electricity in this novel form, and successively they were overcome.

It was about the beginning of 1882 when the Technical Commission charged with organizing the Electric Exhibition at Munich, placed itself in communication with M. Deprez. The question of transmission had been already raised at the Paris Exhibition, and it was decided to render it one of the main features of the Munich Exhibition. But, as may be understood, it was decided to present the transmission under novel forms and to show results which had hitherto not been seen. The Commission addressed itself to various German firms, asking their assistance. Messrs. Siemens & Halske declined the proposal, doubtless being able to do merely what they had done previously and not wishing to repeat themselves. Messrs. Schukert accepted, and effected a transfer to to the distance of five kilometres. The motor machine was impelled by a fall of water on the river Isar, at Hirschau. The conducting wire was of copper, and presented a total resistance of 12·61 ohms.

It is necessary to insist upon this point. We must carefully note that in transfers the distance does not act strictly by its length but by the resistance of the conducting wire necessary to connect electrically the two machines. Doubtless, we may diminish this resistance by selecting a good conducting metal and increasing the diameter of the wire. But this can only be done by increasing the expense. Now, we must remember that the transmission of power is not merely a scientific question, but should admit of an industrial application. Hence, economic considerations play an important, and even a preponderating part. If the transfer is to have any interest, the distance must be considerable and it must be traversed by means of a cheap conductor, that is, a wire relatively slender and therefore having a considerable resistance. As will be seen directly, the experiment of Messrs. Schukert responded very imperfectly to these conditions, the distance being small and the conductor very thick. Hence this transfer did not differ essentially from former experiments, and especially from what had been done at the Palace of Industry in 1881. For the rest, no measurements were made with this transfer, which is the more singular as the Munich Exhibition was got up for the very purpose of securing precise data, and the apparatus were generally submitted to a thorough examination.

We will say nothing of an alleged transfer effected at Munich by the Edison Company, the generating and the recipient machines being placed only at a distance from each other of 10 metres!

On the contrary, it is necessary before coming to the principal experiment, to say a word on a transfer of a peculiar kind exhibited by M. Deprez. As regards the distance of the transfer, properly speaking, it offers no novelty. But it displays an interesting manner of utilizing electric action for the production of mechanical work. In the course of the experiments, the solenoids have been studied, and it has been found that the attractions developed in these apparatus are very energetic. But in their ordinary arrangement they cannot give great displacements, nor, consequently, much work. By an ingenious arrangement, M. Deprez constructed a solenoid of a series of small, very flat solenoids, superimposed. Each of them is connected to the preceding one so as to form a continuous whole. But at the junction of two sections there is a stop of copper and these stops together form a collector, like those of the Pacinotti-Gramme machines.

Two rubbers convey the current, comprising between them a certain number of contacts, for instance, 10. There is, then, in the column forming the solenoid an acting portion traversed by the current, formed of 10 sections. By causing the brushes to travel along the commutators we cause at the same time the active portion to move along the solenoid and the iron core will follow it. We may thus raise it rapidly, cause it to descend in the same manner and make it act like a steam hammer. The power produced has been brought up to 180 kilos ; at Munich it was 70 kilos.

We now come to the most important experiment.

M. Deprez having announced that he purposed working to great distances, the Commission immediately proposed to him to go to 50 kilometres, and offered him as conductor, an ordinary telegraph line. Here were certainly conditions quite exceptional, nothing of a similar kind having yet been attempted. As to the resistance to be overcome, M. Deprez was prepared ; we have described one of his experiments in which he traversed in his laboratory resistances greater than the 500 ohms of a line of 50 kilometres. But there remained a doubtful point—to know how a telegraph line would behave, if its insulation was sufficient, if atmospheric disturbances had any influence. Experience alone could answer. To accept the investigation thus publicly, at so great a distance and under such conditions, was certainly bold. M. Deprez was bold enough, and he was justified by success.

It must be added that at this time he had no dynamos furnishing high tensions save the two transformed Gramme machines which have been previously mentioned. These apparatus were originally imperfect, and were already a little injured by the experiments for which they had served. These he sent on to Munich. The first project was to effect a transmission between Augsburg and Munich, but a Bavarian manufacturer, M. Fohr, who had works at Miesbach, a small town at the distance of 57 kilometres from Munich, urged that the generating machine should be placed there, and undertook to supply the necessary power. The distance was about the same.

As a conductor, the existing telegraph line was employed without alterations. It was at first intended to effect the return by the earth, but on further reflection this idea was abandoned and a second telegraphic wire completed the circuit. This arrangement certainly doubled the resistance of the line and, consequently, the difficulty of transport, but it was thought necessary to avoid danger. The effect of high electric tensions was then excessively dreaded ; and if the earth was used for a return, the body of any person touching any point of the line would form at once a derived circuit.

It was subsequently found that high tensions were less formidable than had been supposed. Still, it is certainly imprudent to play with them, and a return wire seems a necessary precaution. It seemed still more important at the time in question. Thus arranged, the line offered a total resistance of 950 ohms according to the measurement of the Commission.

It must be said that, whilst inviting M. Deprez to carry out his experiment, it does not appear that the Munich Commission had much confidence in his success. Thus, on the day when M. Sarcia, the engineer employed by M. Deprez, announced that he would make his trial, many members of the Commission were present, and when, on the signal being given, the obedient machines began to move, there was a burst of applause. The machine at Munich was employed to work a rotary pump, feeding an ornamental cascade.

The success was clearly and fully proved, but, as might have been expected, a number of small accidents interfered to limit its duration. On this subject it is best to quote the certificate given by the Commission :—

"The dynamo machines were set in motion for the first time on Sept. 25th, at 7 p.m., and, according to the data of M. Datterer, the engineer appointed by the committee, the receiver placed at Munich revolved at the speed of 1,500 turns per minute, the brake, serving to measure the work, being loaded with 1·5 kilog.

"A series of accidents, due to the fact that the machines were constructed for laboratory experiments and not for practical work, arrested, after eight days, the progress which up to that time had been completely satisfactory. The circles surrounding the ring of one of them broke, consequently the wires of the ring of 0·4 mm. in diameter were damaged, and had to be insulated afresh. In the remote town of Miesbach these repairs were effected wtth great difficulty, and required,