CHAPTER I

THE BEGINNINGS OF THE POWER STATION INDUSTRY

They had no vision amazing
Of the goodly house they are raising,
They had no divine foreshowing
Of the land to which they are going;
But on one man's soul it hath broken,
A light that doth not depart;
And his look, or a word he hath spoken,
Wrought flame in another man's heart.

A. W. E. O'SHAUGNESSY

THE birth of the Power Station Industry was foreshadowed by Faraday's discovery, in 1831, that electricity could be generated by mechanical means, though many years had to elapse before machinery was available for its production on a commercial scale, or apparatus for its utilization had been devised. The development of the dynamo in its present form may be said to have started in 1845 when Wheatstone and Cooke patented the use of electro-magnets in place of permanent magnets for the field. Machines were not, however, made completely self-exciting before 1866 when the brothers C. and S. A. Varley, Dr Werner Siemens and Sir Charles Wheatstone, independently and practically simultaneously, discovered the principle of self-excitation. The production by Gramme, in 1870, of a dynamo with a ring-wound armature then brought matters to a point when the industrial generation of electricity really became a practical question. The following years were prolific in inventions concerning dynamo-electric machinery, notable amongst these being the open-coil dynamo of Brush in 1878, which played a prominent part in the early history of electric lighting. Long before this time, however, serious attempts had been made to obtain electricity from mechanical power by the use of machines of the magneto type.

The first Company to be formed for the exploitation of electric machinery was probably La Société Générale d'Electricité, of

Paris, which was founded in 1853 to develop a machine designed by Professor Nollet for the purpose of generating current for the electrolysis of water. The object was to produce hydrogen and oxygen for making limelight. The project was not successful, but the machine was modified by Professor F. H. Holmes and used for experiments in connection with electric light. Holmes's first machine was tried in the lighthouse at Blackwall in 1857, and on December 8 of the next year, light produced by his second machine was thrown over the sea from the South Foreland Lighthouse. These experiments were so promising that about 1859 another Company, called the Compagnie de l'Alliance, was formed for the manufacture of electric generators of the type in question. The "Alliance" machines, as they were called, produced alternating current, and were used to a considerable extent for lighthouse work by both the French and British authorities. Their characteristic feature was the production of their magnetic fields by means of a large number of permanent magnets of horseshoe shape.

On 1 February 1862, electric light was installed permanently in the Dungeness Lighthouse, the machine and lamp being of Holmes's design. A Holmes machine, dating from 1867, which was installed in the Souter Point Lighthouse in 1871, is preserved by the Institution of Electrical Engineers, to whom it was presented by the Corporation of Trinity House on its removal from the lighthouse in 1915. The machine, which weighs 3 tons, was driven at 400 R.P.M. by an Allen engine. It absorbed 32 H.P., from which a light of 1,520 c.p. was obtained. Alternators of the same type were employed for operating the two lighthouses at Cap la Hêve, near Havre, in 1863 and 1865 respectively.

The fact that a brilliant light could be produced by allowing an electric current to form an arc between a pair of carbon points had been demonstrated by Sir Humphry Davy before the Royal Institution in 1808, the current being obtained from a battery of 2,000 zinc-copper cells. Arc-lighting was for many years the only way of utilizing electricity for illumination. A mechanical arc lamp was produced in 1847 by Staite, who was followed by numerous other inventors, but the first type of arc lamp to achieve success on a large scale was the famous "Jablochkoff Candle"

invented in 1876. This consisted essentially of two carbon rods placed parallel to each other and separated by a plate of kaolin. A bridge of carbon paste connecting the tips of the rods was burned away when the current was switched on, and the arc thus formed maintained itself between the carbon rods, volatilizing the intervening partition as the rods were consumed. Self-regulating arc lamps did not appear until 1878, when von Hefner-Alteneck introduced the differential solenoid type, and Brush devised the clutch mechanism to effect the same purpose.

With dynamos and arc lamps at their disposal, the pioneers of the electric supply industry were able to proceed. They started, as we have seen, with lighthouse installations, as the intensity of the light rendered the arc lamp specially suitable for such work. On land the only field for the new light was in the illumination of large spaces, and one of the first applications for such a purpose was the lighting of the Gare du Nord in Paris in 1875. In May 1877 the Grands Magasins du Louvre, in the same city, put down an installation of 80 Jablochkoff candles supplied with current from Gramme machines driven by a steam engine in the basement. Within the next 18 months, this system of lighting had greatly extended. In 1878 there were several hundred Gramme machines in service, the latest type supplying alternating current, as this was found more suitable for Jablochkoff candles on account of the equal consumption of the two carbons. These machines had eight salient rotating field poles and a fixed armature. The largest absorbed about 16 H.P. at 600 R.P.M. and would serve 16 Jablochkoff candles. The Avenue de l'Opéra was lit by 46 lamps supplied from three 20 H.P. engines in different places; the Place de l'Opéra had 22 lamps, and there were altogether over 300 Jablochkoff candles in Paris.

Progress in England was slower. In its issue of 20 July 1878, *The Electrician* bewailed the fact that although the use of the electric light was daily extending in Paris, "yet in London there is not one such light to be seen". Londoners, however, had not very much longer to wait, for in the following month six Lontin lamps, installed by French engineers, were employed to illuminate the Gaiety Theatre, this being the first public building in

London to be electrically lighted. The effect was described at the time as that of "half a dozen harvest moons shining at once in the Strand". The Jablochkoff system, so successful in Paris, was introduced in this country on October 15 of the same year by Messrs Wells and Co., of the Commercial Iron Works, Shoreditch, who put up four lamps inside their showroom and two more at the entrance to their works, current being furnished by a Gramme machine.

The first move of importance by a Public Authority with regard to electric light was made on 18 October 1878, when, on the recommendation of their Works and General Purposes Committee, the old Metropolitan Board of Works accepted an offer of the Société Générale d'Électricité of Paris to instal an experimental system of lighting along the Thames Embankment. The Company were to supply 20 Jablochkoff lamps and the necessary electrical machinery, while the Board would bear the cost of providing the motive power, cables, standards, labour, etc. Within a week of this decision the City of London Authorities came to an agreement with the same Company to try the electric light along the Holborn Viaduct and in front of the Mansion House. Before, however, either of these schemes could be realized, the Billingsgate Fish Market, controlled by the Markets Committee of the City Corporation, was lit both inside and outside by electricity. The inauguration of the new system took place on 29 November 1878, thus giving Billingsgate the credit of affording the first demonstration of electric lighting by any Public Authority in London. The installation, which comprised 16 Jablochkoff candles in opaline globes, was also carried out by the Société Générale d'Électricité.

The Victoria Embankment was illuminated by electricity for the first time on 13 December 1878. The lights, which were along the river wall of the Embankment between the Waterloo and Westminster bridges, consisted of 20 Jablochkoff lamps spaced about 45 yards apart. On the other side of the Embankment, just west of Charing Cross Bridge, was a wooden shed containing a semi-portable steam engine constructed by Messrs Ransome, Sims and Head, having two cylinders each 10 in. diameter by

13 in. stroke. The engine, which worked with steam at 60 lb. pressure, was capable of developing about 60 I.H.P. at 160 R.P.M. It was belted to a countershaft from which were driven a direct current Gramme dynamo at 650 R.P.M. and its separate exciting dynamo at 700 R.P.M. The lamps were arranged five in series on four circuits, the eight conductors of bare wire being led through a 4 in. drain-pipe to the subway and thence to the lamp standards. The farthest lamp in the direction of Waterloo Bridge was 470 yards from the engine-house, and the farthest in the other direction was at a distance of 700 yards from the house. The original engine, after running nearly 5 years, was replaced by a Davey Paxman engine in August 1883. The system was extended on 16 March 1879, to a total of 40 lamps, and on October 10 following, a further extension brought the number of lamps to 55, the mains then extending from a point 6,092 ft. below Waterloo Bridge to a point 6,007 ft. above it. In June 1881 an agreement was entered into between the Metropolitan Board of Works and the Jablochkoff Electric Light and Power Co., by which the Company should maintain 40 lights on the Embankment and 10 on Waterloo Bridge for the price of $1\frac{1}{2}d.$ per lamp-hour. After the termination of this arrangement in 1884, the Company went into liquidation, as the price had been an unremunerative one, and as no other Company could be found willing to undertake the work on terms satisfactory to the Board, gas lighting was then reverted to.

The Holborn Viaduct installation was put into commission before the end of 1878, but the lighting of the Viaduct by electricity was discontinued on 9 May 1879, as being too costly, the expense being stated to be about four times that of adequate lighting by gas. It comprised 16 Jablochkoff lamps distributed over a distance of 473 yards, and supplied with current from a Gramme dynamo driven by a Robey undertype engine, the details of the work being generally similar to those of the undertaking on the Embankment.

In addition to the installations mentioned, the year 1878 also witnessed much enterprise by industrial undertakings and private individuals with regard to electric lighting, and various munici-