maintained in the accelerating tube, thus producing a stream of swift protons corresponding to a current of 20 micro-amperes. By the multiple acceleration of charged atoms, Lawrence and Livingston in California have been able to obtain a stream of protons of energy so high as 1,200,000 volts by the use of a voltage so low as 4,000 volts.

Effects of Atomic Bombardment

IN the second part of his address, Lord Rutherford described the applications of atomic projectiles. After considering the way in which swift α-particles from radioactive substances have been used for throwing light on the dimensions of the atomic nucleus, he gave an interesting account of experiments on the transmutation of matter. This has been effected by the bombardment of matter by swift atomic projectiles of different kinds. In 1919, Rutherford was able to demonstrate the disintegration of the nitrogen nucleus as a result of a close collision with an α-particle in which a swift proton was expelled. The discovery of the 'neutron' followed upon experiments by Bothe, who observed a very penetrating type of radiation when beryllium was bombarded by α-particles. Chadwick carried out further experiments by counting methods, and concluded that the radiation consists of a flight of material particles which are supposed to be close combinations of a proton and an electron. Within the last year, Cockcroft and Walton have obtained definite evidence that certain atoms can be transformed by a stream of fast protons produced artificially in a discharge tube. This new method of attack, so successfully begun, is certain to give us much new information on the structure of nuclei and the problem of the transmutation of the elements.

Egypt and the Nile

THE presidential address delivered by Sir Murdoch Macdonald to the Institution of Civil Engineers at the first meeting of the session on November 1 was almost entirely devoted to a consideration of the engineering development of Egypt and the Sudan, with which his life work has been closely associated, and, in particular, to the measures taken to bring into cultivation vast areas of waste land which have lain unproductive for centuries. Of the 360,000 square miles over which the King of Egypt rules, 95 per cent is desert. The combined area of the two cultivated districts of Lower and Upper Egypt is only about 12,000 square miles, one tenth of the area of Great Britain and Ireland; and the narrow strip of cultivated land, running for some 550 miles on each side of the Nile from Cairo to Assuan, has an average width of not more than 6 miles. Referring to the geological history of the country, Sir Murdoch said that, on the supposition that the Delta of the Nile lay in an ancient bay of the Mediterranean now filled with silt, the original mouth of the river was at Cairo. The depth of silt and sand in that locality indicates that the river once ran at a much lower level than it does now. From records of water levels on the Roda gauge, near Cairo, extending over many hundred years, it has been deduced that the bed of the river and the general level of the cultivable land must have been raised at the rate of 1 mm. a year and the process has been going on probably for 20,000 years.

Irrigation Schemes in Egypt and the Sudan

AFTER alluding to ancient indigenous methods of providing water for crops, Sir Murdoch Macdonald proceeded to discuss the modern system of perennial irrigation (under which provision has also to be made for drainage) adopted in consequence of the introduction of cotton cultivation by the Khedive, Mohammed Ali. The first work of construction in that connexion was the Delta Barrage, completed in 1861, but, owing to defects in the foundations, not brought into effective use until the British occupation, when the works were strengthened. The succeeding structures of the same type at Assuan, Asyut, Esna and Nag Hammadi were historically noticed, and then reference was made to various schemes put forward from time to time for impounding the water of the Blue Nile and the White Nile above Khartoum. Figures were quoted to show the benefit to Egypt of the Assuan Dam. The 1,000 million cubic metres of water originally impounded would be increased by the re-heightening to at least 4,800 million cubic metres and the normal summer supply would be increased by about 66 per cent. The contemplated Gebel Aulia reservoir would contain about 3,000 million cubic metres and would possibly be able to pass 2,500 million into the river. A Lake Albert Dam, only 8 metres in height, would impound about 40,000 million cubic metres, but would require to be coupled with works which would conserve the waters as they passed down the river and prevent their being wasted as at present in the Sudd region. Sir Murdoch touched upon the schemes put forward for preventing the immense loss of water due to evaporation from the marsh formed by the main stream between the Sobat and Bahr-el-Ghazal. The whole territory including the marsh region has an area of about 90,000 square miles and might become a wonderful timber growing country. Summing up the position between Egypt and the Anglo-Egyptian Sudan, he said that the large volumes of water passing in flood, of which Egypt can only use a small part, would make it possible for the Sudan to divert a great quantity without detriment to her neighbour. All the conceivable diminution by future reservoirs would not be sufficient to reduce the flood volume below the known requirements of Egypt for the fertilisation of its flood crops.

Telephony and Telegraphy in Great Britain

SIR THOMAS PURVES, engineer to the Post Office, contributes to the British Industries Number forming a supplement to the *Times* of November 1 an interesting article on the industries connected with telegraphy and telephony. In the earlier days of telegraphy, Great Britain was pre-eminent in the manufacture of high quality Morse and Wheatstone automatic apparatus. The very fact of the excellence

of this equipment somewhat delayed the adoption of type-printing telegraphs in Great Britain, but the whole supplies of the telegraph system are now being manufactured at home. It is hoped that the establishment of the teleprinter exchange service which is being introduced by the Post Office as an adjunct to the public telephone switching system will produce a further extensive demand for these ingenious machines. Before the year 1912, when the telephone service of Great Britain was transferred to the Post Office, a large portion of the equipment was purchased from abroad. Now the proportion of foreign material purchased by the Post Office is less than one per cent of the whole. A great impetus was given to the mass production of apparatus on precision principles in 1922 by the general adoption of standardised types of automatic exchanges. This policy encouraged other nations to follow suit and export markets to several countries were opened up for automatic telephone equipment manufactured in Great Britain. The circuits and mechanisms developed for automatic exchanges opened up independent fields of application in other directions, such as the supervisory control of electrical power plant, centralised railway control and the electrical equipment of the totalisators now operating on racecourses. Telephone manufacturers were quick to take advantage of these applications.

Telephone Development

THE economic blizzard from which the world is now suffering has affected the rate of telephone development in Great Britain to a smaller extent than in any other of the principal nations. Sir Thomas Purves states that the net increase per annum in Great Britain in recent years has been about 125,000 stations. In the last complete year (1931–32) it fell to 84,000. Nevertheless, it is the largest increase recorded in any country of the world for the same period. For the whole of Europe, outside of Great Britain, the net increase was less than 200,000. In some countries the number of cessations of service exceeds the number of new subscribers and a net loss is registered. In North America, for example, the net loss is about 550,000 stations. For the current year, it is probable that there will be a net increase in Great Britain of about 80,000 and that many of the countries of Europe will show actual losses. In America there will be a large loss. If a revival of trade occurs, the telephone development of Great Britain will go forward by leaps and bounds. In the matter of underground, telegraph and telephone cables, Great Britain has been from the first a pioneer. For building open telegraph and telephone lines it is still necessary to depend on Norway and Sweden for slow-grown raw timber. English and Scottish mountain pine and Canadian and Australian timber have proved disappointing. The use of poles of metal and concrete has been investigated on numerous occasions, but so far the cost of these alternatives has proved prohibitive. The timber used for general construction purposes is obtained entirely from home and Empire sources. The whole of the extensive radio plant and apparatus for long-distance communication used by the Post Office is of British manufacture.

Recent Developments in the Utilisation of Electricity

IN his inaugural address as chairman of the North-Western Centre of the Institution of Electrical Engineers, Mr. G. F. Sills discussed a very large number of recent developments in the utilisation of electricity. One of the most important and most promising of electric devices is the mercury arc rectifier. When supplied with direct current, it can be made to generate alternating current voltage at any frequency. It can also supply direct current when supplied with alternating current. It provides a link between a.c. and d.c. systems which works either way. Batteries can thus be used as a reserve on a.c. systems. One of the most important applications is to feed single-phase railways from a three-phase system at a different frequency. The standardisation of systems of supply for electric railways is thus not likely to lead to much trouble, as by the aid of the rectifier any kind of electric supply can be converted into any other. By its use it will soon be possible to transmit power by high-voltage direct current and this will lead to considerable economies in transmission. Obstruction lights are now being placed on power lines for marking obstacles along airways. They generally consist of neon tubes operated either at high or low voltages. They are used also to indicate high buildings and wireless masts. The light gives a large splash of red colour and is easily distinguished from other lights near the ground. Another interesting application is the reading of consumers' electric meters by means of telephone lines, the connexion being made through the power company's connexion with the telephone exchange. A device for indicating the presence of a dangerous amount of coal gas is also described. It works automatically, closing an alarm circuit, and it can be made to switch on an electric fan to clear the dangerous area.

Manufacture of Lenses

THE presidential address of Mr. W. Taylor to the Institution of Mechanical Engineers on October 28 was mainly devoted to the application of mechanical engineering to the production of lenses, particularly photographic lenses, which to-day are made by the tens of thousands. One of the characters of mechanical engineering, he said, is the extraordinary accuracy regularly attained in its best products. One thousandth of an inch is approximately the limit of accuracy which can be attained in the ordinary machining of metal with cutting tools, one ten thousandth the order of accuracy by grinding and lapping; but in making the best photographic lenses and other optical instruments of precision, the accuracy of the surfaces of the elements, such as lenses, prisms and mirrors, must be from one hundred thousandth to a few millionths of an inch, and this accuracy is attained in everyday working, not only by skilled artist craftsmen, but also by less skilled