HIGH-TENSION TRANSMISSION LINES.

INTRODUCTION BY PRESIDENT SCOTT.

The invention of the steam engine underlies the progress of the nineteenth century. Cheap and abundant mechanical power has been a prime factor in that advancement. The railroad, the steamship, the machine shop, the factory, the rolling mill, the modern printing press and the mine hoist are developments which are based upon the steam engine. If the coal supply be shut off, the whole mechanism of our modern civilization comes to a standstill. There have been two lines of development; one of the engine for producing power, the other of machines and appliances for utilizing power. On the one hand, the development has been toward engines of large output to secure highest efficiency, and on the other hand, its load of innumerable tools and machines has sprung up demanding power often in small units and sometimes at varying speed. The development of the engine and of the machines for utilizing power has been much more rapid than that of the appliances for transmitting and distributing power from the source to the consumption. All of the various agencies; shafting, belting and various types of mechanical, pneumatic and hydraulic transmission—the primitive methods of transmission—found their ready limitations in efficiency, in capacity or in distance. It was because it supplied this missing link so effectively that the electric motor and electric power distribution has had so phenomenal a development. Electric distribution is so far superior in point of flexibility, efficiency and effectiveness to other methods that it has superseded them except in the most limited fields. But the transcendent characteristic of electric transmission is its application to long dis-

tances. Compared with preceding methods of transmission electric distances are infinite.

Electric transmission in its unique and infinitesimal form has replaced the speaking tube by the telephone, and has given new possibilities to human speech. So, also, it has given to power development—the vital element in the industrial and commercial progress of the past century—possibilities of a new order. It not only transmits and conveys, but it has made available a new source of power—not beds of stored energy, but waterfalls of wasting energy.

The relation between distance and voltage is well known. The past ten or a dozen years have witnessed a steady advance in the voltages in commercial use. Additions from the experimental and undeveloped regions of high voltage have been conquered and brought into the domain of commercial service. The line between that which is practicable, and that which is indefinite and uncertain, has continually advanced. Each increase in voltage introduces new problems, reveals new classes of phenomena and presents difficulties more complex. Problems in construction and design and installation of apparatus; problems in insulators and line construction; problems in switching, controlling and measuring current; problems in lightning and static protection have been presented and solved with each advance in voltage. It has not been so many years since 100 or 200 k.w. to be transmitted 20 or 30 miles at 10,000 volts, was considered a somewhat remarkable undertaking.

The changes from the conditions of ten years ago to those of to-day have been, step by step, along the lines of scientific and engineering progress. The advance has been an evolution. The problems in transmission have been engineering problems, they have been far-reaching problems. Electrical theory, mathematical formulæ, the brilliant inventor, the skillful designer, the careful experimenter and the intelligent operator have all contributed to the continuous solution. Prime factors in the advance have been experience and the ability to interpret experience and make it the foundation for further advance. The purpose of the Transmission Committee of THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS is to utilize experience. Mistakes have been made; they have been overcome. Experience has demonstrated what is successful. There is no credit to the electrical engineering profession in reducing the efficiency of electrical enterprises by repeating mistakes. The responsibilities

which rest upon the profession call for the most efficient coöperation for the elimination of inadequate methods. We must crystallize through present practice that which should be made standard practice. We must make definite the steps already taken and lay the foundation for the future.

The progress in high tension transmission is indicated by the transformer statistics of one of the large manufacturing companies. Transformers for 10,000 volts and over have been built during the past twelve years. Units recently built have three times the output of the largest transformers of five years ago. The aggregate output has been over a million kilowatts. The average kilowatt output per month during the past year is equal to the total output during the first seven years. The output of the past two years has exceeded that of the preceding ten years.

I repeat that the transmission problem is an engineering problem. It is not a simple one. It is difficult; it is comprehensive; it is not a one man problem to be solved by some individual with a peculiar scheme. It is a problem for the engineering profession. It is one to which the engineers who operate plants, who use apparatus as well as those who invent and design must contribute. We must coöperate. After we have helped one another all we can there are still problems which will tax the most able and most active.