DYNAMIC ELECTRICITY, ITS MODERN USE AND MEASUREMENT, CHIEFLY IN ITS APPLICATION TO ELECTRIC LIGHTING AND TELEGRAPHY

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Trieste

DYNAMIC ELECTRICITY,

Its Modern Use and Measurement, chiefly in its Application to Electric Lighting and Telegraphy;

INCLUDING

I. SOME POINTS IN ELECTRIC LIGHTING,

BY DR. JOHN HOPKINSON, F. R. S.

II. On the Measurement of Electricity for Commercial Purposes,

BY JAMES N. SHOOLBRED, M. INST. C. E.

III. ELECTRIC LIGHT ARITHMETIC,

BY R. E. DAY, M. E.

NEW YORK:
D. VAN NOSTRAND COMPANY.
23 MURRAY AND 27 WARREN STREET.
1896.

I.

SOME POINTS

—IN—

ELECTRIC LIGHTING.

BY

DR. JOHN HOPKINSON,

F. R. S., M. Inst. C. E.

PREFACE.

THE component parts of this little book relate entirely to the practical uses of electricity.

Dr. Hopkinson's lecture before the Institution of Civil Engineers presents the subject of Electric Lightning in the aspect of an engineering problem, in which the *quantities* in question are as satisfactorily estimated as in hydraulics.

Mr. Shoolbred's paper, prepared for the Society of Telegraph Engineers, is an extension of the subject in the same direction. As it was prepared for practical electricians it is the more technical of the two papers.

The problems are selected from R. E. Day's excellent compilation known as Electric Light Arithmetic.

SOME POINTS IN ELECTRIC LIGHTING.

ARTIFICIAL light is generally produced by raising some body to a high temperature. If the temperature of a body be greater than that of surrounding bodies it parts with some of its energy in the form of radiation. Whilst the temperature is low these radiations are not of a kind to which the eye is sensitive; they are exclusively radiations less refrangible and of greater wave-length than red light, and may be called infra red. As the temperature is increased the infra red radiations increase, but presently there are added radiations which the eye perceives as red light. As the temperature is further increased, the red light increases, and yellow, green and blue rays are successively thrown off in addition. On pushing the temperature to a still higher point, radiations of a wave-length shorter even than violet light, are pro-

duced, to which the eye is insensitive, but which act strongly on certain chemical substances; these may be called ultra violet rays. It is thus seen that a very hot body in general throws out rays of various wave-lengths, our eyes, it so happens, being only sensitive to certain of these, viz., those not very long and not very short, and that the hotter the body the more of every kind of radiation will it throw out; but the proportion of short waves to long waves becomes vastly greater as the temperature is increased. The problem of the artificial production of light with economy of energy is the same as that of raising some body to such a temperature that it shall give as large a proportion as possible of those rays which the eye happens to be capable of feeling. For practical purposes this temperature is the highest temperature we can produce. Owing to the high temperature at which it remains solid, and to its great emissive power the radiant body used for artificial illumination is nearly always some form of carbon. In

the electric current we have an agent whereby we can convert more energy of other forms into heat in a small space than in any other way; and fortunately carbon is a conductor of electricity as well as a very refractory substance.

The science of lighting by electricity very naturally divides itself into two principal parts—the methods of production of electric currents, and of conversion of the energy of those currents into heat at such a temperature as to be given off in radiations to which our eyes are sensible. There are other subordinate branches of the subject, such as the consideration of the conductors through which the electric energy is transmitted, and the measurement of the quantity of electricity passing and its potential or electric pressure. Although I shall have a word or two to say on the other branches of the subject, I propose to occupy most of the time at my disposal this evening with certain points concerning the conversion of mechanical energy into electrical energy. We know nothing as