A Text-Book On Static Electricity

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STATIC ELECTRICITY

BY

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NEW YORK
McGRAW PUBLISHING COMPANY
114 LIBERTY STREET
1904

PREFACE.

The author was led to the preparation of this volume by the apparent lack of any suitable work of similar description. The subject of Static Electricity is touched on in the average "Physics" or "Natural Philosophy" in a most gingerly fashion; text-books devoted entirely to electricity seem to be either "Electric Machines" or "Alternating Currents," and avoid the subject entirely save for some slight consideration of the electrodynamic aspects of the condenser; some of the very numerous "Electricity and Magnetisms" have a certain amount of matter, not happily arranged for either a text-book or a book of reference, and are often unfortunately loose in statement and definition; and it would seem that the only adequate literature on the subject lay in papers so profound as to be practically inaccessible to the ordinary student or to him who desires to make a reference without reading whole volumes.

And so the author, who has had perforce to do a certain amount of reading on the subject, ventures to put forth this work. There is little or nothing original in it, but it is hoped that by the judicious combining of the wisdom of others in lucid and orderly fashion, and by keeping strictly to the subject of Electrostatics, he has made a volume valuable to the student, the physicist, and the casual seeker after electrostatic truths.

There has been a constant endeavor throughout the work to make the reading as simple as is consistent with exact-

ness and a reasonable terseness. The methods of the calculus have been avoided save where demanded for preciseness or compactness of expression. The copious index will enhance its value as a book of reference.

In the Appendix have been put two tables and a few paragraphs which, while not strictly appertaining to the subject of this book, will, it is believed, be of interest to him who is interested in electrostatics. Many students of electricity are hazy regarding, if not quite ignorant of these two subjects, the physical dimensions of units, and the relation between the units of the electrostatic series and those of the electromagnetic system.

Acknowledgment of indebtedness is herewith made to those manufacturing concerns that have given information regarding, and loaned electrotypes of their apparatus.

HOBART MASON.

BROOKLYN, N. Y., *November,* 1903.

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STATIC ELECTRICITY.

CHAPTER I.

GENERAL PHENOMENA.

1. Historical.—Electricity is the name given to that which produces electrical phenomena, but while electrical phenomena are well known and understood, the nature of electricity is as yet unknown. The term "electricity" comes from the Greek ἤλεκτρον, amber, since, as Thales of Miletus (600 B. C.) informs us, the ancient Greeks recognized the fact that amber when rubbed attracted light particles to it, or as we would say, became electrified. Until about 1600 amber and jet were the only substances that were known to have this property. Then Dr. Gilbert discovered that many substances, such as glass, resin, sulphur, and others, also possessed this property, so the seventeenth century marks the real beginning of electrical science.

2. Attraction.—The most obvious property of an electrified body is that of attraction. This property is easily illustrated by rubbing a piece of amber, as did the Greeks, and noting that it will then attract dust, chaff, small bits of straw and paper, or a pith ball suspended on a thread. In experiments of this nature it is usual to use not amber for the body to be electrified, but a stick of vulcanite (hard rubber) which is rubbed by a

piece of cat's fur, or a glass rod rubbed by a silk cloth. The property of attraction can further be well shown by holding the electrified stick of vulcanite near a thin stream of water, as in Fig. 1, and noticing that stream is deflected so as to flow nearer the vulcanite. Since the presence of moisture precludes the possibility of successful electrification, care must be taken in this experiment that neither the stream nor any spray from it be allowed to touch the electrified body.

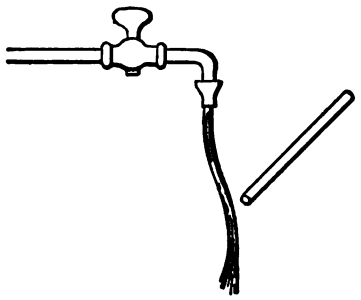

FIG. 1.

Electrostatic attraction can also be shown by briskly drawing a sheet of paper between the coat-sleeve and the side. The paper is then electrified, and if laid against the wall without more handling than necessary, it will so strongly attract the wall as to sustain its own weight until its electrification is exhausted, perhaps for a quarter of an hour. Like all other electrostatic experiments, this one will work more satisfactorily on a dry day, and even a reasonable amount of humidity may cause it to fail entirely.

Those who have dry, light hair have often observed that, on running the comb through it, the hair is attracted

by the comb even after the latter has been removed some inches from the head. This happens only on dry days and with combs of hard rubber or similar material. Metal combs cannot be made to produce this effect. It sometimes occurs that on brushing the clothes it seems impossible to remove the dust, and the more vigorously the brush is wielded the more tenaciously the dust seems to stick. This is due to the electrification of the cloth and the consequent attraction of the dust particles.

3. Electrification and Charge.— When a body has acquired the power of attraction illustrated in the last section it is said to be electrified, or to carry a charge of electricity. In the consideration of this matter it is convenient to think of the electricity as something material that is laid on to the body in charging it. The quantity laid on is a measure of the *quantity* of the charge, and the thickness with which it covers the body is a measure of the *surface density,* sometimes called *tension,* of the charge. It must be remembered that this idea is entirely fictitious, but it affords a convenient way of gaining a comprehension of the actions and relations of electricity which in itself is uncomprehended.

When a charged stick of vulcanite attracts to itself a piece of paper, energy must be expended in moving that paper. Since the vulcanite was powerless to move the paper before it was electrified it must have received the energy in the process of charging, since by the law of conservation of energy, energy cannot be created, but only transferred and transformed. If the vulcanite had been charged by rubbing with cat's fur, enough energy was expended in the rubbing to account for the energy the vulcanite afterward showed itself to possess when it attracted the paper chip. If the vulcanite had been electri-