

**A PRACTICAL TREATISE
ON LIGHTNING
PROTECTION**

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A Practical Treatise on Lightning Protection by Henry W. Spang

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HENRY W. SPANG

**A PRACTICAL TREATISE
ON LIGHTNING
PROTECTION**

A
PRACTICAL TREATISE
ON
LIGHTNING PROTECTION.

GIVING COMPLETE AND EXPLICIT INSTRUCTIONS FOR THE
PROTECTION OF BUILDINGS AND EXPLAINING THE
DEFECTS OF THE LIGHTNING CONDUCTORS
NOW ERECTED.

BY
HENRY W. SPANG.

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PREFACE.

THE following treatise is based upon observation and facts, and is the only work which fully and properly explains the action of the electricity of the air and earth, while uniting during a lightning discharge.

It contains more complete and explicit directions for applying lightning-conductors to buildings than those given in the treatise issued by me in April, 1877, or contained in any other work. It is issued with a view of effecting a general introduction of the radial systems of lightning-conductors herein described, which are patented and endorsed by the most prominent electricians and scientists, and will, beyond doubt, supersede the unreliable systems of lightning-conductors heretofore employed, many of which have no less than four serious defects.

The persons heretofore engaged in the business of manufacturing and erecting lightning-conductors have not thoroughly and properly investigated the action of the electricity of the air and earth while uniting during a lightning discharge, and, consequently, have not constructed and applied them to buildings, etc., in a proper manner. They have, erroneously, been governed by experiments with artificial electricity, which are not legitimate illustrations of the action of the electricity in a lightning discharge.

The author has had a practical experience of over twenty years in the electrical business, and has given the subject of lightning protection considerable attention.

He is confident, when the radial systems of lightning-conductors herein described are employed, and applied to buildings, etc., in accordance with the directions given, that absolute protection to life and property will be effected.

HENRY W. SPANG.

READING, PA., July, 1883.

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A
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LIGHTNING PROTECTION.

Introductory.

IN order that the reader may have a proper knowledge and comprehension of the electrical laws and principles in accordance with which lightning-conductors should be constructed and applied to buildings, etc., the principal technical terms used in the electrical science, certain properties and relations with which electricity is endowed, also the principal known facts relating to the electricity of the atmosphere and earth, and to the destructive discharges, commonly known as lightning, which take place between them, are first explained. After which, general information in reference to lightning-conductors is given, including complete and explicit directions for their proper construction and application to buildings, also a full explanation of the defects of those heretofore employed.

Notwithstanding the failure of many of the lightning-conductors heretofore erected to afford protection, and the prejudices existing against their employment, it remains an undoubted truth that the large number of lives and vast amount of property that are needlessly jeopardized can, with certainty, be protected from injury or damage by lightning.

Electricity and its Action.

ELECTRICITY is one of the great forces of nature pervading the air, earth, and all matter, and is as universal in its effects as are light and heat. It was first noticed by Thales, of Miletus, the

founder of Ionic philosophy, about 600 years before the Christian era. He observed that when amber was subjected to friction, it acquired the power of attracting light substances, such as small pieces of feathers, paper, etc., and on this account was led to attribute to it a species of vitality. Its name is derived from *elektron*, the Greek word for amber.

We are cognizant of its existence, but we do not know its particular form any more than we know that of sound or light. It is, however, subject to laws as definite and invariable as those which govern the motion of the planetary system. Adopting the views of the eminent electrician, Faraday, who considered electricity as "an axis of power having contrary forces, exactly equal in amount, in contrary directions," scientific men of all nations now recognize two kinds of electrical force, which are distinguished by the terms *positive* and *negative*; but they do not assume the existence of any particular kind of matter to which the term electric fluid may be applied. The positive electrical force is generally indicated by the algebraic sign + (plus), and the negative by the sign - (minus).

In the natural state of a body, the two electrical forces are supposed to be equally balanced or distributed, or, in other words, every portion of the body contains the same amount of each of the two electrical forces, thereby forming an equilibrium between them, and they are then said to be *neutral*, or inactive.

The electrical equilibrium of a body may be disturbed by friction, chemical action, changes of temperature, and other causes; and then the two electrical forces will be separated, the positive accumulating in one portion of the body, and the negative in another, and in such case electrical action is exhibited, and the body is then said to be *electrified*, or charged with electricity.

When a body, or part thereof, contains all positive, or more positive than negative electricity, it is said to be positively electrified or charged; and when it contains all negative, or more negative than positive, it is said to be negatively electrified or charged.

Electric quantity is the term applied to the amount of electricity present. *Potential* (heretofore generally termed tension) implies that function of electricity which determines its motion from one

point to another, and the difference of potential, which determines the amount of this motion, is known as *electro-motive force*.

When the two opposite electricities are accumulated on bodies separated from each other, and are in a state of rest, they are said to be in a *static* state; and when they rush towards each other, to restore the equilibrium between them, they are said to be in a *dynamic* state. In the static state they reside upon the surface of the bodies, while in the dynamic they pervade every portion of the body through which they pass.

The rushing together and uniting of the two opposite electricities is known as a *discharge*; and when the discharge takes place over a good conductor, it is generally termed a *current*, and the path over which a current of electricity flows is known as the *circuit*.

Resistance is the term applied to the opposition or obstacle opposed to the passage of electricity by the substance or body through which it passes. It is the inherent property of every substance. The various metals offer a low resistance and permit electricity to flow freely through them, and are termed *conductors*, while stone, brick, wood, dry earth, glass, gutta-percha, and the air offer a high resistance to it, and retard its flow, and are termed *non-conductors* or *insulators*. Well burnt charcoal, metallic ores, coke, water, and vapor are medium conductors; and all the so-called non-conductors or insulators allow electricity to flow through them, to a certain extent.

Bodies charged with the same kind of electricity repel each other, but when charged with opposite electricities, there is a mutual attraction and disposition to unite and form an equilibrium between them. This is the fundamental law of electric action. Electricity manifested by different means is characterized by different properties. The electricity manifested by ordinary friction has a high potential, and is able to readily overcome the resistance of poor conductors, while its quantity is small, and therefore produces weak magnetic and mechanical effects.

On the other hand, the potential of the electricity manifested by the chemical action in a galvanic cell or battery is low, and cannot overcome great resistance, while its quantity is great and is capable of producing powerful magnetic and mechanical effects.