CIRCULAR OF INFORMATION. PROTECTION FROM LIGHTNING

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U. S. DEPARTMENT OF AGRICULTURE,
WEATHER BUREAU.

CIRCULAR OF INFORMATION.

PROTECTION FROM LIGHTNING

BY

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LETTER OF SUBMITTAL.

WASHINGTON, D. C., *April* 24, 1894.

SIR: In accordance with the direction of the Honorable the Secretary of Agriculture, in letter of April 18, 1894, the accompanying paper, entitled "Protection from Lightning," is submitted for publication as a circular of information. Upon few subjects is the community so liable to be misled as the question of the best methods of protecting life and property from lightning. The following pages give statistics of actual losses, the theory of protection in language free from technicalities, a collection of practical rules for guidance in selecting and maintaining conductors, and, finally, a notable illustration of the successful use of protectors.

The aim of the paper is to furnish information of practical value to all classes, and especially to farmers, builders, and physicians.

Very respectfully,

ALEXANDER MCADIE.

MARK W. HARRINGTON,
Chief of Weather Bureau.

PROTECTION FROM LIGHTNING.

At the Aberdeen meeting of the British Association for the Advancement of Science Sir William Thomson made the remark, "If I urge Glasgow manufacturers to put up lightning rods they say it is cheaper to insure than to do so."

This was the answer given by practical business men, concerned only with questions of profit and loss, to the foremost physicist of our time; and their answer will serve as fairly representing views widely held, founded upon the double belief that the risk from lightning is not so very great and the protection afforded by the present methods not sufficiently certain to warrant implicit confidence and justify the necessary expense.

The recent remarkable experiments of Dr. Oliver Lodge, in his lectures before the Society of Arts, opposing and to some degree directly contradicting the empirical rules of the Lightning Rod Conference, have given support to the belief that the protection was uncertain. Indeed, realizing that his work might be misinterpreted, Lodge has stated "an idea at one time got abroad that my experiments proved existing lightning conductors to be useless or dangerous; this is an entire misrepresentation. Almost any conductor is probably better than none, but few or no conductors are absolute and complete safeguards. Certain habits of lightning rod practice may be improved and the curious freaks or vagaries of lightning strokes in protected buildings are intelligible without any blame attaching to the conductor; but this is very different from the contention that lightning rods are unnecessary and useless. They are essential to anything like security."[1]

What Lodge's brilliant experimental work does show is that the momentum of an electric current can not be overlooked in a lightning discharge. The old "drain-pipe" idea of conveying electricity gently from cloud to earth must give place to the new proposition, based upon recent discoveries, that even draining off must be done in an appropriate way to be effective. To illustrate, the rocks and trees upon a mountain side may influence and determine the course of a mountain stream, but even a good sized channel would not suffice to carry off safely an avalanche, or control the path of a landslide; so with lightning. In the past four years we have learned, through the work of Hertz and others, that when an electric current flows steadily

[1] Page VI. "Lightning Conductors and Lightning Guards."

in one direction in a cylindrical wire its intensity is the same in all parts of the wire; but if the current be of an oscillatory character, i. e., a current which rapidly reverses its direction, the condition no longer holds, and if the alternations are very rapid the interior of the wire may be almost free from current. If lightning then be a discharge of an oscillatory character, it may happen that the current down the lightning rod would be only *skin* deep. The experiments of Tesla and Elihu Thomson with currents of great frequency of alternation and very high potentials open the door to systematic study of discharges such as the ordinary lightning flash. In daily work currents of this type are coming more and more into prominence, and the time is not far distant when the lightning flash will be studied as an electrical discharge of this character. Protection entirely adequate for such discharges will then be forthcoming. Indeed, the reasons why present methods occasionally fail are now understood, and the proper remedies apparent.

And first let us see whether it is cheaper to insure than to provide proper protection. Foreign countries, especially Germany, France, and Great Britain, have recognized the importance of obtaining reliable data concerning the loss of life and damage to property through lightning. Perhaps the work of the Royal Prussian Bureau of Statistics[1] gives the fullest and most detailed accounts of the damage done by lightning in Germany, and the relative injury. Statistics are available for the number of houses struck, the number of fires, the character of the roofing, soil, etc.

In 1891 the Weather Bureau issued to its observers instructions to report at the end of every month the names, with corroborative dates and places, of all persons killed by violent windstorms, tornadoes, and lightning. During 1890 somewhat similar statistics had been gathered, but the returns were less systematically arranged. In preparing the Weather Bureau lists, observers were directed to examine all daily papers published in their respective cities, consult all local authorities, and make inquiry if necessary. Naturally, where dependence was had upon newspaper items, there resulted much duplication, but in verifying names and dates the duplicates quickly appear and exaggerated reports are easily confined to proper limits.

Mr. H. F. Kretzer, of St. Louis, Mo., has for some years tabulated the number of deaths due to lightning, and has kindly placed his lists at the disposal of the Bureau. His sources of information were 192 newspapers, daily, weekly, and monthly. He found for five years, 1883–'87, a total of 1,030 deaths caused by lightning, or a yearly average of 206.

[1] Beiträge zur Statistick der Blitzschlage in Deutchland; von Dr. Hellman, Berlin, 1886.

This agrees very well with the Weather Bureau records which I have tabulated.

Deaths due to lightning in the United States, Weather Bureau records.

Month.	1890.	1891.	1892.	1893.
January				
February				
March	2			5
April	6	13	5	19
May	8	23	27	17
June	37	73	74	66
July	55	58	67	73
August	12	34	54	18
September		9	15	8
October			6	2
November			1	
December			2	1
Totals	120	204	251	209

Or 784 lives in four years, an average of 196 lives per year.

A glance at the table shows that these lives were practically all lost in five months—April to September—and that in June and July the maximum death rate occurs.

The Weather Bureau records unfortunately do not give information as to the extent of damage to property. To get at something like a fair commercial estimate of the destruction of property by lightning, I have made use of the "Chronicle Fire Tables" for the eight years 1885-'92. It is hardly necessary to remark that these tables are compiled from the reports of the fire departments, insurance companies, and the reports of fires in the public press, and represent a high degree of accuracy.

From information contained in these volumes, the following tables have been compiled:

Fires caused by lightning.

Year.	Number of fires.	Loss on original risk.
1885 to 1890, inclusive	2,220	$8,386,826
1891	457	1,355,525
1892	839	2,921,484

Or, in eight years, ending 1892, in the United States, and for the most part west of the Rocky Mountains, 3,516 fires, with a loss of $12,663,835.

It is very evident, therefore, that the damage done by lightning is no inconsiderable matter to be lightly passed over or turned off by replies such as the one given by the Glasgow manufacturers. It is certainly worth while to erect the proper protective apparatus.

The losses in detail are as follows: