Lightning
Nature's fireworks

Each year lightning strikes cause expensive damage to electrical power transmission systems. In the laboratories of the Division of Electrical Engineering, intense electrical impulses can be produced for short durations. These are used in the testing of insulators, switches, transformers and other components of our electric power system. Tests like these aid in the establishment of standards and the improved design of power equipment.

The masters of mystery weave an aura around it — for what better time for dastardly deeds than "in thunder, lightning, or in rain". Throughout the ages, fear, superstition and myth have surrounded it. Today, entire cities can be crippled by it. But what is lightning — that phenomenon of weather usually accompanied by storm activity, which causes more direct deaths than tornadoes or snowstorms, and is the greatest single cause of forest fires in Canada, igniting over 2,100 annually?

Dr. T. R. McComb of the National Research Council's Electrical Engineering Division explains: "Electrical charges building up in the atmosphere cause an increase in voltage between parts of a thundercloud and between the cloud and ground; when the voltage generated becomes large enough a spark-over occurs. This high current discharge of atmospheric electricity occurs from one part of a cloud to another, or from cloud to ground, and it is the lightning stroke that is seen."

Dr. McComb and his colleagues in the Power Engineering Section of the Division simulate lightning in the laboratory using an impulse generator. In this generator, capacitors are charged in parallel and then switched into a series connection by spark gaps. In the NRC laboratory, up to 1.2 million volts can be generated in this way using a 100,000 volt supply. One of the Section's concerns is with the effects of lightning on transmission systems which, as evidenced by last summer's blackout in New York City and last fall's in Quebec, are the lifelines of our very existence.

In order to minimize lightning damage to electrical transmission systems, lightning protection devices are used which dissipate the energy of lightning-induced surges. The voltage at which these devices operate must be coordinated with the voltage which the system insulation will withstand and an appropriate safety factor used. "Present practice," points out Dr. McComb, "uses a large safety factor which is not economical. As transmission lines carry higher and higher voltages, a large safety factor has become very expensive so we are seeking ways of significantly reducing this margin." One part of the work is on impulse measuring systems which are used to measure test voltages applied to power system equipment. If these test voltages can be measured more accurately, a part of the uncertainty can be reduced.

The Division is also carrying out lightning research on the CN Tower — at 1,800 feet, the world's tallest self-supporting structure — in cooperation with the University of Toronto, Ontario Hydro and others. Because of its height, this tower is struck many times each summer by lightning, disproving the old adage that lightning never strikes twice. For this reason it is an ideal site to study the electrical currents associated with lightning. The Tower has lightning protection built into it, "but," points out Dr. McComb, "this is another of the common misconceptions about lightning. Lightning protection does not prevent lightning, it simply provides a safe path for its discharge."

When it comes to personal safety in a lightning storm, the following points should be remembered. Since a car has an all-metal body, it acts as a shielding cage — the lightning currents flow through the metal protecting the occupant. When a body of water is struck, the current flows through it so that people are often injured while swimming. Thus, it is advisable to get out of the water at the first hint of a lightning storm. Concludes Dr. McComb: "Golfers should know the location of underground sprinkler systems and avoid them and never go under isolated trees which are more likely to be struck with the attendant possibility of a side flash to anyone nearby." □

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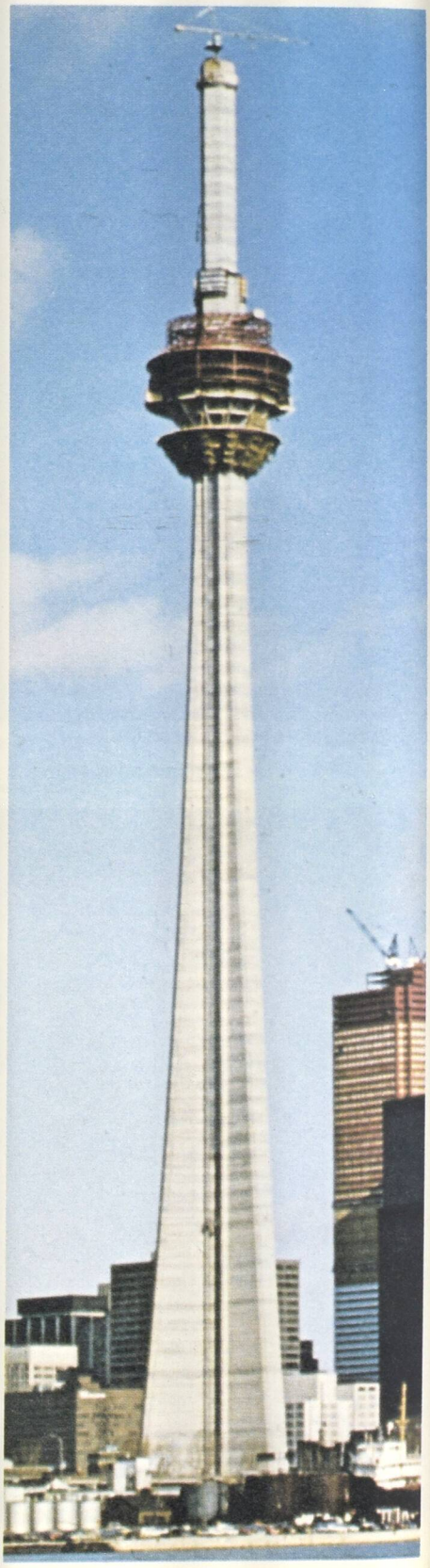

Toronto's CN Tower, struck many times each summer, is an ideal site to study the electrical currents associated with lighting.

La Tour du CN à Toronto est frappée plusieurs fois par la foudre chaque été et c'est pourquoi les chercheurs la considèrent comme un site idéal pour l'étude des courants électriques qui accompagnent ce phénomène naturel.

CN Tower/La Tour du CN