BOOK REVIEW

V.A.Rakov and M.A.Uman, *Lightning: Physics and Effects*, Cambridge University Press, Cambridge, U.K., 2003, 687 pp., ISBN 0-521-58327-6, £ 160.

This is an extremely comprehensive – and, hence, incredibly useful – scholarly compendium of all that is known about lightning, its causes, and the many different ways in which lightning influences our world and our human activities. This resource has more than 300 top quality illustrations, including six pages of dramatic colour plates, 70 tables, and over 6000 bibliographic and reference entries.

Each of the 20 chapters starts with an introduction, closes with a valuable summary, and is followed by the references and bibliography for that chapter. Chapter 1 is a broad ranging historical introduction to the topic of lightning, where terminology, some salient features of negative cloud-to-ground lightning, and the global atmospheric electric circuit are explained. The next chapter is on the incidence of lightning, its geographical variations, ''thunderstorm days'', lightning flash counters, lightning location systems (including satellite-based systems), long-term temporal variations, seasonal variations and lightning strike characteristics. Chapter 3 reviews the electrical structure of clouds which produce lightning, derived from electric field observations made at different distances from the thunderclouds. Mechanisms of electrification in cumulonimbus clouds are covered, as are those for stratiform clouds, particularly Mesoscale Convective Systems (MCS). The next chapter is a long one, on downward negative lightning discharges to ground (including the return stroke, leader processes and the continuing current); the next is on positive and bipolar lightning discharges to ground.

Chapter 6 is on upward lightning initiated by objects on the ground, with the next being on the triggering of lightning, e.g., by launching a rocket carrying a wire attached to the ground. The special topic of winter lightning in and around Japan is considered in Chapter 8. Discharges within or between clouds are considered in Chapter 9, with the next one being on discharges to aircraft – this includes reports on the accidents so caused.

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Thunder, together with infrasonic waves, generated by lightning is the subject of Chapter 11, with the modelling of lightning processes (particularly the return stroke and leaders) being dealt with next. Chapter 13 is on electromagnetic radiation from lightning at distances of more than a few hundred kilometers, i.e. atmospherics (''sferics''), plus Schumann resonances of the Earth-ionosphere cavity and whistlers. Sprites, elves and blue jets are reviewed in Chapter 14, and their causes investigated. The effects of lightning on the chemistry of the middle atmosphere, e.g., the production of nitric oxide and ozone, are then discussed.

Chapter 16 is on lightning occurring elsewhere in the solar system, especially on Venus, Jupiter and the other giant planets. Various lightning location systems for use on planet Earth are then covered. Chapter 18 concerns lightning protection techniques on the Earth's land surface and at sea. The hazards posed by lightning to both humans and animals are reviewed. The final chapter is on unusual lightning phenomena such as ball lightning, bead lightning and volcano lightning.

This magnificent work, so useful both for teaching at postgraduate level and for reference, closes with a very comprehensive index.

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