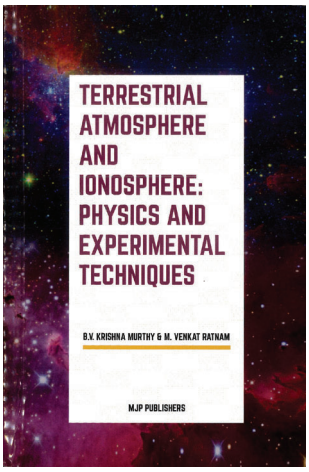

Terrestrial Atmosphere and Ionosphere: Physics and Experimental Techniques. B. V. Krishna Murthy and M. Venkat Ratnam. MJP Publishers, 44, Nallathambi Street, Chennai 600 005, 2021. xxiv + 672 pages. Price: Rs 2400.

Life on Earth is enabled, in part, by the type of constituents that exist in the terrestrial atmosphere. The right amount of oxygen in the lower atmosphere, the ozone in the stratosphere, the water on the ground and the magnetic fields of the earth, all contribute to enabling life on earth. The X-ray and extreme ultraviolet solar radiation ionize part of the upper atmosphere, forming the ionosphere, which refers to the charged particles (plasma) present in the background of neutral species in the thermosphere. Solar ultraviolet radiation is absorbed by the Ozone in the stratosphere. The magnetic field of the earth prevents the ionospheric plasma from being lost into deep space due to its interaction with the solar wind. The upper atmosphere is also the region where almost all the application satellites orbit. Thus, understanding the terrestrial atmosphere and the ionosphere and their inter-coupled nature is of utmost importance for not only ensuring the sustenance of life on earth, but also for enabling various societal applications, dependence on which is growing day by day. The atmospheric regions are dynamic in nature as they respond to variations in solar and lunar forcings, tidal influences, temperature and pressure gradient forces, etc. All these vary as functions of the solar cycle, seasons and solar zenith angle. As the earth is a magnetized body, magnetic field lines render the motion of charged particles anisotropic, introducing further complications in modelling the ionosphere–thermosphere system. Therefore, to comprehensively understand and model atmospheric dynamics as a whole, it is essential to understand the underlying theory well and appreciate the experiments that have been carried out so far. In this background, the book, *Terrestrial Atmosphere and Ionosphere: Physics and Experimental Techniques*, written by B. V. Krishna Murthy and M. Venkat Ratnam, is extremely apt, as it addresses all these aspects. It is also timely as there is a growing interest in the country in studying all the Earth's atmospheric regions, coupling among them, and Space Weather.

The authors share over eighty years of experience in active research in atmospheric dynamics. They are renowned scientists and researchers that the country has produced. They have been prolific with high-quality and impactful peer-reviewed publications. The senior author (late) B. V. Krishna Murthy, a doyen in this field in India, has blended nearly six decades of his experience of active research, interaction with scientists, and mentoring of young minds in ensuring that the narration of the topics and their treatment seems more like a novel, rather than a textbook, so that even the uninitiated in the field can pick it up and go through it to obtain a flair of what atmospheric physics means. For scientists in other fields too, this book provides an easy gateway into the nuances and intricacies of the terrestrial atmosphere and ionospheric physics. Those who would have had the good fortune to be mentored and listened to the lectures given by B. V. Krishna Murthy would recollect his unassuming nature and the clarity with which he approached any given topic. His signature and imprint are clearly seen in this book. Some of these qualities have been imbibed by the other author M. Venkat Ratnam.

The topics covered extend from the boundary layer to the magnetosphere in twelve chapters. It includes aspects from the evolution of the earth's atmosphere to vertical structure and composition of neutral atmosphere, thermodynamics, energetics, interaction of solar radiation with atmospheric constituents, aerosols, radiative transfer, greenhouse gases, troposphere–stratosphere exchange processes, dynamical processes, circulations including monsoon, atmospheric waves and turbulence, boundary layer, middle atmosphere thermal structure, ionization in the upper atmosphere, ionospheric irregularities, ion-neutral coupling, radio wave propagations, and magnetospheric processes. In 655 pages, these topics and more are organized in three sections: (i) Terrestrial Atmosphere – Structure, Composition, Chemistry, Aerosols and Green House gases, (ii) Atmospheric Dynamics – Atmospheric Boundary Layer, Troposphere and Middle Atmosphere, and (iii) Ionosphere and Magnetosphere. The first two sections are covered in greater detail and occupy nearly three-fourths of the content.

Among the first two sections, the Dynamics of Earth's Atmosphere is covered exhaustively. The other three topics that are covered in greater detail in comparison to the others are Atmospheric Structure and Composition, Aerosols, Greenhouse gases and their effects on radiation budget, and Middle Atmosphere, wherein experiments with regard to ground-based and balloon-borne instrumentation for the measurements of winds and temperature, wind measurements from VHF and meteor radars, methods of investigation of the middle atmosphere are described. One full chapter is devoted to remote sensing of the atmosphere, wherein the retrieval of various atmospheric parameters from satellites is described.

The inclusion of chapters/sections specifically covering experimental techniques for measurements of winds, temperature, pressure, humidity, boundary layer, remote sensing of atmospheric parameters, and ionospheric parameters, etc. is a noteworthy feature of this book. The basics of all the experimental techniques are explained, along with the theoretical treatment required to appreciate the experiments.

The book has two Appendices, one with values of various parameters as a function of altitude which can serve as a ready reckoner, while the other lists a few questions pertaining to each of the twelve chapters.

This lucidly written book will be useful for the students, researchers, and faculty of atmospheric and space physics. Almost all the standard instruments, either small or big, that are used for earth's lower atmospheric studies are covered in reasonable detail. Almost all the terms used in the lower atmosphere are explained as required. Several of the complex topics are explained in a simple manner with illustrations that are easy to understand. Some standard or noteworthy figures from published literature are reproduced at appropriate locations to convey the concepts and large-scale processes. Many sketches are drawn to explain various atmospheric phenomena. Several mathematical derivations are given in an organized manner at appropriate locations with reasonable details to explain the point in question with a clear focus on the purpose. A student of atmospheric physics

would find almost all the topics of his/her interest in this book. The description of topics is good enough to gain a basic understanding of the concept(s) and to prepare the student to delve into greater details in more specialized books or peer-reviewed research publications. While going through several topics in this book, I felt that they were like lecture notes that a teacher could easily follow in his or her class. The topics are covered without losing sight of the rigour and, at the same time, allotting optimal space to do justice.

This book takes on the herculean task of covering a large canvas as it touches upon topics and processes right from the surface of the earth to deep above into the earth's space environment. Such an effort is commendable. In some sense, it can be considered a treatise on earth's atmospheric structure and dynamics. It is a must-read for students pursuing their Masters or Ph.D. in atmospheric sciences and a must-have in the libraries of universities and institutes.

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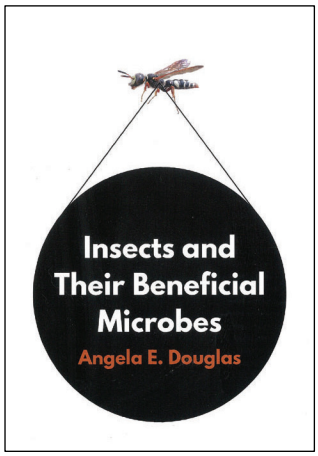

Insects and their Beneficial Microbes. Angela E. Douglas. Princeton University Press, 41, William Street, Princeton, New Jersey 08540; and 6 Oxford Street, Woodstock, Oxfordshire OX20 1TR, 2022. xiv + 330 pages. Price: US$ 39.95/£ 30.00.

In the burgeoning field of microbiome research, the study of insect microbiomes is making remarkable progress. Since Paul Buchner's fundamental work on unravelling intricate associations between insects and their microbial allies, the field has witnessed tremendous advancement. Over the years, technical advances coupled with the growing fascination for studying insects have uncovered the extraordinary might of tiny insects and their even tinier microbial partners. In her recent book *Insects and their Beneficial Microbes,* Angela Douglas provides an overarching, inside-out synthesis of our understanding of insects and their symbionts, stringing together a complex discipline filled with numerous model systems, approaches, outcomes, and applications.

Insects are an incredibly successful group of animals – their abundance, species richness and diversity in functional roles are unmatched. There are insects that feed on detritus, leaves, flowers, plant sap, animal excreta, blood, meat and even feathers. There are partially aquatic, terrestrial, and those that feed on different diets as larvae and adults. Within this bewildering diversity, the five major orders – Hemiptera, Coleoptera, Diptera, Hymenoptera, and Lepidoptera contain over 100,000 described species. One other life form that is spectacularly diverse, abundant, and functionally important is that of microorganisms. Reviewing these vast groups with dispersed literature, volatile taxonomies, and varying degrees of 'beneficial' interactions is no insignificant task. Therefore, a book that aims to document and describe beneficial associations between insects and microorganisms has a mammoth task. A task that Douglas accomplishes effectively through this lucid, instructive, and enjoyable book. Combining theory, specific examples, broad lessons, and stitching together commonalities and differences, the book provides an extensive overview of the past, present, and future of this emerging field.

One of the hallmarks of the book is a clear and logical flow of topics. Douglas carefully introduces the reader to the necessary concepts and terminology, providing a clear introduction to insect biology and possibilities for how insects can host and cooperate with beneficial microorganisms. There is remarkable diversity in how insects can associate with beneficial microorganisms. Douglas begins by classifying these associations as cases of ectosymbioses; describing the leafcutter ants, termites, and ambrosia beetles – the original inventors of farming who have been growing symbiotic fungi for millions of years; then considering the gut ecosystem, and the patterns and challenges involved in surviving and colonizing gut tissue, finally moving to endosymbioses – the most extreme form of symbioses where microorganisms reside inside specialized cells, organs or cavities in the insect.

The origin and maintenance of insect–microbe associations are central to the study of insect symbiosis. Exposure to myriad microorganisms through food, inter- and intra-specific contact, or the environment, the acquisition, and transmission of symbionts is a crucial aspect of these long-term associations. Parents, especially mothers, are important sources of beneficial microorganisms. In insects, parental care is not always present or is not as extensive as in higher animals, thereby limiting direct contact between mothers and offspring. Insect mothers have evolved complex and resourceful ways of transmitting microbes to their offspring. These involve symbiont transmission through egg surface, transovarial transmission directly through the germline, or through mature oocytes via somatic cells, viz. bacteriocytes, fat body cells, or those of specialized glands. Apart from the mother, insects can also acquire symbionts from other (conspecific) insects, a phenomenon often observed in insects across the social spectrum. Coprophagy (feeding on faeces) and trophallaxis (feeding on anal or oral fluids) transmit important beneficial microbes especially to younger, newly eclosed insects that do not acquire symbionts directly from their mother. Finally, many beneficial gut inhabitants in insects are acquired from their external environment, often through their diet, from parasitoids or during copulation. Douglas navigates the reader through these complex phenomena by providing a general framework and describing the mechanistic diversity in well-studied model systems such as *Drosophila* as well as in ants, bees, beetles, and other insects. Douglas describes how the host primarily controls the location, composition, and abundance of symbionts through specific immune factors and antimicrobial peptides, but also through broad strategies such as control of gut pH, oxygen tension, food availability, gut compartmentalization, and host development – specially during metamorphosis. Apart from host determinants, the book discusses how the prevalent microbial community can modulate the growth and colonization of incoming organisms. These can be cooperative, where the cross-feeding of metabolites produced by one group is further broken down by other members of the community, cumulatively benefiting the host by providing nutrition.