Book Review

Introduction to Geomagnetism

W.D. PARKINSON

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The author is one of the most distinguished geomagneticians in the field of electromagnetic induction, as the term "Parkinson vector", which often appears in articles on local anomalies of short-period geomagnetic variations, clearly implies. Whenever "Parkinson vector" is referred to, an impressive scene revives in my memory. In September, 1978, the fourth international workshop on electromagnetic induction was held at Murnau, Federal Republic of Germany. At one of the sessions of this workshop F.E.M. Lilley presented one slide which was not a scientific one, contrary to audiences' expectation, but a picture showing W.D. Parkinson (the author) who is standing in a field with his right hand pointing to a certain direction. Nobody seemed to have understood Lilley's joke until he said, "This is a real Parkinson vector."

The author's name is so popular through the term "Parkinson vector" that readers may anticipate that in this book much emphasis would be put on electromagnetic induction phenomena and related theories, although the book title "Introduction to Geomagnetism" implies a variety of aspects in geomagnetism. Quite contrary at least to my presumption, careful consideration is given to the balance for major fields of geomagnetism and it even seems to me that the author refrained rather too much from detailed description of electromagnetic induction; for instance, I could find the term "Parkinson vector" only once in this book. As the author states in the Preface, his main aim is to fill the gap between the too brief description in textbooks on general geophysics and detailed description in specific fields in geomagnetism such as rock magnetism, paleomagnetism, electromagnetic induction, dynamo theories, ionospheric and magnetospheric electromagnetism, and so on.

This book consists of four main chapters along with the "Introduction" (Chapter 1) and "Miscellaneous Topics" (Chapter 6). In "Introduction" are described methods of measuring the magnetic field and its variation along with routine operation at magnetic observatories. The most characteristic is a long section on principles of magnetism with special reference to rock magnetism. Most of

the mathematical expressions in this section can be found in textbooks on classical electromagnetism, and readers who are acquainted with fundamental electromagnetism can skip this section and refer to some specific portions whenever necessary in later chapters.

The author divides geomagnetism into four major categories and assigns one chapter to each of them: "The Main Field", "The Local Field", "External Fields", and "Induced Fields". In Chapter 2 are introduced the earth's main magnetic field, its secular variation, and dynamo theories. Most students in the geophysics course find it quite difficult to understand dynamo theories. This chapter must be helpful for such students. I point out, however, that the famous Bullard process and the Bullard-Gellman dynamo which is a mathematical formulation of the Bullard process are almost entirely omitted, although recent advancement in dynamo theories such as the turbulent dynamo and the Busse dynamo are introduced. The Bullard process is now a classical concept but I believe that it is still instructive to students.

Chapter 3 "The Local Field" includes rather detailed description on rock magnetism and various aspects in paleomagnetism in addition to magnetic anomalies on land and at sea. Paleomagnetism and marine magnetic anomalies have played a very important role in plate tectonics. However, the author seems to have refrained from entering into detail in view of some excellent textbooks on topics related to plate tectonics. The author also avoided topics concerning electromagnetic exploration.

Contents in Chapter 4 are different from those in the other chapters in the sense that motion of charged particles in space and their interaction with the magnetic field govern electromagnetic phenomena and plasma physics becomes important. Besides external magnetic field variations which are closely related to the next chapter, phenomena in the ionosphere and the magnetosphere are described in some detail and part of this chapter is beyond my ability of review. Those who are interested only in electromagnetic phenomena within the solid earth may read through this long chapter (88 pages) without paying much attention to detail.

Chapter 5 is concerned with electromagnetic induction in the earth. Fundamental concepts of electromagnetic induction are first introduced and then their application to global and local induction problems follows. This chapter includes much of the author's own contribution to geomagnetism and essential points are well arranged in both theoretical and observational aspects. It may be an excessive desire of the reviewer belonging to the induction group to require more content in this chapter.

Readers will find Chapter 6 interesting, because it includes historical accounts on geomagnetism and also biological effects of the geomagnetic field. In addition to the above-mentioned six chapters, some mathematical formulas and expressions are given in Appendices 1-5.

This book is based on the author's lectures given to final year undergraduates in the geophysics course at the University of Tasmania, Australia. The author's aim to cover various aspects in geomagnetism at the level of advanced undergraduates

is well attained. It should be noted that the author took "geo-" literally and excluded planetary magnetism. In view of recent great advancement in planetary magnetism and its contribution to dynamo theories, I think it better for planetary magnetism to be included. However, this comment should not be taken as degrading by any means to the author's invaluable work. I recommend this book as a standard textbook for advanced undergraduates and postgraduates in the geophysics course.

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