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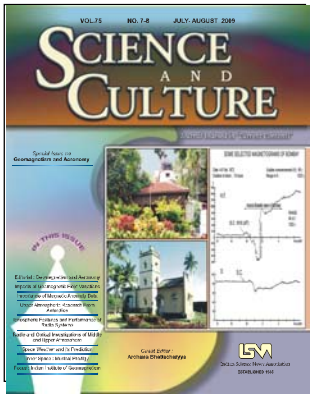
EDITORIAL

GEOMAGNETISM AND AERONOMY



There is not much general awareness of this branch of science, which deals with the Earth, its middle and upper atmosphere and near-Earth space, amongst scientists and students of science in India. Therefore, we were delighted to accept the offer from ***Science and Culture*** to bring out this special volume devoted to Geomagnetism and Aeronomy. Although some technical details have crept into the articles in this issue, it is hoped that they provide a glimpse of this field to a broad spectrum of readers.

Geomagnetism is one of the oldest branches of science, considering that William Gilbert published his treatise 'De Magnete' in the year 1600. The term "Aeronomy" was coined only in the twentieth century by Sidney Chapman and adopted officially by the International Union of Geodesy and Geophysics (IUGG) in 1954. This interdisciplinary field as such deals with the physics and chemistry of all planetary atmospheres where ionization and photodissociation processes play a role. In this special issue, however, the articles only deal with Earth's atmosphere and the aeronomy that is described here refers to the region which starts with the stratosphere and extends up to the boundary of Earth's magnetosphere, and in this region there is considerable overlap between geomagnetism and aeronomy.

The first article in this issue gives a brief history of geomagnetic observations around the globe and the beginning of such observations in India. Many questions still remain about the dynamo process in the fluid outer core of the Earth, which is believed to sustain Earth's main magnetic field, as computer simulations based on highly simplified assumptions reproduce only some known aspects of the geomagnetic field. The geomagnetic field has a profound influence on the movement of charged particles that are present in the Earth's ionosphere and magnetosphere in near Earth space, and also on the energetic particles that come from the Sun as well as cosmic rays that come from outside the solar system. The stream of charged particles which come from the Sun and the occasional 'Coronal mass ejections' from our tempestuous star, carry with them a part of the solar magnetic field, the orientation of which seems to hold the key to how much of the solar wind energy enters the Earth's magnetosphere and ionosphere, causing a 'magnetic storm'. Whereas processes deep inside the earth cause the main magnetic field to change on time scales extending from decades to millions of years, the ultimate source of shorter period variations in the observable part of the geomagnetic field is the Sun.

Today geomagnetic field measurements are not only made at observatories located in different parts of the globe, but also in the ocean, above the ground by instruments on board airpcrafts, and in near earth space by satellites. The present-day accuracy of these measurements allows the identification of localized magnetic anomalies due to variations in Earth's crust. These magnetic anomalies thus provide a useful tool for geophysical exploration and also for understanding regional tectonics. The article by Anand and Rajaram describes some of the work done in India in this area.

The structure of the main geomagnetic field is such that the Arctic and Antarctic regions see some of the most spectacular effects linked to magnetic activity, in the form of aurorae, and these regions are very important from the

point of view of geomagnetism. India has been carrying out scientific expeditions to Antarctica since 1981. Some of the research on geomagnetism in this dynamic environment is reported in the article by Pathan and Lakhina.

The geometry of the main geomagnetic field near the magnetic equator, which in the Indian region passes through the southern tip of the country influences the large scale distribution of plasma in the ionosphere and also creates a unique situation for the possible development of instabilities in the ionosphere that sometimes transform the ionosphere into a highly irregular medium. The effects of variations in the tropical ionosphere on radio wave propagation through this region of the ionosphere are described by Lakshmi and Reddy. Radio waves are useful for studying not only the ionosphere but also the dominant neutral atmosphere at altitudes below 100 km. Mukherjee and Gurubaran describe some of the research done in India using radio and optical techniques to probe the middle and upper atmosphere including the ionosphere.

Today's space-borne and ground-based technological systems are vulnerable to the changes in the Earth's ionosphere, thermosphere and magnetosphere by magnetic storms and substorms, and the importance of acquiring the capability to quantify and ultimately forecast 'space weather' has been recognized all over the world. Uberoi describes for the readers what impact space weather has on technology that is used by humanity today.

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I thank the Editorial Board of ***Science and Culture*** for providing us this platform to present some of the research that has been carried out in India in the field of 'Geomagnetism and Aeronomy', and I am especially grateful to the Editor-in-Chief, Prof. S.C. Roy, for his immense patience. Finally I thank all the authors for their contributions, which made it possible to put together this special volume. ❐

Archana Bhattacharyya
Guest Editor

Dr. Archana Bhattacharyya is Director of the Indian Institute of Geomagnetism located in Navi Mumbai. A physicist by training, her areas of interest are: plasma instabilities in Earth's ionosphere, ionospheric scintillations, space weather, and spatio-temporal variations of the geomagnetic field. She is a fellow of the Indian Academy of Sciences, Indian National Science Academy and National Academy of Sciences, India.

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