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Preface

The Plasmasphere Revisited: A Tribute to Donald Carpenter

"Step by step, a few being giant strides, and others little steps in random directions": these words of Marcel Nicolet describe how things are often discovered gradually, and it is the usual way in which progress is made in the Natural Sciences. At least, this is how geophysicists came to recognise the existence of continental drifts, of field-aligned currents, and of many other natural phenomena and physical processes operating in our terrestrial environment. Though at first strongly rejected or ignored, these discoveries were finally admitted, sometimes abruptly, into the corpus of scientific knowledge.

The discoveries of the protonosphere, now called the plasmasphere, and subsequently of a sharp transition in the ion density in the protonosphere, now called the plasmapause, have followed similar steps, and in roundabout ways. After more than a decade of great scientific enthusiasm for the study of the plasmasphere, this topic became dormant until the mid-1990s when a renaissance took place.

The workshop on "The Plasmasphere Rediscovered", organised at the University of Toronto on August 14, 1999, as part of the XXVIth URSI General Assembly, was one of these steps which, we hope, have helped to advance our understanding of the physics of the plasmasphere and of its outer boundary, the plasmapause. This Workshop was sponsored by the Commissions H and G of URSI (Union Radio-Scientifique Internationale), by COSPAR, by IAGA and by the Belgian Institute for Space Aeronomy in Brussels.

An earlier step that led some magnetospheric communities back onto the "roads" of the plasmasphere was a workshop held at IKI, Moscow, in the spring of 1998. This well-attended workshop was organised by M. Verigin in honour of Konstantin Gringauz, the experimenter who first detected, in 1959 with the LUNIK-1 & 2 probes, the characteristic plasmapause gradient of the density of thermal ions at high altitudes in the topside extension of the Earth's ionosphere. The proceedings of this workshop were published in Vol. 25 (No. 1–2) of Physics and Chemistry of the Earth (c), 2000.

It was at this memorial meeting in 1998 that the suggestion was made that another workshop be organised as a "tribute to Donald Carpenter". The 1999 General Assembly of URSI was the ideal forum for such a workshop. Indeed, it was at the XIVth General Assembly of URSI, in Tokyo, that Carpenter's important discovery of the plasmapause was first presented to the space science community. It was also at this General Assembly in the autumn of 1963 that the two pioneers, Carpenter and Gringauz, met for the first time.

Another step that possibly contributed to the renaissance of interest in the study of the plasmasphere and plasmapause was the project for a book titled "The Earth's Plasmasphere", with Gringauz as co-author and contributions by Carpenter. This project began in 1991, and the book was published by the Cambridge University Press in 1998. In the first chapter, Gringauz and Carpenter present the history of their discoveries of the plasmasphere–plasmapause system. This book also contains comprehensive summaries together with an inventory of relevant measurements and theoretical ideas and models proposed so far to describe these regions of the Earth's magnetosphere, and to explain their origin, constitution and dynamics.

Most of the articles in the present special issue of JASTP were presented at the 1999 Toronto Workshop, the scientific programme of which is posted at http://www.magnet.oma.be/WS-H/index.html. A summary report of the workshop is available in these World Wide Web pages, and it was also published in the COSPAR Information Bulletin, 146, pp. 16–17, December 1999. A few more contributions concerning the study of the plasmasphere and plasmapause were included later, though not presented at the workshop. Besides the contributed articles, the reader will also find in this issue several review articles updating our knowledge of particular aspects of plasmaspheric observations and theories. In a historical perspective, D. Stern suggested that we should include an unpublished manuscript written in 1973 by Neil Brice where, incidentally, he reconsiders his earlier ideas on the formation of the plasmapause, and on its identification with the "last closed equipotential" of a global convection electrostatic field. In this paper, N. Brice discusses the roles of interchange motion and of differential drifts of plasma clouds in the magnetosphere. Because of the historical interest of this manuscript and the largely underestimated role of

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interchange in magnetospheric processes, we found it useful to include the text essentially with no changes other than corrections of some typographical errors. In an accompanying paper by one of us, Neil Brice's contributions are discussed in the perspectives of the state of knowledge at the time when he wrote this paper and of what we believe we know today.

We hope that the new generation of physicists currently involved in studying the plasmasphere, and in analysing the new data sets collected with modern instruments, will find in this collection of articles devoted to the plasmasphere some foundations on which they can build even more comprehensive and satisfactory models of the physical processes responsible for the origin, the deformation, and the re-formation of the plasmasphere and of its outer frontier: the plasmapause.

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