CONTENTS

I. *Geomagnetism and Related Phenomena* 3

1.1 Historical 3
1.2 The external field of a uniformly magnetized sphere 7
1.3 The magnetic field at the earth's surface 10
1.3a Isomagnetic charts 11
1.3b The magnetic potential and the dipole field 12
1.3c The origin and secular variation of the field 13
1.4 The magnetic field above the earth's surface 13
1.5 Electric currents in and beyond the ionosphere 14
1.5a The Sq electric current system 15
1.5b The electrical conductivity in the ionosphere 16
1.5c Solar flares, short-wave radio fadeouts and the Sq currents 19
1.6 The polar current system DP 20
1.7 The sudden commencement current DCF 24
1.8 The ring current DR and its field 24
1.9 Local and world indices of geomagnetic disturbance 24
1.10 The solar rotation 27
1.11 Measures of solar activity 28
1.12 Sunspot latitudes and magnetism 28
1.13 The 27-day recurrence tendency in geomagnetic disturbance 29
1.13a Interpretation of the recurrence tendency in geomagnetic disturbance 31

II. *The Solar Plasma on its Way to the Earth* 32

2.1 The path of a solar particle 32
2.1a Special case: no radial force 34
2.1b Special case: the Milne Doppler force 34
2.2 Continuous emission from P; the "stream"-curve 35
2.3 Numerical illustrations, for constant radial speed 36
2.4 Emission within a conical solid angle 39
2.5 Transported solar magnetic fields and cosmic rays 39
2.6 Attempts to find the radial speed by the superposed epoch method 39
2.7 The lateral expansion of a stream in transit from a point source 40
2.8 The lateral expansion of a stream in transit from an emitting area 42
2.9 Emission fron non-equatorial areas on the sun 43
2.10 The nature of the onset of a stream-produced magnetic storm 45
2.11 The shell of solar gas emitted from a solar flare 45

2.12 Retardation on the way from the sun ... 47
2.13 Plasma kinetic density and magnetic field energy ... 48
2.14 The electrical discharge theory of solar streams ... 49

III. *The Mutual Influence of the Solar Gas and the Geomagnetic Field* ... 51
3.1 Neutral ionized solar gas (or plasma) ... 51
3.2 The interaction between a thin plane conductor and the dipole field ... 52
3.3 The cylindircal sheet plasma problem ... 57
3.4 The case of unseparated sheets ... 59
3.5 Radial projection: sheets unseparated ... 61
3.5a Equal oblique projection: sheets unseparated ... 61
3.6 The case n = 3 ... 62
3.7 Energy transformation: radial projection from infinity without separation ... 69
3.8 Oblique projection from infinity ... 71
3.9 The impact of a plane-faced volume stream upon a plane-stratified field ... 74
3.10 Instabilities ... 78
3.11 The steady-state form of the hollow in the stream ... 78
3.12 Exact solutions of related problems: two-dimensional cases ... 81
3.13 Somewhat analogous axially symmetrical three-dimensional problems ... 84
3.14 The hollow round a point dipole: approximate calculations ... 86
3.14a The hollow at the equinoxes ($\lambda = 0$) ... 88
3.14b Oblique incidence of the solar plasma ... 93

IV. *Magnetic Disturbance and Aurora* ... 95
4.1 The parts M,S,L,D, of the geomagnetic field ... 95
4.2 The morphology of the D Field ... 97
4.3 Some auroral features ... 106

V. *The Ring Current and its DR Field* ... 108
5.1 Störmer's hypothesis concerning the DR field ... 108
5.2 Schmidt's ring current ... 108
5.3 The Chapman-Ferraro ring current ... 109
5.4 Singer's model ring current ... 109
5.5 The equation of motion of a charged particle ... 110
5.5a Larmorian motion: B uniform and constant, F = 0 ... 110
5.5b Modified Larmorian motion: B uniform and constant, F constant ... 112
5.5c Motion in a constant non-uniform magnetic field ... 112
5.6 The drift motion ... 114
5.7 The drift current; B non-uniform and constant; F = 0 114

5.8 Diamagnetism and the equivalent electric current . . 115
5.9 The total plasma current intensity i 115
5.10 The pitch angle and density distributions 116
5.11 The motion of the charges in a constant dipole field, F = 0 117
5.12 Model calculations of the DR current and field 123

References 128
Name and place index 133
Dates, historical, or series of data 136
Dates: geophysical events 136
Subject index 137