

Satellites as they cross the night sky look like moving stars, which can be accurately tracked by an observer with binoculars as well as by giant radars and large cameras. These observations help to determine the satellite's orbit, which is sensitive to the drag of the upper atmosphere and to any irregularities in the Earth's gravity field. Analysis of the orbit can be used to evaluate the density of the upper atmosphere and to define the shape of the Earth.

Desmond King-Hele was the pioneer of this technique of orbit analysis, and this book tells us how the research began, before the launch of Sputnik in 1957. For thirty years King-Hele and his colleagues at the Royal Aircraft Establishment, Farnborough, developed and applied the technique to reveal much about the Earth and air at a very modest cost. In the 1960s the upper-atmosphere density was thoroughly mapped out at heights of 100 to 2000 km, revealing immense variation of density with solar activity and between day and night. In the 1970s and 1980s a picture of the upper-atmosphere winds emerged, and the profile of the pear-shaped Earth was accurately charted. The number of satellites now orbiting the Earth is over 5000.

This book is the story of how this orbital research developed to yield a rich harvest of knowledge about the Earth and its atmosphere, in a scientific narrative that is enlivened with many personal experiences.

Cambridge University Press
0521017327 - A Tapestry of Orbits
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CAMBRIDGE UNIVERSITY PRESS
 Cambridge, New York, Melbourne, Madrid, Cape Town, Singapore, São Paulo

Cambridge University Press
 The Edinburgh Building, Cambridge CB2 2RU, UK

Published in the United States of America by Cambridge University Press, New York

www.cambridge.org
 Information on this title: www.cambridge.org/9780521393232

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First published 1992
 This digitally printed first paperback version 2005

A catalogue record for this publication is available from the British Library

Library of Congress Cataloguing in Publication data

King-Hele, Desmond
 A tapestry of orbits/Desmond King-Hele.
 p. cm.
 Includes bibliographical references and index.
 ISBN 0 521 39323 X
 1. Artificial satellites – Orbits. I. Title.
 TL 1080.K55 1992
 629.43'4 – dc20 92-11674 CIP

ISBN-13 978-0-521-39323-2 hardback
 ISBN-10 0-521-39323-X hardback

ISBN-13 978-0-521-01732-9 paperback
 ISBN-10 0-521-01732-7 paperback

Contents

<i>Preface</i>	<i>page</i> ix
<i>Prologue, 1948–1953</i>	1
1 Prelude to space, 1953–1957	4
Long-range ballistic rockets	6
Satellites at last	8
The effects of air drag	10
Blue Streak and Black Knight	13
Satellite orbits	14
Orbits about the oblate Earth	17
2 The real thing, 1957–1958	21
The tracking of Sputnik 1	24
The orbit of Sputnik 1	26
What did the orbit tell us?	27
The final-stage rocket of Sputnik 1	31
Sputnik 2 arrives	33
Variations in upper-atmosphere density revealed by Sputnik 2	35
The shape of the Earth revealed by Sputnik 2	38
Upper-atmosphere winds from Sputnik 2	41
The end of Sputnik 2	41
3 Full speed ahead, 1958–1960	45
The prediction service	46
Variations of air density with time, and their origin	49
The variation of air density with height	53
Real life breaks in	55
The day-to-night variation in air density	57
Long-term changes in density dependent on solar activity	58
Creating new theory for the effect of air drag on orbits	60

Gravity field and shape of the Earth	65
The wider world	71
4 Sailing through the sixties, 1961–1969	74
Determining satellite orbits from observations	79
Observations	82
Air density and its variation with height	89
Variations of air density with time	93
Determining the density scale height	95
How fast does the upper atmosphere go round?	96
Hard at work on orbital theory	99
The flattening of the Earth: even zonal harmonics	107
The Earth's pear-shaped profile: odd zonal harmonics	110
The real world in quite good shape too	117
5 Into the realm of resonance, 1970–1979	127
Observations new and old	133
Computer programs for orbit determination and analysis	141
The pursuit of resonance	142
Refining the pear shape of the Earth	151
Is the upper atmosphere still going round too fast?	153
Monitoring the density scale height	156
Air density and its variations	157
The underlying orbital theory	159
The world outside	163
6 On the shelf, 1980–1988	169
Observations and orbits	173
A final polish for the terrestrial pear	178
Resonance	181
Winds in the upper atmosphere	197
Researches on upper-atmosphere density and structure	202
A renaissance of theory	207
Back into the outer world	211
7 Out of the fray, 1988–1991	217
Questionings	224
References	230
Index	235

Preface

This book is a personal account of the researches based on analysis of satellite orbits between 1957 and 1990 at the Royal Aircraft Establishment, Farnborough, work in which I played a leading role. The book is most definitely not an impartial history of the subject world-wide: contributions by other groups are mentioned only when necessary. Nor is the book an autobiography, though the science is punctuated – and perhaps enlivened – by some personal experiences.

A book of this kind, a hybrid of science and life, presents the author with many stylistic problems. I have ruthlessly gouged out as many ‘I’s as possible, and have tried to avoid mentioning too many names (with apologies to all those who find themselves liquidated). I decided to use ‘we’ quite often: throughout the book *we* means ‘those of us at the RAE who were concerned with or working on the problem’. Individual names are mentioned too, of course, and often the *we* is defined by giving the authors of a paper in a note.

I have tried to make the book widely intelligible to readers without specialized knowledge. There is a light sprinkling of mathematical equations: but if you don’t like them you can skip them without losing the thread.

Most spacecraft chatter continuously, sending back to the ground stations so much data that storage can be quite a problem. The satellites selected for orbit analysis, on the other hand, are usually dumb (and deaf and blind): but they can be seen from the ground as they cross the sky, and from the observations their orbits can be determined. The changes in the orbits can be measured to obtain detailed information about the Earth’s upper atmosphere and gravity field (from which the shape of the Earth can be derived). Thus small changes in satellite orbits lead to great changes in perceptions of the Earth and air. Acclaimed as the most cost-effective form

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of space research in the 1960s, orbit analysis lost some of its shine in the 1970s, when wider horizons beckoned space scientists as expensive ‘hitech’ spacecraft came into vogue. By the 1980s orbit analysis was in a siding rather than on the main line of space research: but the techniques were improved and the work continued to produce new and relevant results, as the book demonstrates.