



Disturbing the Universe

Freeman Dyson

FREEMAN DYSON

DISTURBING
THE UNIVERSE

Harper & Row, Publishers

New York, Cambridge, Philadelphia, San Francisco

London, Mexico City, São Paulo, Singapore, Sydney

Portions of this work originally appeared in *The New Yorker*.

A hardcover edition of this book is published by Harper & Row, Publishers.

DISTURBING THE UNIVERSE. Copyright © 1979 by Freeman J. Dyson. All rights reserved. Printed in the United States of America. No part of this book may be used or reproduced in any manner whatsoever without written permission except in the case of brief quotations embodied in critical articles and reviews. For information address Harper & Row, Publishers, Inc., 10 East 53rd Street, New York, N.Y. 10022. Published simultaneously in Canada by Fitzhenry & Whiteside Limited, Toronto.

First HARPER COLOPHON edition published 1981.

ISBN: 0-06-090771-1

86 87 88 89 90 10 9 8

DISTURBING THE UNIVERSE

400000

DISSEMINATING THE DOCUMENT

THIS BOOK IS PUBLISHED AS PART
OF AN ALFRED P. SLOAN FOUNDATION PROGRAM

To the undergraduates of the Universities of Idaho, California–Riverside, Emory, Furman, San Diego State and Florida State, Reed College and Smith College, with whom I talked as Phi Beta Kappa Visiting Scholar in 1975–76. They asked the questions which this book tries to answer.

Preface to the Series

The Alfred P. Sloan Foundation has for many years included in its areas of interest the encouragement of a public understanding of science. It is an area in which it is most difficult to spend money effectively. Science in this century has become a complex endeavor. Scientific statements are embedded in a context that may look back over as many as four centuries of cunning experiment and elaborate theory; they are as likely as not to be expressible only in the language of advanced mathematics. The goal of a general public understanding of science, which may have been reasonable a hundred years ago, is perhaps by now chimerical.

Yet an understanding of the scientific enterprise, as distinct from the data and concepts and theories of science itself, is certainly within the grasp of us all. It is, after all, an enterprise conducted by men and women who might be our neighbors, going to and from their workplaces day by day, stimulated by hopes and purposes that are common to all of us, rewarded as most of us are by occasional successes and distressed by occasional setbacks. It is an enterprise with its own rules and customs, but an understanding of that enterprise is accessible to any of us, for it is quintessentially human. And an understanding of the enterprise inevitably brings with it some insight into the nature of its products.

Accordingly, the Sloan Foundation has set out to encourage a representative selection of accomplished and articulate scientists to set down their own accounts of their lives in science. The form those accounts will take has been left in each instance to the author: one may choose an autobiographical approach, another may produce a

coherent series of essays, a third may tell the tale of a scientific community of which he was a member. Each author is a man or woman of outstanding accomplishment in his or her field. The word "science" is not construed narrowly: it includes such disciplines as economics and anthropology as much as it includes physics and chemistry and biology.

The Foundation's role has been to organize the program and to provide the financial support necessary to bring manuscripts to completion. The Foundation wishes to express its appreciation of the great and continuing contribution made to the program by its Advisory Committee chaired by Dr. Robert Sinsheimer, Chancellor of the University of California-Santa Cruz, and comprising Dr. Howard H. Hiatt, Dean of the Harvard School of Public Health; Dr. Mark Kac, Professor of Mathematics at Rockefeller University; Dr. Daniel McFadden, Professor of Economics at the Massachusetts Institute of Technology; Robert K. Merton, University Professor, Columbia University; Dr. George A. Miller, Professor of Experimental Psychology at Rockefeller University; Professor Philip Morrison of the Massachusetts Institute of Technology; Dr. Frederick E. Terman, Provost Emeritus, Stanford University; for the Foundation, Arthur L. Singer, Jr., and Stephen White; for Harper & Row, Winthrop Knowlton and Simon Michael Bessie.

Author's Preface

The physicist Leo Szilard once announced to his friend Hans Bethe that he was thinking of keeping a diary: "I don't intend to publish it; I am merely going to record the facts for the information of God." "Don't you think God knows the facts?" Bethe asked. "Yes," said Szilard. "He knows the facts, but He does not know *this version of the facts.*"

I have collected in this book memories extending over fifty years. I am well aware that memory is unreliable. It not only selects and rearranges the facts of our lives, but also embroiders and invents. I have checked my version of the facts wherever possible against other people's memories and against written documents. For thirty years I wrote home regularly to my parents, and they kept most of my letters. These letters are the source of many details which memory alone could not have preserved.

I am grateful to the Alfred P. Sloan Foundation for funding the Science Book Program, under whose auspices this book appears. I thank Sloan Foundation Vice-President Stephen White and the members of his advisory committee for inviting me to write the book and for their editorial guidance. I am indebted for help and criticism to many friends, including Eileen Bernal, Jeremy Bernstein, Simon Michael Bessie, Hal Feiveson, Muguette Josefsen, Matthew Meselson, Mike O'Loughlin, Peter Partner, Leonard Rodberg, Barbara Scott, Martin Sherwin, Massoud Simnad, Daniel and Maxine Singer, Ted Taylor, Janet Whitcut, and

my family. Above all I am grateful to my secretary, Paula Bozzay, for typing and retyping the manuscript.

Parts of chapters 10, 11, 12, 13 and 18 have appeared in print before. Detailed references will be found in the bibliographical notes at the end of the book.

Contents

Preface to the Series : ix

Author's Preface : xi

I. ENGLAND

1. The Magic City : 3
2. The Redemption of Faust : 11
3. The Children's Crusade : 19
4. The Blood of a Poet : 33

II. AMERICA

5. A Scientific Apprenticeship : 47
6. A Ride to Albuquerque : 58
7. The Ascent of F6 : 69
8. Prelude in E-Flat Minor : 84
9. Little Red Schoolhouse : 94
10. Saturn by 1970 : 107
11. Pilgrims, Saints and Spacemen : 118
12. Peacemaking : 127
13. The Ethics of Defense : 142

14. The Murder of Dover Sharp : 155
15. The Island of Doctor Moreau : 167
16. Areopagitica : 179

III. POINTS BEYOND

17. A Distant Mirror : 187
18. Thought Experiments : 194
19. Extraterrestrials : 205
20. Clades and Clones : 218
21. The Greening of the Galaxy : 225
22. Back to Earth : 239
23. The Argument from Design : 245
24. Dreams of Earth and Sky : 254

Bibliographical Notes : 263

Index : 277

I. ENGLAND

Oh England! Oh my lovely casual country!
Serenity of meadowland in April—
Carelessly littered with fritillaries,
Ladysmock, kingcups, cowslips, and wild apple!

FRANK THOMPSON, 1943

And there's a dreadful law here—it was made
by mistake, but there it is—that if any one asks
for machinery they have to have it and keep
on using it.

E. NESBIT, 1910

The Magic City

A small boy with a book, high up in a tree. When I was eight years old somebody gave me *The Magic City* by Edith Nesbit. Nesbit wrote a number of other children's books, which are more famous and better written. But this was the one which I loved and have never forgotten. I did not at the age of eight read deep meanings into it, but I knew that it was somehow special. The story has a coherent architectural plan, covered with a surface frosting of crazy logic. *The Wizard of Oz* was the other book that I used to read over and over again. It has the same qualities. An eight-year-old already has a feeling for such things, even if he spends most of his waking hours climbing trees. *The Magic City* is not just a story about some crazy kids. It is a story about a crazy universe. What I see now, and did not see as an eight-year-old, is that Nesbit's crazy universe bears a strong resemblance to the one we live in.

Edith Nesbit was from every point of view a remarkable woman. Born in 1858, she was intimate with the family of Karl Marx and became a revolutionary socialist long before this was fashionable. She supported herself by writing and brought up a large family of children of mixed parentage. She soon discovered that her survival depended upon her ability to write splendidly bourgeois stories for the children of the rich. Her books sold well, and she survived. She made some compromises with Victorian respectability, but did not lose her inner fire. She wrote *The Magic City* in 1910, when she was fifty-two. By that time her personal struggles were over and she could view the world with a certain philosophic calm.

There are three themes in *The Magic City*. The first is the main

theme. The hero is an orphan called Philip who is left alone in a big house and builds a toy city out of the ambient Victorian bric-a-brac. One night he suddenly finds his city grown to full size, inhabited by full-size mythical people and animals, and himself obliged to live in it. After escaping from the city, he wanders through the surrounding country, where every toy house or castle that he ever built is faithfully enlarged and preserved. The book records his adventures as he stumbles through this world of blown-up products of his own imaginings.

The second theme is concerned explicitly with technology. It is a law of life in the magic city that if you wish for anything you can have it. But with this law goes a special rule about machines. If anyone wishes for a piece of machinery, he is compelled to keep it and go on using it for the rest of his life. Philip fortunately escapes from the operation of this rule when he has the choice of wishing for a horse or a bicycle and chooses the horse.

The third theme of the book is the existence of certain ancient prophecies foretelling the appearance of a Deliverer and a Destroyer. Various evil forces are at large in the land, and it is the destiny of the Deliverer to overcome them. But it is also foreordained that a Destroyer will come to oppose the Deliverer and give aid to the forces of darkness. At the beginning Philip is suspected of being the Destroyer. He is only able to vindicate himself by a succession of increasingly noble deeds, which ultimately result in his being acclaimed as the Deliverer. Meanwhile the Destroyer is unmasked and turns out to be the children's nursemaid, a woman of the lower classes whom Philip has always hated. Only once, at the end of the book, Nesbit steps out of character and shows where her real sympathies lie. "I'll speak my mind if I die for it," says the Destroyer as she stands awaiting sentence. "You don't understand. You've never been a servant, to see other people get all the fat and you all the bones. What you think it's like to know if you'd just been born in a gentleman's mansion instead of in a model workman's dwelling you'd have been brought up as a young lady and had the openwork silk stockings?" Even an eight-year-old understands at this point that Philip's heroic virtue is phony and the nursemaid's heroic defiance is real. In an unjust world, the roles of Deliverer and Destroyer become ambiguous. "Think not that I am come to send peace on earth," said Jesus. ✓ "I come not to send peace, but a sword."

I do not know how far Nesbit consciously intended *The Magic City* to be an allegory of the human condition. It was only after I descended from the trees, and tasted the joys and sorrows of becoming a scientist, that I began to meditate upon the magic city and to see in it a mirror image of the big world that I was entering. I was plunged into the big world abruptly, like Philip. The big world, wherever I looked, was full of human tragedy. I came upon the scene and found myself playing roles that were half serious and half preposterous. And that is the way it has continued ever since.

I am trying in this book to describe to people who are not scientists the way the human situation looks to somebody who is a scientist. Partly I shall be describing how science looks from the inside. Partly I shall be discussing the future of technology. Partly I shall be struggling with the ethical problems of war and peace, freedom and responsibility, hope and despair, as these are affected by science. These are all parts of a picture which must be seen as a whole in order to be understood. It makes no sense to me to separate science from technology, technology from ethics, or ethics from religion. I am talking here to unscientific people who ultimately have the responsibility for guiding the growth of science and technology into creative rather than destructive directions. If you, unscientific people, are to succeed in this task, you must understand the nature of the beast you are trying to control. This book is intended to help you to understand. If you find it merely amusing or bewildering, it has failed in its purpose. But if you find none of it amusing or bewildering, it has failed even more completely. It is characteristic of all deep human problems that they are not to be approached without some humor and some bewilderment. Science is no exception. ✓

My colleagues in the social sciences talk a great deal about methodology. I prefer to call it style. The methodology of this book is literary rather than analytical. For insight into human affairs I turn to stories and poems rather than to sociology. This is the result of my upbringing and background. I am not able to make use of the wisdom of the sociologists because I do not speak their language. When I see scientists becoming involved in public affairs and trying to use their technical knowledge politically for the betterment of mankind, I remember the words of Milton the poet: "I cannot praise a fugitive and cloistered virtue, unexercised and unbreathed, that never sallies out and sees her adversary." These words, written three hundred