Contents

1 A Place Like Home
   The Nebular Theory of Planetary Formation 3
   The Spiral Nebulae: Small and Close or Large and Distant? 4
   Hello Out There 6
   Homes for ET 8
   Someone to Talk To 9

2 Early Ideas and Lessons from Our Own Backyard 11
   Moving Off the Center 11
   Getting the Message Across 14
   The Goldilocks Principle 17
   Migrating Habitable Zones 19
   Starring Roles 20
      M Dwarfs 22
      K-Type Stars 23
      G-Type Stars 23
      F-Type Stars 24
      A-Type Stars 24
      B-Type Stars 25
      O-Type Stars 25
      From Supernova to Black Holes 25
   Habitable Zone Types 26
   Past Lives of Our Earth 28
   The Great Dying 32
   Earthlike Planets in Our Solar System 32
Isn't That Special? 36
A Really Big Habitable Zone? 39
Applying Lessons to Exo-Earths 39

3 The Search for and Discovery of Exoplanets 43
Finding Invisible Worlds 44
   Direct Imaging 44
   Radial Velocity 45
   Timing Technique 47
   Gravitational Microlensing 47
   Autocorrelation Function Timescale Technique 49
   Transits 49
   Astrometry 52
The New Age of Discovery: Orbiting Observatories 55
51 Pegasi b…and Beyond 59
Chilled Giants 62
Earths, Mega-Earths, Sub-Neptunes and Super-Earths 63

4 Strange Solar System Architectures 67
Migrating Planets and the Search for Life 70

5 Zeroing in on Earth 2.0 75
Sub-Neptunes 75
Giant Planets and Earth-Moons 82
Other Super-Earth Types 82
Assorted Super-Earths 85
What’s the Forecast? 89
Zeroing in on Earth 2.0 94
Super-Habitable Places 97
Giants Inside the Habitable Zone: The Promise of the Moons 103

6 Looking for Life in All the Right Places 105
Life Based on What? 105
Life in Our Own Image 105
A Martian Invasion of a Different Sort 107
Is Carbon the Only Game in Town? 114
Extreme Biomes 115
Under the Surface: Extremophiles Galore 116
7 Could We Make Contact?

Fermi’s Paradox

Answer #1: A “Special” Rare Earth
Answer #2: Extinction
Answer #3: Not Interested, Thank You!
Answer #4: We’ve Moved On
Answer #5: Sentient Suicide
Answer #6: Natural Quarantine
Answer #7: Cosmic Menagerie
Answer #8: Spectator Sport
Answer #9: Missed It By That Much

Using Waves
What Are the Odds?
Amoebas to Technology
Reaching Out
Transmission in a Bottle
Calls for Caution
Undertakings in the Search for Extraterrestrial Intelligence
A Different Kind of Message
If I Could Talk With the Animals…
Assumptions
UFOs
Civilization’s Fingerprints Here and Beyond

8 Could We Visit Earths of Distant Suns?

Interstellar Vacations
Roadblock to Faster-Than-Light Travel
Project Orion
Project Daedalus: To the Stars 202
Project Icarus 204
Non-Nuclear Options for Star Travel 206
Arrival 211
Interstellar Exploration’s Human Component 213
Generation Ships 215
Why Go? 217

9 First Contact: What Will It Mean? 219
Life’s Rich Pageantry 221
Visualizing World SETI 222
Why Bother? 224
SETI All Grown Up 225
Culture Clash 226
Dreams of Distant Earths 228
Engaging with the Others 228

Index 231
Earths of Distant Suns
How We Find Them, Communicate with Them, and
Maybe Even Travel There
Carroll, M.
2017, XI, 234 p. 65 illus., 62 illus. in color., Softcover
ISBN: 978-3-319-43963-1