

Contents

1 Introduction	1
1.1 The Drake Equation	4
References	6
 Part I Bottom Up: What We Learn from Basic Science About the Likelihood of Extraterrestrial Life	
2 Astrophysical Factors	11
References	17
3 Planetary Considerations	19
3.1 Frequency f_{PS} of Planetary Systems	20
3.2 Fraction f_{hab} of Planets Which are Habitable	23
References	29
4 Biological Factors	31
4.1 The Probability f_{prebio} That Life Begins on a Habitable Planet	32
4.2 The Random Polymer Assembly Model	36
4.3 Other Models for Prebiotic Evolution	41
4.4 Other Arguments Relevant to Estimating f_{prebio}	48
4.5 Summary of Conclusions Concerning f_{prebio}	51
4.6 The Probability f_{evol} That a Biosphere Evolves to the Complexity of a ‘Civilization’	53
References	55

Part II Top Down: What We Learn from the Failure of Attempts to Detect Extraterrestrial Life

5	Unidentified Flying Objects	59
5.1	Separating Scientific from Irrefutable Claims	59
5.2	Conspiracies	63
5.3	Hypotheses on the ‘States of Mind’ of Extraterrestrials	64
	References	65
6	Colonization and Panspermia	67
6.1	Implications of the Failure to Observe Colonization of Earth by ‘Advanced’ Civilizations	67
6.2	Diffusion Models for Civilization Spread	70
6.3	Estimating Civilization Lifetimes	73
6.4	Implications of Bacterial Colonization: Panspermia	75
6.5	Conclusions from the Failure to Observe Evidence of Colonization	77
	References	78
7	Electromagnetic (SETI) Searches	81
7.1	Effect of the Finite Time for Propagation of Electromagnetic Signals	86
7.2	Bounds on N_{civ} from the SETI@home Search	87
7.3	Possible Alternative Signal Processing Strategies	88
7.4	Conclusions from the Survey of Results from Electromagnetic Searches	93
	References	93
8	Direct Searches for Primitive Forms of Life	95
8.1	Mars	95
8.2	Europa	100
8.3	Titan	102
8.4	Summary and Outlook for the Search for Life Using Robotic Space Probes	104
	References	106
9	Policy, Ethical and Other Implications	107
9.1	Short Term Policy Implications	110
9.2	Implications for Environmental Ethics	110
9.3	Implications for Views of the Human Condition	111
9.4	Psychological Implications	112
9.5	Implications for the Long Term Future	112
9.6	Can a Probability Distribution for a Rare Event be Defined in the Case of Option 3?	113

9.7	Anthropic Principles, Religion and Other Nonscientific Aspects	114
9.8	Biases Held by Scientists	115
9.9	The Anthropic Principle	116
9.10	Intelligent Design.	117
9.11	Religious Attitudes.	118
	References	119
Appendix 1.1: Forms of the Drake Equation		121
Appendix 2.1: The Doppler Shift		123
Appendix 3.1: Doppler Shifts for Circular Planet Orbits		125
Appendix 4.1: Catalysis at Surfaces		127
Appendix 4.2: A Kauffman-Like Model		129
Appendix 5.1: Evaluating How an Experiment or Observation Affects the Relative Likelihood of Two Competing Theories		131
Appendix 6.1: Diffusion and Random Walks		133
Appendix 6.2: Modeling Diffusion, Birth and Death		135
Appendix 6.3: Units of Radiation Dosage		137
Appendix 7.1: Origin of the 21 cm Line		139
Appendix 7.2: SETI Microwave Searches		141
Appendix 7.3: FM and AM Signals		143
Appendix 7.4: Quantitative Analysis of Messages: Correlations, Information, Entropy and Complexity		145
Index		149



<http://www.springer.com/978-3-642-22753-0>

How Likely is Extraterrestrial Life?

Halley, J.W.

2012, IX, 151 p. 49 illus., 27 illus. in color., Softcover

ISBN: 978-3-642-22753-0