Contents

1 Phasers Weapons of Less Destruction 1
1.1 Introduction 1
1.2 Particle Beams as Directed Energy Weapons. 4
1.2.1 Were *Star Trek* Phasers Particle Beam Weapons? 4
1.2.2 Using Lasers to Accelerate Particle Beams 8
1.2.3 Plasma Laser Particle Accelerators 9
1.3 Light Beams as Directed Energy Weapons 10
1.3.1 The Phaser Goes from Maser to Laser 10
1.3.2 *Star Trek* Phasers Are Really Just Lasers 12
1.4 Masers Weapons 15
1.4.1 The Adaptive Denial System Is a Microwave Emitter Weapon 16
1.5 High Energy Lasers as Directed Energy Weapons 18
1.5.1 The Protocol on Blinding Laser Weapons and Dazzler Lasers 20
1.5.2 Mechanisms to Reduce Laser Thermal Blooming 21
1.6 Examples of Weaponized Lasers 22
1.6.1 The US Navy LaWS 23
1.6.2 The US Air Force HELLADS Laser 24
1.6.3 The DARPA Excalibur Project 25
1.7 Emerging High Power Laser Technologies 26
1.7.1 Free Electron Lasers and X-ray Free Electron Lasers 26
1.7.2 Laser Induced Plasma Channels 28
1.8 Conclusion 31
References 32

2 Cloaking Devices: Vanishing Into Thin Space 35
2.1 Introduction 35
2.2 Ways to Stay Hidden 36
2.2.1 Active Camouflage in *Star Trek* and on Earth 37
2.2.2 Mirrors and Rochester Cloaks 40
2.2.3 Stealth Technologies as Cloaks 41
2.3 Cloaking the *Star Trek* Way 42
2.4 Cloaking by Bending Light 44
2.4.1 Transformation Optics 45
2.4.2 Gradient Index Metamaterial Cloaks and Their Limitations 48
2.4.3 Natural Calcite Carpet Cloaks 52
2.4.4 Natural Guanine Crystal Carpet Cloaks 54
2.5 Cloaking by Destroying Light 55
2.5.1 Plasmonic Cloaks 55
2.5.2 Mantle Cloaks 56
2.5.3 Spoofing and Illusion Coatings with Mantle Cloaks 58
2.6 Future Cloaking Possibilities 59
2.6.1 Wide Band and Active Cloaks 59
2.6.2 Slow Light and Positional Cloaks 60
2.7 Conclusion 63
References 64

3 The Replicator: Maybe You *Can* Have Everything 67
3.1 Introduction 67
3.2 *Star Trek* Replicators 68
3.2.1 Replicators Are Both a Necessity and a Convenience 69
3.2.2 Replicator Function 70
3.2.3 Replication of Organic Materials 71
3.3 Current Replicators 72
3.3.1 Additive Manufacturing Is 3D Printing 73
3.3.2 4D Printing 80
3.4 Current 3D Printing of Organics 82
3.4.1 Printing Cells and Tissues 82
3.4.2 Printing Food 86
3.5 The Future of Replicators 88
3.5.1 Nanobots 89
3.5.2 Molecular Assembly 90
3.6 Conclusion 97
References 99

4 Deflector Shields: The Best Offense Is a Good Defense 103
4.1 Introduction 103
4.2 Star Trek Defensive Technologies 105
4.2.1 Deflector Shield Function and Capability 105
4.2.2 Coherent Graviton Fields 107
4.2.3 The Search for Gravitational Waves 109
4.2.4 The Graviton and Deflector Shield Plausibility 112
4.3 Current Military Energy Deflector Shields 112
4.3.1 Electromagnetic Shielding 113
4.3.2 Military Plasma Shielding 114
4.3.3 Shockwave Shielding. 116
4.4 Shields as Protection from Space. 117
4.4.1 Cosmic Rays 117
4.4.2 The Magnetosphere and the Ionosphere 119
4.4.3 Plasma Deflector Shields 121
4.5 Shields Against Cosmic Rays 122
4.5.1 Superconducting Magnetic Fields as Shields. 123
4.5.2 Magnetic Shields Build Plasma Shields 124
4.5.3 Mini-Magnetospheres. 127
4.5.4 Magnetic and Plasma Shields on the Moon 127
4.6 Metamaterial Shields 129
4.6.1 Metamaterial Black Holes 130
4.7 Conclusion 131
References 132

5 The Tractor Beam: Pulling Earth Out of the Fire 135
5.1 Introduction 135
5.2 *Star Trek* Tractor Beams at Work 137
5.2.1 Tractors Generate Attenuated and Collimated Gravity Beams 138
5.2.2 Gravity Beams Exert Force 139
5.3 Current Tractor Beams on Earth 141
5.3.1 The Aquatic Tractor Beam Pulls with Waves 142
5.3.2 Pulling with Sound, an Acoustic Tractor Beam. 143
5.3.3 Laser-Based Tractor Beams 145
5.4 Saving the Earth with Tractor Beams. 152
5.4.1 Magnetic Field Architecture for Repulsor Forces. 152
5.4.2 The Real Threats to Earth 154
5.5 Near Earth Object Collision Avoidance Strategies Using Beams 156
5.5.1 Ablation by Repulsive Laser Beams 157
5.5.2 Ion Beam Shepherds 158
5.5.3 Gravity Tractors 159
5.5.4 Enhanced Gravity Tractors 161
5.6 Conclusion 162
References 163

6 Universal Translators: Now You're Speaking My Language 167
6.1 Introduction 167
6.2 *Star Trek* Universal Translator Usage 168
6.2.1 *Star Trek* UT Mechanism and the EEG 170
6.2.2 Audiovisual Sensors of the UT 172
6.2.3 The Translation Matrix of the UT 174
6.2.4 Linguacode 174
6.3 Current Translation Mechanisms 175
6.3.1 Optical Character Recognition 176
6.3.2 Speech Recognition 179
6.3.3 Language Recognition 181
6.3.4 Translation 182
6.3.5 Synthetic Speech Generation 184
6.4 Computational Linguistics and the Possibility of a UT 187
6.4.1 What Is a Language? 187
6.4.2 Linguistic Universals and Speech Characteristics 189
6.4.3 Using Linguistic Universals to Translate Dead Languages 190
6.4.4 Can Neurolinguistics Identify Universals 191
6.5 Limitations in Developing a UT 192
6.5.1 Culture and the UT 192
6.5.2 The Lessons of Klingon 193
6.6 Conclusion 195
References 196

7 Geordi's Visor: A Vision of the Future 199
7.1 Introduction 199
7.2 Visual Processing 201
7.2.1 Converting Light to Electricity 201
7.2.2 Translating Visual Information 203
7.3 Camera Based Visual Prostheses 205
7.3.1 Degenerative Retinal Diseases 205
7.3.2 Parameters for Making Visual Prostheses 207
7.3.3 The Argus II Epiretinal Implant 208
7.3.4 The Alpha-IMS Subretinal Implant 211
7.3.5 Visual Cortex Implants—The Orion I 215
7.4 Vision Based on the Retinal Code 217
7.4.1 The Retinal Code 217
7.4.2 Visual Prostheses as Artificial Retinas 218

7.5 Future Visions for Visual Prostheses 221
7.5.1 Software Updates 221
7.5.2 Virtual Electrodes and Current Focusing 222
7.5.3 Algorithms to Improve Recognition 223
7.5.4 Expanding Our Vision Beyond Visible Light 225
7.6 Conclusion 228
References 229

8 The Transporter: Are We There yet? 233
8.1 Introduction 233
8.2 Issue: Targeting a Spot in Space 235
8.2.1 Celestial Reference Frames and Coordinate Systems 235
8.3 Issue: Quantum Level Patterning 237
8.3.1 Quantum Information. 238
8.3.2 Heisenberg Uncertainty 241
8.3.3 Quantum Entanglement and Coherence 243
8.3.4 Quantum Computing Uses Qubits 245
8.3.5 Coherence and Entanglement in Quantum Computing 246
8.4 Issue: Reducing You to Atoms or Less 249
8.4.1 Breaking Down Matter 249
8.4.2 Chemistry, Light and Plasma to Break Down Molecules 251
8.4.3 Colliders Can Break Down Matter Further 253
8.4.4 Converting Matter Directly to Energy 255
8.5 Issue: Transmitting Atoms or Information 258
8.5.1 Entanglement Allows Teleportation of Information 259
8.5.2 Examples of Teleportation 261
8.6 Issue: Rematerialization 262
8.6.1 Building Macroscopic Objects from Atoms 263
8.6.2 Building Macroscopic Matter from Subatomic Particles 264
8.6.3 Fusion Builds Matter 266
8.6.4 Building Matter from Energy 269
8.7 Conclusion 272
References 273

9 The Tricorder: A High Tech Multitool 279
9.1 Introduction 279
9.2 Star Trek Tricorders 281
9.2.1 Tricorder Functions 281
9.3 Smartphones as Tricorders 282
9.3.1 Peripheral Sensors for GEO Tricorder Functions 283
9.3.2 Environmental Smartphone Sensors 284
9.3.3 Smartphones as Health Monitors 285

9.4 Achieving a Medical Tricorder 286
9.4.1 The Qualcomm Tricorder XPrize. 286
9.4.2 Team Aezon, Undergraduate Tricorder XPrize Finalists 287
9.4.3 Vitals Functions Monitoring 289
9.4.4 Tricorders for Diagnosis of Disease 291
9.5 Point of Care Testing and the Medical Tricorder 294
9.5.1 Microfluidics 294
9.5.2 Lateral Flow Testing 296
9.5.3 Quantitative Polymerase Chain Reaction in POC Testing. 298
9.5.4 Differential Diagnoses from Computers 299
9.6 Emerging Platforms for POC Testing. 300
9.6.1 Microcantilevers 301
9.6.2 Quantum Dots 302
9.6.3 Magnetic Nanoparticles and Nanorobots. 304
9.6.4 Smelling Disease. 305
9.7 Conclusion 309
References 310

Bibliography 313

Index 317



http://www.springer.com/978-3-319-40912-2

The Realization of Star Trek Technologies
The Science, Not Fiction, Behind Brain Implants, Plasma Shields, Quantum Computing, and More
Lasbury, M.
2017, XXII, 320 p. 77 illus., 69 illus. in color., Softcover
ISBN: 978-3-319-40912-2