Contents

1	Intr	oduction – A Revolutionary Cipher	1	
	1.1	A Traitorous Doctor	1	
	1.2	A Few (Vocabulary) Words About Cryptology	5	
	1.3	Codes	6	
	1.4	Ciphers	8	
	1.5	Substitution Ciphers	8	
	1.6	Transposition Ciphers	10	
	Refe	rences	11	
2	Cryptology Before 1500 - A Bit of Magic			
	2.1	Veni, Vidi, Cipher	13	
	2.2	Cryptology in the Ancient World - The Greeks	14	
	2.3	Cryptology in the Middle Ages – The Arab Contribution	15	
	2.4	Monastic Geniuses and Poets	15	
	2.5	Frequency Analysis, The First Cryptanalytic Tool	18	
	Refe	rences	23	
3	The Black Chambers: 1500–1776			
	3.1	Bacon vs. Shakespeare	25	
	3.2	Crypto Brings Down a Queen: Mary, Queen of Scots	29	
	3.3	Nomenclators	34	
	3.4	The Black Chambers	36	
	3.5	The Next Complexity – Polyalphabetic Substitutions	37	
	Refe	rences	42	
4	Cry	Crypto Goes to War: The American Revolution 4		
	4.1	Secret Writing and Espionage	44	
	4.2	British Cipher Systems	45	
	4.3	American Cipher Systems	52	
	4.4	American Diplomatic Cipher Systems	57	
	4.5	After the Revolution	60	
	Refe	rences	61	

5	Cryp	to Goes to War: The American Civil War 1861-1865	63
	5.1	Technology Goes to War	63
	5.2	The Union Tries a Route	64
	5.3	Crypto for the Confederates	68
	5.4	Solving a Vigenère Cipher – Babbage & Kasiski	69
	5.5	Solving a Vigenère - Friedman's Index of Coincidence	71
	5.6	Solving a Vigenère – Finding the Key Length	76
	5.7	Solving a Vigenère – Barr and Simoson	78
		5.7.1 Computing the Keyword Length	78
		5.7.2 Finding the Keyword	82
	5.8	Conclusion	84
	Refer	rences	85
6	Cryp	to and the War to End All Wars: 1914–1919	87
	6.1	The Last Gasp of the Lone Codebreaker	87
	6.2	The Last "Amateur" Cipher Bureau – Room 40	88
	6.3	The Americans Start from Behind	94
	6.4	America Catches Up: Herbert Yardley and MI-8	95
	6.5	The A.E.F. in France	96
	6.6	Trench Codes	97
	6.7	Ciphers in the Great War – the Playfair	100
	6.8	Ciphers in the Great War – The ADFGVX Cipher	102
	6.9	The Home Front – Cracking the Waberski Cipher	104
	6.10	A New Beginning	113
		ences	114
7	The Interwar Period: 1919–1941		117
•	7.1	Room 40 After the War	117
	7.2	The U.S.A. – Herbert O. Yardley and the Cipher Bureau	118
	7.3	William Friedman and the Signal Intelligence Service	124
	7.4	The Other Friedman – Elizebeth Smith Friedman	126
	7.5	Agnes Meyer Driscoll, the Navy, and OP-20-G	131
		ences	135
0		Rise of the Machines: 1918–1941	
8			137
	8.1	Early Cipher Machines	137
	8.2	The Rotor Makes Its Appearance	138
	8.3	The Enigma	142
	8.4	Solving the Enigma – The Polish Mathematicians	145
	8.5	SIS vs. Japan: Solving Red and Purple	146
		ences	150
9		e Against the Machines: World War II 1939-1945	151
	9.1	How Does the Enigma Work?	151
	9.2	Solving the Enigma – Alan, Marian, and the Bombe	154

		SIGABA – Friedman and Rowlett's Triumph How Does the SIGABA Work? Women in Crypto During World War II ences	157 160 162 164
10	The N 10.1 10.2	Machines Take Over: Computer Cryptography The Shoulders of Giants: Friedman, Hill, and Shannon Modern Computer Cipher Algorithms – DES 10.2.1 How Does the DES Work? 10.2.2 The f() Function	167 167 169 169 171
	10.3 10.4 10.5	10.2.3 The Key Scheduler	172 173 175 179 181
		ences	184
11	11.1 11.2 11.3 11.4 11.5 11.6	and Bob and Whit and Martin: Public-Key Cryptography The Problem with Symmetric Ciphers Enter Whit and Martin The Key Exchange Problem Public-Key Cryptography Appears (and GCHQ Too) Authentication Is a Problem Too Implementing Public-Key Cryptography – The RSA Algorithm 11.6.1 RSA Key Generation Example 11.6.2 Encrypting and Decrypting Example Analysis of RSA Applications of Public-Key Cryptography Elliptic Curve Cryptography	185 185 186 187 189 191 192 193 194 194 196 201
12		and Mobile Device Cryptology	203
_	12.1 12.2 12.3	Web Security and Cryptology Mobile Device Security and Cryptology Wi-Fi Security and Cryptology	203 205 207 212
13	13.1 13.2 13.3	Weapons and Cyber Warfare Cyber Attacks, Types, Players, and Definitions Malware – Viruses and Worms 13.2.1 Computer Viruses	213 213 216 216 218 219
	13.4	Stuxnet	220

	13.5	Mitnick, Morris, and Zimmermann	22
		13.5.1 Kevin Mitnick, the World's Most Wanted Hacker	22
		13.5.2 Robert Tappan Morris and the First Worm	224
		13.5.3 Phil Zimmermann and PGP	229
	13.6	Playing Defense	233
	Appe	ndix: A Simple Linux Virus Program Written in C	234
		ences	238
14	Cryn	tology and the Internet of Things	24
	14.1	A Day in the Life – All Your Devices Are on the Net Now	24
	14.2	The Internet of Things	243
		14.2.1 Internet of Things – What Is It	243
		14.2.2 What Issues Are There with IoT Security?	244
		14.2.3 How to Make IoT Devices More Secure	245
	14.3	Security and IoT Devices – Examples	246
		14.3.1 IoT Botnets – The Dyn Denial of Service Attack	246
		14.3.2 Taking over Household Devices	248
		14.3.3 Autonomous Vehicles and the Internet of Things	249
	14.4	Conclusion	25
	Refer	ences	252
15	What	Is Next in Cryptology?	253
10	15.1	Quantum Computing	253
	15.1	15.1.1 What Is Quantum Computing?	254
		15.1.2 So What Is the Problem for Cryptography?	256
	15.2	Post-quantum Cryptography	258
	15.3	Quantum Key Distribution (QKD)	259
		ences	262
16	-	er Mysteries	263
	16.1	The Voynich Manuscript	263
	16.2	The Beale Ciphers	271
	16.3	Kryptos	281
		ndix – Beale Cipher Messages #1 and #3	289
	Refer	ences	291
Pho	to and	Illustration Credits	293
Ind	O.B.		200