

Acknowledgments

Law and Policy for the Quantum Age has been a fascinating and challenging book to research and write. We went long on the history of technology, as we believe that experience with the introduction of previous game-changing technologies offers important context for making decisions about such technologies today. We believe that good technology policy can only be made with a rough-and-accurate understanding of the underlying technology. We are determined to correct much of the misinformation that is present in the popular literature of quantum information science today.

Quantum technologies was a new topic for both authors. Author Hoofnagle decided to research the field after conversations with Lily Lin (Berkeley MIMS 2019), whose narrative made clear that quantum sensing was much more interesting than cryptanalysis. Then, the good folks at Delta Airlines seated author Garfinkel together with Hoofnagle on a long flight back from Tel Aviv in the summer of 2019. Together we discussed the national security implications of quantum technologies and formed plans to write this book.

As part of researching this book, the authors downloaded and reviewed over 1500 scientific articles, popular articles, and books pertaining to the topics discussed herein. We purchased sheets of polarizing material, 3D glasses, and large optical grade calcite crystals so that we could experience first-hand the mysteries of superposition at the macro scale. We haunted online forums, emailed with a Nobel Laureate, and tried the very best we could to make up for the fact that neither of us had studied quantum physics in college.

This book would not have been possible without the thoughtful engagement from many experts in quantum information science, who gave generously of both their time and counsel. We owe many thanks to those who helped us with difficult material, and acknowledge that any mistakes remaining are our own.

We would like to explicitly thank those who answered questions about technology and history while working on this project, including Scott Aaronson, Ross Anderson, Syed Assad, Holger Axelsen, Philip Ball, Charles Bennett, Scott Bradner, Steve Crocker, Nike Dattani, Peter Denning, Edward Fredkin, Joyce Fredkin, Michael Frank, Shohini Ghose, David Grier, Aram Harrow, Marco Lanzagorta, Seth Lloyd, Chao-Yang Lu, Norman Margolus, Henry Minsky, Margaret Minsky, Christopher Monroe, Jian-Wei Pan, Daniel Polanic, Peter W. Shor, Adam Shostack, Bill Silver, Tommaso Toffoli, Rainer

Weiss, and Stephen Wolfram. Tom Slee reviewed our section on chemistry and found several errors, which we attempted to correct; those that remain are ours, not his.

Mark Horowitz at Stanford worked with us to resolve several lingering questions regarding the National Academies report on the potential of quantum computing. Overall, we found the report useful as an initial, highly technical introduction to this complicated topic; we strongly recommend the report to anyone looking for a description of quantum computing that is more technical than the one we present here.

At IBM, we would like to thank Chris Nay for working with us over the course of more than a year in both answering questions and arranging interviews with Charles Bennett, John Smolin, and Bob Sutor.

We would like to thank Diane Carr at ColdQuanta for answering our questions and providing us with overview information; Misha Rindisbacher at Launch Squad for her help in answering questions about the D-Wave computer; and Jason Freidenfelds at Google for answering our questions about Google's efforts.

We especially benefited from Bill Silver sharing with us his notes and recollections of Ed Fredkin's course on Digital Physics, and from Charles Bennett sharing with us his photograph of the 1981 Conference on Physics and Computation.

We also benefited from commentary and support from Geoff Cohen, Andrew Grosso, Burt Kaliski Jr., Darrell Long, Hartmut Häffner and Stuart Schechter..

The text benefited from workshops held by the Haifa Center for Law and Technology (with commentary by Amnon Reichman, Tal David, Shay Gueron, Michal Gal, and Orr Dunkelman); the Sandia National Laboratory (with thanks to Andrew Reddie); and the Ohio State University (with thanks to Dennis Hirschman).

In its final form, various chapters of this book benefited from in-depth reviews by Ross Anderson, Michael Grant, Ted Huffmire, and Bill Silver.

Author Hoofnagle's family, doctors Jay and Mark Hoofnagle and Cheryl Winchell, read drafts and provided commentary; Hoofnagle's father-in-law, Jon Wilbrecht, provided commentary and suggested the ultimate organization of the work. Yasemin Acar helped us with German translations.

We are grateful to our editor, Matthew Gallaway, and colleagues Cameron Daddis, Jadyne Fauconier-Herry, and Chloe Quinn of Cambridge University Press. Our copy editor, Ken Moxham, our proofreader Ian Pickett, and the TeX Support team at SPi Content Solutions, particularly Suresh Kumar, caught and fixed many problems with the text and formatting. Those that remain are ours, not theirs.

This work started as an article that received comment from Lily Lin, Evan Wolff, and Peter Swire; the participants in the Future of Cybersecurity Working Group, particularly Andrew Reddie and Kristy Cappelli; the participants of the Berkeley faculty scholarship workshop, including Jennifer Urban, Sonia Katyal, Christopher Kutz, Andrea Roth, Amnon Reichman, Mark Gergen, Nicole Ozer, Steven Sugarman, Eugene Bardach, Peter Schuck, and Christopher Slobogin; the participants of the Yale Information Society Project paper series, including Laurin Weissinger, Sam Hayek, Nikolas Guggenberger, Tiffany Li, and Mason Marks; the participants of the Privacy Law Scholars Conference including Andrea Matwyshyn, Sue Glueck, Andrew Odlyzko, Maria Brincker, Ot Van Daalen, Katherine Strandburg, Alex Deane, Ari Waldman, Aaron Massey, Pam Dixon, Jeff Brueggeman, Mary Madden, and Nick Merrill.

Special thanks are due to the contributors of *tex.stackexchange.com* who answered our L^AT_EX questions, as well as to our respondents on *quantumcomputing.stackexchange.com*, *chemistry.stackexchange.com*, *crypto.stackexchange.com*, and *hsm.stackexchange.com* (history of science and mathematics).

The appearance of US Department of Defense (DOD) visual information in this work does not imply or constitute DOD endorsement.

Publication with a *CC-BY-NC* license was made possible in part by support from the Berkeley Research Impact Initiative (BRII) sponsored by the University of California, Berkeley Library and by the Berkeley Center for Law and Technology. We are grateful to Timothy Vollmer, Rachael Samberg, Margaret Phillips, and James X. Dempsey for their support in making an open access version of this work available.

0	1	0	0	0	1	1	0	0	1	1	0	0	0	0	1
0	1	1	0	1	0	0	1	0	1	1	1	0	1	0	0
0	0	1	0	0	0	0	0	0	1	0	0	1	1	0	0
0	1	1	1	0	1	0	1	0	1	1	1	1	0	0	0

