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BOOK REVIEW

Understanding the Morally Gray Roots of Engineering

Review of Ethan Blue, Michael Levine, and Dean Nieusma's *Engineering and War: Militarism, Ethics, Institutions, Alternatives*, San Rafael, CA: Morgan and Claypool, 2014, 122 pp, ISBN: 978-1-608-45876-9

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The engineering occupation, which can be understood as "the application of science to the common purposes of life,"[1] doesn't appear to raise any moral red flags. Under this definition, an engineer's job should be to make life better for people by developing technology, systems, or other inventions that improve people's daily lives, right? This simplistic perception quickly falls apart when one considers the relationship between engineering and the development of military technology. While most realize that choosing to actively contribute to the production of weapons of mass destruction raises several difficult moral questions, many never consider less obvious issues. In reality, the intertwining of engineering and militarism extends far deeper; military influences pervade nearly all facets of the occupation and raise far more profound and broad questions about what it means to be an engineer. The pursuit of making moral sense of their intertwinement is taken up in *Engineering and War: Militarism, Ethics, Institutions, Alternatives* by Ethan Blue, Michael Levine, and Dean Nieusma.

The book is part of the Synthesis Lectures on Engineers, Technology and Society series that develops interdisciplinary research meant to help engineers understand the far-reaching effects of their profession. *Engineering and War* is one of the most comprehensive starting points for engineers seeking to understand the historical interrelationship between their profession, its stated ideal of engineering integrity, and its historical connection with military efforts. It aims to provide the groundwork for sensible reimagining of the occupation as a whole.

Unlike most issues in engineering ethics, which arise due to some failure, even military engineering successes can be morally problematic. In pursuit of victory, military engineers have developed mines, incendiary weapons, and blinding laser weapons, all now banned by the Geneva Convention for either being too indiscriminate or causing unnecessary suffering (International Committee of the Red Cross, 2019). But indirect contributions can be just as morally troubling.

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Somewhat surprisingly, it is hard to figure out how many engineers are involved in military- and defense-related work. In a 2008 conference paper, Chris Papadopoulos and Andrew Hable's estimates for U.S. engineers ranged from 8.8 percent to 60 percent (Papadopoulos and Hable, 2008). The lower estimate was calculated using Bureau of Labor Statistics and Department of Defense purchasing data and includes direct (e.g., ammunition) and indirect (e.g., paint) efforts, but excludes other agencies. The higher estimate is based on federal military and defense research and development expenditures. But even the conservative estimate is staggering—almost one in ten!—and is three times the defense-related contributions of non-engineers. The challenges in determining the engineer's role also shows the implicit dual-use possibilities in scientific and technological advances: much of the progress made in designing modern technology for the betterment of mankind (another definition of the engineering vocation, usually understood in the civilian context) simultaneously creates potential military advancements, regardless of the engineer's intent.

Part of the reason it is so hard to figure out how many engineers are involved in such work is that few in the profession say much about it. Blue, Levine, and Nieusma propose four hypotheses to explain the relative silence about the relationship between engineering and war. Psychological repression as a means of cognitive self-defense is presented as a primary explanation: the idea is that even considering the relationship between engineers and the military is damaging enough to an engineer's psyche to repress it and avoid conversation altogether. A second hypothesis, based on the cognitive tendencies of engineers, is that the dominant ideology of engineers includes a skepticism about politics and discussing politics, which creates an aversion to discussing the relationship between their livelihood and war. A third explanation is that engineers are political conservatives, who have favored defense initiatives. The fourth is that they are influenced by ingrained patronage structures through which the military supports a large number of engineers working in military research. Of the four hypotheses presented, the evidence for psychological repression is by far the weakest, followed somewhat closely by the dominant ideology argument: both hypotheses depend on some questionable assumptions about the psyche of engineers as a whole. The dominant ideology argument is presented without reference to any research, and the psychological repression argument relies on the idea of disciplinary repression, a Freudian theory that humans repress beliefs and desires that challenge our self-conception, but without any evidence that this applies to engineering and warfare. The arguments that political learnings and economic self-interest result in a widespread taboo on discussion are better supported, particularly when both are backed up by studies indicating that such leanings and economic incentives exist (Lucena 2005; Gambetta and Hertog 2009). Though no hypothesis sufficiently explains the silence by itself, they do fill a more important role: prompting discussion on engineering and military work. This discussion functions as a precursor to real change, a daunting task for a profession that struggles to even self-regulate.

From their analysis, the authors discern two additional tasks budding engineers seeking to live morally must take on that non-engineers do not. First, they must identify how much their work contributes directly and indirectly towards the perpetuation of global conflict. Second, they must determine whether they find these conditions morally acceptable to work in, or barring that, how they can change either themselves or the system as a whole to accommodate their view.

Knowing that over 7,000 U.S. soldiers have died and 53,242 soldiers have been wounded between 2000 and 2020 in various military operations (U.S. Library of Congress 2020), how can war be morally justified? The book follows the standard approach to this question by investigating *jus ad bellum* (justice of waging war) and *jus in bella* (just conduct in war). The book presents three conditions for a morally just war: it must be the last resort, declared by legitimate authority, and morally justified in some way. A myriad of questions can be raised regarding each criterion, but for engineers the primary question is whether they are able to justify a given war for themselves knowing the weapons they create may be used in a context they were never intended for by their creator. There is a marked difference between aiding in military development for a war that seems just compared to one that seems unjust. The authors use J. Robert Oppenheimer's invention of the atomic bomb and his moral concerns over its use to discuss *jus in bella*. Its demands have changed drastically over the past hundred years, in no small part thanks to modern engineering technology such as smart bombs and laser guided missiles forcing the international community to constantly reevaluate what is and is not morally justified for use in war. The book argues that engineers are morally responsible for the current landscape of war, even if they are not the ones making the decisions for just war conduct on the field, regardless of what the international community thinks.

If an engineer accepts this, what should he or she do? The authors present engineering integrity as a way to chart one's path. The authors believe there are several ways to come to integrity: "self-integration," "maintenance of identity," "standing for something," "moral purpose," as a virtue to be striven for, and by considering how one fits in various social structures. On the whole, these approaches encourage a person to maintain coherence in their beliefs and concerns, to adopt appropriate aims, to hold true to and stand up for their commitments, and to conscientiously seek to develop integrity as a character trait, with attention to the social context in which one acts. They allow an engineer to start coming to his or her own conclusions regarding the morality of his or her work and whether it allows his or her integrity to remain intact. The range of perspectives is extensive, accounting for everything from the impact of educational structures that institutionalize militaristic values to the cognitive dissonance created when the commitments one holds closest to them conflict with their career choices. One small criticism of this chapter is that it starts with a vignette in which Georgina, a pacifist, struggles with whether to take a job that would involve producing weapons for chemical warfare. The authors could have explained how the integrity

principle of standing for something would help, but they did not revisit Georgina's dilemma at any point in the chapter (or the rest of the book, for that matter).

The advent of the military-industrial complex and later the military-industrial-academic complex are both explored as historical context to the current situation engineering finds itself in. The first complex was born from government interest in advancing military prowess, which led to the development of industry around war manufacturing. Industry became increasingly reliant on the business of war as the proportion of manufacturing plants dedicated to producing weapons and supplies for the military grew. As war evolved and began to depend more on the weapons used than on the number of soldiers, the two global superpowers of the United States and the Soviet Union started investing more and more in military research to avoid being outclassed in weapon technology by each other, leading to the engineering academic research tie-in.

The authors trace this development back to British gunboat diplomacy, where colonies of Britain at the turn of the twentieth century agreed to terms of trade that favored their colonizers under threat of overwhelming naval force, and helped lay the groundwork that would grow into the post-Cold War "soft kill" weapons (those that at least temporarily debilitate without killing) research, in a way that is fascinating and easy to follow. At the same time, these descriptions make it clear that much, if not close to all, engineering advancement in the past few centuries has led to related development in the way war is conducted. This intertwinement is explored further in Carl Mitcham's "Science, Technology, Engineering, and the Military," recently republished in *Steps toward a Philosophy of Engineering: Historico-Philosophical and Critical Essays* (2019) with an addendum based on *Engineering and War*. Mitcham extends the questioning of the entanglement of militarism and engineering to all aspects of STEM. Both works argue that engineers need a better understanding of the forces that have affected the history of their profession, in particular the proliferation of military technology and how the disproportionate amount of engineering research directed towards military interests came to be.

The last chapter of the book outlines some of the responses to militarism in engineering with an emphasis on contemporary problems such as depersonalization of violence (e.g, drone strikes). This overview of responses and the organizations that support them provides engineers with some options available to them. Though this part seems like a slight contradiction to the earlier claim about the silence of engineers on warfare, these little-known responses are a critical addition for anyone seeking to understand what can be done to reshape the connections between war and engineering. Though the history of such movements, spearheaded by organizations like Scientists and Engineers for Social and Political Action (SESPA) and the Committee on Social Responsibility in Engineering (CSRE), is useful for context, the strength of this chapter rests with the explanation of contemporary responses to engineering and war. Other initiatives such as Peace Engineering, the Engineering, Social Justice, and Peace (ESJP) movement, and green or sustainable engineering have mission statements that encourage a less

militaristic type of engineering that attempts to live up to Rutherford's classic definition of engineering. The book touches on all of these major movements and their impact, but too briefly, in part because the organizations each address a different front rather than offering a comprehensive "new vision" for engineering. Tying the rationale behind the silence over militarism in engineering to these non-military engineering movements could have led to a better understanding of both.

The book is an important contribution to the literature, especially given how little has been said about the topic of engineering and warfare. That in mind, it is not without its faults. Other rationale for the silence on engineering and warfare's relationship should have been explored, especially since such a gap in knowledge was what drove the creation of this book in the first place and understanding the origin of the problem is one of the critical steps in designing a long-term solution. Had the authors wanted to adequately consider the potential psychological sources for the reasoning behind engineering and warfare's teamwork, they could have considered other methods and tools such as personality matrix ratings for engineers or other proven testing methods that identify dominant personality traits that would cause engineers to prioritize their work without enough concern for its potential consequences. Comparing this information to the tendency of these people to speak out on controversial issues might have yielded more tangible results. Previous research on the relationship between career choices and personality have yielded interesting results on the correlations between a person's interests and their desired careers that could be expanded on if future studies include the context of engineering and warfare (Ackerman and Beier 2003)

This book is an excellent primer for the often-overlooked connections between the field of engineering and the warfare that continues to plague our world daily. It achieves its primary goal of getting engineers to pay attention to the nature of their craft on a moral level, to rightly see their field as morally grey. Many readers will likely seek to escape the spiral of innovation fed by a military-industrial-academic complex they did not even realize they were a part of. My eyes have been opened to the pervasiveness of this military complex within engineering after reading this book, and what I have learned from it will cause me to think twice about both how the work I plan to do might perpetuate global conflict and whether I find those conditions morally acceptable when making career choices. While the book has minor imperfections, it is an excellent step in the right direction for pursuing the ideal world that the engineer applying science to the common purpose of life seeks to realize, compelling readers to confront difficult questions about what it means to be an engineer in the modern world.

Notes

1. The authors attribute this definition to Count Rutherford in 1799, though without citation. It is in the founding documents for the Royal Institution of Great Britain, which Rutherford co-established with Joseph Banks (http://www.rigb.org/docs/brief_history_of_ri_1.pdf).

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