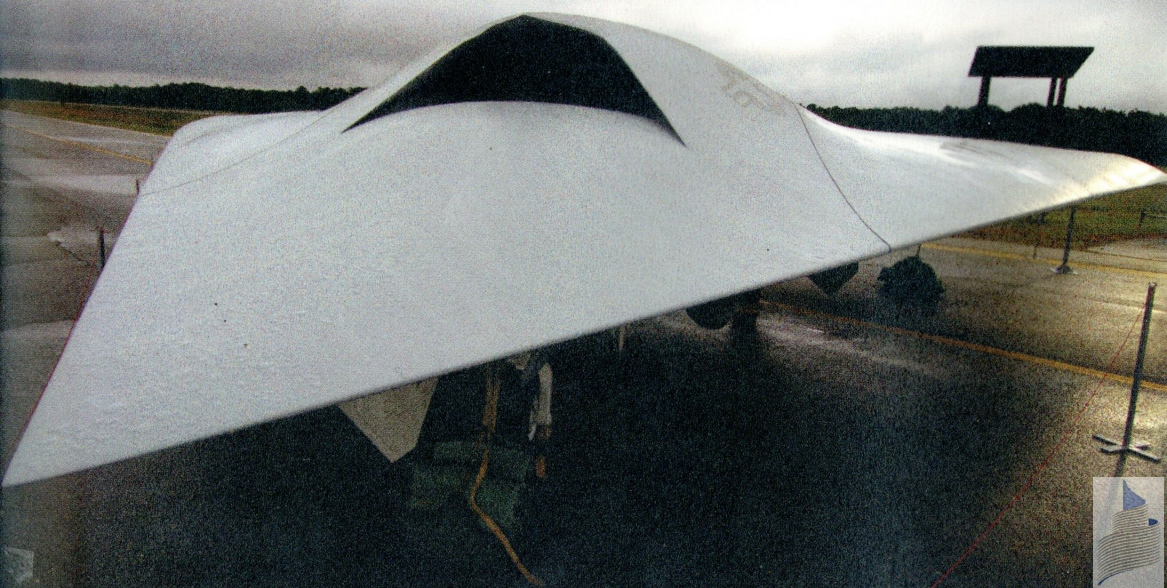


WIRED FOR WAR

THE ROBOTICS REVOLUTION AND
CONFLICT IN THE 21ST CENTURY

P. W. SINGER



What happens when science fiction starts to become reality on the battlefield? A military expert reveals how technology is changing, not just how wars are fought, but also the politics, economics, laws, and ethics that surround war itself.

P. W. Singer's previous two books foretold the rise of private military firms and the advent of child soldiers—predictions that proved all too accurate. Now, he explores the greatest revolution in military affairs since the atom bomb—the dawn of robotic warfare.

We are on the cusp of a massive shift in military technology that threatens to make real the stuff of *I, Robot* and the *Terminator*. More than twelve thousand robotic systems are now deployed in Iraq. Pilots sitting in Nevada are remotely killing terrorists in Afghanistan. Scientists are debating just how smart—and how lethal—to make their robotic creations. And many of the most renowned science fiction authors are quietly consulting for the Pentagon on the next generation.

Blending historical evidence with interviews of an amazing cast of characters, Singer shows that as these technologies multiply, they will have profound effects on the front lines, as well as on politics back home. Moving humans off the battlefield makes wars easier to start but more complex to fight. Replacing men with machines may save some lives, but will lower the moral and psychological barriers to killing. The “warrior ethos,” which so long defined

Your Excellency Dato' Sri Najib,
I hope you enjoy the book, and
even more so find useful to your
important work.

With kindest regards,





[WIRED FOR WAR]



ARMY SENIOR OFFICERS INSTITUTE (INSPEKA)

BRIG GEN DATUK SUHAIMI BIN HJ MOHD ZUKI
Commandant

Kem SiRusa,
71050 Port Dickson
Negeri Sembilan Darul Khusus
MALAYSIA

Tel : 06-6479 491
Fax : 06-6479 840
H/P : 019-388 3253
Email : suhaimizuki@hotmail.com



PERDANA
LEADERSHIP
FOUNDATION
YAYASAN
KEPIMPINAN
PERDANA



ALSO BY P. W. SINGER

Children at War

*Corporate Warriors:
The Rise of the Privatized Military Industry*



PERDANA
LEADERSHIP
FOUNDATION
YAYASAN
KEPIMPINAN
PERDANA



[WIRED FOR WAR]

The Robotics Revolution and Conflict in the Twenty-first Century

P. W. SINGER

THE PENGUIN PRESS
NEW YORK 2009

PUSTAKA PERDANA



1013656



THE PENGUIN PRESS

Published by the Penguin Group

Penguin Group (USA) Inc., 375 Hudson Street, New York, New York 10014, U.S.A. • Penguin Group (Canada), 90 Eglinton Avenue East, Suite 700, Toronto, Ontario, Canada M4P 2Y3 (a division of Pearson Penguin Canada Inc.) • Penguin Books Ltd, 80 Strand, London WC2R 0RL, England • Penguin Ireland, 25 St. Stephen's Green, Dublin 2, Ireland (a division of Penguin Books Ltd) • Penguin Books Australia Ltd, 250 Camberwell Road, Camberwell, Victoria 3124, Australia (a division of Pearson Australia Group Pty Ltd) • Penguin Books India Pvt Ltd, 11 Community Centre, Panchsheel Park, New Delhi-110 017, India • Penguin Group (NZ), 67 Apollo Drive, Rosedale, North Shore 0632, New Zealand (a division of Pearson New Zealand Ltd) • Penguin Books (South Africa) (Pty) Ltd, 24 Sturdee Avenue, Rosebank, Johannesburg 2196, South Africa

Penguin Books Ltd, Registered Offices: 80 Strand, London WC2R 0RL, England

First published in 2009 by The Penguin Press,
a member of Penguin Group (USA) Inc.

Copyright © P. W. Singer, 2009
All rights reserved

ISBN 978-1-59420-198-1

Printed in the United States of America

1 3 5 7 9 10 8 6 4 2

DESIGNED BY NICOLE LAROCHE

Without limiting the rights under copyright reserved above, no part of this publication may be reproduced, stored in or introduced into a retrieval system, or transmitted, in any form or by any means (electronic, mechanical, photocopying, recording or otherwise), without the prior written permission of both the copyright owner and the above publisher of this book.

The scanning, uploading, and distribution of this book via the Internet or via any other means without the permission of the publisher is illegal and punishable by law. Please purchase only authorized electronic editions and do not participate in or encourage electronic piracy of copyrightable materials. Your support of the author's rights is appreciated.

This is your last chance. After this, there is no turning back. You take the blue pill—the story ends, you wake up in your bed and believe whatever you want to believe. You take the red pill—you stay in Wonderland and I show you how deep the rabbit-hole goes. Remember that all I am offering is the truth. Nothing more.

—Larry and Andy Wachowski, *The Matrix*, 1999



[CONTENTS]

<i>Author's Note: Why a Book on Robots and War?</i>	1
---	---

PART ONE: THE CHANGE WE ARE CREATING

1. <i>Introduction: Scenes from a Robot War</i>	19
2. <i>Smart Bombs, Norma Jeane, and Defecating Ducks: A Short History of Robotics</i>	42
3. <i>Robotics for Dummies</i>	66
4. <i>To Infinity and Beyond: The Power of Exponential Trends</i>	94
5. <i>Coming Soon to a Battlefield Near You: The Next Wave of Warbots</i>	109
6. <i>Always in the Loop? The Arming and Autonomy of Robots</i>	123
7. <i>Robotic Gods: Our Machine Creators</i>	135
8. <i>What Inspires Them: Science Fiction's Impact on Science Reality</i>	150
9. <i>The Refuseniks: The Roboticists Who Just Say No</i>	170

PART TWO: WHAT CHANGE IS CREATING FOR US

10. <i>The Big Cebrowski and the Real RMA: Thinking About Revolutionary Technologies</i>	179
11. <i>"Advanced" Warfare: How We Might Fight with Robots</i>	205



12. <i>Robots That Don't Like Apple Pi: How the U.S. Could Lose the Unmanned Revolution</i>	237
13. <i>Open-Source Warfare: College Kids, Terrorists, and Other New Users of Robots at War</i>	261
14. <i>Losers and Luddites: The Changing Battlefields Robots Will Fight On and the New Electronic Sparks of War</i>	279
15. <i>The Psychology of Warbots</i>	297
16. <i>YouTube War: The Public and Its Unmanned Wars</i>	315
17. <i>Changing the Experience of War and the Warrior</i>	326
18. <i>Command and Control... Alt-Delete: New Technologies and Their Effect on Leadership</i>	344
19. <i>Who Let You in the War? Technology and the New Demographics of Conflict</i>	360
20. <i>Digitizing the Laws of War and Other Issues of (Un)Human Rights</i>	382
21. <i>A Robot Revolt? Talking About Robot Ethics</i>	413
22. <i>Conclusion: The Duality of Robots and Humans</i>	428
<i>Acknowledgments</i>	437
<i>Notes</i>	439
<i>Index</i>	483

[WIRED FOR WAR]





[AUTHOR'S NOTE]

WHY A BOOK ON ROBOTS AND WAR?

Those people who think they know everything are a great annoyance to those of us who do.

—ISAAC ASIMOV

Because robots are frakin' cool.

That's the short answer to why someone would spend four years researching and writing a book on new technologies and war. The long answer is a bit more complex.

As my family will surely attest, I was a bit of an odd kid. All kids develop their hobbies and even fixations, be it baseball cards or Barbie dolls. Indeed, I have yet to meet a six-year-old boy who did not have an encyclopedic knowledge of all things dinosaur. For me growing up, it was war. I could be more polite and say military history, but it was really just war. In saying the same about his childhood, the great historian John Keegan wrote, "It is not a phrase to be written, still less spoken with any complacency." But it is true nonetheless.

Perhaps the reason lies in the fact that the generations before me had all served in the military. They left several lifetimes' worth of artifacts hidden around the house for me to pilfer and play with, whether it was my dad's old military medals and unit insignia, which I would take out and pin to my soccer jersey, or the model of the F-4 Phantom jet fighter that my uncle had flown over Vietnam, which I would run up and down the stairs on its missions to bomb Legoland.



But the greatest treasure trove of all was at my grandparents' house. My grandfather passed away when I was six, too young to remember him as much more than the kindly man whom we would visit at the nursing home. But I think he may have influenced this aspect of me the most.

Chalmers Rankin Carr, forever just "Granddaddy" to me, was a U.S. Navy captain who served in World War II. Like all those from what we now call "the Greatest Generation," he was one of the giants who saved the world. Almost every family gathering would include some tale from his or my grandmother's ("Maw Maw" to us grandkids) experiences at war or on the home front.

It's almost a cliché to say, but the one that stands out is the Pearl Harbor story; although, as with all things in my family, it comes with a twist. On December 7, 1941, my grandfather was serving in the Pacific Fleet on a navy transport ship. For three months after the Pearl Harbor attack, the family didn't hear any word from him and worried for the worst. When his ship finally came back to port (it had actually sailed out of Pearl Harbor just two days before the attack), he immediately called home to tell his wife (my grandmother) and the rest of his family that he was okay. There were only two problems: he had called collect, and that side of my family is Scotch-Irish. No one would accept the charges. While my grandfather cursed the phone operator's ear off, in the way that only a sailor can, on the other end the family explained to the operator that since he was calling, he must be alive. So there was no reason to waste money on such a luxury as a long-distance phone call.

Granddaddy's study was filled with volume after volume of great books, on everything from the history of the U.S. Navy to biographies of Civil War generals. I would often sneak off to this room, pull out one of the volumes, and lose myself in the past. These books shaped me then and stay with me now. One of my most prized possessions is an original-edition 1939 *Jane's Fighting Ships* that my grandfather received as a gift from a Royal Navy officer, for being part of the crew that shipped a Lend-Lease destroyer to the Brits. As I type these very words, it peers down at me from the shelf above my computer.

My reading fare quickly diverged from that of the other kids at Myers Park Elementary School. A typical afternoon reading was less likely to be exploring how Encyclopedia Brown, Boy Detective, cracked *The Case of the Missing Roller Skates* than how Audie Murphy, the youngest soldier ever to win the Medal of Honor, went, as he wrote in his autobiography, *To Hell and Back*. War soon morphed over into the imaginary world that surrounds all kids like a bubble. Other kids went to Nar-

nia, I went to Normandy. While it may have looked like a normal Diamondback dirt bike, my bicycle was the only one in the neighborhood that mounted twin .50-caliber machine guns on the handlebars, to shoot down any marauding Japanese Zeros that dared to ambush me on my way to school each morning. I still remember my mother yelling at me for digging a five-foot-deep foxhole in our backyard when I was ten years old. She clearly failed to understand the importance of setting up a proper line of defense.

I certainly can't claim to have been a normal kid, but in my defense, you also have to remember the context. To be so focused on war was somewhat easier in that period. It was the Reagan era and the cold war had heated back up. The Russians wouldn't come to our Olympics and we wouldn't go to theirs, the military was cool again, and we had no questions about whether we were the good guys. Most important, as a young Patrick Swayze and Charlie Sheen taught us in *Red Dawn*, not only were the Commies poised to parachute right into our schools, but it was likely us kids who would have to beat them back.

What I find interesting, and a sign of the power of Hollywood's marketing machine, is that usually some artifact from science fiction is in the background of these memories, intertwined with the history. For example, when I think back to my childhood bedroom, there are the model warships from my grandfather's era lined up on display, but also Luke, Leia, Han, and Chewbacca peeking up from my *Star Wars* bedsheets.

As most of science fiction involved some good guy battling some bad guy in a world far, far away, the two memes of my fantasy world went together fairly well. In short, your author was the kind of little boy to whom a stick was not a mere piece of wood, but the makings of a machine gun or a lightsaber that could save the world from both Hitler and Darth Vader.

WAR! WHAT IS IT GOOD FOR?

I look back on these memories with some embarrassment, but also guilt. Of course, even then, I knew that people die in war and many soldiers didn't come home, but they were always only the buddy of the hero, oddly enough usually from Brooklyn in most World War II movies. The reality of war had no way of sinking in.

It was not until years later that I truly understood the human costs of war. I remember crossing a jury-rigged bridge into Mostar, a town in Bosnia that saw some of the worst fighting in the Yugoslav civil war. I was there as part of a

fact-finding mission on the UN peacekeeping operation. Weeks of back-and-forth fighting had turned block after block of factories and apartments on the riverfront into a mass of hollowed-out hulks. The pictures of World War II's Stalingrad in an old book on my grandfather's shelf had sprung up to surround and encompass me. The books never had any smell other than dust, but here, even well after the battles, a burnt, fetid scent still hung in the air. Down the river were the remnants of an elegant 500-year-old bridge, which had been blasted to pieces by Serb artillery. The people, though, were the ones who drove it home. "Haunted" is the only adjective I can think of to describe the faces of the refugees.

The standout memory, though, was of a local provincial governor we met with. A man alleged to have orchestrated mass killing and ethnic cleansing campaigns for which he would soon after be indicted, he sat at an immense wooden desk, ominously framed by two nationalist paramilitary (and hence illegal) flags. But he banally talked about his plans to build up the tourism industry after the war. He explained that the war had destroyed many of the factories and cleaned out whole villages. So on the positive side, the rivers were now clear and teeming with fish. Forget the war crimes or the refugees, he argued, if only the United States and United Nations would wise up and give him money, the package tourists would be there in a matter of weeks.

This paradox between the "good" wars that I had fought in my youth and the seamy underside of war in the twenty-first century has since been the thread running through my writing. During that same trip, I met my first private military contractors, a set of former U.S. Army officers, who were working in Sarajevo for a private company. Their firm wasn't selling widgets or even weapons, but rather the very military skills of the soldiers themselves. This contradiction between our ideal of military service and the reality of a booming new industry of private companies leasing out soldiers for hire became the subject of my first book, *Corporate Warriors: The Rise of the Privatized Military Industry*. During the research, I was struck by another breakdown of the traditional model of who was supposed to be at war. In West Africa, the main foes of these new private soldiers were rebel bands, mostly made up of children. Many of these tiny soldiers had been abducted from their schools and homes. For me as a child, war had merely been a matter of play; for these children, war was the only way to survive. My next book, *Children at War*, tried to tell their story, in a way that didn't just tug at heartstrings, but also explained the causes and effects of child soldiers, such that we might finally act to end this terrible practice.

This contradiction of war as we imagine it to be, versus how it really is, isn't just the matter of a young boy growing up and putting his lightsaber away. It is part of something bigger that has haunted humanity from its very start.

One of the original sins of our species is its inability to live at peace. From the very beginning of human history, conflicts over food, territory, riches, power, and prestige have been constant. The earliest forms of human organization were clans that first united for hunting, but soon also for fighting with other clans over the best hunting grounds. The story of the dawn of civilization is a story of war, as these clans transformed into larger tribes and then to city-states and empires. War was both a cause and effect of broader social change. From war sprung the very first specializations of labor, the resulting stratification into economic classes, and the creation of politics itself.

The result is that much of what is written in human history is simply a history of warfare. It is a history that often shames us. And it should. War is not just merely human destruction, but the most extreme of horror and waste wrapped together. Our great religions view war as perhaps the ultimate transgression. In the Bible, for example, King David was prohibited from building his holy Temple, because, as God told him, "You are a warrior who has shed blood" (1 Chronicles 28). The ancient prophets' ideal vision of the future is a time when we "will learn warfare no more" (Isaiah 2:4). As one religious scholar put it, "War is a sign of disobedience and sinfulness. War is not intended by God. All human beings are made in the image of God and they are precious and unique."

The same disdain for war was held by our great intellectuals. Thucydides, the founder of both the study of history as well as the science of international relations, described war as a punishment springing from man's hubris. It is our arrogance chastised. Two thousand years later, Freud similarly described it as emanating from our Thanatos, the part of our psyche that lives out evil.

Yet for such a supposed abomination, we sure do seem to be obsessed with war. From architecture to the arts, war's horrors have fed the heights of human creativity. Many of our great works of literature, arts, and science either are inspired by war or are reactions to it, from the founding epics of literature like *Gilgamesh* and the *Iliad* to the great painters of surrealism to the very origins of the fields of chemistry and physics.

War then, appears in many more guises than the waste of human destruction that we know it to be. War has been described as a testing ground for nobility, the only true place where man's "arête" (excellence) could be won. In the *Iliad*,

the master narrative for all of Western literature, for example, “fighting is where man will win glory.” From Herodotus to Hegel, war is described as a test of people’s vitality and even one culture’s way of life versus another. War is thus often portrayed in our great books as a teacher—a cruel teacher who reveals both our strengths and faults. Virtues are taught through stories of war from Homer to Shakespeare, while evils to avoid are drawn out by war in stories ranging from Aeschylus to Naipaul.

War is granted credit for all sorts of great social change. Democracy came from the phalanx and citizen rowers of the ancient Greeks, while the story of modern-day civil rights would not be the same without Rosie the Riveter or the African American soldiers of the Red Ball Express in World War II.

War then is depicted as immoral, yet humanity has always found out-clauses to explain its necessity and celebration. The same religions that see violence as a sin also licensed wars of crusade and jihad. And it is equally the case in politics. We repeatedly urge war as the means to either spread or defeat whatever ideology is in vogue at the time, be it enlightenment, imperialism, communism, fascism, democracy, or even simply “to end all wars.”

This paradox continues in American politics today. Avoidance of war has been a traditional tenet of our foreign policy. Yet we have been at war for most of our nation’s history and many of our greatest heroes are warriors. We are simultaneously leaders of weapons development, being the creator of the atomic bomb, and the founders of arms control, which seeks its ban.

We are repulsed by the idea of war, and yet entranced by it. In my mind, there are two core reasons for humankind’s almost obsessive-compulsive disorder. The first is that war brings out the most powerful emotions that define what it is to be human. Bravery, honor, love, leadership, pity, selflessness, comradeship, commitment, charity, sacrifice, hate, fear, and loss all find their definitive expressions in the fires of war. They reach their ultimate highs and lows, and, in so doing, war is almost addictive to human culture. As William James put it, “The horror is the fascination. War is the strong life; it is life in extremis.”

The other reason that war so consumes us is that for all humanity’s advancement, we just can’t seem to get away from it. After nearly every war, we cite the immense lessons we learned that will prevent that calamity from repeating itself. We say over and over, “Never again.” Yet the reality is “ever again.”

“THE FUTURE AIN’T WHAT IT USED TO BE”

If humanity’s fascination comes down to how war reveals its best and worst qualities, this book comes from wrestling with a new contradiction in warfare that humanity finds itself hurtling toward. We embrace war, but don’t like to look to its future, including now one of the most fundamental changes ever in war.

Mine is a generation that, as one analyst put it, is “producing more history than it can consume.” With all the focus over orange alerts and Iraq, it is tough to take a step back and notice some of the tidal shifts we are living through. For example, in my lifetime, computers went from an oddity to omnipresent. I still remember when my dad first took me to the local science museum at the age of eight to see what a computer looked like. You could only communicate with it through an obtuse “Basic” language, a sort of evil technologic shorthand. As I recall, the only useful thing we could do with that early computer (I think it was a Texas Instruments) was design a smiley face made out of hundreds of the letter M, which we then printed on one of those old spool printers that you had to tear the paper off the edges. Today, the last thing my wife does before she goes to bed is check her e-mail on a handheld computer linked up wirelessly to a shared global server, all the while brushing her teeth. In the blink of an eye for history, something revolutionary happened.

Computers seem overwhelming enough, but over the last few years I became more and more convinced that my generation was living through something perhaps even more momentous. From the robot vacuum cleaner that patrols my floors to the unmanned planes that my friends in the air force use to patrol Iraq, humanity has started to engineer technologies that are fundamentally different from all before. Our creations are now acting in and upon the world without us.

I certainly cannot claim to be the only one to see these changes. Bill Gates, the world’s richest man and perhaps most responsible for the spread of computers, for instance, describes robotics today as being where the computer industry was around 1980, poised to change the way we think about what technology can do for us. “As I look at the trends that are now starting to converge, I can envision a future in which robotic devices will become a nearly ubiquitous part of our day-to-day lives. . . . We may be on the verge of a new era, when the PC will get up off the desktop and allow us to see, hear, touch and manipulate objects in places where we are not physically present.”

By the end of 2007, a United Nations report found that there were 4.1 million robots around the world working in people’s homes (as vacuum cleaners and the

like). That is, there were more robots than the entire human population of Ireland. The same study found that this “personal” robotics industry had a current market value around \$17 billion. What is more important than the raw numbers is the trajectory of the growth. In 2004, the number of personal robots in the world was estimated at 2 million. By 2007, it had doubled. Another 7 million more were expected to be bought by the end of 2008.

Looking forward, many see the numbers expanding at higher rates. By 2010, one technology research group predicts there will be 55.5 million personal robots in the world. This would be just the start. Indeed, in South Korea (human population 49 million), the Ministry of Information and Communication has announced plans to put a robot in every home by 2013. Here in the United States, it will likely take a little longer. One industry leader projects 2014 as the year by which 10 percent of the American population will have some form of personal robot in their household.

Robots are also showing up at work, from the more than forty-five hundred drones doing crop-dusting on Japanese farms to what many males would perhaps find the most disturbing example of mechanized outsourcing, the robot that handles security access at the offices of Victoria's Secret. Indeed, assembly-line factory robotics is an \$8 billion a year industry, growing at a 39 percent pace in the United States. This is not good news for everyone, of course, as it has put many blue-collar workers out of work, most notably at carmakers. Roughly one of every ten workers in automobile manufacturing is now a robot, and Toyota has announced a plan to eventually automate all its factories.

These trends project an industry that many analysts believe is poised for a breakout. Future Horizons, a technology research group based in Kent, England, describes how “the electronics industry is on the cusp of a robotics wave.” Many even think that by 2025, the robotics industry might rival the automobile and computer industries in both dollars and jobs. *BusinessWeek* summed up the future of the industry as “A Robotics Gold Mine.”

To put it another way, the robots that had once only populated my action figure collection were now becoming all too real. Science fiction appeared to be turning into science reality.

THE PARADOX OF THE FUTURE AND OF WAR

If robots were starting to appear in almost every aspect of life, I began to wonder how they would matter for war and politics. It is with some trepidation that

I made such a seeming leap of reason. Indeed, people have long peered into the future and then gotten it completely and utterly wrong. My favorite example took place on October 9, 1903, when the *New York Times* predicted that “the flying machine which will really fly might be evolved by the combined and continuous efforts of mathematicians and mechanics in from one million to ten million years.” That same day, two brothers who owned a bicycle shop in Ohio started assembling the very first airplane, which would fly just a few weeks later.

Similarly botched predictions frequently happen in the military field. General Giulio Douhet, the commander of Italy’s air force in World War I, is perhaps the most infamous. In 1921, he wrote a best-selling book called *The Command of the Air*, which argued that the invention of airplanes made all other parts of the military obsolete and unnecessary. Needless to say, this would be news both to my granddaddy, who sailed out to another world war just twenty years later, and to the soldiers slogging through the sand and dust of Iraq and Afghanistan today.

The result is yet another paradox. It is completely normal to look forward into the future in realms like science, business, or even the weather. But forecasts of the future and, even more important, serious explorations of the changes that might result from such a future are generally avoided in the study of war. People play it safe and the gatekeepers of the field often try to knock down anything that feels too unfamiliar.

My own first experience with this was when I began my research on private military firms. A senior professor thereupon informed me that I would do well to quit graduate school and instead “go become a screenwriter in Hollywood,” for thinking to waste his time on such a fiction as companies providing soldiers for hire. I still wonder how he squares this worldview with the 180,000 private military contractors now deployed in Iraq. A similar thing happened when I first presented my early research on the problem of child soldiers. A professor at Harvard University told me that she didn’t believe child soldiers existed and that I was “making it up.” Today there are some 300,000 children at war around the globe, fighting in three out of every four wars.

The irony is that while we accept change in other realms, we resist trying to research and understand change in the study of war. For example, the very real fear about what the environment will look like as far away as 2050 has driven individuals, governments, and companies alike to begin (belatedly) changing their practices. Yet we seem willing to stay oblivious to the changes that will come well

before then for war, even though, just like the changes in global climate, we can already see the outlines of the transformation under way.

Each time I perused the Sharper Image catalog or read a report mentioning a drone taking out a terrorist camp in Afghanistan, I felt myself living at the time of the most important weapons development since the atomic bomb. One could even argue that the rise of these digital warriors is more significant, in that robotics alters not merely the lethality of war, but the very identity of who fights it. The end of humans' monopoly on war surely seemed something momentous, which historians would talk about centuries from now, if humankind is so lucky to still be around.

Yet for something so seemingly important, no one was talking about it. Time and again, I was struck by this disconnect. For example, as I describe later in the book, I once went to a major conference in Washington, D.C., on "the revolution in military affairs." The speakers included many of the most notable scholars in the field, as well as several key political and military leaders. And yet, over the course of several hours of pontificating on what was supposedly new and exciting in security issues today, not one mention was made of these new technologies, not even a single word.

Another time I arrived at the airport, facing a long flight but having forgotten a book to read on the plane. So I picked up one of those potboiler paperback novels at the bookstore. It turned out to be a courtroom drama about the suspicious murder of a beautiful scientist. About halfway through the flight, I read one of the characters describe the scientist's work. "Genetics, nanotechnology, and robotics.... It has the capacity to replace the NBCs of the last century—nuclear, biological and chemical. In its own way the potential is much more insidious. There is always a downside. The other side of the coin of progress. Some people don't want to take the chance. You can see why. The question is: How do you stop it? How do you put the genie of knowledge back in the bottle?"

And with that, I thought, a fictional character in a cheesy crime novel had just put more thought into the future of war than pretty much the entire set of real-world university political science departments, think tanks, and the foundations that fund them.

This lack of study began to disturb and fascinate me more and more. A failure to research, understand, and weigh the changes going on around us could only lead to bad results for our politics and policies. Yet some of the most important changes in the wars of today and tomorrow were either not talked about at all or

merely tossed aside, as one military expert put it, to the categories of “science fiction and futurism.”

And that didn't seem right. My fear also began that while all this change was incredibly exciting, it was also somewhat terrifying. We seemed to be repeating past cycles of only dealing with a huge change after the fact, when the genie was already out of the bottle. And thus somewhere along the way from reading military books in my grandfather's study to playing with lightsabers in the backyard, I decided that the serious questions that surround robotics in war and what happens when humankind's monopoly over it is broken were worthy of study. *Wired for War* is the result.

YOUR MISSION, SHOULD YOU CHOOSE TO ACCEPT IT

When we look back at history, one thing that stands out is how the truly momentous events were often missed. When Gutenberg invented the printing press, no one held a parade. Likewise, when Hitler decided to give up his painting career, no one thought to convince him to give selling crappy watercolors just one more try, in lieu of a bid for world domination. This is all the more difficult in our present chaotic news environment of talk shows, blogs, webcasts, and so forth. As one writer put it, “The true watersheds in human affairs are seldom spotted amid the tumult of headlines broadcast on the hour.”

If my growing sense was that we are in the midst of something important, maybe even a revolution in warfare and technology that will literally transform human history, then my aim in the book's research quickly became to capture that incredible moment. Imagine, I thought, if we had been able to wrestle with the great changes that atomic bombs brought to politics while they were being invented, rather than waiting to puzzle our way through their implications years later. Moreover, as I set off on my research path, I quickly learned that what was impossible in 1945 is possible now. This revolution is not occurring in secret desert test facilities, but playing out right in front of us.

My goal then became to write a book built on careful scholarship, resting on hard-core research, not speculation or exaggeration. I hoped to offer not only an entry point into this exciting and unnerving change, but also a 360-degree view of what was going on, a resource that could prove useful to leaders and public alike, both today and tomorrow. And yet I also hoped to bring readers the same sense of wonder and amazement that originally drove me on this journey.

If you haven't noticed by now, this will be a book somewhat different from the normal look at either war or technology. It's a product of who I am and the forces that shape me. I am the kid who played with Transformers who now consults for the military. I am a scholar who studied under Sam Huntington, one of the most distinguished political scientists of the twentieth century, and yet I am shamefully addicted to watching *The Real World*. The eloquence and brilliance of authors like John Keegan and Jared Diamond inspire me, and yet the writer I read most religiously is Bill Simmons, the irreverent "Sports Guy" columnist for ESPN, who blogs on the finer points of the NBA Draft and *The Bachelor* dating show.

Fortunately, the topic I am wrestling with is located where warfare, history, politics, science, business, technology, and popular culture all come together. So unlike most books on war or politics, this one isn't aimed at just one audience. The issues of robotics and war are so compelling and important that people with all sorts of interests and backgrounds can and should dig into them. In other words, you will find references of both sorts. There will be references of the scholarly type, pointing to the sources of the data, and there will be references of the pop culture type, pointing to parallels and lessons in mass media.

As such, the research for this book involved a melding of methodologies. I spent nearly four years seeking out anything and everything useful that I could find on the topic, whatever the source. I checked out musty old history books that hadn't left the library in years. I scoured the last twenty years of each U.S. military branch's professional journals, printing table-high stacks of any article relevant to the topics of war, technology, leadership, and change. I searched the online archives of all the major technology journals. Indeed, I even spent several wonderful days cruising through the "Wookipedia," the Internet hub for all things *Star Wars*.

The comedian Stephen Colbert famously said, "I don't trust books. They're all fact, no heart." So I also made sure to interview anyone I could find who brought an important or unique perspective to the issues. I sought out the ideas of robot scientists and weapons developers, professors and journalists, human rights activists and science fiction writers, as well as the men and women now using these new technologies to fight. Rank mattered less to me than what they could bring to the issue. I quizzed four-star generals and secretaries of the army, navy, and air force, as well as nineteen-year-old specialists at the bottom of the chain of command. I met with pilots of robotic drones, who had never left the United States, and special operations soldiers just back from missions in Iraq and Afghanistan. Robots have no one nationality, so my interviews also became quite international.

I gathered the views of everyone from German army officers and an Indian news editor to a set of Iraqi insurgents. Where possible, these individuals are identified, but sometimes the interviewees chose not to be named, which I have respected in the citations.

Sometimes these interviews would take place in person and sometimes via e-mail or phone. The research took me from robot factories and military bases around the world to one interview of an Arab general from the backseat of his BMW 7 series luxury car, discussing robot strike scenarios as we toiled about town. A hotel conference room oddly enough turned out to be the most dangerous of all these research locales. While I was observing a meeting of robotics developers and their military counterparts, a rogue robot tried to run me over. A demonstration model brought in by one of the developers, the little bugger was programmed to patrol around the room but avoid contacting any humans. But it just kept on coming and coming and nearly broke my foot. In my mind, it makes me a bit like the nerdy version of John Connor, hunted down by a machine obviously sent to keep you from reading about our robotic future.

THE END OF THE BEGINNING

As you work your way through the chapters, then, you will likely note a few things. Some admittedly may be a bit different from the traditional book that originates at a public policy “think tank.”

The first is that there is a mix of traditional hard data (numbers, statistics, and the like) as well as a heavy dose of untraditional anecdotes. In turn, the chapters tend to weave together scores of “characters,” rather than following just one throughout the book. My research and interviews brought in an amazing and colorful cast of people at work in this field. In the translation of research to book, I didn’t want to lose this human side. The reason is that, ironically for a topic on nonhuman changes in war, the stories and personalities are what tell us the most about where we are today, as well as where we are heading tomorrow. Or as one scientist described, “These robots are extensions of us.”

The use of vignettes, personalities, and anecdotes also has a methodological rationale. It is not just a more effective way of giving readers a true “feel” of what is going on and capturing our historic moment in time. It is also an echo of the strategy used by ethnographers, who collect individual stories and anecdotes to discern broader trends and conclusions. Indeed, so much of what I learned, as well

as how we tend to communicate to each other, came via storytelling that it seems only fitting to share many of these stories in the context of the issues. Indeed, one story may be an anecdote, but a collection of them is data.

Second, the book deals with the future and thus has to be, in part, predictive or conceptual. As the earlier examples showed, this is no easy task. The prognostications of nonscientists often fail because they frequently don't pay close attention to what is technically feasible or not. In turn, scientists' predictions tend to overstate the positive, especially when it comes to war. Franklin, Edison, Nobel, and Einstein, for example, all thought that their inventions would end war. They knew the science, but not the social science. Both groups tend to disregard how social change can intervene and intertwine with technology, yielding not one definite future, but rather many possible futures.

Researchers have found that these three problems can be diminished by relying on actual facts rather than hopes or fears, having a firm technical and social science footing, making conclusions built on sound reasoning, and being sure not to ignore the doubts of the skeptics. This book follows those lessons. For instance, you'll read here only about technologies either operating now or already at the prototype stage. I steer clear of the imaginary ones fueled by the Klingon power packs, dragon's blood, or the hormones of teenage wizards.

Third, for a book supposedly on the future, there is a lot of history. My sense is not that history repeats itself, but that there are patterns and lessons that we can draw from, a key way to ground any look forward. There will be much change in the future of war, but also much continuity.

Fourth, nothing in this book is classified information. I only include what is available in the public domain. Of course, a few times in the course of the research I would ask some soldier or scientist about a secretive project or document and they would say, "How did you find out about that? I can't even talk about it!" "Google" was all too often my answer, which says a lot both about security as well as what AI search programs bring to modern research.

Fifth, the book makes many allusions to popular culture, not something you normally find in a research work on war, politics, or science. Some references are obvious and some are not (and thus the first reader to send a complete list of them to me at www.pwsinger.com will receive a signed copy of the book and a Burger King *Transformers* collectible). It is also, as far as I know, the first book to come out of a think tank with a recommended music playlist, designed to get into the vibe of the research results, also available on the Web site.

The reason for this different approach is not simply to break the mold, or rather mould, of scholarly style or to give heart attacks to the old guard with my generation's manner of thinking and writing, even on important issues like war. Rather, as much as we pointy-headed scholars hate to admit, this is how people process information most efficiently. Humankind has long best understood and digested things that are new by flavoring them with stories of personal experience (“There was this one time, in band camp, where we...”) as well as by allusions to what is already culturally familiar, especially icons, symbols, and metaphors (“It’s just like when...”). And, whether we like it or not, our twenty-first-century folklore is that of the popular movies, TV shows, music, gadgets, and books that shaped us growing up.

You have now been dutifully warned of what may come. I hope you find the results of this journey simultaneously interesting, educational, and maybe even a bit scary. In other words: frakin’ cool.

EARLY ACCLAIM FOR WIRED FOR WAR

“P. W. Singer has fashioned a definitive text on the future of war around the subject of robots. In no previous book have I gotten such an intrinsic sense of what the military future will be like.”

—ROBERT D. KAPLAN,
author of *Imperial Grunts: The American Military on the Ground*

“Singer’s book is as important (very) as it is readable (highly), as much a fascinating account of new technology as it is a challenging appraisal of the strategic, political, and ethical questions that we must now face. This book needs to be widely read—not just within the defense community but by anyone interested in the most fundamental questions of how our society and others will look at war itself.”

—ANTHONY LAKE,
former U.S. National Security Advisor and professor of diplomacy,
School of Foreign Service, Georgetown University

“Drawing from sources spanning popular culture and hard science, Singer reveals how the relationship between man and robot is changing the very nature of war. He details technology that has, until now, been the stuff of science fiction: lethal machines that can walk on water or hover outside windows, machines joined in networks or thinking for themselves. I found this book fascinating, deep, entertaining, and frightening.”

—HOWARD GORDON,
writer and executive producer of *24*, *The X-Files*, and *Buffy the Vampire Slayer*

“Lively, penetrating, and wise. A warmly human (even humorous) account of robotics and other military technologies that focuses where it should: on us.”

—RICHARD DANZIG,
former Secretary of the Navy and director, National Semiconductor Corporation

“Will wars someday be fought by *Terminator*-like machines? In this provocative and entertaining new book, one of our brightest young strategic thinkers suggests the answer may well be yes. Singer’s sprightly survey of robotics technology takes the reader from battlefields and cutting-edge research labs to the dreams of science fiction writers. In the process, he forces us to grapple with the strategic and ethical implications of the ‘new new thing’ in war.”

—MAX BOOT,
Senior Fellow for National Security Studies at the Council on Foreign Relations
and author of *The Savage Wars of Peace* and *War Made New*

“Weaving together immaculate academic research with a fan boy’s lexicon of popular culture, Singer looks at the people and technologies beta-testing tomorrow’s wars today. The result is a book both hilarious and hair-raising that poses profound ethical questions about the creation and use of ever more powerful killing machines.”

—GIDEON YAGO, writer, *MTV News*

