The Physics of War: From Arrows to Atoms

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This fascinating blend of popular science and military history examines the science of war, demonstrating the close connection between the discovery of basic physical principles and the development of weaponry over the ages.

Physics has played a critical role in warfare since the earliest times. Barry Parker highlights famous battles of the past as well as renowned scientists and inventors such as Leonardo, Galileo, Newton, Maxwell, and Einstein whose work had an impact on the technology of combat. Mechanics and the laws of motion led to improved shell trajectories; gas dynamics proved important to the interior ballistics of rifles and cannons; and space exploration resulted in intercontinental missiles, spy satellites, and drone aircraft.

Parker emphasizes the special discoveries that had revolutionary effects on the art of warfare: the Chinese invention of gunpowder, the development of firearms, the impact of the Industrial Revolution, the deployment of the airplane in the First World War, and in our era the unleashing of the enormous power inherent in nuclear fission and fusion.

The Physics of War: From Arrows to Atoms Details

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From Reader Review The Physics of War: From Arrows to Atoms for online ebook

Andre says

An interesting if uneven read. The physics explanations are very good and the anecdotal information about physics and war is interesting but the periods covered offer different level of treatment and the overall feeling I got out of it was of a book done to publish instead of a more comprehensive work.

Bettie? says

From the description: *This fascinating blend of popular science and military history examines the science of war, demonstrating the close connection between the discovery of basic physical principles and the development of weaponry over the ages.*

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Peter Mcloughlin says

The laws of physics rule are world. We as people are products of basic laws of physics at a high level of complexity. Warfare is also governed by physics and knowledge of physics has been applied for both offensive purposes arrows, guns, Atomic bombs etc. It has also be used defensively as well such as metallurgy for shields, building techniques for fortifications, and during WWII for Radar. Many of the famous people in physics were tied to warfare. This book combines the history of warfare and it explains the physical laws used in weapons and defenses from early ballista like long bows and catapults to lasers and hydrogen bombs. The physics is well explained at the level of a layperson and the history of the development of technology and its uses through history is pretty well covered for such a short book. Good for science enthusiasts and military history buffs.

Pradheep says

high school physics.
Definitely not for engineers

Book says

The Physics of War: From Arrows to Atoms by Barry Parker

"The Physics of War" is a fun and easy-to-read book that shows the close connection between physics and the development of weaponry over time. Professor emeritus at Idaho State University and author, Barry Parker provides the public with an accessible book that highlights famous battles and the most significant science behind them. This accessible 322-page book includes the following eighteen chapters: 1. Introduction, 2. Early Wars and the Beginning of Physics, 3. Basic Physics of Early Weapons, 4. The Rise and Fall of the Roman Empire and the Early English-French Wars, 5. Gunpowder and Cannons, 6. Three Men Ahead of Their Time, 7. From Early Guns to Total Destruction and Discovery, 8. The Impact of the Industrial Revolution, 9. Napoleon's Weapons and New Breakthroughs in Physics, 10. The American Civil War, 11. Where Does the Bullet Go?, 12. Hey, Look...It Flies!, 13. The Machine Gun War - War World I, 14. The Invisible Rays, 15. Sonar and the Submarine, 16. The Great War, 17. The Atomic Bomb, and 18. The Hydrogen Bomb, Intercontinental Missiles, Lasers, and the Future.

Positives:
1. A very accessible book intended for laypersons. It's easy to read and Parker keeps the math to a very basic level.
2. A fascinating topic. The important role that physics has played in the development of weapons, from chariots to drones.
3. Parker has great command of the topic. He presents the war history, the "wonder weapon" and the technology and science behind it. "Known as the Hundred Years' War, this period yielded one of the greatest advances in weaponry. It first appeared in the Battle of Crécy in 1346, and it was called the longbow."
4. Does a good job of explaining the basic physics. "The principle of conservation of momentum. It states that the total momentum of any isolated system remains constant. This means that the total momentum before the collision will be equal to the total momentum after it, assuming there are no outside influences."
5. Very good at introducing weaponry and establishing when they were first used and by whom. "The cannon was first used by the English in the Hundred Years' War, which started in 1337 and ended in 1453. It was a long war that was fought off and on between the French and English."
6. The scientists behind the physics. Leonardo da Vinci's military inventions. "Because Leonardo was employed so frequently as a military engineer, most of his inventions were war machines."
7. No book of physics would be worth reading without going through the contributions of Sir Isaac Newton. "Newton solved this mystery with his law of gravity. It is as follows: every particle in the universe attracts every other particle of matter with the force that is personal to the product of their masses and inversely proportional to the square of the distance between them. In mathematical terms this is F = m1m2/r2, where F is force, m1 and m2 are masses, and r is the distance between them."
8. The impact of the Industrial Revolution. "The revolution in England, which began about 1760, was fueled mostly by three technical advances: James Watt's steam engine, John Wilkinson's new techniques for iron production, and new techniques in the textile industry."
9. The contributions of Michael Faraday. "Within a few years Faraday's work led to two very important inventions: the electrical generator and the transformer."
10. An interesting look at the American Civil War. "In addition, developments in physics and other sciences led to the wartime use of the electric telegraph, electric generators, surveillance balloons, better and larger ships, torpedoes, and significantly improved telescopes."
11. Ballistics. "To see why a spinning bullet was so revolutionary, we have to look at the physics of a spinning object. When an object of any type rotates, it rotates around an axis, and this axis of rotation acquires a special status. In the case of a bullet in flight (shot from a rifle) there are two motions we have to

consider: its translational motion (that gives it its trajectory) and its rotational motion."
12. Where mass production meets history. "The Civil War was, in fact, one of the first truly industrialized wars. Mass-produced weapons, ironclad steamships, large factories producing various goods for the war, railroads, and so on all played important roles."
13. Fascinating historical tidbits. "In 1844 it was paraded out before President Tyler and a large audience in Washington, DC. Stockton, eager to show off its guns, ordered a demonstration. As the third shot was fired, the large gun exploded, spraying the attending crowd with fragments of iron. The secretary of state, the secretary of the navy, and several other officials were killed. It was a tremendous blow to both Stockton and Ericsson, who had helped in the design."
14. The science behind flight. "One of the most important people in the history of aeronautics, however, was the engineer George Cayley of England. He is usually considered to be the first person to understand most of the basic underlying principles and forces involved in flight, and because of this he has frequently been referred to as the father of aerodynamics."
15. The development of the machine gun. "The machine gun played such a central role in the war that World War I is now sometimes referred to as the machine-gun war."
16. Poisonous gases. "Then Haber came up with the most dreaded gas of the war--mustard gas. The Germans used it for the first time against the Russians in September 1917. Mustard gas was almost odorless, and it caused serious blisters both internally and externally."
17. Electromagnetic waves. "James Clerk Maxwell is regarded by many as one of the most important physicists ever born. His prediction of the existence of electromagnetic waves led to major advances in science and also to important changes in everyday life."
18. The physics of submarines. "And when it is floating its average density has to be less than that of water, but when it dives its average density has to be greater. So it obviously has to change its density, and it does this using ballast tanks that are on its outer surface. When these tanks are full of air the average density of the submarine is less than that of water, so the submarine floats. To submerge, the submarine releases the air through small vents and allows the tanks to fill with water. When they are full (or partially full), the average density of the submarine is sufficient for it to sink. To surface, air is pumped into the ballast tanks from a compressed air tank. It forces the water out."
19. The technology behind the Great War. "The British Spitfire was, without a doubt, one of the best. It was used very successfully against the Luftwaffe in the Battle of Britain. It had a maximum speed of approximately 350 miles per hour, and it performed well in climbs; furthermore, it was relatively easy to fly."
20. The atomic and hydrogen bombs. "The development of the atomic bomb is, without a doubt, one of the most impressive and awe-inspiring developments in history."
21. Links to notes and formal bibliography provided.

Negatives:
1. The book lacks depth. It is intended for laypersons. Engineers like me and scientists will find the book too basic.
2. Tables, timelines, comparative charts, maps would have added value.
3. The writing style though informative lacks panache.

In summary, this was an easy book to pick up and read. Parker provides a good overview of the most significant battles of history and shows how physics in particular contributed to the technology of war. Laypersons looking for a synopsis of war history and science will enjoy this book. The writing style lacks panache and the science is basic but Parker succeeds in providing the general public with an accessible book the covers the science behind war. I recommend it!

Further recommendations: "Engineers of Victory: The Problem Solvers who Turned the Tide in the Second World War" by Paul Kennedy, "The Science of War: Defense Budgeting, Military Technology, Logistics, and Combat Outcomes" by Michael E. O'Hanlon, "Corporate Warriors: The Rise of the Privatized Military Industry, Updated Edition (Cornell Studies in Security Affairs)" and "Wired for War: The Robotics

Revolution and Conflict in the 21st Century" by P.W. Singer, "War Made New: Weapons, Warriors, and the Making of the Modern World" by Max Boot, "The Dawn of Innovation: The First American Industrial Revolution" by Charles R. Morris, "For the Love of Physics: From the End of the Rainbow to the Edge of Time - A Journey Through the Wonders of Physics" by Walter H.G. Lewin, "Science Matters: Achieving Scientific Literacy" by Robert M. Hazen "Fool Me Twice: Fighting the Assault on Science" by Shawn Lawrence, "Lies, Damned Lies, and Science" by Sherry Seethaler, and "Science Under Siege" by Kendrick Frazier.

Drew says

Meh. Written at a 5th grade reading level. I mean, I know I'm just a chump, but I really can't believe this guy is a professor emeritus with a bunch of books to his credit.

Michael Webb says

Competent. But written more for an ambitious 10th grader than an adult. If you know nothing about the topic, you'll probably enjoy this.

Rod says

A broad treatment of the use of physical science in warfare. Perhaps understandably, the level of treatment is not particularly deep, nor broad for that matter. Coupled with a number of typos or misapprehensions in the text makes this volume less useful than it might have been.

Clearly, the author had to make a number of judgement calls about what topics to include. He spends significant space in describing some of the military action to no real purpose. He could have used this space in describing the physics itself in greater detail. For example, there is very little treatment of sensing technologies (aside from radar and sonar), much less the use of information science, or all of C4ISR (Command, control, communications, computers, Intelligence, Surveillance, and Reconnaissance) for that matter.

The volume could have used a closer editing/proofreading. Examples:
- The description and figure of a parabola instead show an ellipse.
- His discussion of the forces on a screw/propellor ignore the fact that the same aerodynamic/hydrodynamic forces operate here as on the wings/ hull.
- It is not true that projectiles deliver all of their kinetic energy to their target if they bounce back.
- The description of thermal imaging is very superficial and misleading. These systems do not sense temperature, but radiance, which can be used to calculate an approximate temperature by assuming an emissivity.
- The speed of sound in the ocean is determined by depth, temperature, and salinity (not solubility!).
- Limited lifetime is not a shortcoming of sonobuoys, but a feature! You don't want a lot of sonobuoys cluttering up limited radio channels (at least in the days before operators had the ability to command scuttle buoys.
- His judgment on aircraft is a little suspect. The FW-190 was a superior aircraft to the Bf-109 in almost all respects, and the F6F was a better Zero killer than the F4U (having been designed for exactly that).

- The PPI radar display is "plan position indicator" not "plane positive indicator"

Bottom line is that this book could be useful especially for the high school student interested in science and warfare.

Budd Margolis says

This is in no way a well written book but it is very interesting and, as far as I can tell, accurate!

Edward says

Enjoyable book - in places it was heavier on history, then heavier on science. The chapter about nuclear weapons was really interesting, but a lot of the information was covered more deeply in "Atomic Accidents".

Chris Bauer says

I listened to interview on NPR with the author and was convinced to buy this book. The topics of the evolution of warfare from stones to the atom bomb were all covered, along with the physics behind them. But I found the work to be exceptionally dry, repetitive and pretty boring.

The author mixes up historical accounts of warfare along the way, which were interesting at first, but at a point a little more than halfway through the book, I felt like I was re-reading prior chapters. The style is very academic and both the history and physics were described at survey level. This would be an interesting book for a curious high-school age reader, but I felt it missed the mark for an adult reader with more than a passing familiarity of military history and science.

Brian says

somehow, someway.... this was still quite boring

Jim Wilson says

Really interesting information. Writing style is off-putting. Short choppy sentences. Need a good proofreader besides spellcheck. Gives the impression that it is a series of lectures strung together. Glad I read it.

Tnb says

Let's see. This is written by a physics professor and is aimed at the layperson. There is some physics

introduced, there are some equations, but neither the equations nor the "conclusions" are explained or provided intuition for. What is worse, the math/physics is not referred to when the real physical tools of war are discussed.

This books tells you: here is A, it does B. It does not explain, nor does it inspire you to go figure out how A achieves B. Thus the goal of this book is not met. It leaves the mystery a mystery.

Dreadfully awful.

G. Branden says

While I like the premise of this book--use the technology of warfare to explain basic concepts in physics that some people dismiss as "boring" or "abstract"--the execution left me a bit disappointed.

First of all, it needed more editing--typos were frequent. Secondly, I didn't care for the author's diction when he recounted the histories of wars--the sentences got very short and choppy, like a children's storybook. And yet the audience is expected to be fairly sophisticated in other respects. It probably would have been better to omit the historical recaps entirely.

Simple equations were presented but not properly typeset. I found that distracting and annoying.

Worst of all was the author's numerous source citations in the endnotes to--Wikipedia! Seriously? If your supporting source is an encyclopedia (apart from discussions of, say, the quality of the encyclopedia), online or otherwise, then what you are discussing is "common knowledge" and doesn't require a citation. Were I the author, I'd be embarrassed to do this. Further, for anything central to the presentation, a real source should be used. The author did not cite a single textbook as far as I can recall, and I read his "Selected Bibliography" and every endnote. This last fact was particularly irritating, as in an otherwise good chapter on aerodynamics and the physics of flight, he discusses three models of lift: the Bernoulli Principle, which he identifies as oversimplified, a more careful explanation which recognizes the drag imposed by wing tip vortices among other factors, and then the precise approach--which he explicitly passes over--used by aeronautical engineers. I would have appreciated a recommendation for a source on this point.

All of that said, this book fulfills its core mission well. The physical principles behind war machines from the chariot to the H-bomb are explained in an accessible way. Along the way, the author familiarizes the reader with simple vector mechanics (though this could have been slightly more explicit in the case of trajectories of falling objects), Archimedes's principle (of buoyancy), the Bernoulli principle, Charles's Law, Newton's three Laws of Motion, kinetic and potential energy, the liquid drop model of the atomic nucleus (in the explanation of the fission bomb), and the quantization of energy as manifested by electrons orbiting the nucleus (in the explanation of lasers), among other subjects.

Calculus and differential equations are not used, nor even mentioned as far as I can recall. A familiarity with simple rules of algebra (an equation remains valid if you perform the same operations to both sides of it) is all that is needed in terms of mathematical background, and equations are used as sparingly as possible. The famous F=ma and E=mc^2 appear, and little else.

One oddity was that in a discussion of pressure (I think in a chapter on how a firearm works), the units were described as *mass* per unit area, not force per unit area--even in SI units. This of course does not work, but it is the only outright error in the science that I noticed.

For the right reader, this book should be fairly rewarding. If it gets someone excited to learn more about physics, it will have done its job well. It didn't do that for me, but that's only because I'm already there--and trying to teach myself matrix mechanics, lagrangians, and hamiltonians...