Kaushik Roy

A Global History of Warfare and Technology

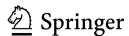## From Slings to Robots

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Preface and Acknowledgements

It would not be an overstatement to assert that warfare is intrinsic to humanity. Fighting, hunting/eating and mating are probably the three characteristics that define a human. Initially, humans fought with stones. The passage of time saw the continuous evolution of tools and technique for making warfare. While sling was the weapon of choice in the Stone Age, drones and robots are the state-of-the-art weapons in the Digital Age. The evolution of military technologies and the concurrent changing contours of warfare through the ages are the central themes of *From Slings to Drones*. The term warfare, and not war, is used in this volume. While war refers to inter-state conflicts, this monograph also concerns itself with intrastate conflicts like civil wars, insurgencies, etc. Rather than merely concentrating on battles, I also take into account sieges, skirmishes, ambushes and raids. Hence, the term warfare which is a more expansive and inclusive one, is being used. However, individual and family feuds, and homicides do not come under the purview of warfare. Basically, warfare is organised violence between two or more territorial groups/communities, and the principal motivation behind combat is collective impersonal material elements, and not any individual/personal factors. Technology, in this book, is defined as the application of scientific knowledge in practical affairs. This volume is concerned with the application of scientific ideas in matters related to warfare.

Undergraduate and postgraduate students, besides researchers of world history, history of science and technology, history of warfare and imperialism and international relations, will find this volume useful for supplementary reading. In addition, general readers, policy analysts and military officers will find the book relevant. Hopefully, this volume will rekindle interest and generate specialist volumes on the interlinkages between conflicts and technology, in the near future. It goes without saying that for all the possible shortcomings of this monograph, the responsibility lies with myself.

encouraged me to take up this project, and Mr. Gowrishankar Ayyasamy who allowed me two extensions to finish this project. Finally, thanks to my wife for sustaining me emotionally and intellectually.

Kolkata, India   Kaushik Roy
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About the Author

Kaushik Roy is Guru Nanak Chair Professor in the Department of History at Jadavpur University, India and Global Fellow at the Peace Research Institute Oslo (PRIO), Norway. He has been attached to PRIO in various capacities for nearly a decade. He has previously held teaching positions at Visva Bharati University, India, and at Presidency College, India. He received his Ph.D. from the Centre for Historical Studies at Jawaharlal Nehru University, India, and was also a Junior Fellow at the Centre for Contemporary Studies at Nehru Memorial Museum and Library, New Delhi. He has received the Charles Wallace Fellowship and research grants from institutions including the Indian National Science Academy and the UGC. He is the chief editor of Oxford Military History Bibliographies and a member of the Indian National Science Academy's Research Council. Roy specializes in the military history of the modern period. He has worked extensively on both conventional and unconventional wars during the pre-modern, early modern and present eras. He has published multiple books and chapters in edited volumes released by publishers including Routledge, Cambridge University Press and Oxford University Press. He has also published articles in various peer-reviewed journals including the *Journal of Global History*, the *Journal of Military Ethics*, the *Journal of Military History*, *War in History*, *First World War Studies*, *Modern Asian Studies*, *Economic and Political Weekly*, *Studies in History*, and the *Indian Economic and Social History Review*.

Abbreviations

AFV	Armoured fighting vehicle
AI	Artificial intelligence
ATR	Automated target recognition
BP	Before the present
CC	Cubic centimetre
C3I	Command, control, communications and intelligence
C4I	Command, control, communications, computer and intelligence
DARPA	Defense Advanced Research Projects Agency
ECM	Electronic countermeasure
EIC	British East India Company
GDP	Gross domestic product
GNP	Gross national product
JDAM	Joint Direct Attack Munition
KT	Kiloton
LAWS	Lethal autonomous weapon system
MT	Megaton
NATO	North Atlantic Treaty Organization
NCO	Non-commissioned officer
OODA	Observe, orient, decide and act
ORBAT	Order of battle
PGM	Precision-guided munition
PIE	Proto-Indo European
PLA	People's Liberation Army of China
POW	Prisoner of war
RAF	Royal Air Force
RMA	Revolution in Military Affairs
SAM	Surface-to-air missile
SLOC	Sea lines of communication
UAV	Unmanned aerial vehicle
UCAV	Unmanned combat aerial vehicle
UGV	Unmanned ground vehicle

USAF	United States Air Force
USN	United States Navy
USV	Unmanned surface vehicle
UUV	Unmanned underwater vehicle

Chapter 1
Introduction: A Global History of Technology and Warfare

Tools, or weapons, if only the right ones can be discovered, form 99% of victory.
Fuller (1998: 31).

We may dislike warfare but cannot neglect it. Warfare has been with us even before the dawn of civilisation and continues as this book goes to print. According to one calculation made in 1975, there had been only 268 years of peace during the last 3400 years. Another computation made in 1976 claims that there were 14,500 wars in the last 5600 years of history or 2.6 wars per year. Between 1946 and 1980, there were more than 150 conflicts (including interstate and intrastate struggles). In fact, intrastate conflicts have proved to be more dangerous than interstate wars in the post-Second World War period. One estimate is that 20 million people have died between 1946 and 1973 due to conflicts. According to one calculation, some 35 million people have died due to warfare between 1945 and 1980 (Shaw & Wong, 1989: 3).

Territory, resources and ethnicity have been the principal drivers in the history of conflicts. These factors motivated the tribes in the prehistoric era to fight, and at present, these causal agents generate conflicts between and within the polities. Before the dawn of civilisation, humans started fighting with slings and stones, tools which were also used for hunting. With time, *Homo sapiens* perfected specialised tools for combat. Nevertheless, most of the fighting tools have been products of dual use technology. At present, human civilisation uses digital technology for peaceful economic activities (trade and commerce, entertainment). The same technology is also used to manufacture killer robots and drones for combat in the battlefield. This book attempts to tell this story.

The perception that the West has always been technologically superior to the non-West, from the dawn of history is challenged in this monograph. To trace military-technical superiority of the West from Classical Greece to present-day USA is untenable. It is historically erroneous to categorise the pre-modern Asian societies as dominated by magic and religious ideologies which made them non-technocratic. As this volume reveals, Asia introduced several military-technical innovations in the pre-modern era. This volume argues that technology is a crucial driver in the evolution of warfare. I have used the term warfare because this volume studies both

interstate and intrastate conflicts. I argue that the military-technical superiority of the West is a comparatively recent phenomenon which started after circa 1750. Furthermore, concepts like the Military Revolution, Revolution in Military Affairs (RMA), Military-Technical Revolution used by certain Western historians to describe the triumphal rise of the West do not completely encompass the global history of military technology.

I have an aversion towards the term 'revolution'. The so-called revolutions (Agricultural Revolution, Industrial Revolution, Military Revolution, etc.) occurred over several centuries in different parts of the globe. Historians still debate about when one revolution started and when it actually ended. Rather, to my understanding, slow changes occur in halting stages. Over the span of several centuries, incremental changes did occur in the sphere of technology. But, during times of stress and strain (especially war), military-technical developments accelerate. Nevertheless, it is not universal. For example, during the Second World War, Nazi Germany developed one tank models after another: Mark IV-Panthers-Tigers. However, Italy failed to innovate successfully as regards tank designs. Politics, strategic choice and economic factors among others shape and reshape technological progress of a particular country during a specific time frame.

Technology has two components: hardware and software. For instance, an implement/tool constitutes the hardware, while the set of ideas which resulted in its manufacture and also the ideas associated with its use constitutes the software. I am more comfortable with the term innovation rather than invention. Technological/technical innovation for me refers to a process/procedure involving slow gradual changes in which different people participate along a broad timeline. In contrast, technological invention for me means sudden creation of a new piece by one or a few persons. A point to be noted is that when we speak of chariot or aircraft as a piece of technology, they are actually not discrete pieces of technology by themselves. For instance, a chariot or an aircraft is combination of several other technologies. Hence, each of them is a technological system in their own right. In my framework, a piece of military technology like a fighter aircraft is a collection of several pieces of interrelated technologies like engine, cannon, missile, optics, etc. All these technological pieces come into existence slowly, and in this process, many scientists and engineers participate. All these small technological pieces are actually little systems which create the bigger system called fighter aircraft. No single scientist or an engineer can be given credit for it. The same applies for other pieces of military technology like tank, battleship, etc.

Innovations in the field of technology and efficient use of a particular piece of technology depend on the balanced fusion between hardware and software. Technology defines the paradigm of warfare at a given moment in history. To give an example, in 4000 BCE, infantry in Eurasia was using slings. However in circa 1700 CE, foot soldiers of Eurasia were equipped with smoothbore muskets. This is not to argue in favour of technological determinism. Interactions between technology and other factors like geography, demography, economy, society and culture also shape the grammar and logic of warfare. This book looks at the interaction between technological and non-technological factors to chart the evolution of warfare from

its origins till the present times. In fact, one of the principal arguments of this monograph is that interactions between civilian and military sectors have shaped the use of technology in warfare. So, any clean or hermetical distinction between civilian and military technologies is actually a red herring.

I follow a blend of top-down and bottom-up perspectives. For instance, certain individuals were responsible for the introduction of the latest technology at certain dates in different regions. To give an example, Heinz Guderian played an important role in introducing panzers in the *Wehrmacht* during the 1930s. However, how a particular piece of technology had been used in history also depends on the nameless and faceless common soldiers. Hence, I have included the thoughts and emotions of the common soldiers when they have been using cutting-edge killing technology. Individual agency is important in the history of warfare. In the fourth century BCE, Philip of Macedon, the father of Alexander, was responsible for introducing siege engines in the Macedonian Army. But, individual agency can only operate in conjunction with material reality. Macedonia and Classical Greece were technologically one of the most advanced regions of the world at that time. Had Philip been born in Central Africa, he would not have been able to create a state-of-the art military machine geared for world conquest. So, this book shows the interaction between human agency and the structural factors in constructing the story of the complex web of technology and warfare. Finally, there is no universal criteria for judging technological effectiveness. One example will suffice. The Israeli tanks in the new millennium were useless against the lightly armed Islamic guerrillas who fight and hide among the civilian population.

My perspective is truly global as the volume covers all the continents. However, bulk of the space goes to Eurasia for the simple fact that most of the world's population inhabits this supra-continent. Further, as this volume will show, due to amalgamation of certain factors, most of the technological progress occurred in Eurasia. This book covers the changing dynamics of warfare in the three dimensions. However, war in the third dimension started only in the twentieth century. Humanity inhabits the continental landmass. So, compared to aerial and naval warfare, most of the space is devoted to portraying the developments of warfare on land. This volume is organised in ten chapters. Each chapter shows how economic and demographic changes and technological advancements caused military transformation. Further, physical geography, social factors and economy caused variations in the use of technology. For instance, tropical jungles of South-East Asia limited the use of cavalry during the medieval era. Then in the late medieval era, introduction of gunpowder infantry was obstructed by the social and economic interests of the *mamluks* and the *mansabdars* (politico-military aristocracy) in the *Mamluk* Sultanate of Egypt and Mughal Empire in India. For building the story portraying the co-evolution of technology and warfare, I have depended on a plethora of sources: ancient and medieval chronicles, archival documents, autobiographies, biographies, official histories, regimental accounts, travelogues, etc.

Several scholars have studied the dialectics between warfare and technology. Due to the paucity of space, only some of the most important works dealing with technology and warfare throughout history will be discussed here. We will not deal

with books dealing with particular military technology like gunpowder or aircraft or with volumes concentrating on developments in military technology during a particular time period like early modern era, etc.

Major-General J. F. C. Fuller, the British armoured war theorist in his *Armament and History* which came out in 1945, overemphasises the importance of hardware in shaping war from Classical Greece till the end of Second World War. Besides the Eurocentric bias, Fuller neglects the non-material factors in his *longue duree* analysis of warfare. This is strange because Fuller himself had written several training manuals for the British Army. Proper training is required for using a new weapon system effectively. For example, effective use of tanks requires combined arms training. A similar book is the US Army's Colonel Trevor N. Dupuy's *The Evolution of Weapons and Warfare* (1990). Dupuy describes various weapon systems which had evolved from 2000 BCE onwards till the Cold War and their tactical impact on combat. Despite its Western bias, the book is good for detailed description of the military hardware which modern Europe produced. *From Crossbow to H-Bomb* (initially published in 1962, reprint 1973) by the two Brodies is a linear story of technological advances in the military field spanning from Classical Greece to the era of Cold War. The focus is exclusively on Western Europe and after 1850s on USA. The rest of the world plays a cameo role in this monograph. Moreover, 80% of the space in this volume is given to the modern era.

Robert O'Connell's *Of Arms and Men* (1989) is a *longue duree* study of the evolution of tools of war from ancient Egypt to the Cold War era. This refreshing work suffers from two limitations. The first one is common to most of the works penned by the Western historians: the focus remains on West Europe. Further, a teleological linkage is established between Classical Greece and present-day USA. Again, O'Connell published his work in 1989. So, he stops with the Nuclear Revolution. The post-Cold War era is witnessing massive technological and social shifts both in cases of conventional and unconventional warfare. My volume will look at the interrelationship of technology and warfare not merely from the Western perspective but will also bring the story till 2022.

Martin van Creveld's *Technology and War: From 2000 BC to the Present* (London: Brassey's 1991) is a complex work. He integrates ideas with hardware and presents significant pieces of technology as a system. However, he remains focused on West Europe from circa 1500 onwards. The non-Western perspective in integrating technology for combat purpose especially in the pre-modern era receives short shrift in van Creveld's work. The latest in this genre is Jeremy Black's *War and Technology* (2013). Most of the case studies of this volume deal with Western Europe and the USA from early modern era onwards. Black breaks fresh ground in showing the improvement of a technology on one hand and its limitations on the other hand. His insightful survey shows that hardware slowly transformed the conduct of combat, but this process of transformation was influenced by culture, strategic choices and geoeconomics factors. Black concludes that despite the dreams of the technology triumphalists, the output in the battlefields due to the introduction of latest technologies fell far short of what the advocates of 'silver bullets' postulated.

All the works discussed above have several common characteristics. They give primacy to the West and the modern period. West for them includes Greece and Rome in the Classical Antiquity, pre-1990 NATO Europe for the Middle Age and early modern era, Western Europe and the USA for the modern period. The common assumption in all these works is rapid, and significant technological advances which are worth studying occurred in the modern period. Further, for some reasons (not explained) everything of importance occurred in the West from the dawn of history. The present monograph does not privilege the modern era over the ancient and medieval eras. Further, my monograph makes a deliberate and conscious attempt to tell the story as it unfolded in regions beyond the 'West'. In addition, this volume provides a snapshot of the military-technical developments which are occurring in the post-Industrial Age.

Of the ten chapters, the second chapter focusing on the Stone Age traces the origins of warfare. Warfare emerged from hunting, and hunting tools were used for intergroup conflicts. Tribal warbands fought for territory, big games, women and prestige. In fact, the demands of military leadership accelerated the formation of larger political units which could mobilise larger number of demographic and economic assets. The onset of agriculture in the 'Fertile Crescent', which set the transition from Stone Age to the Bronze Age provided a spurt in the emergence of large-scale warfare. Domestication of animals and increased production of food and their storage made possible by agriculture enabled feeding of larger number of males. Agricultural surplus made possible the emergence of a separate military profession along with specialised tools designed for killing humans.

The next chapter details the rise and fall of chariot warfare in the Bronze Age. Chapter 3 shows the transition from hunter gatherer economy to agrarian economy ushering in the Bronze Age. The dominant weapon of the Bronze Age was chariot. But, variations existed. While the Egyptians used light chariots and bowmen for fighting from a distance, the Hittites used heavy chariots filled with spearmen for generating shock and awe. Climatic changes along with the advent of iron weapons wielding infantry ended the dominance of war chariots.

Chapters 4, 5 and 8 concentrate on the military-technological evolution on land in the Iron Age. The emergence of heavy infantry in Mediterranean Europe (Greece and Rome) is the theme of Chap. 4. The next chapter paints the replacement of heavy infantry with cavalry in Eurasia. Chapter 8 deals with gunpowder warfare and the rise of the 'West'. I ask the question: Was the rise of the 'West' inevitable and examine why instead of Asia, the West acquired global supremacy in this period? Chapters 5 and 6 encompass both the Bronze Age and the Iron Age. While Chap. 6 is concerned with siege war, the next chapter turns the focus to combat on water. Warfare in the Industrial Age or the 'Steel Age' is the subject matter of Chap. 8. Finally, the last chapter shows that due to technological breakthrough, the logic and grammar of warfare in the near future might change radically.

Periodisation is problematic, still we cannot avoid it. The Dark Age (1100–650 BCE) in the Mediterranean context is now called Early Iron Age. From my global perspective, the era of Classical Antiquity is termed as the Early Iron Age. Chapter 4 portrays two contradictory developments which occurred with the onset of the Iron

Age from 500 BCE onwards. Large-scale use of iron, which was cheaper and more easily available than bronze, resulted in the rise of sword and spear-equipped infantry. While China and Mediterranean Europe focused on 'Iron Age armoured infantry', Central Eurasia came up with warriors mounted on horses. Even within the infantry paradigm, variations existed. While Mediterranean Europe emphasised drilled and disciplined heavy infantry equipped with spears, China focused on armoured infantry equipped with crossbows. But, slow moving infantry armies failed to cope with fast-moving cavalry forces. The steppe nomads were pioneers in generating horse riding technologies (saddle, bridles, stirrups, etc.). War horses and composite bows, as Chap. 5 shows, enabled the mounted steppe nomads from Attila to Chingiz Khan to ride roughshod over the big sedentary empires of Rome, Persia, India and China. Even the spread of Islam to a great extent was possible due to the desert nomadic tribes' fusion of horses and camels. As a gut reaction, the sedentary polities evolved javelin-equipped heavy cavalry. But, hot and humid climate of China and India was not conducive to raising good quality horses. Further, the nomads due to their ecological settings were masters in the art of horsemanship compared to sedentary cavalrymen. Chapter 6 portrays the action-reaction dialectics that generated modifications of military architecture and gradual improvements of missile throwing weapons in the pre-Gunpowder Age.

Chapter 7 turns the spotlight from land to sea. Eastern Mediterranean region was the pioneer in developing oared sailing ships. It first emerged in *Pharaoh*'s Egypt during the era of Bronze Age Civilisation. Then, the Phoenicians who were the principal seafaring nation of the ancient world and engaged in overseas commerce developed oared combat vessels. Sea power is linked with expansion of overseas commercial activities. In an action-reaction dialectic, Phoenicia and Classical Greece came up with biremes and triremes, the principal warships of the Mediterranean during the Iron Age. Under the Roman Empire, the triremes gradually evolved into galleys. Along with commerce, geography remains a key determinant in shaping the technology of combat vessels. Since Mediterranean is an inland sea, oared vessels remained functional till the fifteenth century. However, in the Far East and Indian Ocean, the scenario was different. Bronze Age China developed paddle boats for controlling the rivers, the principal arteries for conducting trade and commerce. Despite being a continental power, Chinese polities required seagoing ships for projecting power into Korea, Japan and the countries of South-East Asia. Moreover, the Sea of Japan and South China Sea are turbulent unlike the placid Mediterranean Sea. So, the Chinese came up with sailing ships with watertight compartments and complex rudders. The Arabs and South Indian polities utilised the monsoon wind for plying their wares across the vast maritime space of Indian Ocean. A fusion of maritime technologies occurred between West Asia and South-East Asian countries. Several maritime technologies like lateen rudders, etc., were borrowed by the West from the East. It is to be noted that not any European nations but only China and India maintained 'blue water navies' before circa 1500 CE.

The rise of Western Eurasia actually started with the onset of the Gunpowder War between 1450 and 1770. This is the subject matter of Chap. 8. Absence of steppe nomadic threats and the economic requirement for breaking out across the

Atlantic were among other factors that generated the gunpowder-oriented armies and navies in North-West Europe. Australasia, Africa and the two Americas did not experience the Iron Age for several reasons. These continents fell easily to the capital-intensive firepower heavy Western armies which were transported by ocean-going ships equipped with cannons. However, Asia and Maghreb region provided tough opposition to the Western gunpowder armies. Especially, the agrarian bureaucratic polities of Asia were capable of mobilising large amount of economic and demographic assets against the European invaders. In the end, politics and disease along with gunpowder swayed the balance in favour of the West.

Western Europe experienced the emergence of Gunpowder War and Commercial/Merchant Capitalism almost simultaneously. In fact, both these two processes were interlinked like a DNA double helix and fed on each other. Commercial Capitalism mutated into Industrial Capitalism which in turn gave birth to modern war. This is the subject matter of Chap. 9. The Age of Industrialisation occurred in West Europe from circa 1800 onwards. The Industrial Age generated more wealth and resulted in the expansion of population and productive capacities. This made possible larger armies and expensive navies. Technological innovations followed one after another. Musket was replaced with rifle. Machine-guns, mortars and howitzers followed shortly. In the sea, sailing ships were replaced with steam ships. Internal combustion engines further transformed the hardware of war on land, sea and air. Thanks to such tools, the West ruled the 'rest'. However, high intensity industrial war among the Western industrial nations as exemplified in the two World Wars accelerated the decline of the West European colonial empires. Along with this, the spread of the idea of nationalism and other secular ideologies like Marxism encouraged the Afro-Asians to wage Small Wars. Probably, the last and most spectacular innovation of the Industrial era is the nuclear technology. But nuke-equipped firepower heavy capital-intensive Western armies failed to cope up with the Small War waged by the Latin Americans and the Afro-Asians. And this brings us to the Postmodern Age.

The Industrial Age is now replaced with Information Age. Warfare in this era is the topic of the last chapter. Silicon computer chips instead of iron and steel machines in the factories are now dominating the economic framework of planet earth. High standard of living and decline of birth rate among the Western nations along with ebbing away of nationalism have resulted the dawn of post-heroic era in the Anglo-American part of the world. The Western males are no longer willing to die in the battlefields. Xenophobic nationalism which characterised the Western youths during the two World Wars is *passe*. Moreover, the presence of nuclear weapons and high level of economic interdependence has made large-scale war a non-option among the Western nations. So, many pundits have asserted that war has died a natural death. Is it so really? The last chapter of this book tackles this issue.

In fact, as Chap. 9 shows that in the post-Cold War era, the non-state actors in large parts of Afro-Asia and Latin America are waging attritional Small War quite effectively. Breakdown of states, resurgence of ethnic, tribal and religious identities after the collapse of Marxism, spread of Internet, light hand-held automatic weapons and amalgamation of organised crime with the guerrillas have resulted in the emergence of what some scholars call as New Wars. Whether they are actually new or traditional