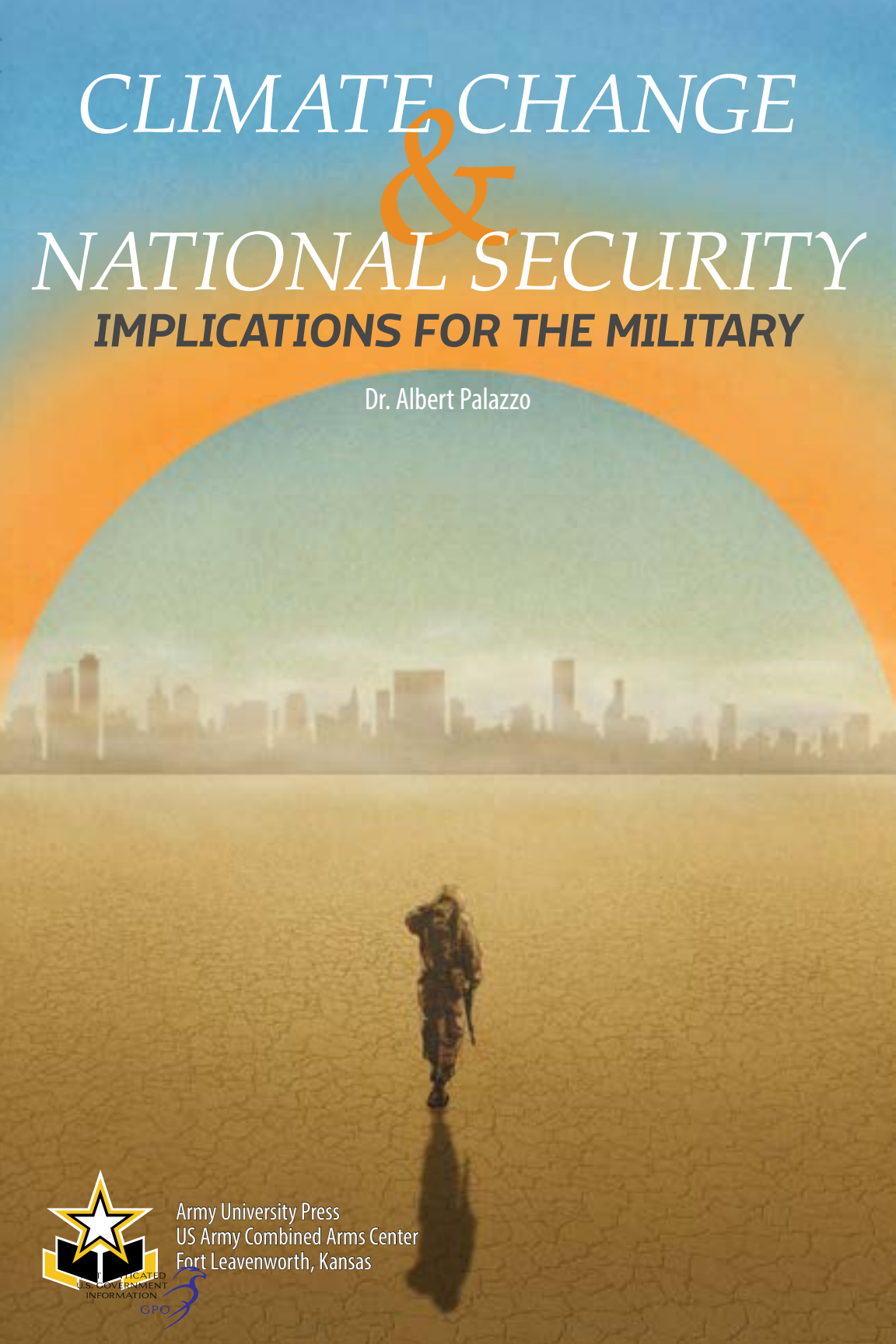
CLIMATE CHANGE & NATIONAL SECURITY

IMPLICATIONS FOR THE MILITARY

Dr. Albert Palazzo



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Chapter 1
Introduction

The climate is in crisis. The threat to civilization from climate change is grave—so grave that the Secretary General of the United Nations, António Guterres, has called it a "code red for humanity."[1] Joining Guterres in sounding the alarm is US Secretary of Defense Lloyd Austin, who has labeled the climate crisis an "existential threat."[2] The Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report, a global collaboration between scientists, under the auspices of the United Nations, describes the changes to the world's environment that are underway as being without precedent, and concludes that significant and irreversible climatic shifts are already taking place.[3] Scientists, politicians, and military leaders who describe the climate crisis as a threat to humanity have become unremarkable, and with the passage of time they have become increasingly forceful in their tone.[4] In 2021, the new US administration made it clear that addressing the "climate crisis" was a top priority, noting that humanity would experience the most "dire consequences of climate change for the health of our people, our economy, our security, and our planet" if no action was taken.[5] For humanity, the moment of truth has arrived.

Signs of climate change are everywhere. In his latest book, leading climate scientist professor Michael E. Mann outlines the scope of the danger:

> For Puerto Rico, which was devastated by an unprecedented Category 5 hurricane with Maria in September 2017; for low-lying island locations like Tuvalu and coastal cities like Miami and Venice, which are already facing inundation by rising seas; for the Amazon, which has seen massive burning and climate-change-induced drought; . . . and for California, which has experienced unprecedented death and destruction from wildfires that now occur year-round.[6]

Perhaps the most visible evidence that the climate is changing is found in the cryosphere, the part of the planet's surface that is covered by ice. Everywhere, the ice is retreating.[7] On 14 August 2021, rain fell on the highest point of Greenland's vast ice sheet for the first time in recorded history. At the same time, reef systems in the tropics, including the 1,400-mile-long Great Barrier Reef in Australia, are dying due to the rising temperature of the water.[8] After an unprecedented three bleaching events in five years, the Great Barriers Reef's production of coral larvae is down by as much as 71

percent, undermining its future resilience.[9] No place on this planet, and none of its 7.9 billion people, is exempt from the changes taking place.[10]

Internationally, a host of scientists, engineers, and public policy experts are working on the means to mitigate the worst effects of climate change. Supporting them are ordinary citizens, both young and old, who have joined together to demand action.[11] I heartily encourage their work. May they succeed in averting the worst effects of climate change by finding the leverage needed to motivate international political leaders to take effective action. To a certain extent, however, our die is already cast and there is no going back. Climate change is here. For humanity, what remains to be determined is the extent of the temperature rise and the magnitude of the threat climate change poses to our civilization. Effective and speedy action to reduce global greenhouse gas emissions to zero will limit climate change's damage but not eliminate it entirely. If these gases continue to be released, the temperature will rise further and the damage will be greater. How much greater is a function of how long and in what quantity humanity adds greenhouse gases to the atmosphere.[12]

Senior military commanders have publicly described climate change as a threat. In 2013, the former US Commander in the Pacific, Adm. Samuel Locklear, went so far as to call climate change the biggest danger in his area of responsibility, a position he reiterated to the Senate Committee on Armed Services.[13] In Australia in 2019, General Angus Campbell, the Chief of Defence Force, observed that "climate change and Australia's national security are inextricably linked."[14] The US security community has continued to proclaim their fears about climate change. Between 2017 and 2019, more than thirty-five senior US Department of Defense leaders publicly voiced their concerns over the security implications of climate change.[15] Meanwhile in the United Kingdom, Rear Adm. Neil Morisetti declared that no country could afford to ignore security-related risks from rising temperatures.[16] In 2014, the United Kingdom's Ministry of Defence labeled climate change a major strategic threat, a position it has maintained to the present.[17]

This book addresses the threat climate change represents to the security of the United States and other countries. Its target audience is the military—the soldiers, sailors, and aviators who safeguard the sovereignty of their countries, as well as the national security commentators and defense civilians who support them. The military has a critical role to play in safeguarding society from the effects of climate change. What humanity is now experiencing is the first instance of human-induced climate change; however, it is not the first climate change event in our history. Previous

events, such as the Little Ice Age of the seventeenth century, show a similar pattern: reduced food harvests and resource scarcity leading to increasing tension and societal collapse and, finally, intrastate and interstate war.[18] All previous episodes of climate change have been catastrophic for most of those who experienced them.

Whether it is assisting the civil government's response to a natural disaster, stabilizing a collapsing state, controlling mass migration, or employing force against another state, the military is likely to have a major role in responding to our climate crisis. This book's primary goal is to explain what climate change means for those who serve, so that they can prepare for a future dominated by threats resulting from, or exacerbated by, a more dangerous, disruptive, and less beneficent environment. Human-induced climate change is not an event the present military has faced before. Therefore, the book cannot be prescriptive nor can it be a history. Rather, its intent is similar to what is known in the military as "future concept." The book describes the threat that climate change represents, examines the military's place in managing it, and explores what a future response might require so that the force can continue to provide utility to the government and its people.

The book also has several secondary objectives:

• Highlight the implications of climate change for force readiness and combat capability.

• Examine whether, and if so the extent to which, the military must reassess its role in society.

• Outline where climate wars fit within the hierarchy of war, conflict, and peace.

• Explain why national security must sit at the heart of every nation's response to climate change.

In a relatively short period, the literature of climate change has grown markedly. Most of this output concerns the science of climate change, while another large component debates the means to provide for the human security of those affected.[19] Some authors posit ways to stop or slow the emission of greenhouse gases in order to minimize future harm, supported by a smaller number who see climate change as an opportunity to remake human society on a more sustainable and equitable basis.[20] Some works take a doom-laden approach, predicting and describing the end of the world, or at least the end of the world as we know it.[21] Other writers take a more positivist approach and, while recognizing that the planet is

changing, see opportunity to adapt.[22] The United Nations, numerous governments, and a plethora of think tanks have issued a host of reports that add considerable depth and knowledge to the field.[23]

Other leaders from a range of fields have also begun to anticipate the effect climate change will have on their respective areas. In finance, for example, observers now routinely point out the blows to the economy society is risking if businesses continue to invest in emissions-intensive enterprises.[24] Some business thinkers expect that within a few years investors will abandon entire sectors of the global economy that are exposed to fossil fuels.[25] Actualizing this prediction, in 2021 the Bank of England declared any bonds associated with coal mining ineligible for its purchasing program.[26] Investor divestment away from fossil fuel industries is already well underway, and advocates of such actions for doing so are gaining strength.[27] Investment firms are responding by increasingly considering climate risk in their recommendations.[28]

Within the academic world, a similar outpouring of analysis, commentary, and advice is taking place. Environmental history has become a fruitful field for inquiry, and its practitioners reward readers with innovative analysis.[29] Many in the national security community have shifted their focus away from traditional geopolitical factors to highlight climate change as a driver of intrastate and interstate conflict. Military historians and archaeologists have leapt into the fray, identifying the effect of past climate events on the well-being of civilizations.[30]

Surprisingly, despite this prodigious output across a wide range of disciplines, there remains a glaring gap in the literature. There is virtually nothing published of practical utility to those who actually protect society and fight wars—the military. There has been nothing until now that frames climate change from the perspective of soldiers and other service personnel.

This work maintains that climate change is firstly a matter of national security, making it a core responsibility for the military and, importantly, its political masters.[31] It is the job of a military to protect its society from threats to sovereignty, where sovereignty can be defined as the ability of a state and its people to make their own decisions free of pressure from other states. While constraints on actions, such as international agreements, do of course exist, these are limitations a state has freely entered into. Simply put, a sovereign nation is able to decide for itself. At first glance, climate change may not appear to be a threat to sovereignty, but one must not overlook the defining role climate plays in creating the environment in which human societies exist, and its part in determining whether they

prosper, struggle, or die. The ability of leaders to encourage their societies to adapt to climatic shifts can make an enormous difference to a people's well-being, including that of the generations to come. Humanity's belief that its future is solely under its own control is based on arrogance and faith, not reality.[32] The global ecosystem is the bedrock of all societies, and ongoing survival requires constant interaction with and response to the natural world.[33] An adverse or rapidly changing climate invariably places great strain on the functioning and well-being of a society, and examples of collapse are commonplace in human history. For some peoples—for example, the Mayans of Central America and the Norse of Greenland—climate change proved a terminating event.[34] Climate change will also cause a people to recalibrate the calculus by which they decide for war. In the words of the United Nations, climate change is a "threat multiplier."[35]

This work might sometimes appear to be written from the perspective of the role and mission of the land force. When this happens, it is only because the author was formerly an academic employee of the Australian Army. The work's message is intended to resonate equally for those belonging to the other services. To use language that everyone wearing a military uniform will find familiar, climate change is "joint" by nature.

The work divides into several sections. Chapter 2 contains three sections. The first provides an overview of climate change, and does so with the expectation that most readers already have an awareness of the subject. The chapter's second part introduces the idea of the Earth System, the mechanisms by which the earth creates and provides resources that have supported the evolution and sustainment of life on the planet. This leads to an analysis of how the systems that humans created to support civilization interact with the systems that drive the natural world. The chapter closes with a discussion of the role of biodiversity and population on the availability of resources that humanity requires.

The book's next chapter focuses on the risks, new and existing but intensified, that humanity will face from climate change. It then highlights the role of the social contract in creating and maintaining a society. Finally, the chapter will explain how climate change will lower the threshold of a nation's decision for war, resulting in a more violent world.

As the work develops it will consider a number of disruptions in the art of war that are essential for military readers to understand if they are to successfully fulfill their role in the climate crisis. Some of these are timeless, but reinterpreted from a climate change perspective, such as the effect climate change will have on logistics. Others are relatively new but will

gain importance as the climate shifts, such as the end of privilege. This work identifies twelve critical disruptions—shown in Figure 1.1—which underpin the character of war in a changing climate. They are divided into two parts, the society-focused disruptions and the military-focused disruptions. The discussion of these disruptions makes up Chapters 4 and 5.

Figure 1.1. Twelve Society-Focused and Military-Focused Disruptions that underpin the character of war in a changing climate. Created by Army University Press from the author's information.

The work's sixth chapter demonstrates that although climate change is the major event of our generation (and likely many generations to come), it will not change war in any fundamental sense. The nature of war will remain largely the same. The chapter also provides a best-case timeline for how climate change will play out over the rest of the century. The book ends with Chapter 7, which includes recommendations for the military to reflect upon as well as the author's final thoughts on humanity's future.

In writing this book, I have been aware that I would not be sharing an optimistic or pleasant story. This is not by my choice. Rather, it is the nature of all crises, particularly one for which the failure to take substantive global action has been the policy response for far too long. Whenever humanity has experienced climate change in the past, the outcome has almost always been catastrophic for those involved. It has meant at best a hardening of life for some, while for the less prepared or agile it has resulted in societal collapse and sometimes even extinction as a people. Because humanity has been unable to rein in the release of greenhouse gases into the atmosphere, pain is unavoidable no matter what we do next. The longer the delay in drastically scaling back greenhouse gas emissions, however, the worse the pain will be. There is no reason to believe or hope that the earth will be any less ruthless in determining our future than it has been to other species in the distant past. The only advantage we have over our predecessors is that we understand the science of what is happening, and we recognize that our fate is not the result of malevolent actions by supernatural forces.

Understanding and responding are two different steps, however, and the lack of action by the world's political leaders has created the crisis we now face. It is true that there has been some progress, such as the Paris Agreement of 2015 in which the signatory states pledged to limit global warming to 1.5ºC (2.7ºF).[36] Yet action remains slow, and some states have been dismissive of the crisis, such as the fossil fuel-dependent nations of Australia, Russia, and Saudi Arabia.[37] A group of twenty-four "like-minded developing nations," which includes major greenhouse gas polluters China, India, and Saudi Arabia, recently described the minimal emission reduction goals set by the 2015 Paris Agreement as an "aspiration" rather than a "target."[38] According to the Climate Action Tracker, an independent assessor of international commitment to climate change measures, only one developed country—the United Kingdom—has implemented domestic policies that support the goals of the Paris Agreement.[39] One frustrated scholar has been particularly direct in his condemnation, writing that the

political reaction to climate change has been one of "near-total futility, featuring prodigious grandstanding and hypocrisy."[40]

Unfortunately, gaining of knowledge on what climate change means and the threat it poses has far outpaced willingness to act on that knowledge; one can politely describe the international efforts to halt the rise in atmospheric greenhouse gases as slow and disheartening. When dealing with nature, however, political compromises and points for trying are useless; nature simply does not care. To employ an analogy in the language of contemporary policymakers: when the Mongols arrived at the gates of a city, pretending they were not there was unlikely to result in a good policy outcome for the residents.[41]

While climate change does not fit the template for a traditional security threat, it represents the greatest risk to the world, with the possible exception of a full-scale nuclear war between great powers.[42] The military has an obligation to think and plan for the worst. Because climate change is such a severe threat, soldiers would be remiss in their duty if they did not prepare for a different and more disruptive and violent future. This work does not provide a plan for what the military should do in the climate crisis. Such a plan would be far too complex for a single author to conceive. More importantly, it would need to be locally focused; and while similarities do exist between countries and regions, different governments will require different plans. Instead, this work should be seen as a contextualization of climate change for the military point of view. It is a guide to *how* you should plan, not *what* you should plan. For soldiers and others who defend sovereignty, the point at which climate change represents a threat to your nation is upon you. It is now time to think and prepare for the challenge to come.

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Chapter 2
Climate and Civilization

Our civilization is a product of a geological time period known as the Holocene Epoch, a 12,000-year-long period of consistently favorable climate conditions that provided a sweet spot for humanity's development. It is on this stable and fortuitous foundation that the human race expanded in numbers and societal complexity as its members harvested the world's resources to build the world that we know today.[1] In doing so, however, humanity changed the planet's atmosphere, initiated global warming, and brought the Holocene to an end. A new age has begun, known as the Anthropocene Epoch, a term that refers to humanity's ability to modify the environment on a planetary scale. Instead of the Holocene's favorable and stable climate, the Anthropocene promises more challenging and unpredictable conditions that will likely test the resilience of our civilization and the survival of many societies.

This chapter will establish the critical concepts that underpin the argument and discussion in this book. First, it will introduce and define the term climate. Building on this definition, the chapter will then explore the implications of a changing climate. The chapter next discusses the rise of civilization through humanity's ability to design and implement production and distribution systems that exploit the planet's natural resources to meet our needs and desires. In doing so, the chapter will establish that to achieve maximum production, people have integrated their resource production systems with the natural systems that operate global climatic conditions. For scientists, these natural systems are better expressed collectively as the Earth System. This section demonstrates that humanity's ability to meet needs and desires is ultimately dependent on how efficiently a society can harness the resources found in the natural world.

The last part of the chapter will present two further challenges that are occurring at the same time as climate change. Like climate change, population growth and biodiversity loss are the result of human action. As human numbers expand, the additional people will require access to resources. These extra mouths add further demand stress to a human production system that is already at capacity. At the same time, the natural system is under threat from biodiversity loss, which may lessen the Earth's ability to provide the services that humanity exploits to meet its needs. A full discussion of how population growth and biodiversity loss can affect the ongoing survival of humanity is beyond the scope of this book. However,

the reader needs to be aware of the additional pressure population growth and biodiversity loss will bring human civilization already buffeted by climate change. In addition, both of these factors will interact with climate change in ways that may make the consequences of a destabilizing natural world more dangerous for humanity.

What is Climate and Climate Change?

Climate is important because it is the foundation on which humanity has built its civilizations, and throughout history climatic shifts have contributed to the rise and fall of many of them. Despite its fundamental nature, climate is often confused with weather; therefore, a definition is required. Climate refers to conditions such as temperature, precipitation, and wind that one can expect in a particular place at a particular time of year, expressed as an average developed through observations over a long period. NASA defines climate as "the average weather for a particular region and time period, usually taken over thirty years. It's really an average pattern of weather for a particular region."[2] For example, New York and Oslo typically will be cold in February, whereas Sydney and Cape Town will be hot. Climate change is easier to define; it is a persistent deviation from the historical climate norm. Weather is measured in much shorter time periods than climate: hours, days, and weeks. Weather, essentially, is what you see when you look out the window.

While it is possible to offer a simple definition of climate, the factors that produce it are complex. Fortunately, a deep understanding of the drivers of climate is not required here; a superficial overview will do for our purposes.[3] Climate is an outcome of the interactions of planetary mechanisms that govern the capture and distribution of energy that the earth receives from the sun. Figure 2.1 outlines the interacting factors that create the earth's climate.

A change in one or more of the energy capture and distribution factors holds significant implications for climate stability. Additionally, a change in one factor can cause other factors to react, and not necessarily in a linear manner. For example, humanity's addition of greenhouse gases to the atmosphere has caused an increase in the average temperature. This has led to a reduction in the amount of sea ice in the Arctic, which in turn has reduced the overall reflection of the sun's rays back into space. The reflective ability of a surface is termed the albedo effect. Ice is a good reflector of sunlight, while liquid water—being darker than ice—is a good absorber of sunlight. Less ice at the poles, therefore, means the earth is absorbing more energy from the sun than it would if the normal amount of ice was

Capturing of Energy Factors	Distributing of Energy Factors
Position, distance, and tilt of the earth in relation to the sun.	Atmospheric distribution of heat via air currents.
Amount of activity on the sun's surface (sunspots).	The oceanic distribution of heat via water currents.
Variations in the albedo of the earth's surface.	Arrangement of earth's continents and their topography.
Degree of volcanic activity on earth.	
The composition of the earth's atmosphere.	
Arrangement of earth's continents and their topography.	

Figure 2.1. Factors that affect the capture and distribution of energy on earth. Created by Army University Press from the author's information.

present. The extra absorbed heat increases the surrounding air and water temperature, which causes more ice to melt, further reducing the albedo effect and so on, as a cycle of increasing solar absorption results. Since satellite observations began in 1979, the annual minimum extent of Arctic sea ice has declined significantly. The present rate of decline is approximately 13.1 percent per decade.[4]

Another example of a climate factor is the Atlantic Meridional Overturning Circulation (AMOC)—the Gulf Stream as it is popularly known, one of earth's main mechanisms for the distribution of energy via an ocean current. The AMOC moves warm water from the tropics to the Arctic, thereby heating Northern Europe sufficiently to support human habitation. The AMOC has two settings, strong and weak. Presently, the AMOC is in its strong setting, but climate scientists are not sure how much longer this will be the case. Because of the flow of fresh water into the Atlantic Ocean from the melting Greenland ice sheet, scientists fear that the AMOC may soon flip to its weak setting. This would see less warmth reach Northern Europe, plunging the region into a local ice age. A change in the speed of the AMOC flow will also have a secondary effect on the East coast of the United States and the property of the people living there. A slower-moving AMOC would back up water along the East coast, causing sea levels to rise and thereby putting coastal communities at greater risk of tidal and storm flooding.[5]

Because of its general stability, the 12,000-year Holocene era was an unusual period in the earth's geological history and it seems likely that the growth of human civilization during this era was no coincidence. The earth's climate can change quickly and dramatically. Scientists have drilled deep into the Greenland ice sheet to learn about past climates. The extracted ice core goes back more than 130,000 years and documents changes in the planet's temperature. The ice core record has revealed two important facts. First, it shows that Greenland is warmer today than it has been at any time during the past 2,000 years. Second, it establishes that once a climate becomes settled, it may remain stable for a long time. However, the ice record also shows that a climate may lose stability in as little as a few years and remain unstable for a considerable period of time, oscillating wildly from year to year. Greenland's ancient ice demonstrates that the transition to a new climate is not a smooth passage but instead features a series of moves toward, and retreats from, the new normal. Climate scientists have likened this oscillation to that of a young child who discovers the joy in turning a light switch on and off quickly.[6] What this means is that human activities that rely on a stable and predictable climate for maximum production of resources, such as food, will see yields reduced due to rapid and unexpected shifts in temperature and rainfall.

Humanity's rise to become the planet's dominant species has been due to the favorable conditions that appeared with the onset of the Holocene. Prior to that event, humans and our hominid ancestors lived through several ice ages. The environmental conditions were so unfavorable that life

was little more than a struggle to survive. The stable warmth that the Holocene brought allowed humans to begin the transition from a hunter-gatherer way of life to one based on animal domestication, agriculture, and permanent dwellings. The Holocene also laid the foundation for population growth from what were bands of scattered humans totalling as low as the tens of thousands, to today's population of more than 7.8 billion people, with an expected almost 10 billion by the mid-twenty-first century.[7] This progression has by no means been even; most of this population growth took place in the twentieth and twenty-first centuries. It took humanity only twelve years from 2000 to 2012 to add the most recent billion.[8]

For most of the Holocene, humans did not have the ability to change the climate in any meaningful way. They did clear forests, drain swamps, irrigate cropland, and terrace slopes where they could. However, they did not possess the technological and cultural means, or the population numbers, to exploit the environment on a scale that could cause a shift in the global climate. The climate did change, but as a result of natural cycles.

Sometimes nature was kind. From about 200 BC to AD 150, the Mediterranean region enjoyed a favorable warm and wet climate during which Rome reached the zenith of its power. Agricultural output surged and Rome built its Empire on a foundation of food surplus and trade. This period is called the Roman Climate Optimum. At its peak, the city of Rome had more than a million residents who depended on the timely arrival of grain ships from around the Empire for sustenance. Perhaps Rome's greatest accomplishment was its ability to organize a sophisticated system of food production and distribution that kept its urban populations fed. Unfortunately, at some point around AD 150, the Mediterranean's climate shifted and the new conditions ushered in a new era called the Roman Transitional Period. For the next three centuries, Rome's climate became less beneficent and more unpredictable. The entire Mediterranean region experienced episodes of colder temperatures which resulted from a natural change in earth's orbit, including the planet's movement farther from the sun and a shift in its axis. Less of the sun's energy reached the surface, resulting in a shorter growing season. Rome was an agriculturally based Empire and the reduction in solar energy reaching its fields lowered crop yields. Climate change alone did not bring about Rome's fall—there are more than 200 hypotheses to explain that event—but it was an underlying factor.[9]

It was not until the start of the Industrial Revolution in the eighteenth century that humanity gained the ability to interfere with the planet's many interacting physical, chemical, and biological processes, collectively known as the Earth System. The most commonly understood Earth System

process is the water cycle by which the earth cycles fresh water. This involves the evaporation of water, its formation into clouds, the movement of clouds by wind, and the return of water to the earth as rain, sleet, and snow. Specific cycles exist that regulate carbon, nitrogen, phosphorus, sulphur, and other elements, as well as the deep earth processes that bring new rock to the surface in volcanic eruptions.[10] Humanity, through gaining the ability to interact with these cycles, is now also a component of the Earth System.

By burning increasing quantities of coal, and later oil and natural gas, humans have been able to harness the fossilized energy of the sun, support a much larger population, and accelerate the exploitation of the natural world. The waste products released in the course of mining, refining, and burning these fuels include carbon dioxide, methane, and other greenhouse gases. These enter the atmosphere and create a "greenhouse effect"—the trapping by the atmosphere of heat radiating from Earth toward space. The higher the concentration of these gases in the atmosphere, the greater the retention of heat. The result is what we know as global warming.

The level of greenhouse gases in the atmosphere has risen significantly since the onset of industrialization. Previously the presence of CO_2 in the atmosphere averaged less than 280 parts per million (ppm).[11] As of November 2021, the Mauna Loa Observatory in Hawaii reported that the amount of carbon dioxide in the atmosphere was 414.88 ppm. The concentration of carbon dioxide varies from day to day, but the overall trajectory is upward. In 2021, it topped 420 ppm, a figure higher than at any other time in the last 800,000 years. That number was also higher than at any other time in humanity's existence, perhaps the highest since the era of the dinosaurs. In 1958, when Mauna Loa Observatory began tracking the CO_2 concentration in the atmosphere, the level was under 320 ppm. Figure 2.2 illustrates the rise in carbon dioxide as recorded by Mauna Loa Observatory. Other greenhouse gases, such as methane and nitrous oxide, have also risen.[12] The increase in methane (CH_4) is shown in Figure 2.3.[13]

The rise in carbon dioxide, methane, and the other greenhouse gas concentration accelerated after the Second World War due to the emergence of a large and economically aspirational middle class. Between 1990 and 2019, the Average Greenhouse Gas Index, which factors in all greenhouse gases, increased by 45 percent.[14]

While the presence of these greenhouse gases in the atmosphere allows the earth to retain sufficient heat to sustain life, the balance is a narrow one. For comparison, Venus is much hotter than the Earth, not because it is closer to the sun but because its atmosphere consists mainly of carbon

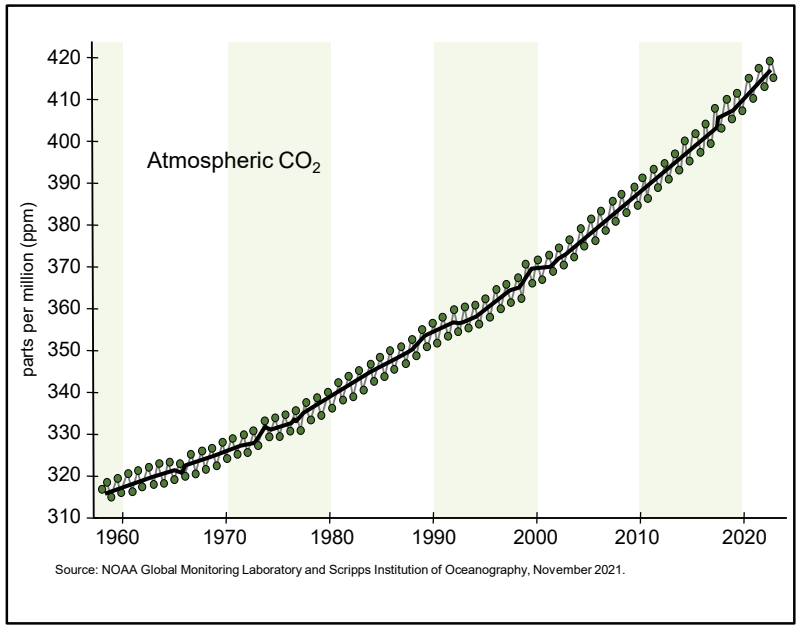

Figure 2.2. Mauna Loa Observatory CO_2 Measurement, 1958 to the Present. Courtesy of the National Oceanic and Atmospheric Administration.

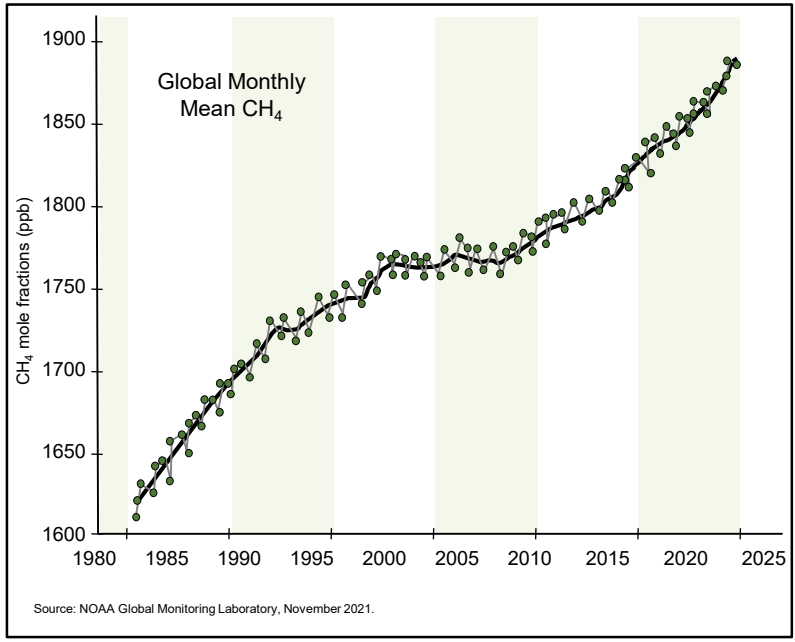

Figure 2.3. Mauna Loa Observatory CH_4 Measurement. Courtesy of the National Oceanic and Atmospheric Administration.

dioxide and other greenhouse gases; its surface temperature is 900°F.[15] Humans built civilization during an epoch when the atmosphere contained a percentage of greenhouse gases that generated a climate favorable to the success of our species. This success is now at risk as human-induced CO_2 concentration rises. The greater the rise, the greater will be the climate's reaction and the more heat energy retained by the planet.

That the climate is changing due to increasing greenhouse gases is not new information. French scientist Joseph Fourier first explained the greenhouse effect in the 1820s, American scientist Eunice Foote conducted experiments with greenhouse gases in the 1850s, and Swedish scientist Svante Arrhenius first predicted greenhouse warming in 1896.[16] The consequence of the additional carbon dioxide has been a steady increase in the earth's average temperature, initially quite small but now larger and accelerating. To date, the temperature rise has been just over 1°C (1.8°F).[17] That figure is a global average. The rise is much higher at the poles, and while 1°C may sound small, it represents an enormous increase in planetary heat. In the last twenty-five years, the energy contained in the ocean has increased by 217 Zetta Joules (217×10^{21} Joules). This additional energy has led scientists to predict more powerful hurricanes and storms, and research has shown a direct correlation over time that warmer waters fuel stronger storms with more intense winds.[18] To put this in military terms, the warmth humans have pumped into the ocean is the equivalent of the energy released by 3.6 billion Hiroshima-size atomic bombs.[19] The warming is also accelerating, a trend visually illustrated in Figure 2.4, which shows temperatures rising in alignment with the increase of CO_2 in the atmosphere.

The association between the increase in carbon dioxide and other greenhouse gases in the atmosphere and a rising temperature is irrefutable.[20] The planet's temperature is highly sensitive to even small changes in atmospheric greenhouse gas concentrations.[21] Modeling has also shown that as the concentration of greenhouse gases continues to increase, warming will do the same. International efforts are focused on limiting the rise to 1.5°C (2.7°F), but discussions on how to accomplish this have not been successful.[22] The lack of agreement itself is a source of tension as the world divides into states that have implemented changes to their economies to address climate change and states that have not. The developing world may have grounds to be particularly annoyed if climate change negotiations are not matched by action. The economies of these states did not create the crisis, but many of them are especially vulnerable to its effects. Unfortunately, the international climate change dialogue continues to achieve only minor breakthroughs as obdurate nations prevent significant

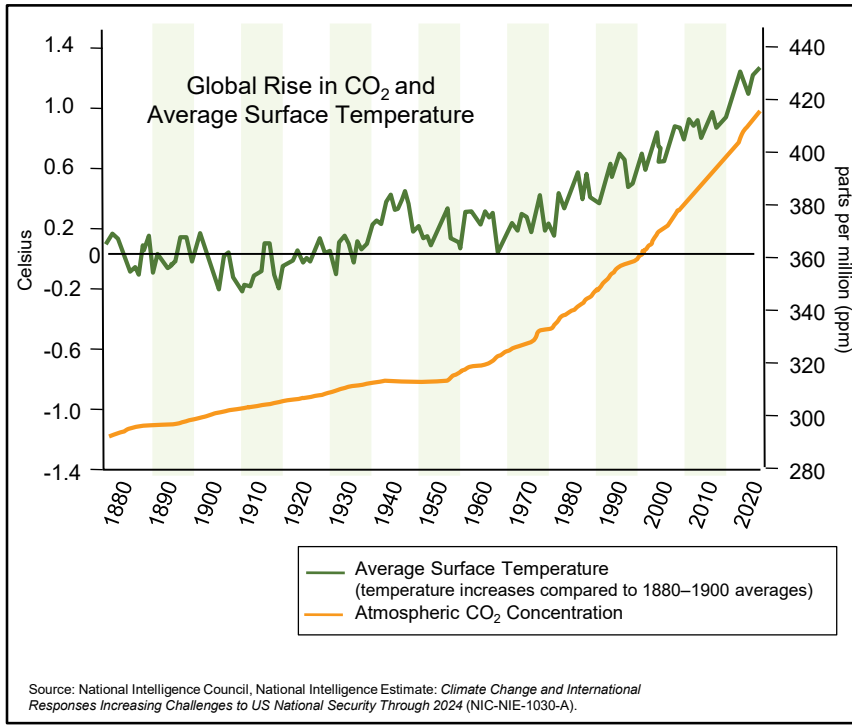

Figure 2.4. Average Temperature Rise since 1880. Created by Army University Press.

action.[23] China and India, now major emitters, have also resisted reining in their burning of fossil fuels; China is the world's largest producer of greenhouse gases and India is fourth after the United States and the European Union (twenty-seven countries).[24] Figure 2.5 illustrates the major emitting nations and the quantity of greenhouse gases they put into the atmosphere.

If major action does not commence soon and ramp up quickly, the already highly disruptive conditions of a 1.5°C (2.7°F) warmer world will be out of reach and humanity will be locked into the much more dangerous 2°C (3.6°F) or higher. There is a growing consensus among security analysts that humanity must halt the rise in greenhouse gases by 2030. Otherwise, the world could "face a perfect storm of food, water, and energy crises" and an increasing threat to peace.[25]

Evidence from the geological past shows the dangerous experiment humanity is conducting in its modification of the atmosphere. Scientists have identified excessive carbon dioxide in the atmosphere as the likely cause of most mass extinction events on our planet. The greatest of these

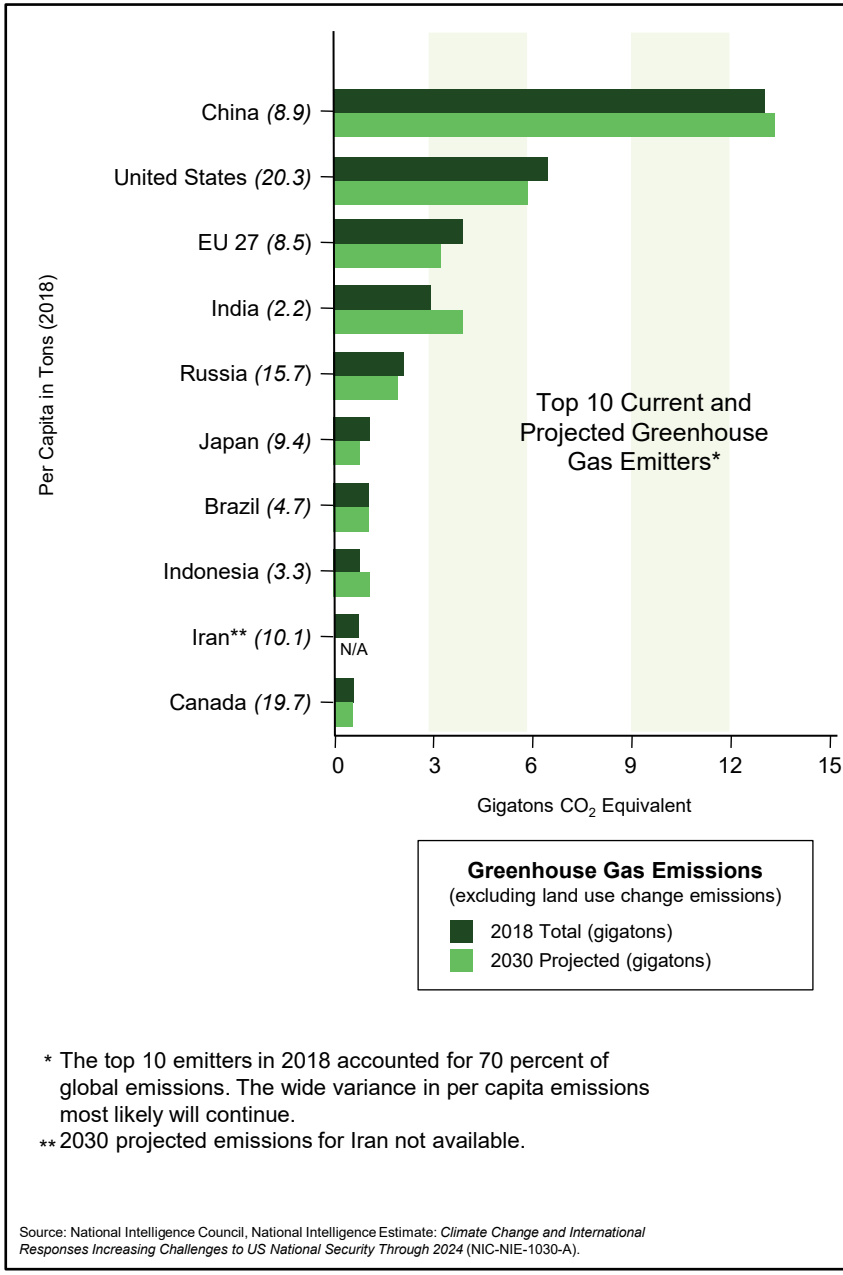

Figure 2.5. Top 10 Greenhouse Gas-Emitting Countries. From National Intelligence Council, "Climate Change and International Responses Increasing Challenges to US National Security through 2040," 2021.

was the End-Permian Die Off, which extinguished 95 percent of marine and 70 percent of terrestrial life on the planet 250 million years ago. The consequences of warming may not reach the levels of the End-Permian Die Off, but humanity is still playing a very dangerous game if it does not check the emission of greenhouse gases.[26]

The Earth System-Human System Link

To fully understand the risk that climate change poses for humanity, first consider the relationship between humanity and nature. Humans, like all species, are highly dependent on the Earth System to meet their needs and ultimately for survival. It is, to quote one scholar, "one of the dynamic backdrops of the human experience."[27] In a major 2019 report on biodiversity, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) observed that nature is essential to human existence and quality of life and identified some aspects of nature's contribution to civilization as irreplaceable.[28] Humans like to think they are separate from nature, as reflected in the creation of national parks and preserves and the belief that one can periodically escape modern life by holidaying in the wilderness, whether that be a local hike or a cruise to an Alaskan fiord. This is an illusion, because humanity is and has been a part of nature as much as any species.[29] These contributions include pollination of food crops, nutrient cycling, medicinal plants, and the basic necessities of air to breathe and water to drink. These systems gradually arose over millions of years as plants and animals provided services to each other, and in doing so established the atmosphere's makeup and kept it within a favorable band for the support of life.[30]

In addition, the Earth System has allowed humanity to access the resources needed to thrive: to meet consumption needs, create wealth, support economic and population growth, and even deal with our waste.[31] For example, many households compost their food scraps, lawn clippings, and other green waste. Some municipalities pick up compost-suitable waste for residents in addition to trash and recycling items. In the compost pile, micro-organisms, worms, and insects break down organic material and turn it into soil which humans can use for growing food. The backyard process of making soil also occurs on a planetary scale as a host of specialized organisms convert forest litter, manure, animal remains, and other dead materials to soil. Any keen observer strolling in a field or woods would invariably witness fungi hard at work. A different process involves the building of coral reefs, which is the result of free-swimming coral larvae attaching to submerged rocks or other hard surfaces. As the coral

grow and expand, the reef begins to take shape.[32] The reefs become habitat for sea life and also protect coastlines from storms. Reefs sustain a variety of food sources that fisherfolk can harvest and also allow humans to live in an environment that would otherwise not be possible. Across the world there are a number of atoll countries where land consists entirely of coral reefs which are just six feet or less above sea level. The Marshall Islands in the Pacific Ocean and the Maldives in the Indian Ocean are examples. Unfortunately, reefs are in trouble and dying from warming waters. Globally, marine heatwaves have increased in frequency and duration, further damaging reefs and also providing less time for recovery. According to a new report from the International Coral Reef Initiative, the world lost 14 percent of its reefs in the ten years from 2009 to 2018. If this loss continues, many species that depend on reefs for their livelihood—including humans—will be affected and a vital barrier against coastal storms lost.[33]

A 2014 study estimated the value of nature services at $125 trillion.[34] A 2018 study returned a similar estimate.[35] By contrast, the total global gross domestic product (GDP) in 2018 was only $80 trillion.[36] It could be argued that the Earth System provides greater value to our species than what we ourselves create. Climate change will put much of this contribution to human existence at risk.

Humans exploit nature's bounty by integrating production and distribution systems with natural services.[37] Humanity also develop systems that leverage nature to create conditions for optimal harvesting of resources needed for our survival, especially food, water, and shelter. For example, when plants flower, farmers need pollination to take place in order to later harvest fruits, vegetables, or seeds. Nature provides numerous pollination options to assist with this task, bees being among the most important. Three out of four crops that humans grow depend on the services of insects, birds, bats, and other pollinators for fertilization.[38] Further examples of the intersection of nature with human production are commonplace. Farmers prepare their soils for planting timed with the regular arrival of the monsoon or the flow of water from the upriver melting of glaciers. Fisherfolk go to sea when they know particular fish will be available in a particular location. Ranchers and shepherds move their stock in accordance with the growth of grass and the availability of water. There was a time when humans located their settlements where nature provided what was needed, such as fertile river flats, or supplied systems that allowed them to move the resources closer to where they were consumed, such as a natural harbor. Classical-era Rome, the largest Mediterranean city with a population that topped one million in the first century AD, produced

little of what its inhabitants needed; instead, Rome relied on the Empire's resources. The city's most important food source was Egypt, which was the ancient world's granary, and a constant flow of ships kept Rome's inhabitants fed and content.[39]

Some readers may question the strength of the connection between nature, climate, and civilization—particularly as industrial-based societies have tended to distance themselves from nature. This is only a recent development; industrial society is not even three centuries old. A glance at any map of pre-industrial civilizations will show that human settlement prioritized a natural resource such as fresh water, rich fishing grounds, or good soil. The founders of ancient Tell Leilan, a locale in the Akkadian Empire of the third millennium BC, located their city on a fertile plain that received regular rainfall which permitted dry land farming. In about 2,200 BC, a weakening of Mediterranean westerlies accompanied by a reduction in the Indian monsoon generated a megadrought that spanned northeast Africa to the Indus Valley in modern-day Pakistan and lasted more than 200 years. Average rainfall fell by approximately 30 to 50 percent, and yields from dry farmland plummeted. Tell Leilan was caught in a multi-decadal drought that led the inhabitants to abandon the city. They adapted by either becoming nomads or moving to the permanent water supply of the Tigris and Euphrates rivers, where farmers could irrigate their fields. Tell Leilan belonged to the Akkadian Empire, which collapsed under the strain.[40]

Population Growth and Biodiversity Loss

Unfortunately for humanity, climate change is occurring at the same time as two other potential threats that must be addressed: rapid population growth and a loss of biodiversity as humanity dominates the planet. Modern humankind, therefore, has a plethora of major, simultaneous challenges to resolve.[41] Population growth and biodiversity loss are interconnected with climate change; both will magnify the stressors that societies must manage.

Humanity's population will likely reach approximately 10 billion by mid-century, an increase of more than 2 billion people from today.[42] Barring a major catastrophe, this population growth is essentially locked in. More mouths require more resources; there is no escaping this relationship. Therefore, as population grows, additional resources will have to be found to meet the minimum needed to sustain life. Moreover, few people are satisfied with just the minimum. Most want more. In fact, most aspire to become like the conspicuous consumers who live in the world's wealth-

ier nations. Those who escape poverty quickly add more meat to their diets, acquire more possessions, and become tourists. As societies climb the affluence ladder, their resource demands increase. In 2017, China's new middle class spent $250 billion on tourism, more than the citizens of any other country.[43] Thus, not only is the human population increasing but so is its rate of consumption.

Feeding these new mouths, especially as they become wealthier, will require allocating additional resources to humanity's share of the biosphere. In 2000, the human biomass, including domesticated animals, was thirty-five times that of wild terrestrial mammals. In 1900, it was less than five times. While the human biomass is relatively small compared to the planet's total weight of life—we make up only .01 percent of the total—human activities have a far greater impact than those of other species.[44] Plants still dominate the earth's total biomass, but their biomass has roughly halved since the start of human civilization. Humans have an effect on the total biomass that is far in excess of their relatively low mass. Our energy usage has also greatly increased. The average Roman citizen consumed 10 billion joules per year, but the average contemporary American uses 340 billion joules, a thirty-four-fold increase.[45] Figure 2.6 compares Roman and American energy use.

Increasing human access to resources would be less of a challenge if the Earth System had infinite resources, but of course that is not the case. The Earth System is finite. Humanity's belief in infinite growth is "completely unsustainable and will therefore someday stop. Nothing can grow forever, at least anything that consumes finite resources."[46] Water is humanity's most critical resource, but already 70 percent of the planet's available fresh water is committed to agricultural irrigation, and the depletion of aquifers is accelerating as farmers mine water from the ground. Farmers in India are rapidly depleting groundwater to satisfy their irrigation needs, while in the United States the great Ogallala Aquifer is fast disappearing.[47] According to the United Nations, billions of people already suffer from water scarcity, and water is one of the key inputs to another critical human requirement—food. A report on water stress and violence that was prepared by CNA, a research organization located in Virginia that conducts analysis for the Department of Defense and other government agencies, highlighted that water shortages are a threat multiplier across the spectrum of conflict. CNA researchers have produced a number of important security-focused publications on the likely effects of climate change. The report's authors concluded that inadequate water supply drives violence and conflict, including state-on-state conflict.[48] Unfortunately, de-

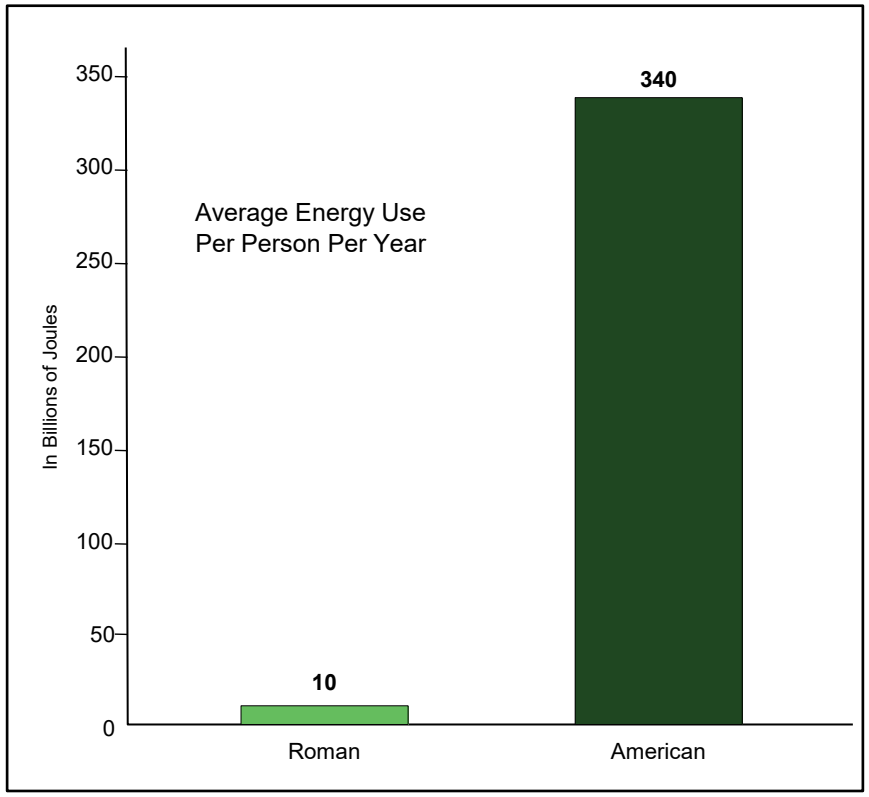

Figure 2.6. Roman versus American Energy Use. Created by Army University Press from the author's information.

mand for food is slowly outstripping supply, just at the point when climate change threatens to reduce harvests. The reality is that there is not a lot of spare capacity to allocate more fresh water to grow more food.[49]

Resource scholars have great doubt that the additional inputs required to increase production can be found, or at least not without placing at risk the safety of human society and the natural world, or increasing global security tensions, or both.[50] As humans demand more resources, they take a greater share of nature's bounty. This ruthless exploitation of the Earth System is resulting in what biologists have identified as the sixth mass extinction. Over the history of life on the planet, there have been five recognized mass extinctions—all caused by a natural event, such as the meteor that crashed into the planet and brought an end to the dinosaurs. Human exploitation of the planet's resources and the changes that we have

wrought, such as cutting down forests to create more farmland, have resulted in an increased rate of species extinction. Habitat loss, industrial pollution, widespread use of pesticides, and now climate change are denying other species their future. The best estimate is that the current rate of species extinction is between one hundred and one thousand times the pre-*Homo sapiens* rate.[51]

Forgotten in the quest for more resources are free services that nature provides, such as pollination of food crops. Less-vibrant biodiversity will reduce nature's contribution to human production systems. At some future date, tipping points will be crossed and humanity will have to create expensive substitutes for what nature now provides for free.[52] Already, scientists are working on robotic "bees"' to pollinate crops when real bees are driven to extinction by habitat loss and careless, excessive use of pesticides. Success may bring fame and wealth to the designers of such robots, but keeping bees in the biosphere probably would be better for humanity.[53] The reality is that "our economic system and our planetary system are now at war. Or, more accurately, our economy is at war with many forms of life on earth, including human life."[54]

Modern humanity has so far avoided the doomsday fate advanced in the books *Population Bomb* and *The Limits to Growth*, and predicted by nineteenth century political scientist Thomas R. in his essay on population, but that is not for want of trying.[55] Hitting the hard limits on resource availability has periodically tormented humanity, but—to date—the ingenuity of our species has prevailed and kicked the can down the road to a future reckoning. Individual societies may have succumbed, and humanity—particularly in the early days of its evolution—occasionally flirted with extinction; but none of these crises were global, and the species as a whole has managed to muddle through to the next crisis. Climate change is different; it is a global threat.

Muddling through is not quite the appropriate term for our past efforts; identifying the solution to such threats did require impressive ingenuity and risk-taking by some. At the turn of the twentieth century, for example, high food yields in Europe and North America depended on the nitrogen, phosphate, and potash found in bird droppings mined from seabird islands off the coast of South America. Supply of this guano was finite, however, and without nitrogen, yields would fall below the nutritional needs of crowded European and American cities. In 1909, future Nobel Laureate Fritz Haber achieved a breakthrough in fixing nitrogen from the air, and synthetic fertilizer was born. To this day, farmers and consumers remain dependent on Haber's genius.[56]

Yet when a population nears or exceeds its territory's carrying capacity, an inventor of Haber's caliber is not always to be found. The list of societies that flourished, outgrew their capacity to feed themselves, and then crashed is a long one. Author Jared Diamond, in *Collapse*, highlights a number of such civilizations, including the inhabitants of Easter Island.[57] To escape the ian trap, early societies (3000 BC) had limited options. They could either add territory through imperial expansion—usually involving violence—or they could intensify commerce, labor, bureaucracy, or technology to fuel growth.[58] The options available to our distant ancestors remain largely the same for humanity today.

In modern democracies, the military can do little to ease the crisis that comes when a nation exceeds its carrying capacity. Soldiers have no real role in limiting a nation's population growth; paradoxically, population sustainment is a critical factor in safeguarding sovereignty. Population management, at least in liberal democracies, is the responsibility of other government agencies. However, the military can help stop the sixth extinction. Armies are stewards for vast tracts of their nation's estate. They maintain ranges and training areas; some—for example the White Sands Range in the United States and the Woomera Range in Australia—are larger than entire countries. The military is also an enormous procurer of equipment, vehicles, and kit; the environmental impact of the manufacture, operation, and sustainment of these items is rarely considered in the acquisition decision. This may sound like a call for the military to transition to a green movement; in fact, every element of society must now—for the sake of humanity's future—consider the Earth System in its acquisition, concept development, operational planning, and decision-making. This work has maintained that the human systems and the Earth System in combination generate the resources and wealth humanity requires to survive and prosper. For the military to ignore the Earth System's role will further accelerate the breakdown of the interaction between the created and natural systems that humans need for survival. Furthermore, a hostile and depleted Earth System will reduce humanity's ability to create wealth, and the tension between states will increase operational requirements. By ignoring the Earth System's needs, the military will contribute to a declining national estate that will be less able to provide the resources needed to safeguard sovereignty.

To accommodate the Earth System in their deliberations, and meet the challenges of the Anthropocene, military professionals will need to undergo a significant cultural and intellectual adjustment. Throughout the

Holocene, the reason for a state to support a military was to protect itself from other states that would do it harm. In the future, political leaders will need to consider if the purpose of the armed forces is also to protect humanity from itself.[59] Climate change is a global event with global consequences. Can intervention in a foreign country be justified on environmental grounds? This is a significant shift in a military organization's mission and one that requires careful thought. In the Western Democratic tradition, such presumptuousness by politicians could be seen as a threat to societal liberties. The best that can be said at this point is that such a development requires consideration and watchfulness.

In summary, the climate change problem is complicated by the need to meet the demands of a growing and increasingly wealthy population while also preserving the Earth System on which human productivity depends. For the military professional, the complexity of solving such challenges must be daunting. Yet by triggering climate change through its modification of the atmosphere, humanity demonstrates the folly in not considering environmental concerns when thinking on national security. Militaries, like most parts of society, have not recognized the legitimate national security interest that a stable ecosystem represents. Going forward, the military must pay more attention to the security of the ecosystem, because the sovereignty and security of the nation cannot be treated in isolation from the surrounding environment without grave risk.[60] Future chapters will outline in greater depth what the military needs to do to help develop the necessary integration between military preparedness and the environment.

Conclusion

By initiating climate change, and in bringing the Holocene to an end, humanity has embarked on a new era in its development. The beginning of the Anthropocene means that humans have left the climatic sweet spot during which civilization developed and now is heading toward a much more unsettled and potentially dangerous future. The danger is not just a fear of the unknown. The threat is that our civilization will no longer align with optimal climatic conditions. These are wholly uncharted waters.

The lack of human-nature optimization will cause inefficiency in the resource production and distribution systems that support human life. This inefficiency may hold tragic consequences for much of humanity, particularly individuals who struggle to adjust to the new, more variable climatic conditions. Humanity's continued depredation of the biosphere and ongoing population growth will only make the situation worse as the Earth

System suffers from habitat and species loss. States will need to stretch resources further to meet the requirements of more people.

The next chapter will explore risks a changing climate holds for humanity, from the level of the US (and other) militaries to that of entire societies. As risks rise, the prospect of war will similarly increase. The risks humanity will contend with will range from the need to reassess the cost of flood insurance, as is already occurring, to the decision for war. None are trivial. Rather, in sum, they are integral to the future of society as we know it as well as the survival of the species.

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Chapter 3
Adjusting to Greater Risk

Climate change will bring with it a heightened level of risk across all aspects of society. This is because of the interconnections between the society humans have constructed and the resources provided by the Earth System. Humans are as dependent as any other species on the largesse of nature, perhaps more so. Natural systems surround us—even if we do not notice them, understand how they work, or grasp their connection to human systems. Human systems, such as finance, energy, transportation, and health all at some point interact with the natural world and—together—provide us with the resources and amusements we want.[1] Disconnected as we are from the natural world, most humans are unable to perceive the harmony that exists between farm, ranch, and fishery production systems and the underlying natural systems that provide water, nutrients, soil, and solar energy in the right quantity and at the right time.[2] Those who grow our food optimize the yield of their crops by optimizing their interaction with the Earth's natural systems.[3]

For communities across the globe, climate change is already requiring changes in risk management. This is occurring in the form of higher insurance premiums for storms, floods, and fires or modifications to building codes to make structures more survivable. Munich Re, one of the largest reinsurance companies in the world, has observed an increase in losses due to natural disasters since 1980.[4] Responding to this trend, Chief Risk Officer of Insurance Australia Group, Australia's largest insurer, has called for improvements in the industry's ability to assess climate-related risk, if the sector is to survive.[5] Following Hurricane Ida in 2021, the US Treasury Department has sought input to better understand and manage climate-related risk, while the Federal Emergency Management Agency is updating how it rates risk on properties insured through the National Flood Insurance Program.[6] A Canadian study warned that by mid-century, climate change will increase the baseline risk of coastal flooding up to 18 percent, while timber supply would decline up to 2.23 percent, a loss of $17 billion (CDN) in gross domestic product.[7] Some communities have updated zoning regulations and effectively outlawed building in particular high-risk areas. As climate change intensifies, governments will need to take additional precautions to protect both life and property from a more challenging and threatening environment.

The military is not exempt from the increasing risk profile that climate change will bring. The US Army's most recent publication on its operational environment reports that climate change will "almost certainly alter the character of war in the twenty-first century."[8] This, the document continues, is because climate change will alter the global landscape, as well as make clean water, arable land, and other resources increasingly scarce, which will cause governments "to behave in increasingly bold and risky ways."[9] It concludes that the Army and the Department of Defense must "prepare strategies for both adaptation and mitigation."[10] There are four areas of risk enhancement that the Army and the other services need to mitigate. Each area represents essential business for any military force, which means that ignoring them will have a negative effect on combat effectiveness:

- The risk to facilities and equipment.
- The risk to doctrine and concepts.
- The risk of a more dangerous and violent future.
- The risk of the degradation of the national support base.

Each of these areas brings with it different problems; the Army will need to develop innovative solutions to offset and maintain its capabilities.

This chapter is about how climate change poses a threat to the well-being of civilization. In particular, it addresses how climate change will affect the military's ability to respond to crises. Having discussed how increasing risk will challenge the fabric of global society the chapter will examine the binding strength of a unifying instrument that all societies possess: the social contract. The social contract is not an agreement in a document sense. Rather, it is an unwritten agreement between the government and the people on the roles and responsibilities both parties provide in the maintenance of their society. If societies do not undertake measures to control climate change, the risk is that their government and people will no longer be able maintain the social contract, thereby tipping society into chaos. The military will play critical roles in assuring that such a breakdown does not occur. The chapter outlines what it would mean for those who serve in the military if the social contract were voided. Finally, the chapter examines how climate change will alter the calculus for war and why it will encourage countries and peoples under climate change-induced stress to choose war, rather than other non-violent means, to meet their needs.

Considering the Risk

The risk to humanity posed by climate change has been known for some time. The most famous warning took place more than thirty years

ago when US National Aeronautics and Space Administration (NASA) scientist James Hanson outlined the warming threat in his 1988 testimony to the US Congress.[11] However, he was by no means the first to issue a warning. In 1965, President Lyndon Johnson received a report from his Science Advisory Committee predicting that the release of carbon into the atmosphere from the burning of fossil fuels would result in "measurable and marked changes in climate."[12] A decade later, another report similarly highlighted the "acute sensitivity of agriculture, and thus society in general, to even small changes in climate. . . . Small alterations in temperature and precipitation can bring about major changes in total productivity."[13] Fossil fuel producers were also early believers in the risk posed by adding greenhouse gases to the atmosphere. An internal report from one major oil company stated: "There is general scientific agreement that . . . mankind is influencing global climate . . . through carbon dioxide release from the burning of fossil fuels."[14]

In the US Defense bureaucracy, a 2003 report concluded that climate change will be gradual up to a point, after which events will increase in scale, speed, and abruptness.[15] In fact, the report asserted, the climate responds as a non-linear system and a small perturbation in one place can result in a disproportionate response elsewhere. The risks could cascade, a change in one area amplifying risk in another area. For example, the collapse of fisheries leads to the loss of an important source of human nutrition as well as a surge in unemployed fisherfolk, both consequences manifesting as an increase in social tension. Even low levels of atmospheric change could prompt a quite significant response elsewhere in the Earth System. Since these early warnings of the risk, all new evidence supports their prescience, as well as confirming Hanson's 1988 conclusion that greenhouse warming was already occurring.[16]

In combination, these warnings stress that a change in an existing stable system produces a non-linear change in its risk profile and introduces a degree of instability that does not currently exist. For example, introduction of the airplane in the early twentieth century changed the character of war and mandated that militaries respond. To that point, war had existed in two dimensions, the land and the sea. With the addition of the air, there would be three dimensions of war. Military leaders, therefore, had to understand how to employ aircraft to their side's advantage while minimizing the danger to their own forces from their adversary's planes. A new system of war had to be created—one that managed the risk aircraft posed. Perturbations caused by climate change will create more risk that society must minimize or offset to remain a functional polity.

The ability to identify and analyze risk is a critical and ongoing responsibility of all militaries. Military staffs conduct horizon scans of the existing threat environment while also trying to predict emerging future risks. Therefore, risk management is a dynamic activity that plays a fundamental role in preparations for war. Such risk assessments underpin decisions on force structure, equipment, doctrine, and concepts and will guide investments well into the future.

In recent years, the US military has been a leader in producing reports that identify how climate risks affect the nation's security. Since 2000, the US Department of Defense has issued or commissioned at least fifty reports and studies into the possible effects of climate change, including the groundbreaking *National Security and the Threat of Climate Change* by what was then known as the Center for Naval Analyses and which today is called simply CNA.[17] Other militaries have also begun to consider climate change in their risk assessments. In 2018, the New Zealand Defence Force released *The Climate Crisis: Defence Readiness and Responsibilities*, and a year later issued a plan for its implementation.[18] Meanwhile, the French military produced *Implications of Climate Change on Defence and Security in the South Pacific by 2030*.[19] The United Kingdom has produced a number of reports, including the recent *A Changing Climate: Exploring the Implications of Climate Change for UK Defence and Security*; and in early 2020, the Canadian Forces College hosted a packed conference on the threat of climate change.[20] Within the five-eyes community of English-speaking nations—composed of the United States, United Kingdom, Canada, Australia, and New Zealand—the Australian military has been the laggard in considering climate change from the perspective of national security. The Australian Department of Defence has not issued a single climate change report, and its most recent 2016 White Paper made only passing reference to the subject. In the face of growing international concern, Australia's *2020 Defence Strategic Update* went backward; it gave climate change a single mention.[21]

A number of civilian industries are also studying the effect climate change will have on their business models and such reports could assist the military in developing policies to identify and manage future risks. Insurance companies, in particular, fear the potential losses they may face as the cost and frequency of natural disasters increase.[22] An analysis from consultancy company Deloitte recommends that insurance companies raise the profile of climate change with their boards, develop better ways to assess risk, work with policyholders to reduce the potential for damage, and partner with regulators to develop climate-resilient policies.[23] Central

banks have begun to sell off their holdings of entities that derive their wealth from fossil fuels, including normally sound government bonds, because of the risk they pose.[24] All of the top five most-likely threats listed by the 2020 World Economic Forum's global risk report are environmental in nature. The report's authors placed climate action failure at the top of the list from the perspective of severity of impact.[25] The Centre for Policy Development has warned corporate directors that they must consider climate change in their board decisions because any reasonable court of law would consider the risks significant, well-publicized, and foreseeable.[26] A Federal Reserve Bank of San Francisco governor gave a speech titled "Why Climate Change Matters for Monetary Policy and Financial Stability," while Australia's Deputy Director of the Reserve Bank presented a major address on climate change's expected effect on monetary policy.[27] Further, an international campaign for fund managers and individuals to disinvest fossil fuel stocks has grown rapidly—not for ethical reasons, as one fund manager pointed out, but because continued investment in carbon-intensive industries is just financially stupid.[28]

As this compilation of concerned actors suggests, the military is by no means alone in needing to assess climatic risks. To prepare for the future, the military must consider the additional and different risks climate change will create then produce plans for their management. The Biden administration's *Interim National Security Strategic Guidance* makes this requirement explicit, identifying that climate change is one of the most significant national security risks and its mitigation is central to assuring the nation's future.[29]

To better understand the dangers that climate change will create for the military, the chapter will now explore the four risks identified above.

The Risk to Facilities and Equipment

Like any large complex organization, the military maintains a considerable and costly infrastructure of bases, buildings, and equipment to fulfill its responsibilities to the nation. Such bases may be used for training, schooling, storage, maintenance, and power projection. With the onset of climate change, the military will need to conduct ongoing assessment of all of its facilities and equipment to ensure they remain secure and capable of operations in the heightened risk environment that climate change will bring.[30]

The United States has already conducted several detailed surveys of how vulnerable its bases are to climate change effects. In January 2018, the Department of Defense completed the Initial Vulnerability Assessment

Survey (SLVAS) Report, which surveyed all US military bases worldwide. The objective was to estimate the vulnerability of each base to extreme weather, which it categorized as flooding due to storm surge, flooding due to non-storm surge events such as rain or river overflow, extreme temperature (hot or cold), wind, drought, and wildfire. The results were then quantified:

- Drought, 782 bases at risk
- Wind, 763 bases at risk
- Non-storm surge flooding, 706 bases at risk
- Extreme temperature, 351 bases at risk
- Storm surge flooding, 225 bases at risk
- Wildfire, 210 bases at risk

The survey, which included more than 3,500 bases, identified that about half—1,684—had no associated risk.[31]

The US Army has also taken steps to identify which of its bases are at risk. In 2019, US Secretary of Defense Mark Esper provided Congress with a list of the ten most vulnerable. The report also evaluated the effect of six specified climatic factors: recurrent flooding, drought, desertification, wildfires, thawing permafrost, and rising sea tides. The bases were:

- Yuma Proving Ground, Arizona
- Fort Irwin, California
- Fort Huachuca, Arizona
- Fort Bliss, Texas
- White Sands Missile Range, New Mexico
- Camp Roberts, California
- Hawthorne Army Depot, Nevada
- Tooele Army Depot, Utah
- Military Ocean Terminal Concord, California
- Pueblo Chemical Depot, Colorado

Every base on the list had multiple environmental threat factors. Nine were subject to desertification, the exception being Military Ocean Terminal Concord. All were at risk of riverine flooding and wildfires, while Concord was also at risk of coastal flooding. Additionally, most of the ten bases are located in the American Southwest, a region currently in the grip of a multiyear drought, with unprecedented numbers and intensity of

forest fires as well as water shortages.[32] The value of US Defense Department's global base infrastructure was estimated by The American Security Project at $590 billion.[33]

A subsequent Department of Defense report prepared by the Office for Sustainment and Acquisition identified seventy-nine at-risk bases globally. Interestingly, the study looked at those bases currently at risk and those that would be at risk in twenty years. Figure 3.1 summarizes the types of risks that will affect these bases.[34]

		Recurrent Flooding		Drought		Desertification		Wildfires		Thawing Permafrost	
Service	Number of installations	Current	Potential	Current	Potential	Current	Potential	Current	Potential	Current	Potential
Air Force	35	20	25	20	22	4	4	32	32	–	–
Army	20	14	16	4	4	2	2	4	4	1	1
Navy	19	16	16	18	18	–	–	–	7	–	–
DLA	2	2	2	–	2	–	–	–	–	–	–
DFAS	1	–	–	–	1	–	–	–	–	–	–
NGA	1	1	1	1	1	–	–	–	–	–	–
WHS	1	–	–	–	–	–	–	–	–	–	–
TOTALS	79	53	60	43	48	6	6	36	43	1	1

Source: Department of Defense, Office of the Under Secretary of Defense for Acquisition and Sustainment. "Report on Effects of a Changing Climate to the Department of Defense," January 2019.

Figure 3.1. Risk Profile of US Department of Defense Bases. Created by Army University Press.

Recent damage to US military bases caused by climatic events suggests what nature has in store for American defense infrastructure. In 2017, Hurricane Michael hit Tyndall Air Force Base in Florida, ripping its hangars apart and destroying seventeen F-22 Raptors, each costing more than $300 million. In 2018, Hurricane Florence caused nearly $4 billion damage to Marine Corps Base Camp Lejeune in North Carolina. The US Department of Defense ordered bases in Florence's path to evacuate, with personnel and equipment relocating to safer installations or, in the case of ships, heading out to sea, straining training and operational readiness. Future hurricane damage is expected to become more dire and expensive to remediate, if remediation is even possible. In the Arctic, the US Air Force must now refrigerate the permafrost under its facilities to prevent them from sinking into the thawing ground. In Alaska, permafrost under-

lies about 85 percent of the state, and its thawing will have a significant effect on training. For example, the ranges at Fort Greeley are all built on permafrost, which means they will likely become unusable without some form of modification.[35]

It is no longer beyond imagination that the US Navy will have to abandon Naval Station Norfolk, perhaps the most important naval facility in the country, if not the world, as it becomes submerged by rising sea levels. As early as 2012, a major US National Oceanic and Atmospheric Administration (NOAA) scientific report on the coastal impacts of climate change included Norfolk as an area at high risk of inundation.[36] More recently, according to a report prepared by the Union of Concerned Scientists, the low-lying Naval Station is subject to above-average sea level rise combined with natural subsidence. By the end of the century, the waters around Norfolk are expected to rise 4.5 to 6.9 feet. Much of the base lies less than 10 feet above sea level. Thus, the combination of subsidence, sea level rise, tidal flows, and more powerful storms will see the base frequently underwater. The Norfolk area already experiences nine tidal flooding events a year. By 2050, tides will likely flood the station about 280 times per year, and 10 percent of the base will be permanently underwater. Upriver, Joint Base Langley-Eustis is also at risk and will experience a similar degree of flooding and land loss to continuous inundation.[37] In 2003, Hurricane Isabel hit Langley, flooding 35 percent of its buildings, inundating the runway, and knocking out electricity. The damage bill was $166 million. The Air Force's response was to build a 3,000-foot seawall, install steel dam doors on buildings at risk of flooding, and provide a groundwater pumping station to get rid of floodwater. Other coastal bases will need similar remediation to remain operable into the future.[38] Of US military facilities, Naval Station Norfolk is not even the base most at risk of inundation; it is just the most important. Low-lying Naval Air Station Key West will become unusable before Norfolk due to rising seas and coastal flooding. Surprisingly, bases in the country's interior also are at risk from inundation due to flooding from rivers that breach their banks.

Overseas bases, such as Diego Garcia and Guam, needed for power projection into the critical Indo-Pacific and Middle East areas of operation, are also at risk of inundation and storms.[39] Diego Garcia is at particular risk, since its average height above sea level is just four feet.[40]

Saving these bases from climate change would require massive investment in infrastructure protection measures, which may not be fiscally feasible against other competing demands. It may be more practical to abandon these at-risk bases despite the deleterious effect on training

and force projection, as well as organization history and tradition. As the Union of Concerned Scientists concludes, Defense is looking at a permanently altered landscape which will render the continued use of many bases unfeasible in the face of storm surges, flooding, tidal events, and rising sea levels.[41] Climate change is creating a new environment which will necessitate hard decisions on what Defense can afford to retain and what it must give up. Its infrastructure holds strategic implications for the nation's security and force preparation.

The bases of US allies are similarly at risk, an important consideration for the US since Allied facilities may be needed for force projection and sustainment. The Australian Defence Force (ADF) has considered the threat climate change poses to its facilities and the flow-on effect any damage to the corporate estate would have on operational capabilities. Sea level rise, floods, and more frequent and powerful storms all have the potential to prevent operations from low-lying facilities, such as the Royal Australian Air Force (RAAF) base in Townsville, where taxiways and hangars are vulnerable to inundation. In Australia, drought and forest fires pose another significant risk to an already arid continent that climate scientists expect to become even hotter and drier.

A 2015 report from Australia's Climate Council expects climate change to put the ADF under increasing pressure as severe weather events disable bases or make them impossible to access.[42] The United Kingdom faces similar infrastructure issues, though the threat is mainly from flooding. A recent study identified nine of the military's thirteen most important bases are at risk of inundation, including Portsmouth and Brize Norton. The UK Ministry of Defence faces the difficult choice of whether to abandon, retreat from, or defend its bases—even more difficult because open spaces of sufficient size may be difficult to find in the United Kingdom, increasing the potential for capability loss.[43]

The threat to global military infrastructure is a critical one because it goes to the heart of readiness. According to a NOAA report on sea level rise, the Department of Defense can expect to see its ability to sustain operational readiness diminish. In addition, extreme climate events are likely to hinder global power projection due to damage to facilities and assets. In sum, the report suggests that climate change will increase Defense costs and lengthen response times for military operations.[44] Compounding the challenge for the military is that nearby civilian facilities are equally at risk and may be too damaged or isolated to assist the military. The power grid is particularly important because so many other systems depend on it, from access to automated teller machines (ATMs) and the

pumping of gasoline at service stations to the operation of life-saving machines in hospitals. While it may be comforting to limit the threat to military infrastructure, it is clearly a larger issue with national and international ramifications.[45]

The Risk to Doctrine and Concepts

Doctrine and concepts provide military professionals with an intellectual framework for thinking about and waging war. In his history of US military doctrine, author Dale O. Smith defines it as "a body of concepts and principles for waging war which have achieved enough official support to be taught in service schools and which have gained acceptance at the highest staff levels."[46] Importantly, doctrine is not prescriptive, nor can it be allowed to evolve into dogma. Rather it is a body of beliefs that changes as the character of war evolves. Concepts are similar but more rudimentary. They are exploratory thoughts by which a military investigates the operational possibilities of new technologies or ideas before they are incorporated into doctrine. The US Army is currently exploring the potential of Multi-Domain Operations to become its future way of war. At present it is a concept, but with time and further experimentation and thinking, it may become doctrine.

Military professionals understand that the character of war is always changing. War evolves because of advances in weaponry, technology, and social organization, or due to a rethinking of on existing weapon's employment. British Major-General and military theorist J. F. C. Fuller pointed out in his 1923 argument for the mechanization of war that over the course of the nineteenth century, "the whole aspect of civilization has changed, so also must the whole aspect of warfare be changed."[47] Fuller believed military organizations had an obligation to discard the old, despite the protests of the hidebound, and take advantage of scientific advances to create a more effective way of fighting. For Fuller, armies adopting the internal combustion engine represented a fundamental break with the past. Consequently, he called for a new doctrine of war, one that prioritized mechanical power over muscle power.

New technology is not the only, or even the main, motivator for advances in the character of war. Changes in how people organize their society are particularly important in determining the method employed and the effectiveness with which a military fights. American historians Williamson Murray and MacGregor Knox identified five major shifts in the modern era that resulted in significant changes in the waging of war. These were the emergence of the state, the French Revolution, the Industrial Revolu-

tion, World War I, and the Cold War. Each of these events reshaped society and the state and, in turn, redefined how military organizations fought.[48]

The end of the Holocene and the beginning of the Anthropocene represents more than a change in geological epochs—an event that would be of interest only to a small part of the scientific community. Rather, the passing of the Holocene and the commencement of the Anthropocene matter immensely for all of humanity. As the underlying environment on which our civilization is built changes, societies will need to adapt to remain in sync with the opportunities and limitations that nature offers. In climate change, humanity faces a shift in the organization of society that exceeds in importance those identified by Murray and Knox. Climate change represents the greatest change in the foundation on which humanity has built civilization since the great thawing following the end of the Ice Age more than 12,000 years ago. The transition caused by global warming to a new geological epoch dwarfs any technological or organizational advance to date. Some may see this as a big call, but a redefinition of the Earth system is a momentous event. If advances in technology and societal organization trigger changes in how militaries fight, what effect will climate change have on how armies think about and wage war? Particularly, how will entering the Anthropocene affect concepts and doctrine?

Unfortunately, there are no easy answers to these questions. Normally, scholars would study past events to discern patterns of behavior that might illuminate a path forward. This is not possible for climate change, because in the approximately 12,000 years since the transition from the Ice Age to the Holocene, no records exist that would be of use. Therefore, speculation is the only option.

Fuel is a useful area for speculation on how climate change may force a change in how the military trains and fights. The US military is an enormous fuel consumer; its fleets of vehicles, ships, and aircraft are responsible for approximately 80 percent of the federal government's energy use. In fact, the US military is the world's largest single user. Not surprisingly, it is also the world's single largest emitter. In any year, the Department of Defense puts more greenhouse gases into the atmosphere than entire countries, even developed ones. In 2018, for example, the US military contributed 56 million metric tons of greenhouse gases to global warming. By contrast, the entire population of Finland added only 46.8 million metric tons and Sweden just 50.8 million metric tons.[49] Domestically, the US military vehicle fleet emits more greenhouse gases than all civilian cars combined, two and a half times, in fact.[50] Most of the fuel burned is derived from oil and used to power an engine. Today's engines are more efficient

than earlier iterations, but for over a century they have been essentially the same machine. The US Navy does operate fleets of nuclear-powered submarines, aircraft carriers, and other large surface combatants that do not run off an oil-derived fuel, but they are the exceptions. By and large, the US military derives its energy from petroleum and emits greenhouse gases as the waste project of its burning.

The US military has steadily reduced its fuel consumption since 1975, but its use remains extraordinarily high. This is because military operations are intensely fuel dependent for maneuver, sustainment, intelligence gathering, and operation of command-and-control electronics and other devices. The high rate of consumption is not only because many of the vehicles are large or heavy; it is also because they were designed without fuel economy in mind. For example, even the humble HUMVEE gets only four to eight miles to the gallon, much less than the average pickup.[51]

In some areas, however, the US military is making progress to reduce its reliance on fossil fuels. This is occurring mainly in the base and facility areas of the Department of Defense. In 2013, the US Army piloted the Net Zero program to upgrade military base energy use so that all the energy consumed comes from renewable sources. In addition, bases were expected to reduce their use of water and the amount of waste they produced.[52] The following year, the Army expanded the program from the initial nine bases to include all installations. Following the Army's lead, the other services have established their own programs with similar aspirations.[53] These programs have been modestly successful in increasing Department of Defense use of renewable energy and thereby reducing greenhouse gas emissions. The Department's goal was to source 7.5 percent of installation energy from renewable sources, a target the Army met and the US Marine Corps exceeded by fiscal year 2019. The Navy and Air Force are behind but making progress.[54]

The American way of war is energy-intensive, however. Projecting power globally and at speed is only possible with a willingness to burn fuel without constraint in order to meet military need above all other considerations. In the build-up to the First Gulf War, logisticians processed an average of 35 planes and 2.1 ships a day. The rate of transfer into the Middle East Area of Operations was so fast that it exceeded the pace of the build-up for World War II, Korea, and the Vietnam War.[55] No other military had the logistic depth and organization to pull off such a feat. However, as climate change worsens, will the United States need to transform its way of war to less of a shock-and-awe approach? Will there be a reinvention that mandates lighter and more fuel-efficient vehicles, more measured move-

ment overseas, and acceptance that mission objectives may need to consider the level of emissions they will generate? This may seem farfetched but as the climate worsens, the military face is likely to face increasing demands to become greener, perhaps even at the cost of capability.

Those responsible for developing a military's concepts and doctrine should expect that some of what they now understand may become obsolete as the Anthropocene unfolds. This may occur soon or not until generations pass; no one can say for sure. For military thinkers, this assertion will not be controversial. The test of doctrine is how it performs in contact with the enemy, an event that often leads to adjustment. What is different today is that military doctrine will be assessed not only by one's opponent but also by an international community that increasingly seeks to reduce greenhouse gases, and by a natural environment that may be undergoing rapid and unpredictable shifts brought about by climate change. Therefore, a force's doctrine and concepts will be tested by three very different assessors: the enemy, international opinion, and the Earth System, a situation that has never occurred before.

While no clear advice can be provided on what climate change will mean for an army's doctrine and concepts, climate change will be among the stressors to the established way of fighting. Military leaders already have some indication of what they will face. They know their forces will have to contend with extreme temperatures, rising sea levels, droughts, and other environmental intensifications that are already guaranteed.[56] The only correct response on how to change, therefore, is an enduring one: do not treat your doctrine as dogma, always question its suitability, and willingly and quickly embrace change as needed. I am not suggesting the core essence of war will change; the environment might change but those waging the battle—human beings—will still be the same. The best response is that militaries must avoid a refusal to think and a slavish commitment to tradition—a sure route to ruin.

Those militaries that stand blindly by the status quo—refusing to adjust how they fight to address climate change implications—will be the most likely to taste the ignominy of defeat. Concern about climate change extend deep into the US Army and the wider US Department of Defense. At this point, those involved in developing doctrine and concepts must include a changing climate in their considerations. The effects of climate change may take place at the margins of war or somewhere more central but, as with the onset of industrialization, the future cannot be perfectly clear right from the start. Militaries must anticipate change, even if what kind and how much cannot yet be discerned.

The Risk of a More Dangerous and Violent Future

In 2020, the United Nations observed that while the number of war-related deaths continued to decline, a trend that started in 1946, the number of conflicts being waged was on the rise. One of the drivers of this uptick in frequency of violence was the scarcity of resources caused by climate change. This conclusion is just the latest iteration of this point by the United Nations, although one of the more directly stated. The 2014 United Nations Intergovernmental Panel on Climate Change (IPCC) report came to the same conclusion. Its members accept that climate change will increase the risks of violent conflict and noted in their report that "multiple lines of evidence relate climate variability to . . . conflict."[57] United States assessments on future security show a high degree of alignment with those of the United Nations. A 2016 intelligence assessment asserted that climate change would almost certainly "have significant direct and indirect social, economic, political, and security implications during the next twenty years." As a consequence, the assessment made clear, the United States would have to address major national security changes.[58]

A 2013 US intelligence report outlined the process that would drive the increase in conflict:

> Many countries important to the United States are vulnerable to natural resource shocks that degrade economic development, frustrate attempts to democratize, raise the risk of regime-threatening instability, and aggravate regional tensions. Extreme weather events . . . will increasingly disrupt food and energy markets, exacerbating state weakness, forcing human migrations, and triggering riots, civil disobedience, and vandalism. Criminal or terrorist elements can exploit any of these weaknesses to conduct illicit activity and/or recruitment and training. Social disruptions are magnified in growing urban areas where information technology transmits grievances to larger . . . audiences and relatively small events can generate significant effects across regions or the world.[59]

This report also outlined three existing demographic trends that would contribute to an increase in violence:

- Population increase by several billion people
- Urbanization leading to 60 percent of humanity living in cities
- Doubling in the size of the global middle class that will demand more goods and services.[60]

Demography, therefore, will exacerbate the effect of climate change on resource availability and help to drive conflict.

Most of this increase in violence is likely to be internal to countries and territories and on a relatively small scale, especially when compared to major state-on-state war. However, humanity is only at the beginning of a likely irreversible upward trend in climate-driven conflict. It is not surprising, therefore, that security thinkers, military historians, and military professionals expect climate change to usher in a more violent and disruptive future for all of humanity.[61]

Globally, numerous think tanks, militaries, and scholars—both within and outside of government agencies—have expressed concern about growing climate-related risk. Of particular note was a 2015 US Department of Defense report that concluded climate change would have "wide-ranging implications for US national security interests over the foreseeable future because it will aggravate existing problems—such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions—that threaten domestic stability in a number of countries."[62] Building on the findings of its ground-breaking 2007 report, in 2014 CNA reiterated its conclusion that climate change would aggravate existing stressors abroad.[63] Within the Pentagon and elsewhere, there seems little doubt that climate change will serve as an accelerant for instability and conflict, and that war will again become endemic to humanity.[64] Shortages of resources, particularly food and water, are consistently mentioned.[65] In *Climate Wars*, German social psychologist Harald Welzer identifies more than seventy twentieth-century conflicts for which resource security was a major accelerant to interstate tension.[66]

Still, the recognition that climate change is expected to cause more wars and conflicts has not fully taken root at the heart of military organization and planning. A 2019 US Army War College study reported the force was patently unprepared for future climate-induced risks. In part this was due to the lack of a culture of environmental stewardship but also the absence of any organizational accountability for managing the force's response to or mitigation of climate change.[67] The hardening of facilities against climate events is proving more easily done than addressing possible changes to how the organization fights. Not unlike the lack of meaningful progress on the political level by global leaders, the military is struggling to get beyond recognition to implementing significant change in how it operates. Improving the resilience of bases to extreme weather is an important start to the process of adapting to climate change but, as will be highlighted in future chapters, warfighting itself must also be re-examined.

This forecast future of greater climate-induced unrest and war is only a prediction, but it is ably supported by the historical and archaeological record, which is replete with catastrophic climate-induced outcomes. According to author Ian Morris, every great collapse, of which there have been many, has featured the same five forces, all of which are threatening humanity today: "uncontrollable migration, state failure, food shortages, epidemic disease, and—always in the mix, though contributing in unpredictable ways—climate change."[68] For example, the Ottoman Empire was brought to the brink of total collapse in the seventeenth century due to the climate becoming colder during the Little Ice Age. The Ottoman Empire relied on a central provisioning system that brought grain and sheep to Istanbul to support the city's large population and provision the Army. One of the most important functions of the state was to manage the provisions system, which necessitated the orchestration of widely distributed resources for imperial requirements. The provisioning system also managed people, whose labor was another resource available to the state. As the Ottoman Empire expanded its territory, the provisions system moved people to the newly conquered lands so they could be exploited for the betterment of the state. The system worked effectively but had a critical vulnerability. It was dependent on the Empire producing a surplus of food that Imperial officials could gather, concentrate, and distribute where it was needed to ensure its soldiers and the people of Istanbul were fed. The colder climate that accompanied the Little Ice Age put the provisioning system under enormous strain. Accompanying the temperature drop was a shift in the rain pattern: rains fell at the wrong time of the year. As a result, agriculture yields plummeted, and peasants weakened by hunger died in large numbers from cold and disease. Widespread famine stalked the empire, and large areas became essentially depopulated or fell under the control of bandits. The provisioning system failed, and food became scarce in Istanbul. Political collapse followed, severing the relationship between the peasants and the state. In effect, the Ottoman Empire's social contract with its people had been broken. In the ensuing turmoil, the length of a Sultan's rule became briefer and briefer as assassination became the means of succession and pretenders emerged to challenge for power. The Ottoman Empire survived the crisis but never regained vibrancy it once had.[69]

Scholars such as Geoffrey Parker see an obvious correlation between an unstable climate and human misery. He notes that the synergy between human and environmental factors combined to create the demographic, economic, social, and political disaster which was the seventeenth century, a period when shortage and hunger menaced Europe and Asia.[70] Author

Stephen Emmott captures the essence of the problem in his book on the challenge of feeding the 10 billion humans who will exist by mid-century. He writes, "Critically, the entire global food production system is totally dependent on a stable climate. Already the climate is anything but stable, and it is set to become more and more unstable."[71] Brian Fagan sees the situation in a similar light. In recognizing the role of climate in shaping civilization, he observes that it has done so "not by being benign."[72] When collapses came, he continues, they came as a "complete surprise to rulers and elites who believed in royal infallibility and espoused rigid ideologies of power."[73] These authors are highlighting that when "climate changes the context for people and ecosystems, both react, and the derivative effects of these interactions become complicated and unpredictable."[74] If human systems cease to work efficiently with natural ones, production of resources declines and societal desperation increases, which precipitates war as well as the outbreak of famine, disease, and societal collapse. The more stressors, the more likely a collapse will occur.[75]

A shortfall of resources is particularly acute when a society nears or exceeds the carrying capacity of its territory. Environmental scientists express carrying capacity as a limit. It is the amount of essential resources, such as food, that a population is able to produce from its own territory at a particular point in time. A population exceeds its carrying capacity when it has more people than its territory can support.[76] In the past, if a society was unable to generate additional resources, a period of starvation and death ensued until the population and its carrying capacity were again in harmony. For much of human existence, societies went "through boom-and-bust cycles of rapid population growth and starvation."[77] Today only a few countries produce grain in quantities that exceed their own needs, whereas a great number of other countries depend on this surplus. The international food market provides a hunger offset for much of the world's population, while international aid programs allow many poorer countries to avoid the Malthusian Trap, the term given to an observation English political economist Thomas Malthus made in his *An Essay on the Principle of Population*.[78] The Malthusian Trap occurs when a population increases to the point that it exceeds its ability to produce sufficient food to maintain economic stability.[79]

Unfortunately, climate change is a broad stressor that will affect most aspects of human activity, particularly the provision and distribution of resources. In a globally connected world, billions of people are "tightly coupled to a stream of services from a stable climate—depending closely on regular rainfall to grow their food. . . . A sudden flip to a new climate

regime would be a prescription for chaos."[80] Today's dependence on the efficiency of global resource production and distribution systems closely resembles Classical Rome's dependence on the regular arrival of grain ships from Egypt. Our systems are likely to prove similarly delicate when placed under climate change stress.

It is important for policymakers and military professionals to understand American anthropologist Joseph A. Tainter's observation that "civilizations are fragile, impermanent things."[81] Those that survive the shock of change have both prepared for and adapted to the shock. Worryingly, as societies become more complex, they also become more fragile. According to Christopher Coker, a professor of international relations, we are heading toward complexity overload and are over-exposed to even small disturbances. Today's advanced societies are incredibly fragile because, as Morris explained, they sow the seeds of their own destruction. When a society slips out of control, what follows is chaos, ruin, and collapse; and when systems implode, their destruction invariably leads to a period of endemic war. [82]

The Risk of the Degradation of the National Support Base

In Western-style democracies, the military is derived of and from the broader society which it protects. Soldiers and other service members come from the nation's civilian population and return to it when their period of service ends. The equipment the military uses is also a product of the society, either made by workers in a nation's mines and factories or purchased from overseas with taxes raised from the citizenry. When a military force conducts an operation, it does so at the behest of and with the support of the nation. The strength and resilience of the national support base is a determinant of the power that a military possesses and of its ability to project and target that power.

A more dangerous and violent future will also have a cascading effect on the national support base, which will create risk for the generation of military capability. Military professionals, particularly those of the liberal-democratic tradition, know they depend on their nation's citizens for the meeting of their needs. The military safeguards a people's sovereignty but is, in turn, dependent on the people for its members and requirements. The resources allocated by society enable the military to generate capability; the level of a society's support determines the size and capability of the military. This relationship holds even in autocracies, though the people's contribution to the military may be less voluntary.

Climate change will challenge the degree to which a country's national support base is able or willing to support future military operations in two connected yet opposing manners. On one hand, climate change will likely increase a government's demands on its military, requiring a greater share of national wealth. Such demands will range from more frequent and lengthy responses to natural disasters, to overseas interventions on peacekeeping or peace-stabilization missions, to participation in conflicts and larger-scale wars. The 2016 National Intelligence Council assessment postulated US requirements in five and twenty years. Over the five years (2016 to 2021), security risks facing the US would mainly be due to extreme weather events and from the exacerbation of already constrained conditions such as water shortages. In twenty years' time (from 2016), there would be increasingly disruptive weather events but also broader systemic changes caused by, for example, rising sea levels. Such events, the assessment continued, would have "significant direct and indirect social, economic, political, and security implications . . . and pose significant national security challenges for the United States."[83]

Greater activity will bring with it greater wear and tear on equipment, stretched budgets, exhausted personnel and their families, and disrupted training and readiness cycles. For relatively small militaries, climate change demands could overwhelm their personnel and physical resources. Australia, for example, stretches across an entire continent the size of the lower forty-eight US states, but its relatively small population is unable to support a nationwide emergency service force. In fact, the emergency service organizations are largely composed of unpaid volunteers organized at the community level. Australia's defense forces are routinely called on to assist domestic and international authorities with bush fires, cyclones, and floods, including Typhoon Haiyan in 2013 in the Philippines, the 2011 Queensland floods, Cyclone Pam in 2015 in Vanuatu, and major domestic bushfires in 2009, 2011, and 2019. Each of these missions required the commitment of hundreds to thousands of military personnel. The increasing frequency of these callouts has led to one report concluding that the Australian Defence Force is being put under pressure from climate change.[84]

On the other hand, mitigating climate change and adapting to a new environment will likely consume an increasing share of the nation's wealth. The need to divert treasure to mitigation and adaptation will likely occur just when a nation's ability to generate wealth is itself under attack from climate change. In the United States, property lenders are already offloading risk onto the public purse by selling mortgages on vulnerable

coast properties to the federally backed Fannie Mae and Freddie Mac entities. The public will now bear the loss if these properties are inundated.[85] In Australia, climate change is expected to do significant damage to its property and agricultural sectors, while insurance premiums for weather-related events are likely to soar. The Australian property market alone is expected to lose nearly $600 billion (AUD) in value by 2030, while more than $200 billion (AUD) worth of industrial and commercial infrastructure is at risk from coastal inundation. In the United States, the figures are in the many hundreds of billions if not trillions of dollars; Hurricane Sandy alone cost an estimated $70.2 billion.[86] In 2015, flooding-related expenses in the United Kingdom totaled more than 5 billion pounds.[87] In Canada, a 2011 report estimated climate mitigation would require $43 billion (CDN) per year by 2050.[88]

Adapting to and mitigating climate change will not be an inexpensive exercise for any government. The cost of keeping the electricity on in the aftermath of more powerful and frequent storms and other climate-induced events suggests the scale of expenditure that will be needed. California's Pacific Gas and Electric utility is developing a plan to bury 10,000 miles of power lines to reduce the potential that its equipment will spark a forest fire, such as the 2018 Camp Fire that killed at least eighty-five people. The plan is still in development, so regulators have not decided who will bear the significant cost and in what proportion. On the other side of the United States, Duke Energy's plan to spend $13 billion to reinforce its North Carolina power grid has, so far, floundered on the question of how much is to be borne by the utility's customers. If hardening infrastructure is expensive, so is taking care of the victims of a disaster. In the aftermath of 2018 Hurricane Florence, University of North Carolina researchers calculated that providing shelter, food, and emergency food stamp benefits to 100 families for two weeks cost about $572,000. If a major storm hits a densely populated vulnerable area such as Miami, the cost of assistance could be astronomical.

Natural disaster will also consume national resources while diverting the military from its true purpose: preparing for and waging war. The Australian 2019–2020 bushfire crisis provides a recent example of how the military will be drawn into operations to support communities under threat from climate change-driven events. The fires were of unprecedented scale and destroyed approximately 12.6 million hectares (31.1 million acres) by the time they ended in late summer. Across Australia, the fight against the bushfires distracted the nation for months, devastated entire communities, provoked a political crisis, and necessitated the callout of the Army and deployment of numerous ships and aircraft from the Royal Australian

Navy and Royal Australian Air Force. The ADF mobilized 8,000 soldiers, including 2,500 reservists, for what was known as Operation Bush Fire Assist. The troops cleared more than 3,000 miles of roads, purified a million gallons of water, delivered a further 3.36 million gallons of water, and provided 77,000 meals to evacuees at its bases. Navy ships evacuated 1,000 civilians and numerous pets from the coastal town of Mallacoota, which was cut off by fire on all landward sides. The military did not fight the fires, since they lacked the training to do so, but provided logistics, planning, and backup to the firefighters. An examination of Operation Bush Fire Assist concluded the ADF is the only organization in the country with a pool of fit, well-trained people and readily available equipment that could come to the assistance of the community in a disaster.[89] Forest fires have similarly become a drain on US military resources. The Chief of the National Guard Bureau, General Daniel R. Hokanson, has noted that in five years the number of person days allocated to firefighting in the Western United States has grown from 14,000 to 176,000.[90]

It is likely that other states facing similar crises will also turn to their militaries for assistance. As such events increase due to the acceleration of climate change, the military may have to ask whether its primary purpose has changed to safeguarding the security of the nation from natural disasters rather than waging war against a hostile state. This question was asked after the Australian bushfires were extinguished. The answer given was that aid to the civil community was not why the nation funded a military. However, will this be the case in a decade once the climate becomes more hostile?

For the military, the cost of climate change-related disaster assistance is relevant; the funding environment in which Defense fights for money is seeing the emergence of a new competitor: climate mitigation and reconstruction. As budgets come under strain, and destructive weather events wreak havoc on facilities and infrastructure and force citizens to abandon property for safer locations, the cost of climate change mitigation will soar. The military's present level of funding may prove unsustainable in the face of other demands that the populace considers of more immediate need. In the past, societies seeking a peace dividend at the conclusion of a war willingly supported military budget cuts. The destructive effects of climate change may also prompt demand for what could be called a "climate reallocation" of the nation's wealth from the military to other departments and functions.[91]

Rising sea levels and more frequent and powerful storms will inundate coastal zones and destroy homes and critical infrastructure that will need

to be rebuilt, fortified, or moved.[92] This process has already begun with the relocation of some Alaskan villages and their residents. However, as sea levels continue to rise along the densely populated Eastern and Gulf coasts, a much larger evacuation involving millions of people may become necessary. The military will necessarily play a large role in housing, feeding, and caring for these internal refugees.[93]

Increasing aridity, rising sea levels, and loss of access to fresh water will reduce agricultural output—putting additional strain on domestic and international food supplies, as well as reducing US exports and earnings and adding pressure to the balance of payments. Australia is one of the few countries in the world that is a net exporter of food. In 2015, Australian farmers exported 65 percent of their production, which earned the nation more than $41 billion (AUD), the equivalent of $32 billion US. Australia is also one of the countries most vulnerable to climate change. A 2015 report on food production by Australia's Climate Council outlines that as Australia experiences longer and more intense heat waves, accompanied by a reduction in average rainfall, agricultural output will suffer. In the 2014 growing season, for example, rainfall deficiencies across some growing regions resulted in a 12-percent reduction in crop yields. In a warmer environment, livestock also suffer from heat stress, which slows muscle development and reduces milk yields. During a heat wave, dairy farmers typically see a 10- to 25-percent decline in milk output from their cows. There is a wide range of predictions on the extent to which higher temperatures will affect Australian food production, but the one consistent comment is that yields will decline. The Climate Council even considers a worst-case situation where Australia will cease being a food exporter altogether. Other food-exporting nations will also experience yield declines due to a warming world and will be unable to offset Australia's losses.

As the climate grows hotter, the forecast for US agriculture is similar to that of Australia. In 2018, the US Global Change Research Program, under the supervision of the National Oceanic and Atmospheric Administration, presented its Fourth National Climate Assessment Report to Congress. The report contained chapters outlining the effect climate change would have on numerous aspects of the American economy, including forests, water supply, marine resources and agriculture. Its authors predicted rising temperatures would increase the frequency of droughts, their intensity, and their duration, which would exacerbate water shortages. The result would be plant stress causing yield reductions across all major commodity crops. In addition, the harvest of fruits, nuts, and vegetables would decline. Even more worrisome, the report highlighted the loss of synchro-

ny between crops and pollinators, putting at risk one of the most important services that nature provides to farmers.[94] Figure 3.2 illustrates where crop losses are expected to occur and the anticipated percentage of reduction. Of particular concern is reduced production across the Midwest, which is responsible for much of America's wheat, corn, and soybean production. In a hungry world with a growing population, any loss of production by Australia, the United States, and other major food exporting countries will reverberate through the international food system, resulting in higher prices and increased social tension in food-deficient countries.[95]

There is a recent precedence for how a supply interruption can affect global security. The 2010 growing season in Russia was exceptionally dry and hot due to atmospheric conditions across western parts of the country. Wildfires broke out, thousands of hectares of cropland burned, and 20 percent of Russia's harvest was lost. So intense was the heat that about 50,000 people died in Russia from heat stress as well as respiratory illness brought on by the smoke from the many fires. The drought was also felt in eastern China and the Ukraine; meanwhile, too much rain reduced yields in Canada and Australia. The atmospheric conditions over Russia caused a wetter monsoon to strike South Asia, which led to major flooding that affected 20 million Pakistanis and destroyed 1 million tons of grain reserves. In early August 2010, as the head of the Russian Orthodox Church led the nation in prayer for rain, the Moscow government responded decisively and embargoed the export of all grain.[96]

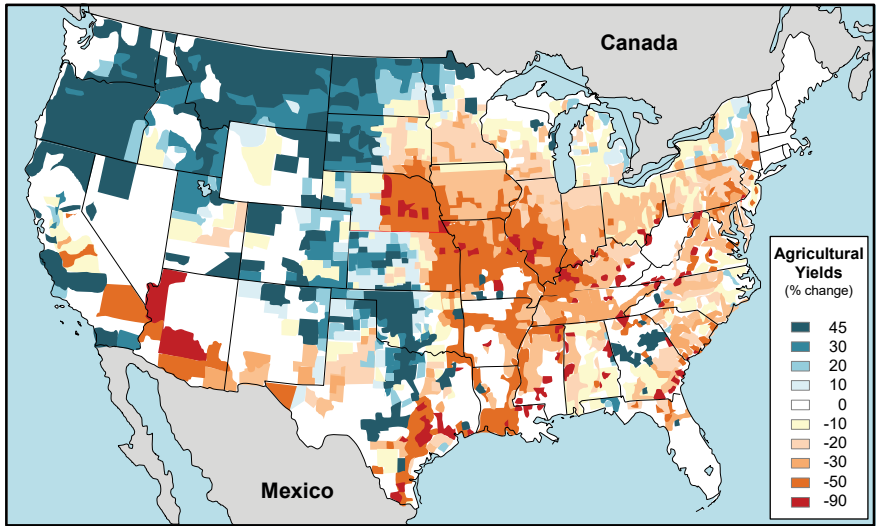

Figure 3.2. Agricultural Yield Reductions in the United States. Created by Army University Press.

The result of these events was a 40-percent increase in the global price of food. According to the United Nations Food and Agricultural Administration, the World Food Index increased from 170 to 240 in the eight months following the Russian embargo.[97] Facing a low winter wheat harvest, China took the precaution of entering the international market and buying wheat, adding more pressure to prices.[98]

Poorer countries that are dependent on food imports are facing a dramatically increased cost for keeping their populations fed. For example, bread provides one-third of the average Egyptian's daily caloric intake. By February 2011, the price of wheat had more than doubled. As bread prices rose, protestors gathered in Cario's Tahrir Square waving loaves of bread as a symbol of their anger. Dramatically increasing food costs sparked protests across North Africa and elsewhere that became known as the Arab Spring.[99] As far away as Madagascar, protests over food prices challenged the legitimacy of governments.

Because some governments were unable to manage the drought-induced 2010 food crisis, citizens overthrew the leaders of several states—most notably Egypt and Libya. Environmental historian J. R. McNeill observed that in the "wake of disasters, government authorities frequently attracted popular wrath either for neglect or for intrusive efforts to minimize or prevent damage."[100] He also noted that the people's response in Tahrir Square was not unusual over the course of humanity's experience with disaster management.

Climate change is likely to affect all levels of human organization, not just that of the state. It is a global issue that, like a pandemic disease, does not respect borders. Action by one country to improve its access to resources will almost certainly have consequences elsewhere.[101] China's determination, for example, to secure its water future by damming the rivers that rise on the Tibetan Plateau will negatively affect downriver riparian states in South and Southeast Asia.[102] In 2019, the lower Mekong River experienced a major drought and nearly dried up. It was not from a shortage of water, however. China's thirteen Mekong River dams were brimming with water, which China had held back to provide a regular supply of hydroelectricity to its people. Based on data collected from the river gauge at Chiang Saen in northern Thailand, climatologists calculated the Chinese held back 410 feet (125 meters) of river height. In China, there was water; in Laos, Thailand, Cambodia, and Vietnam, the great Mekong River was nearly dry.[103] As the Himalayan glaciers disappear, water will become an even greater issue, made more acute by China's diversion of what will be an increasingly scarce but life-sustaining resource; 25 per-

cent of the region's glacial ice has already melted. Nearly a billion people depend on this resource.[104] It is not clear what a small state can or will do when confronted by a large neighbor that takes what it needs. In comparison with China, Vietnam has limited options other than seeking international support. China essentially outsourced its water risk to the people of Vietnam, and that country's government will have to mitigate the next water crisis when it arrives.

For governments, the challenge will be to provide the military with the larger budgets required to mount more frequent and demanding operations from an economy that may be at best stable or possibly shrinking. This is a difficult problem, for which there are no easy solutions, or at least none that are politically palatable. Without humanity quickly punching through to a new global energy system that does not produce greenhouse gases, the only realistic option may be for citizens of wealthy countries to accept that they will need to become effectively poorer. A greater share of national wealth will be directed to guaranteeing national sovereignty and climate projects that reduce emissions and mitigate climate disruptions. Suggesting that society willingly accept a reduction in personal wealth may seem madness, but there may be no other choice.

The Challenge to the Social Contract

All modern societies operate under a social contract that defines the role and responsibilities of those who rule and those who are ruled. This is the case whether a society is a democracy or an autocracy. Social contracts are among humanity's oldest agreements and are what allow people to come together to form a society. The existence of a social contract is discussed in the Platonic dialogue, *Crito*, written some 2,400 years ago.[105] In the modern context, the theory of a social contract is associated with the work of Thomas Hobbes, John Locke, and Jean-Jacques Rousseau.[106]

Hobbes, Locke, and Rousseau were among the leading political philosophers of the seventeenth and eighteenth centuries. Each was a prolific author and leading intellect of the time and left numerous essays and longer works that have contributed to our understanding of how power is distributed and controlled within a society. Thomas Hobbes, the earliest of the three, was born in 1588 in Malmesbury, England, near Bristol. He died in 1679 at the age of ninety-one. Hobbes published his renowned book on political philosophy, *The Leviathan*, in 1651. The book's theme is the relationship between human liberty and the sovereign power of the government. To be secure in their liberty, people enter into a covenant—a social contract—with a sovereign that forms the government. The purpose of the government is

the provision of peace, which it provides through the application of its power. Hobbes, influenced by the turmoil of the English Civil War, believed people could only be secure in the presence of a strong government that ruled with absolute power. In the absence of such a ruler, society would be torn apart by chaos and war, and the rule of law would cease to exist.[107]

John Locke also lived through the English Civil War although he was younger than Hobbes. Locke was born 1632 in Wrington, a village in Somerset, England, and educated at Oxford. He died in 1704, having published arguably his most significant work, *Two Treatises of Government*, in 1689. Locke was an exponent for individual consent, and rejected Hobbes's argument of the necessity for an absolute ruler. Instead, he espoused that the individual possessed natural rights that the government could not trespass upon. He recognized that while government could be established by force or impose limitations on its citizenry, it became legitimate only if it had the explicit consent of the governed. Locke's social contract, therefore, leaned more to the individual than Hobbes's view, and it placed restrictions on the power of the government.[108]

Jean-Jacques Rousseau was born in Geneva in 1712 and died in 1778. A prolific author, Rousseau is one of the leading lights of the European Enlightenment, and his writings helped lay the intellectual foundation for the American and French Revolutions. Amongst his better-known essays was *On the Social Contract*, which he published in 1762. Rousseau's social contract considers the optimal way to establish a community of people and stressed that people possess natural rights, including liberty and equality. Rousseau rejected Hobbes's view of authority, which he equated with a form of slavery. Instead, Rousseau insisted that sovereignty is vested in the people and that freedom and free will are embodied in self-rule. The social contract, therefore, should contain no loss of individual sovereignty, and laws need to accord with the general will of the people.[109]

Despite their philosophical differences, Hobbes, Locke, and Rousseau shared the understanding that a social contract is an implicit agreement between the government and the people of a particular society. The terms of the contract vary with the context of the time and the people involved, but essentially the people surrender to the state the right to commit violence and in return the state (or tribe, clan, or substate actor) offers protection from both internal and external threats. In the contemporary world, the expectations of the people have expanded, and states now provide a host of services that underwrite a citizen's life from birth to death. By subsuming their independence, a people come together into a society that offers both protection and opportunity in a potentially hostile world.[110]

The social contract is important for those charged with protecting a people's sovereignty—particularly the military—because under the stress of climate change, many governments may be unable to meet the expectations of their citizens. History provides an example of this eventuality. In AD 910, a prolonged drought in Central America resulted in the end of the Mayan Culture, a civilization that had flourished in the Yucatan for nearly two millennia. At its peak, the Maya numbered 14 million, but after the collapse only a tiny fraction of that number remained as subsistence farmers; the rest had died from starvation, thirst, and disease.[111] Drought was no stranger to the Mayans; local sediment records show episodic dry periods in the years following AD 860, AD 820, AD 760, and earlier.[112] To manage these dry periods, the Maya constructed a network of reservoirs, cisterns, and canals to capture water in the wet period and distribute it during the dry. In Brian Fagan's words, "the Maya were obsessed with water."[113] The society's elite managed the water system, while most of the population were farmers. The surplus produced by the farmers fed the elite, who in return provided water. The system worked as long as there was water available for distribution.

The onset of the great drought of AD 910 had two effects. First, crops failed and famine gripped the land. Second, and perhaps more important, the failure to provide water brought into question the Mayan societal hierarchy. The legitimacy of the ruling class derived from the rituals and lineage that established them as conduits to the gods who controlled water. Those who ruled the Maya believed themselves to be divine, a status reinforced through elaborate ceremonies and architecture. As the reservoirs and cisterns dried up, the social contract relationship between the farmers and the elite ended. The farmers would have seen the wilting of their crops as a failure of divine kingship to protect the people. The social contract had been severed by a shift in climate that exceeded the resilience of the Mayan civilization.[114]

The Maya were not the only major civilization undone by a sudden and major shift from previous climate patterns. The Old Kingdom of the Nile Valley provides another example. Around 2150 BC, the vital Nile Flood failed. An annual event, the Nile's surging waters normally broke the river's banks and spread over the flood plain, soaking fields and coating them with rich alluvial soil. Within a few years of the flood's failure, food shortages proliferated and the kingdom fell apart. Dynastic texts identify the afflictions that affected the Egyptians, including internal strife, looting, raids by outsiders, famine, revolution, and social anarchy.[115] The pharaohs, whose positions were tied to ensuring the fertility of the fields, lost their legitimacy. The Old Kingdom fractured politically as social chaos took

hold, and Egypt was not reunited until the emergence of the Middle Kingdom more than a hundred years later. The Mayan and Egyptian civilizations had risen while nature was beneficent and fell when they were unable to adjust rapidly enough to changing environmental conditions. The lesson here is that climate matters.[116]

Those who think about climate change agree on the effects it will trigger, including:

- Reduction in the production of food
- Reduced access to fresh water
- More frequent and more powerful weather events
- Rising temperatures and prolonged droughts
- Melting of ice sheets and glaciers leading to sea level rise
- Reduced biodiversity through extinction of vulnerable species
- Migration of disease-carrying organisms to new territories
- Increase in health and pandemic threats
- Increase in societal fragility
- Heightened geopolitical tensions

While the list is lengthy, and more could be added to it, every point has the potential to add considerable stress to the ongoing well-being of a society. Some countries will experience multiple stressors which will interact and compound the pressure on their social contracts. Neither are the effects constrained by national borders. The melting of ice in the Arctic is opening up new trade routes and exposing hitherto-untapped resources for exploitation. International confrontations may occur as Arctic states define borders and access in an area once encased in ice.

Climate change is likely to stress a society's social contract, and when a state falls into turmoil, many human systems will cease to function as effectively, redoubling the strain on that society in a vicious downward spiral of social disintegration. The military will need to help provide stability so that a society has time to adapt to new conditions and define new relationships. For example, if the present drought across the US Southwest continues, some of the population may need to relocate to reduce the demand for water. The federal government and affected states may call on the military to provide planning staff to organize the evacuation; logistic personnel to establish water, food, and fuel points; military police to manage evacuation routes and assist local law enforcement agencies;

and other troops to establish tent cities at rest points. Many of these tasks are normally the responsibility of state and federal disaster agencies, but only the military has enough equipment and personnel readily available to manage such a crisis at a multi-state or nationwide level.

Without an intervention by the military, chaos might ensue as desperate Americans set out on their own to find water and a new place to live. The United States has the resources to manage the mass relocation of people but other states are not so endowed, and the social contract in such less fortunate places may not endure the pressure. The National Intelligence Council anticipates that when a weak state is unable to respond to a climate-related effect, it will lose its authority and lead to large-scale political instability.[117] Once the social contract is severed, the situation could quickly become what Thomas Hobbes believed humanity escaped from—a state of anarchy.[118] To avoid such a fate, the military must be prepared to support the government and the people in securing the social contract. This is the military's most fundamental obligation as protectors of sovereignty.

Climate Change and Reassessing the Calculus for War

Climate change is widely identified as a "threat multiplier." The United Nations and a host of other organizations and individuals routinely use the term to highlight the security risks posed by climate change.[119] While applied to all kinds of threats, including environmental ones, threat multiplier is especially associated with national security.[120] The CNA's military advisors have further pointed out that "as a warming planet affords increased access to the Arctic, the MAB [Military Advisory Board] cannot rule out new disputes arising over natural resource exploration and recovery, fishing, and future sea lanes."[121] While "threat multiplier" captures the sense of the potentially more dangerous future that climate change will create, it does little to explain how or why such conflicts will occur. It confuses an enabling condition with an outcome. Therefore, for the military professional, it is necessary to rethink how a people decide for war in an era of climate change.

Humans have been deciding for war as far back as history and archaeology can perceive. People resort to war because it is one of a number of actions which they can employ to achieve desired objectives. War is useful, Morris believes, because of its ability to establish larger societies that, in turn, impose greater security on a larger number of people. It creates the Leviathan that imposes the order that Hobbes described.[122] The Roman Empire, for example, reached its greatest extent in AD 117. Rome defeated all its enemies and pushed its borders outward to the point that it governed

the entire Mediterranean Basin and much of Western Europe. But this dominance did not come easily; to maintain it, Rome kept forts and outposts on its perimeter. The Empire's 70 million members enjoyed prosperity, stability, and order inside its borders, whereas outside its border rivals awaited their chance.[123] Roman power made the resort to war a foolish option for any would-be challenger. However, as Rome began its decline in the third century, choosing war again became a possibility for its rivals.

Another theory on war's utility is provided by soldier and scholar Mike Martin. His focus is on war's biological/evolutionary role; war is about reproduction and the attainment of status.[124] Like all animals, humans possess a built-in drive to ensure the survival of their genetic code, a goal that is assisted by the possession of high status, access to resources, and opportunities to reproduce. Azar Gat, a national security professor at Tel Aviv University, makes a similar argument regarding reproduction but also highlights a state's resorting to war in order to secure resources, especially food.[125]

These explanations have much merit but are perhaps too indirect. More simply, humans fight because they desire something—land, food, mates—and someone else has, or is believed to have, what they want. This is the explanation that Thucydides provides; humans fight for fear, honor, and interest.[126] Whether they fight at the tribal or international level does not matter. All war, no matter its character, is driven by utility—the desire for something.[127]

But in war, humans do not impulsively act on their desires. War is a serious business with numerous risks, including to one's life. Wars have determined the fate of civilizations and the rise and fall of nations and peoples, and they are not to be entered into lightly. Therefore, the decision for war is an act of reasoning that involves making a calculation: the strength of the desire compared to the price a society is willing or able to pay to achieve it. This applies whether one is the aggressor or the victim of aggression. Defeat is always a possibility, yet no people choosing war anticipate losing, because their calculation has convinced them they will get what they want at a price they are willing to bear. Unfortunately, a society's calculus for war, if not undertaken with great care and honesty, can be perverted by emotion, ignorance, delusional analysis, and, most significantly, hubris.[128] Miscalculation in the decision process for war is a major cause of defeat.

Since the end of World War II, the trend has been that war has become less ferocious and waged less frequently.[129] While the avoidance of a nuclear war is a factor in this trend, it is also apparent across less existential struggles. Admittedly, there is a cultural bias in this assertion. The "state of

peace" applies most accurately to the wealthy countries of Europe, Asia, and North America; and for most of the inhabitants in these regions, the greatest danger has become the occasional terrorist attack on their soil. For others, vicious wars still play out in much of the world; and for those who lived through the lengthy conflicts in Sierra Leone, Syria, Vietnam, Sri Lanka, Yemen, and elsewhere, any suggestion of a golden age of peace would seem ridiculous.[130]

There are a number of theories on why war has become less of an issue for those living in contemporary wealthy states. Canadian-American psychologist Steven Pinker believes that modernity has shaped a more peaceful human. Morris points out that larger states are capable of being more powerful Leviathans and are more able to curtail violence and impose peace. Another explanation is the global acceptance of norms that guide the improvement of society.[131] Others argue that industrialized societies have the ability to generate such an abundance of resources that their members have escaped the Malthusian Trap and, therefore, these fortunate states can meet their critical wants by means other than war.[132] This is the argument advanced by Gat in the *Causes of War and the Spread of Peace*. He observes that in recent decades, abundance has increased at a staggering pace and "the balance of benefits between war and peace has radically altered as independent growth in real wealth has replaced the zero-sum game."[133]

However, none of these theories is truly satisfying because they do not address the primary reason for war—desire. In our immediate future, the fulfillment of the universal basic human attribute of wanting something is why climate change poses such a major threat to our present relative tranquillity. It threatens to change a state or sub-state's calculation in the direction of favoring war. The effects of climate change on a society may provide the additional impetus to accept the risk of war because of the greater urgency of need.[134] Right now, the international system excels at fulfilling a society's needs by other means, particularly in the developed world. Even in poorer nations, needs are met more efficiently and effectively than ever. Hunger remains, but more people than ever have been lifted out of poverty.[135] The current calculus for war tends not to favor violence. A society's need is not usually intense enough to accept the risks that war entails, especially since the international system allows other means to fulfill needs, such as by recourse to the global trade system. Gat suggests that states knowingly assess their odds when thinking about war. He writes that "violence and war occur when the conflictual behavioral strategy is judged to be more promising than peaceful competition and cooperation for achieving any object of human desire."[136]

There has not been any fundamental change in the nature of humans to account for the decrease in the lethality and incidence of war that present-day wealthy states now enjoy. Our evolutionary core remains intact; however, the favorable conditions that made peace more common for much of the world are not permanent. They may prove transient if the world moves into a less comfortable state of existence. If this happens, the more peaceful future that Pinker, Morris, and Gat presume may prove unachievable as people rediscover war's usefulness and again become more accepting of the risks that waging war entails.

From the perspective of national security, one of the greatest threats of climate change is its potential to reset the conditions that allowed humanity to sate many of its wants and needs through means other than violence. There are two primary ways climate change will make a people's calculus for war more likely to lead to what nineteenth century German Chancellor Otto von Bismarck called the rolling of the iron dice:

• The weakening or severing of the integration between human production systems and the Earth System which will encourage societal need and grievance.

• Modifications to the physical environment that heighten the potential for geopolitical tension.[137]

The human systems that we rely on to create and distribute the resources we need or want are tied to natural ones. Nature is not the enemy; it is simply the physical foundation on which humanity constructs its systems of production. The crisis we face is the weakening of ecosystem functionality and a flow-on diminution in the viability of constructed systems.

The most important human systems are those concerned with the capture of water, production of food, and distribution of both. There are already grave concerns that climate change will adversely affect global food production because as natural systems destabilize or become less predictable, human interaction with them will become less efficient.[138] In a hyper-connected world, as the 2010 grain crisis demonstrated, how humans respond to environmental trauma will ripple around the world and create opportunities to disrupt ecosystem access.[139] To sustain production, humans will need to make their created systems interact with a shifting target of greater unpredictability, or of less utility—assuming the requisite natural system still exists at all—for example, the glaciers of the Himalayas. The result of poorer human/natural systems integration will be reduced output, resulting in fewer resources available for distribution, while population continues to rise. Many societies already struggle to meet the needs of

their people. Some only do because the international community is willing to share. Their fate will be bleak when resources are no longer available in sufficient quantities.[140]

Those in the military and their civilian colleagues who are responsible for addressing future security threats should anticipate increasing regional and global instability as water availability, food production, and other critical resources no longer keep up with requirements. Many parts of the world will be affected by internal strife as people compete to secure declining stocks of essential resources, and borders may not contain them. The Syrian Civil War that commenced in 2011 is illustrative of this future. A harsh drought began in 2006 and lasted into 2011—the most severe since instruments were available to record weather data—and was exacerbated by an existing long-term drying trend affecting the Eastern Mediterranean. This drying trend is consistent with modeling of rainfall responses to increasing greenhouse gases in the atmosphere; scientists have concluded that climate change made the onset of the drought two to three times more likely than natural variability alone. Since two-thirds of agricultural land in Syria is rain-fed, the drought made these areas untenable for farming. Additionally, farmers could not access groundwater because aquifers had already been severely depleted by excessive extraction.

The prolonged drought resulted in multi-year crop failures and forced 1.5 million Syrians to abandon their no-longer-productive countryside. Yields of wheat fell 47 percent and barley 67 percent, and livestock populations plummeted. Farmers and their families migrated to the nation's cities; by 2010, internally displaced people made up 20 percent of Syria's urban population. At a meeting with a UN official, the Syrian Minister of Agriculture warned that the economic and social fallout from the drought was "beyond our capacity as a country to deal with."[141] The migration of so many people resulted in the building of illegal settlements (shanty towns) on the periphery of cities, and caused overcrowding; meanwhile, unemployment and crime soared. Migrant children suffered particularly as malnutrition increased dramatically. The Assad Government failed to manage or meet the needs of the displaced people—directly contributing to the outbreak of civil war, a conflict that continues to this day.[142] Facing starvation, desperate people will make desperate decisions. Instability may lead to individuals challenging central authority, the break-up of countries along ethnic or religious lines, intrastate and interstate war, and mass migration.

Climate change is driving a number of modifications to the physical environment which will increase geopolitical tension and hence the

potential for war. The melting of sea ice in the polar north is among the most dramatic, as a new ocean gradually takes form, the liquid Arctic. In the Arctic, sea ice does not extend as far south has it has previously. In September 2020, the average extent of the Arctic sea ice was 75 percent of its level in 1975.[143] By 2030, the IPCC predicts, the Arctic Ocean will be largely ice-free during the summer.[144] However, it is not just the Arctic that is melting. Glaciers are melting worldwide, and bodies of ice that have existed since the last ice age are at risk of disappearing. The US National Park Service anticipates Glacier National Park's name will soon no longer be indicative of what tourists can expect to see when they visit.[145] Additionally, the massive Greenland ice cap is melting at a rate that is seven times faster than in the 1990s, and scientists are increasingly worried about the stability of the huge West Antarctic Ice Sheet.[146]

The quest for a Northwest Passage has been a long-standing ambition for Northern Europeans from the opening of the Age of Exploration in the fifteenth century to the present. Portuguese explorers reached Asia by sailing around Africa into the Indian Ocean. A northern route to Asia around North America promised to be shorter and faster if a route could be found around the ice. Over the centuries, European states sent numerous expeditions, many of which ended in disaster, but no commercial route was identified due to the great extent of sea ice. In more recent times, however, ships have been able to make the voyage from the Pacific to the Atlantic Ocean via the Arctic using specially strengthened ships that can navigate the ice-choked waters.

The retreat of the Arctic Ocean's ice cover is now making the Northwest Passage possible. Additionally, the Northeast Passage across the top of Russia offers another route between Western Europe and East Asia. In 2007, for the first time in recorded history, the Northwest Passage was open to commercial ships without an escorting icebreaker cutting a path. A cruise ship made the voyage in 2016. Figure 3.3 shows the loss of Arctic sea ice.

From a security point of view, freeing up the Arctic holds particular relevance for the United States since Alaska borders the region. But there are other factors that might cause an increase in strategic competition. As the ice melts, hitherto-inaccessible resources can be exploited. The opening of the passage will also allow states to project power across the region in a way that was not possible before. For the United States—and Canada—an entirely new operational front has opened that previously could only be penetrated under or over the ice and not by surface ships. Contests over sovereignty are also likely to occur as states exert their rights to

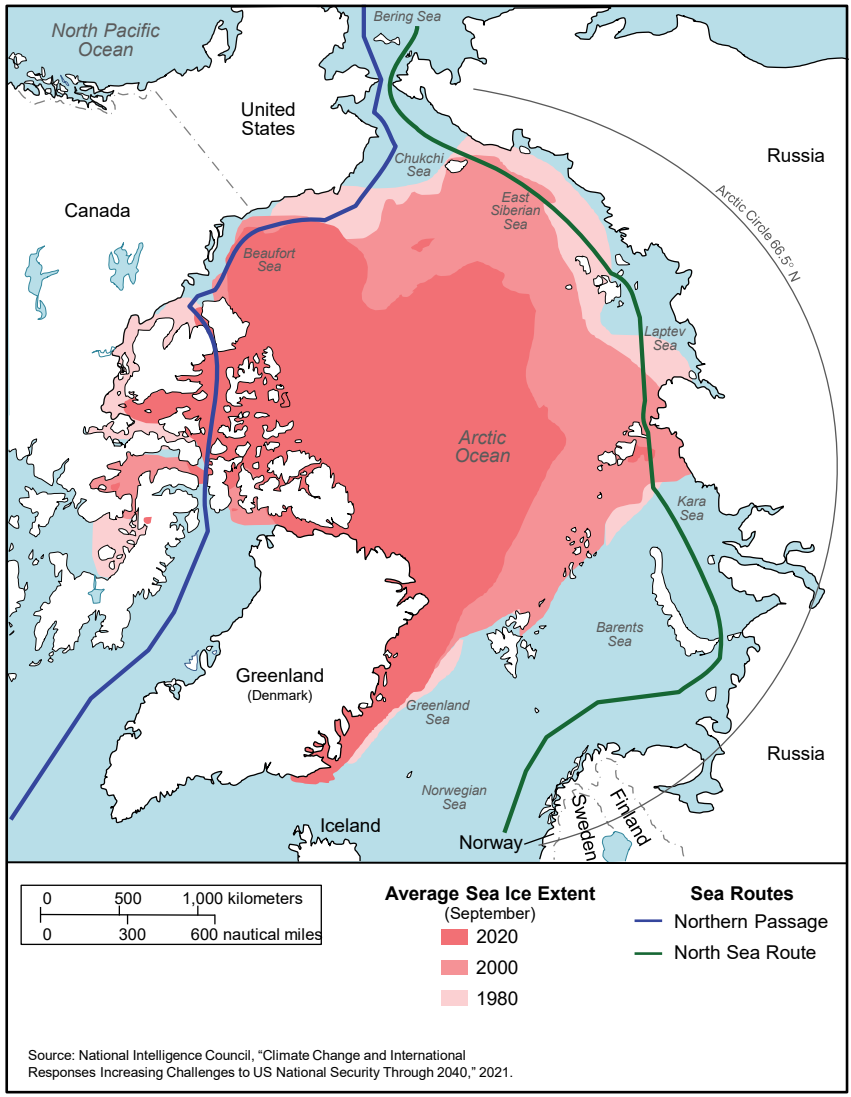

Figure 3.3. Arctic Sea Ice Loss. Created by Army University Press.

200-mile exclusive economic zones and the seabed resources and fisheries contained within.[147] As the Brookings Institute points out:

> Global climate change has catapulted the Arctic into the center of geopolitics, as melting Arctic ice transforms the region from one of primarily scientific interest into a maelstrom of competing commer-

cial, national security, and environmental concerns, with profound implications for the international legal and political system.[148]

Russia has taken an early lead in increasing its claim to the land below the Arctic's waters, which are believed to be rich in fossil fuels and other important minerals. One of Russia's advantages in the quest for access to the Arctic Ocean is its fleet of icebreaker ships. As of 2021, Russia had fifty-five in service, with a further twenty planned or under construction. The United States has three icebreakers in service, Canada ten, Denmark three, and Norway two. Figure 3.4 displays Russia's preponderance of icebreaking ships. Russia has also raised new Arctic units, refurbished old airfields, and established new bases along its Arctic coastline.[149] Dramatically, Russia went so far as to plant a flag on the sea bed to stake its claim.[150] An open Arctic will also see a shorter sea route between Asia and the markets

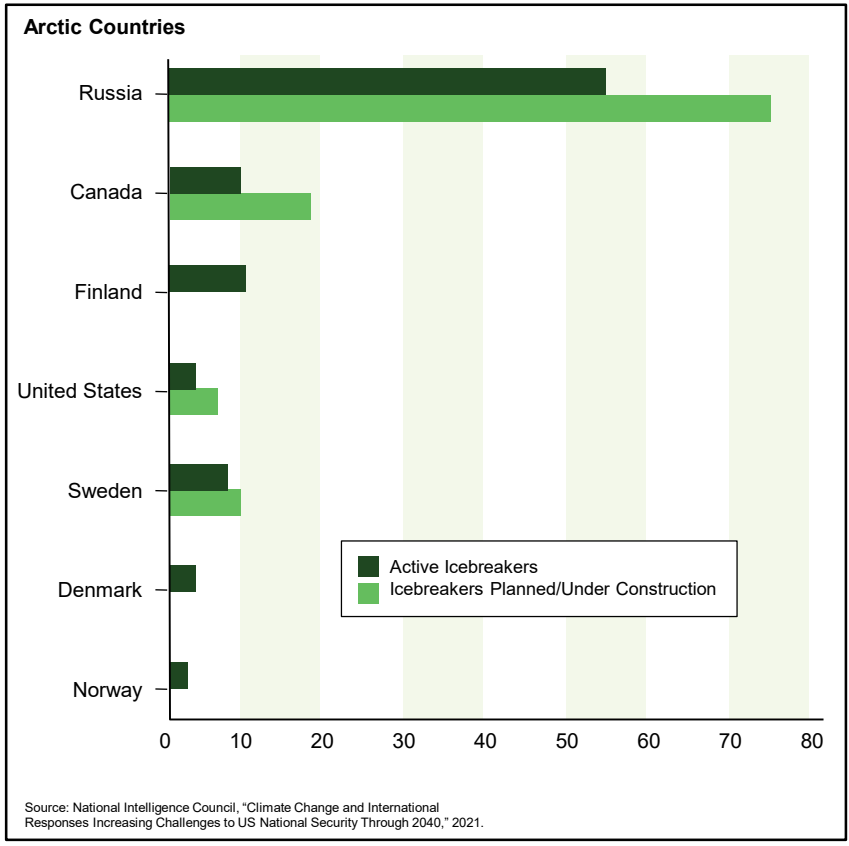

Figure 3.4. Icebreakers in Service and Planned by Arctic Countries as of 2021. Created by Army University Press.

of Europe and Eastern North America. Even China, which does not border the Arctic, has proclaimed interests in the region.[151]

For the US Department of Defense, the opening of the Arctic will increase the force's operational responsibilities. In its 2021 Operational Environment document, the US Army noted that Russia is already working to improve its Arctic capability and conducting more training and exercises in the region.[152] The US Army will need to do likewise and prepare for potential conflict in the region. This will mean providing specialist equipment capable of operating in the Arctic's harsh environment as well as preparing soldiers to endure its hardships and isolation. The Army may also need to raise specialized units such as an equivalent of the Canadian Rangers, a reserve formation that provides a military presence across Canada's sparsely inhabited north.[153] Similarly, the other services will have to adjust to meet this emerging challenge.

Conclusion

The most important task for the military has always been to safeguard the sovereignty of the state it serves. As climate change-induced threats multiply, those who serve will find themselves called on to assist with increasing frequency. The US Department of Defense, and the militaries of other states, can expect to sustain an ongoing higher operational tempo for the foreseeable future.

At some point, all wars end. Some go on for longer than expected, such as the recently concluded conflict in Afghanistan, but the troops eventually come home, peace ensues, and the force undergoes a period of rest and rehabilitation as it prepares for the next mission. This will no longer be the case in the Anthropocene. Climate change will usher in an era of chronic crisis as the military is called on to aid the civil community devastated by an extreme weather event, conduct a peace stabilization mission to hold together a failing state, or even conduct warfighting operations as parties fight for the resources their societies need to survive.

Through all this, the most important task for the military will be to help the rest of society maintain the social contract. As the following chapters will explain, if the social contract is broken, all is lost and the military will effectively cease to exist. The implications of the risks outlined in this chapter are explored in greater depth in the pages to come. Through them, what is also made clear is that there is no going back. The military will have no choice other than to prepare for the more tumultuous Anthropocene age.

Notes

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Chapter 4
Society-Focused Disruptions of Climate Change

The previous chapter outlined many of the risks that climate change will generate for humanity and highlighted the pressure a cascading array of climatic events will have on the capability of the military and the survival of civilization. This chapter and the next will explore the twelve social and military disruptions that climate change will generate, the implications they hold for those who serve in the military, and the additional responsibilities they may create. Since the military is a part of the nation, the focus of this chapter is on the six society-focused disruptions from climate change that pertain to the ongoing stability and functionality of human society.

The discussion here is deliberately widened beyond the perspective of the United States, since climate change impacts are relevant for all people no matter where they live. Climate change does not recognize national borders, and troubles that affect one country are likely to have a cascading effect in other countries. Importantly, what happens outside the United States can also have repercussions for US interests, including its security, so it is useful to explore climate change disruptions as widely as possible. These will vary in intensity, frequency, and duration from nation to nation, due to the differing circumstances of a country's exposure to climatic events and the carrying capacity of its land, as well as the resiliency and capabilities of its people. However, every society in our globally interconnected world, to a greater or lesser degree, is likely to be challenged by every one of the disruptions described below.

As with elsewhere in this work, the discussion here is not prescriptive. The military reader should understand that this work is not doctrine. Rather, it is a starting point for understanding the challenges to their profession that climate change will cause, in order to promote discussion and inform planning and readiness.

The End of the Social Contract

The worst event that any society can undergo is the breaking down of its social contract, the voluntary agreement among the people that they accept that government will secure their peace and prosperity. Of the six society-focused disruptions identified here, this is the most important because it underpins everything a society does. A particular society is effectively at an end when the government no longer prevents private violence. With the disappearance of the controlling hand of the government,

humanity reverts to Hobbes's terrible "state of nature"—that people who lack laws or any restraint on action take what they need or want by force.[1] Stanford historian Ian Morris explains in *War! What is it Good For?* that by building larger and more powerful states with stronger governments, humans have gradually reduced the rate of violence and the likelihood of an individual dying violently. Today we have never been safer from the violence of our fellow human beings. Yet we cannot forget that the Hobbesian state of nature is never far away.[2]

Climate change will create stressors that threaten the continued existence of the social contract in many countries, but this risk is not evenly distributed. Some countries are more likely to collapse than others. Nor is collapse a permanent condition; a new society—given time—will emerge from the ashes of the old, although this may take years, decades, or even centuries, and the interregnum will be marked by disorder and violence. The following traits and advantages will help a society survive as an intact polity, while their absence will encourage dissolution:

- A favorable geography
- A strong infrastructure, and a reserve of wealth that can be tapped
- A robust scientific and engineering research establishment
- An educated population who is willing to adapt
- A food production industry that provides sufficient calories to meet a population's needs
- A people who are socially and culturally cohesive and not riven by factions and partisanship
- Good leadership

While possessing all seven is not necessary, the more a state has, the better its ability to manage a crisis and maintain its social contract.

From a national security perspective, a favorable geography is one of the greatest blessings a state can enjoy. Poland's position on the North European Plain with no defensible borders has historically placed it at a severe disadvantage, as demonstrated by its end-of-the-eighteenth-century partition by neighbors and disappearance as an independent state. By contrast, Australia, an island continent with no land borders, is protected by its natural moat. The United States may dominate North America, but its long overland borders and coastlines provide relatively easy approaches, as the chronic issue of migration across the southern border attests. Although the United States possesses many of the required traits for retaining its

social contract, many other Western Hemisphere countries do not. Five of these—Guatemala, Haiti, Honduras and Nicaragua, and Columbia—are among eleven countries the National Intelligence Council has identified as of concern and with an increased potential for instability and internal conflict. The future stability of these countries may prove problematic and necessitate US aid and even military stability interventions.[3] Some countries have the misfortune of being in dangerous parts of the world, such as sub-Saharan Africa—challenged by ongoing insurgencies in Mali, Chad, Nigeria, and South Sudan. Africa is also threatened from a number of pressing climate change-related disturbances. For example, Lake Chad is drying out and has shrunk by 90 percent. Thirty million people face a bleak future, because they depend on Lake Chad for sustenance.[4] Others occupy geologically insecure homelands, such as the low-lying Pacific Ocean nations. The National Intelligence Council has identified these zones as regional arcs of vulnerability. The developed world can expect a greater need for humanitarian assistance across central Africa. Conflict-prone countries such as South Sudan, Somalia, and Angola possess militaries that are ill-equipped to respond to local natural disasters. The US military and the forces of other states such as Australia may see their troops deployed to these regions to restore order. For low-lying Pacific Ocean islands, the situation is less complex. These nations will simply disappear or become unviable when salt water enters their freshwater aquifers as a result of rising sea levels. The US Navy and the ships of other fleets may be called on to evacuate the millions of people who live on these islands.

As in most things, money matters. Under the strain of climate change, wealth will matter even more. Wealthy states will be more able to fund the adaptations necessary to protect their sovereignty and the well-being of their people, while poorer ones will be dependent on the largesse of the international community for their survival. Having a strong infrastructure will also provide a state with tools to adapt to climate change. The US Army Corps of Engineers has begun to investigate building a sea wall to secure New York City from rising sea levels and the storm surges that inundated it after Hurricane Sandy in 2012. The estimated cost to protect some of the world's most expensive real estate is $119 billion.[5] The island states of the Caribbean, South Pacific, and Indian Ocean do not have this option. As noted previously, military bases around the world are exposed to disruption from climate change—built on permafrost which is now melting, in coastal areas subject to sea level rise and more extreme storms, or on inland waterways which may breach their banks. Costly remediation or relocation will be needed for such bases to continue to function. Even

the wealthiest nations will not have enough money to remediate all problems, but they are better placed than others.

Climate change adaptation will require new ideas, new technologies, and engineering solutions. Those states with an educated population, research universities, and a tradition of seeking scientific and technological solutions will be able to smoothly transition to methods of production that do not increase greenhouse gas emissions. They may even be able to develop technologies to extract carbon dioxide from the atmosphere and return it to the ground; a very small experimental plant to do just that has commenced operation in Iceland.[6] However, a note of caution is warranted since technology can be used as an excuse for doing nothing. The Australian Government's 2021 plan to reduce emissions to net zero by 2050 relies almost entirely on technology—without causing any discomfort to the nation, including its existing fossil fuel-intensive industries. Technology, the Australian Prime Minister expects, will provide a yet-to-be-identified magic bullet that solves everything. The government plan even includes on its reduction road map that technologies are currently "unknown."[7] Australia has been rightly labeled the "weakest link" in the world's pursuit to reduce emissions.[8] Still, countries that possess a strong research and engineering tradition will be more favorably placed to transition to a greenhouse gas-free future than those that do not, but only if they do not succumb to self-delusion.

A state that values education and intelligence also possesses one of the prerequisites for successful adaptation. A population that appreciates science can recognize the need for action and be willing to accept the cost of taking it. Unfortunately, representatives of certain vested interests have devalued the importance of climate expertise.[9] Fossil fuel producers have known about the risks of increasing carbon emissions for many years, but their response has been to sponsor research and pay lobbyists to sow doubt about the science, not unlike tobacco industry actions regarding the causal link between its products and cancer.[10] As early as 1982, a report produced by one fossil fuel giant predicted "almost exactly the amount of global warming we've seen, as well as sea level rise, drought, and more;" the report was kept secret by the company.[11]

Devaluing or concealing critical information is a serious issue for any state that wants to mitigate the effects of climate change. If science is no longer an uncontested truth, if contradictory versions of scientific fact are allowed to exist, how does a society identify its most useful course of action? For the military, science holds a particularly important place in fostering high-tech weaponry and systems. To have faith in the global

positioning system, for example, one must trust the science that brought it into existence. The military is not likely to adapt to climate change if the trend toward rejecting expertise, knowledge, and scientific truth is allowed to continue.

The military possesses a deeply held institutional acceptance that it is critical to seek advantage over one's opponents. Often this manifests itself in a striving for technological or tactical superiority. However, in the future, large parts of the broader society may not share the military's faith that technology will help solve challenges. The military has a deep interest in science and technology progress because new ideas and techniques often result in weapon improvements. No matter what the rest of society may think, the US military must continue to invest in science and engineering to retain its current technological superiority.

As previously mentioned, climate change is expected to reduce food production. States that are currently self-sufficient, or produce a surplus, will be at an advantage. By contrast, states that depend on food imports to meet the shortfall between domestic production and domestic need will become more dependent than ever on international markets. As global population grows and international supplies likely decline as climate change reduces food stockpiles, the world is set for a collision between demand and supply. The situation for many food-importing states will only become graver.[12]

In geopolitics, altruism can never be expected or guaranteed, and this extends to food relief. The response of some food-exporting nations to the COVID-19 pandemic is illustrative of the likely response to a climate-induced food crisis. Kazakhstan opted to hold onto its wheat, while India, Thailand, and Vietnam curtailed the export of rice, if only temporarily. The United Nations is rightly worried about the effect such withdrawals from the international marketplace will have on prices and on the stability of already fragile states.[13] To retain their sovereignty, states will favor their own populations at the expense of those whose need may be greater. A US Army report concludes that "where climate change damages agricultural production, security concerns are likely to follow."[14]

Australia, for example, presently produces more than twice as many food calories as its population requires. In 2016, Australia exported approximately 65 percent of the calories its farmers and ranchers produced.[15] The United States, like Australia, has a calorie cushion, even though expected increases in temperature and aridity may cause agricultural yields to decline. Still, at least for now, Australians or Americans will not feel the

effect of a decline in food exports. The trade-off for food-exporting countries is lower earnings rather than starvation; food-importing countries are the ones that will suffer.[16]

Further affecting the ability of some people to buy food is the percentage of wages that food consumes. In some countries, the outlay for food is relatively trivial, averaging less than 10 percent of income; in other countries like Nigeria, food is so expensive that it consumes more than half the average wage.[17] According to the Global Food Security Index, the most food-secure countries are in the wealthy West while the most insecure are in the developing world, particularly Africa.[18] The fate of the US population, and residents of other wealthy countries, would seem more secure from a food perspective than for those who live in Egypt, Haiti, Pakistan, or any country where need exceeds domestic production.

As countries come under stress from climate change events, such as a prolonged drought or a series of extreme storms, countries that possess a cohesive society will probably fare better. Those divided by factions or partisanship will struggle to maintain cohesion as ethnic groups, political or religious groups, and partisan extremists look to other leaders rather than the national government. A fractured society may also descend into civil strife as people seek what they need from other groups within the country. In societies undergoing climate stress, the identification of scapegoats is a common response; targeted peoples might be witches and Jews as during the Little Ice Age or immigrants and refugees in the present climate crisis.[19] A country such as Afghanistan would be a likely candidate for internal strife because its weak central government lacks the undivided loyalty of the nation's people. Other countries, such as Iraq, Myanmar, Rwanda, and Indonesia have similar fault lines along which they can shatter into smaller political entities, a transformation that is unlikely to be peaceful as the successor entities struggle for control of land and resources.

In any crisis, strong leaders who are capable of bringing a society together are critical for success. When Britain turned to Winston Churchill in 1940, the country found a leader who could envisage the path to victory and harness the nation's resources to achieve that goal. Most importantly, the people of Britain, shocked by France's defeat and taunted by *Luftwaffe* bombs, rallied behind and believed in him. Many years of war followed, but having a visionary leader was the first step toward victory. All too often, however, strong leadership is lacking in a crisis, as demonstrated by humanity's failure to address climate change with sufficient urgency. Leaders like Churchill are admittedly rare, but they do appear. Perhaps one is among the youth who take to the streets to protest against inaction.[20]

For the US military, climate change obstacles that the government must overcome could pose challenges. In the Western Liberal tradition, the military is apolitical and subservient to the government's elected leadership. The US Defense community leads the world's militaries in analyzing climate change as a risk to national security as well as to the global community. This work has cited numerous reports and studies produced internally by the Department of Defense and contracted organizations. However, until clear direction from the political leadership prioritizes a response to climate change, the force's organization, equipment, and method of operations will be driven by other threats. The US military has done much to prepare for climate change, but nearly all efforts have been in the realm of facilities not operations. If climate change proves the global threat—even the existential threat—that is predicted, it will need to dominate consideration behind all Department of Defense preparations.

The militaries of other countries are doing far less than the United States. In Australia, for example, policymakers rarely speak about climate change, much less print comments about it. The Australian Defence Force's political masters have sent a clear message that thinking about climate change is not wanted or valued. Since one obligation of a senior officer is to provide a state's elected leadership with honest and forthright advice on threats to national sovereignty, at some point the Australian military may have to take the initiative and raise the subject.

As climate change progresses, all states will struggle to maintain their social contract. Those in the best position to do so are the ones that possess all or most of the survival factors outlined above. Most of humanity lives in countries with large populations that are poor, undereducated, undernourished, and divided by multiple loyalties or led by elites who are isolated from those they lead. For every Japan—a wealthy, well-educated, science and engineering-minded, and homogenous society—there are many more climate change-disadvantaged states such as South Sudan, Guatemala, Haiti, and Cambodia. Military leaders need to do what they can, both domestically and internationally, to maintain the social contract by supporting the structures that underpin the state. Western militaries working in conjunction with other levels of government will face a greater likelihood of international interventions—probably simultaneous ones—on stability operations or lengthy deployments to improve a weak state's infrastructure, governance, and climate adaptation abilities. While this is an optional tasking, subject to the appetite of one's government for interventions, avoiding such operations may contribute to unraveling countries on one's borders, with a consequent surge in barbarism and mass migration by those seeking

to escape a return to Hobbes's "state of nature." Few nations, even the most powerful, will be able to isolate themselves from a world swept by disorder.

The extinction of a society's social contract raises one further issue that is of great relevance to those who serve. In the Western tradition, militaries exist to protect their state's sovereignty on behalf of the people. The US military has extensive experience in working with fragile and failed states to maintain or rebuild their social contracts, albeit with mixed result. The United States, and other militaries, sometimes work within the United Nations system or else as part of a coalition of like-minded countries. Interventions in Haiti and Somalia, for example, saw US forces deployed to provide security and help reestablish social order.[21] In Iraq and Afghanistan, the military expended much blood and treasure to stabilize, secure, and improve the local government's capacity. Such missions are long, complex, and dangerous—and not always successful—but essential to avoid the less desirable outcome of ungoverned territories.[22]

The question remains, however: what does it mean for the military in the case of a total collapse if the state no longer exists and society reverts to a Hobbesian state of nature? From a technical point of view, the military would also not exist, at least not in a form that owed loyalty to the state that created it since that state would no longer exist. Bodies of troops might roam the land, but they would be best classified as brigands fighting for their own survival.

The military has a particularly acute stake in preserving its own state's social contract and assisting those of other states. This social contract gives the military its legitimacy; without it, soldiers are nothing more than marauders, freebooters, or mercenaries loyal to a warlord or simply to themselves. Those who serve in the armed forces do so out of a sense of duty to the state and the people they defend. Brigands fulfill their own needs; there is no duty or honor in the role, just barbarism and an acceptance that might makes right. To avoid this fate and remain a profession based on honor, service, and duty, the military needs to support survival of the social contract—including the social contracts that hold together other countries—to preserve social stability among regional neighbors. Intervening to support the ongoing survival of other states has benefit for one's own. Once the world begins to slide toward brigandism, it may not be possible to stop the decline; disorder breeds more disorder unless stability is reestablished.

Societal collapse is not a permanent state of affairs, but its duration will vary depending on local circumstances and leadership. The United States has twice witnessed the revocation of its social contract. On 4 July

1776 at the meeting of the Second Continental Congress in Philadelphia, the thirteen American colonies announced the termination of their relationship with Great Britain. The colonies declared their independence and the intent to form a new social contract that had the people, not a king, as its head. The American Revolution followed as Britain attempted to impose its will by force. The new nation won the struggle and its independence, assuring the survival of the new social contract. In 1861, the United States social contract was again challenged, this time by slave-owning states which seceded to form a different social contract that guaranteed the permanent existence of slavery. Four years of Civil War followed as the United States fought the rebels over whether slavery would continue. In this case, the seceding party lost. The social contract of other countries may not be as enduring as that of the United States. When their social contracts are broken, the Hobbesian state of nature may endure for some time.

International Inequity

Humanity will face grave peril if states do not come up with a serious plan to reduce greenhouse gas emissions, and implement it. The United Nations Climate Change Conference of the Parties (henceforth COP26) meeting in Glasgow in late 2021 was the international community's latest attempt to define such a plan. Depressingly, as the title suggests, it was the twenty-sixth attempt; the leaders of major emitter countries, such as China and Russia, did not even bother to attend while Australia attended but fought to weaken the language of the meeting's declaration. Some COP meetings offered hope, such as the twenty-first in Paris (2015), which produced a binding agreement to reduce emissions to a level that would hold the global warming increase to 1.5ºC. Others were less successful, such as COP15 in Copenhagen (2009), which ended in acrimony and failure. Since the 1992 establishment of the United Nations Framework Convention on Climate Change, there has been a misalignment between rhetoric and action by national leaders; scientists have identified crucial targets that exceed the will and capacity of politicians.[23]

Even apparent success can be fleeting if not followed by resolute action. As delegates gathered in Glasgow in late October 2021 for COP26, it was already well known that the emissions pathway following from existing pledges would see the temperature rise by at least 2.4ºC, a catastrophic outcome if it were to occur.[24] Even if all pledged reductions were met—by no means guaranteed, as it looks increasingly likely that most countries will not meet their pledges—this would still be insufficient to meet the Paris Agreement's 1.5ºC goal.[25]

The 2021 United Nations report on the status of emissions admitted that the world was not on track for success. In particular, the report highlighted that G20 nations failed to implement policies that would keep humanity within 1.5ºC degrees of warming.[26] In his conference greeting, United Nations Secretary General António Guterres summed up the situation facing the international delegates. He dismissed the suggestion that the climate situation was improving and described the impression of progress as an illusion. The true picture, according to Guterres, saw humanity on the brink of disaster, with further global heating pushing the world past the point of no return.[27]

The consequences of failing to meet the Paris Agreement emission targets will vary from country to country. This is also the case if by some miracle the international community succeeds in holding the temperature rise to just 1.5ºC. While climate change is a shared problem, not all countries face the same degree of risk. Geography, resource availability, societal development, and a host of other factors make some nations more likely to survive—figuratively speaking although in many cases also literally—and others less so, as climate change generates cascading threat multipliers. It may be grossly unfair, but countries most responsible for altering the atmosphere—those that industrialized first and have pumped greenhouse gases into the atmosphere for the longest period—are also better placed to manage a climate change crisis, while those less responsible—the world's poor states—are less able to manage it.[28] Joining the club of responsibility are China and India, now the world's first and fourth largest emitters; the US is second and the European Union (twenty-seven countries) is third.[29] The developed world is aware of the injustice in that those not responsible will bear the initial brunt of climate change. As compensation, wealthier countries have pledged billions of dollars to assist the world's poorer ones to adjust to the new environmental reality. The 2015 Paris Agreement recognized that the developed world has an obligation to support the developing world to make necessary risk mitigations; their contribution to the reduction in greenhouse gases is insignificant because they release proportionally so little.[30] The developed world, however, has been slow to deliver the required funds and most help has been in loans not grants.[31] By contrast, a 2018 estimate indicated the G20 nations subsidize their fossil fuel industries at $147 billion. This gift has continued to flow to oil, gas, and coal companies despite a 2009 G20 commitment to phase out such subsidies.[32]

Wealthy developed states dominate the more secure side of the Fragile State Index (FSI), whereas poorer, less-resilient states are at greatest risk of collapse. The FSI compares the ability of nearly 180 countries to successful-

ly manage a crisis. The index measures factors like a nation's level of corruption, ability to collect taxes, group-based inequality, brain drain, and demographic pressures. The FSI defines fragility as a state losing control over territory or the monopoly of violence, erosion of its authority, and the government's inability to provide public services and interact with other states as a full member of the international community. The index is managed by The Fund for Peace, which has produced an annual assessment since 2017.[33] The 2021 assessment observes: "Fragility is increasingly linked to climate change impacts and unprecedented environmental degradation."[34] One of the report's deductions is that climate change provides a number of common pathways that lead to the outbreak of war. These pathways include a population's loss of livelihood due to environmental degradation and extreme weather, the effect of food shortages on social tension, and rising pressure to migrate.[35] Climate change will cause a cascading effect on all of these pathways and thereby contribute to a people's decision to embrace intrastate and interstate violence. Confirming the FSI's prognosis, a University of Notre Dame analysis measured the ability of states to adapt to climate change. It, too, found that developing world countries have the least ability to adapt to climate change and therefore are at the greatest risk of collapse—the populations with the least culpability for climate change.[36]

While eliminating greenhouse gas emissions is an international problem, every nation also has to address local and regional issues that may determine the future of its people. Sea level rise means something different for the United States than it does for the Maldives, a low-lying island nation in the Indian Ocean, about 400 miles south of the Indian subcontinent. Its more than half a million people are scattered over 200 islands, nearly all of which will disappear due to sea level rise. One country risks a very serious loss of coastal infrastructure and the expense of moving residents and industry to higher ground, while the other faces extermination as a people; even if the people of the Maldives are able to migrate, their culture and sense of place will disappear, along with their future as a people. For the world's privileged, what is at stake is their beach houses, while the risk for the inhabitants of the world's island states is literally their lives, their history, and their future.

The developing world knows the threat they face is not of their own making. Kathy Jetnil-Kijiner, a poet and the climate envoy for the Republic of the Marshall Islands, spoke at COP26 in Glasgow about how her Central Pacific island country sits at only two meters above sea level. The Marshall Islanders possess no high ground, and sea level rise represents a threat to their nation's very existence. She commented on how emotionally draining

it was "to negotiate with countries you know aren't taking your survival into account."[37] The fate of the Marshall Islands has significance for the United States in more than a moral sense. The United States has a ballistic missile test facility there and will have to find a different site if the Marshall Islands disappear and expend monies that could be used elsewhere.[38]

Jetnil-Kijiner's words are poignant and frightening, particularly for those who live on an atoll. To date, her country and other similarly placed nations have sought a solution for their existential crisis through diplomatic means, but without much success. The United States is aware of the possible fate of such peoples; the Marshall Islands and other island nations appear on an official list of states whose people will likely have to migrate.[39]

For the developed world's militaries, the international inequality manifested through climate change holds several serious implications. The US military already supports agencies such as USAID, including humanitarian assistance, disaster relief, and disaster risk reduction programs. US and other military forces also conduct joint training exercises with allies and partners to enhance the interoperability and effectiveness of humanitarian and disaster relief missions. Such efforts will no doubt continue, and probably gain in prominence as the militaries of the developed world help to hold together weaker states that are struggling with climate change.[40]

At what point will climate change inequity motivate a state or states or to abandon fruitless diplomacy and take violent action instead? How much longer will a person born in the developing world remain content that his or her life will be shorter and less pleasant than for others in wealthier parts of the world? This inequity, which climate change will exacerbate considerably, is bound to affect the way people view the world and their place in it. While the unhappiness of such people has been contained for many years, their situation is "not a recipe for domestic or international harmony, especially if they are young."[41]

Of course, there is little chance that the Marshall Islands will invade the United States, European Union, United Kingdom, Australia, or any other state that bears responsibility for climate change, but the weak do have the means to inflict hurt, both physical and reputational, on the strong. Already facing the end of its society and culture, a weak state with nothing to lose might consider such action. What this means is that international inequity holds national security implications for the wealthy world, not just the poor world. The military will, therefore, need to include planning and training scenarios for an attack from a minor state rather than just a major war against a peer rival. Such attacks may take the form of terror-

ism, which is discussed further in the next chapter—people with no hope simply taking revenge against those who have ended their future.

Mass Migration

Climate change is widely expected to trigger mass migration of people whose homelands are no longer able to provide for their needs.[42] The US Department of Defense expects "as temperatures rise and more extreme effects manifest, there is a growing risk of conflict over water and migration."[43] The number of people displaced by climate change is likely to be substantial; for example, 10 percent of Bangladesh's 164 million people live in coastal areas that are vulnerable to sea level rise and saltwater intrusion.[44] Climate change-induced stressors are expected to generate instability within vulnerable states, leading to partial or total societal collapse and government inability to provide goods and services, particularly food.

In the distant past, humans affected by a shortage of essential resources would move—a simple survival strategy. Up until about 400 BC, migration was not too difficult because unoccupied land was widely available. From about 400 BC on, this was no longer the case; except for isolated islands that were populated later, such as New Zealand, the globe was settled. If a people decided to abandon their lands and resettle elsewhere, they had to take someone else's territory, often by force.[45] The settlement of the Americas, for example, was not peaceful. Rather, it required European settlers to displace a long-established indigenous population, usually by violence. The same settlement pattern played out during the European occupation of Canada, South Africa, and Australia.

Scholars identify two sets of factors that cause a people to choose migration: "push" or "pull." Push factors are those that originate in a people's homeland, including resource shortage, land degradation, increasing aridity, rising sea levels, extreme weather events, or a government that is no longer able to provide desired services including safety—all problems that climate change will exacerbate. Many countries may not be able to support their present population levels for the foreseeable future as their environments change through desertification, salinity increase, or loss of topsoil. Climate change means that for many parts of the world, not just island states under threat from inundation, there will be no going back.[46] Pull factors make a destination suitably attractive for migrants, such as resources or a need for migrants. Importantly, the destination just needs to offer a better chance of life than the place the migrants are leaving. There are three possible outcomes for climate migrants: a destination country or region will give them a refuge; the migrating population will take a refuge

by force; or the climate migrants will perish like the Greenland Norse who remained in place until it was too late.[47]

The context of the decision will be different for every society considering migration. Different situations make outcomes impossible to predict with any degree of accuracy, and the decision-making process is a social one—subject to interaction with a suite of inputs, both rational and irrational. Modifications will also need to be made as the situation changes.[48] Essentially, as climate change reduces resource availability and makes survival harder, more people will likely find themselves having to make a choice. The destination location will also need to make a choice, namely whether to welcome or resist the newcomer. In the 1980s, for example, Bangladeshi peasants fleeing either floods or droughts, depending on the year, encountered violence when they entered India. Even internal Bangladeshi migrants were unwelcome as they sought land in other regions of their own country. Today, a fence demarcates the border between India and Bangladesh. At the other end of the spectrum, Dust Bowl migrants from the American Great Plains were generally accepted at their destinations, although some Californians advocated to close the border and the migrants faced beatings and discrimination. Of thirty-eight twentieth-century migrations prompted by environmental factors, nineteen resulted in violence.[49]

To manage migration crises, the international community has well-established mechanisms supported by international laws and agreements on how to control the movement of people. The United Nations High Commissioner for Refugees (UNHCR) has considerable experience assisting refugees fleeing their homes and providing for their ongoing care, resettlement, or return. As of mid-2019, there were nearly 71 million displaced people globally, mainly from Africa, South Asia, and the Middle East.[50] This includes those displaced within their own countries. However, those fleeing ecological disaster do not meet the existing definition of a refugee, defined as someone fleeing state-led persecution who cannot remain in or return to their home without risk to their life. A refugee must be fleeing the actions of another person, group, or government, not the actions of nature. For example, the Rohingya minority fled Myanmar in 2017 because of the systemic violence perpetrated against them by the majority Burmese population.[51] If the Rohingya had fled a cyclone, they would not have qualified as a refugee. At present, there is no agreed mandate for the treatment of climate refugees, nor is the international community eager to establish one.[52]

Distressingly, 71 million is a huge number but trivial in comparison to the number of refugees that climate change is likely to generate. One

trend of the last century was the increasing percentage of people living in the urban littoral. According to global insurance company Allianz, seventeen of the world's twenty largest megacities are situated on a coast.[53] In coming years, cities such as Bangkok, Dhaka, Calcutta, Shanghai, and Cairo are expected to experience severe inundations that will make much of their urban space uninhabitable. Jakarta may be underwater by 2030, and the Indonesian government has already decided to move the capital from there to Kalimantan. Increased salinity in rivers is expected to reduce food production in major grain-growing regions such as the Nile and Mekong deltas.[54]

Rising sea level is not just a problem for poor countries. Miami Beach was built on sand dredged from the adjacent bay, and its streets flood with increasing regularity. In coastal Alaska, the residents of several villages have already had to relocate or abandon their homes. Moving a single Alaskan village cost an estimated $400 million, or $1 million per resident.[55] The price to save everyone's property will be astronomical, and insurance companies are showing a determined reluctance to foot the bill. Coastal residents across the world will need to relocate and, barring expensive government intervention, write off their homes as an unsalvageable loss.[56]

Too much water is a problem, but so is too little, particularly when paired with too much heat. Some researchers expect an exodus from the Middle East and North and sub-Saharan Africa due to rising temperatures and declining rainfall. A study on Eastern Mediterranean climate trends suggests a change in the seasons is underway. The rainy season is expected to shorten by 56 percent, while the hot dry season is expected to lengthen by 25 percent. The result of such changes will be a decrease in the availability of water for a region experiencing high population growth and a decline in agricultural productivity. As one scholar notes, "Countries will face collapse as water problems become unmanageable," and climate change will push already weak states "deeper into the abyss."[57] As a consequence, much of the Middle East is predicted to become unliveable in the near future.[58]

It is not only humans who are migrating. Because of rising temperatures, animals and plants move as the ecological ranges to which they are adapted shift. According to the National Geographic Society, more than half of all species are on the move.[59] The authors of a recent *Science* article assert that climate change is responsible for the largest redistribution of species since the last ice age, and will produce winners and losers—radically reshaping the pattern of human well-being.[60] As the planet warms, many species will have to migrate toward the poles. Others will move

uphill, seeking the coolness of higher altitudes. Those that cannot move fast enough or that run out of mountaintop will likely die, particularly those that have evolved to occupy a narrow or unique ecological niche such as the monarch butterfly in North America and the bogong moth in Australia.[61] Animals that evolved to feed on these insects will also suffer. The domesticated plants and animals that humanity depends on are not exempt from the effects of climate change. Livestock are expected to suffer greater heat stress, water shortages, and exposure to new diseases, which will result in less meat per carcass, whereas wine producers are looking at reestablishing their temperature-sensitive vines on cooler ground or switching to more heat-tolerant varieties. Northern England is once again a wine producer.[62]

For humans, the loss of so many species should generate more serious concern because of the second-order threat to human security. Those familiar with the expression the "canary in the coal mine" should understand what such species loss represents: "The planet is exhibiting the weakest ecological condition since industrialization began."[63]

As explained earlier, a poorer Earth System will make it harder and more expensive for humanity to generate the resources that people need. The military will suffer because in a less wealthy society, other priorities will claim a larger share of national wealth. The implication for most militaries is that they will need to do more with less, while also confronting the possibility of higher operational tempo in the face of mass migration and other climate change-induced events. The age of militaries acquiring exquisite systems that can perform a limited range of tasks extremely well could be at an end; cheaper, more generalist weapons may be the future. A strong society cannot be built on a sick environment, nor can a powerful military.[64]

Civilianization of War

In Western-style democracies, the waging of war and the acceptance of its risks have become the remit of the professional soldier. Civilians have become exempt from battle and its hazards. Even the monetary cost of war is no longer borne by civilians in any identifiable way; taxes have not risen in the United States as a result of the twenty-year war in Afghanistan. This has not always been the case, and those who enjoy this fortunate circumstance today may not recognize that it is an anomaly. Many less fortunate civilians elsewhere in the world remain the target of war, even the target of attack from Western democracies. There is no shortage of revelers who have died from a mistakenly targeted US drone strike,

or whose lives ended as a result of being at the wrong place at the wrong time—"collateral damage" to use the military expression. Since 9/11, conflicts in Afghanistan, Iraq, Syria, and Yemen have resulted in the death of more than 340,000 civilians from direct war violence alone. In these countries, and many others, civilians certainly know first-hand the hard hand of war, even if Western civilians have largely forgotten it.[65]

Western civilians have not faced the hazards of war, because wars have largely been waged in distant places or managed within the abilities of the professional force, the occasional act of terrorism being the exception. Among wealthy states, perhaps the only civilians with a good understanding of what war means are those living in Israel. Climate change will likely change this, and those who live in the West should again expect to personally witness or experience war.

The wars that climate change spawns will be ones of national survival. Civilians will not be able to avoid exposure because keeping war at a distance may no longer be possible. The world's poor and desperate may not be willing to submit to climate change disruptions when they have contributed so little to its cause. They may not be willing to continue to accept the inequity of climate change. Violence could take many forms, ranging from terrorism to cyber strikes to conventional attacks to the mass migration of mobs of men, women, and children—armed and unarmed. As technological barriers to the manufacture and operation of advanced weapons declines, more states and non-state actors will have access to arsenals such as bio-weapons that were once only available to rich countries. Drones have become ubiquitous in the skies above American cities and elsewhere throughout the Western world. Such devices, as well as driverless delivery vehicles, could carry a pizza, your prescription, or a bomb.

Constant conflict will also see professional militaries stretched, and more troops needed to manage a greater number of missions. This may be a challenge for societies where a professional military is now the norm and those who serve are drawn from a narrow demographic band. Whether this will lead to the conscription of young men and women will be a decision for each society to make.

The civilianization of war may also pose a moral dilemma for those who serve in militaries that adhere to Western ethical principles and rules. The codification of rules of war through numerous conventions has helped limit the cost and destruction of waging war, particularly to minimize collateral damage inflicted on civilians. The United States, for example, has fielded ordnance designed to kill with greater precision and more speci-

ficity. This includes the Rx9 Hellfire missile variant, known as the "ninja bomb" because it kills with sword-like blades rather than explosives.[66] Soldiers are trained in ethics and must follow strict rules of engagement. The enemy is defined as an armed opponent committing or planning a hostile act. The deliberate bombing of cities such as during World War II strategic bombing campaigns is now prohibited. In a war generated or exacerbated by climate change, however, the enemy may be a mass of civilians, some of whom are armed and many who are not. Under current rules, will they pose a threat that allows them to be targeted? The only answer at present is "possibly." This potential situation underscores the need for contemporary military personnel to reflect deeply on the moral position of their organization, as must their parent society, so that they are prepared to act when the time comes.

The End of Privilege

Society's elites depend on money to secure their station. They feel safe because the government provides disincentives to criminality and other threats. Yet many members of this class are questioning whether the security they currently enjoy will endure. Some of the world's wealthy are taking steps to privatize their security in case the government becomes unable or unwilling to safeguard them to the degree that they demand and expect. They are establishing commercially based social contracts that sit outside the national ones, and which are limited to themselves, their families, and like-minded associates. In the United States, for example, wealthy individuals are buying refuges for themselves and their families in out-of-the-way locations—keeping them well-stocked, well-armed, and protected by private security guards.[67]

Privatization of services means that similar arrangements are extending to other areas of the government's normal responsibilities. When wildfires struck California in 2018, some homeowners contracted with private firefighting companies to protect their property. These individuals bought protection that they believed the government would be unable to provide. In the aftermath of Hurricane Katrina, contractor security guards arrived to secure the homes of rich New Orleans residents who were boarding helicopters to escape the flooded city. Countries that the rich perceive to be safe, such as New Zealand, have become attractive sanctuaries for those with money and private jets. For anyone seeking to put even more distance between themselves and trouble, there is always space; the new nation of Asgardia plans to build an ark in the heavens.[68]

The COVID-19 pandemic provides a glimpse into how the wealthy might react to a climate-induced crisis. As governments locked down cities to contain the virus, some elites bolted for the exit—heading to second homes in vacation locales or even to their yachts. These individuals calculated that the countryside or the sea were safer places to ride out the pandemic than cities, which throughout history have been incubators of pestilence. In fleeing, they also demonstrated a prioritization of the individual over the collective, a cavalier attitude toward the state's social contract.

The arrival of the wealthy at their holiday homes was not always welcomed by those who lived in these places year-round. Permanent residents feared the new arrivals might be COVID-19 carriers and would put a strain on medical services and food supplies. In 2020, tensions and resentment were on the rise amongst the rural and resort populations who had to cope with the extra demands of the privileged. Although no significant violence occurred, the reaction of the less fortunate suggests that resistance might be greater in a larger climate change-induced crisis. The reaction of the wealthy has been worldwide, with rich Parisians, New Yorkers, and Muscovites seeking to escape the city and locals resenting them for doing so.[69]

While these actions by the rich may be morally suspect, there is some accuracy in their thinking. The government's protection will exist only as long as the Leviathan is able or willing to impose order on those who would create disorder. Anarchy can be a great leveler, and the totems of wealth may have little meaning in a world with acute shortages of necessary resources and an absence of government control. Great wealth and position, after all, did nothing to save French nobles from the guillotine after revolution broke out in 1789.

Although private security guards have existed for some time—and commercial fire companies predated government or community organizations—we are just at the beginning of a trend that sees the wealthy seeking privatized methods of securing personal security and property.[70] As of 2017, the number of private security workers exceeded those on the public payroll in more than forty countries, including the United States, Australia, China, and the United Kingdom. To give this a financial perspective, the industry is worth an estimated $240 billion, more than the total of the world's international aid budgets. Of course, many of these are "mall cops," security guards who patrol a privately owned but public access space. However, there is no shortage of heavily armed private guards who protect walled compounds cut off from the outside world.[71]

Resorting to private security holds implications for the military, all of them negative:

> Once security ceases to be guaranteed to all citizens by a sovereign state, it tends to become a commodity, which like any other commodity, is distributed by market forces rather than according to need. . . . This disparity between rich and poor will tend to propel society toward a fortified, segregated society and the demise of any residual civic ideal.[72]

Police are a state's first line of defense against the private use of violence. The state can call on its military to support the police, as the United States did when a mob invaded the Capitol Building on 6 January 2021.[73]

The leap from treating private security guards as a commodity to enhancing the perception of one's security by hiring a mercenary military force is not a large one, particularly in a more disruptive age of increasing tension caused by climate change pressure. If the rich perceive that weak, unstable states cannot provide for their security, they will seek to provide their own. Strategist and former soldier Sean McFate commented in *The New Rules of War* that he expects mercenaries to increase in number and capability in coming years and that the future will include wars fought where only one, or neither, combatant is a state. For the uniformed military, the question is whether mercenaries—contractors in Department of Defense parlance—during future wars will be employees, competitors, or both.[74] By investing in private security and creating sanctuaries, the rich are seeking "apocalypse insurance." They may even usurp the exclusive right of the state to violence.

While the privatization of security poses a threat to the Western military tradition, elites are pursuing a high-risk strategy. Most of their expenditure will be money poorly spent; while the reaction of the rich is understandable, it also shows an ignorance of how such events have played out in the past. The daily lives of the rich depend on an infrastructure that provides services ensuring not only comfort but also survival, services which are taken for granted today. If these systems cease to function, the rich will be helpless because they lack practical skills and, as in the past, the mob generally wins when society collapses.[75] The role of the military in such a situation is limited. A traditional task undertaken by the military is aid to the community. In this situation, one must ask which community, as it may not be possible to protect both the privileged and the rest. The military may find itself in the difficult position of having to choose, and this will be a moral choice as well as a practical one. Moreover, if a com-

munity no longer exists because the social contract has come to an end, the military is no longer obligated to help. Therefore, the military's actual role is preventative, to help society withstand the forces of disruption and disintegration and to sustain a civil government. When the government ceases, the military—as those who serve today know it—ceases, too.

Surviving in an Urban Trap

One of the major demographic trends of our age has been the movement of people from rural areas to cities. There was a time when cities were quite rare, and the ones that did exist were generally small. Today, the majority of people live in cities, and the number of megacities—those with more than 10 million inhabitants—is growing. At present, there are thirty-three megacities with an additional ten predicted by 2030. In 2018, there were 467 cities with a population between one and five million. By 2030, there will be 597 with many more not far behind. By 2030, the United Nations estimates that only 40 percent of humanity will live in rural areas. This is a global phenomenon, although urban population is growing fastest in Asia and Africa.[76]

Cities were once quite rare because they could not supply themselves. Because of low agricultural yields, it took an empire-sized hinterland to keep the citizens of ancient Rome, Istanbul, or Beijing fed and content. Until industrialization, the agricultural surplus was so slight that most of the population had to be farmers; the caloric needs of non-farmers could not be met otherwise. Today's cities draw on modern agricultural techniques across a worldwide hinterland and a global transport and distribution network to meet the daily requirements of their residents.

Climate change will make this arrangement more precarious. Maximizing human food production necessitates farmers engaging with the Earth System. In the Anthropocene, this integration will become much harder as the Earth System no longer supports long-established human practice. Climate change's role as a threat multiplier will also increase potential instability, which will affect the efficiency with which the human system transports, stores, and distributes food and other essential resources that cities need. Russia's 2010 embargo on grain exports, in response to a drought-reduced harvest, caused chaos across North Africa and the Middle East—chaos that was a small harbinger of what is to come.[77]

Cities compound other threats too. Temperatures tend to be hotter in cities because of the urban heat island effect, which means with climate change they will rise even more than in surrounding rural areas. Densely

populated areas also attract disease vectors, particularly in poor countries that cannot keep up with their growing population's need for clean water, waste disposal, and medical support. Already around a quarter of urban dwellers live in slums that provide few if any public services.[78]

Cities are also magnets for the dispossessed. Prior to the Syrian Crisis, tens of thousands of farmers abandoned their land and headed for cities. From 2006 to 2011, Syria experienced a harsh drought that resulted in widespread crop failure. Herders suffered, too, losing an estimated 85 percent of their stock. No longer able to make a living on the land, they crowded into the nation's cities, adding fuel to Syria's eventual unraveling.[79]

In our globalized world, the efficient operation of numerous interconnected systems is essential for society to maintain its current level of complexity. Each part of a complex system depends on the proper functioning of the other components. Worryingly, a failure in one part can cause instability across the system as a whole.[80] The United States received a small taste of system failure in the 2021 supply chain disruptions that affected the country as a consequence of the COVID-19 pandemic. To operate at maximum capacity, the global supply system requires the movement of raw materials and finished goods around the world with precision and predictability. Precision and predictability were both lost in the pandemic, causing greatly increased shipping costs, massive congestion at transfer points, and huge delays in the delivery of materials and products. The supply chain needs every link to operate effectively if the system is to restore efficiency, but as of late 2021, every link was performing in a disrupted condition.[81] The threat of disappointed Christmas shoppers made the supply chain into a political problem for the Biden Administration. In mid-October 2021, the White House announced a plan to ease the bottleneck at California ports, including moving to a 24-hour-a-day seven-day-a-week operation schedule.[82]

Urban residents are completely dependent on the supply chain to meet their needs. The current supply chain crisis has meant higher prices for some goods and consumer disappointment about the unavailability of others. However, if the situation worsened and serious food shortages resulted, how would a state feed millions of urban residents? No doubt, the military would be called to assist. The US military has terminal units that can operate ports, and truck units that can haul goods, but the numbers available are trivial compared to the needs of a large metropolis such as New York or Chicago.

For the military, combat in a city is often a painful and brutal mission. Stalingrad may be a distant memory but the Battle for Marawi was waged

only five years ago, and the struggles for Fallujah and Grozny demonstrate that epic street-to-street fights can still occur and that firepower continues to serve a purpose. Like their predecessors, today's soldiers and those of the near future may not be able to avoid operating in urban areas. Consequently, they will need doctrine, training, and specialized weapons to fight in a constricted three-dimensional terrain that also contains large numbers of noncombatants. They will also need to know how to run a city until a local government can function.

Urban warfare is unavoidable in part because this is where most people live; more importantly, government is located and bureaucrats live in cities. To help maintain civil order, the military must be ready to operate in cities and to manage them. Soldiers will also need to provide for the civilian population when the fighting stops, at least until the civil government resumes. However, cities can become traps for residents. In cases of social disorder or the breaching of the social contract, the fate for those living in a city will range from the unpleasant to the fatal. Nor is escaping to rural areas a viable option for most, as few urban dwellers possess the knowledge to grow and process food, build shelter, or source water.

Archaeologists, it should be noted, continue to unearth the remains of cities that once controlled empires but which could not survive instability brought on by crisis.

Conclusion

In the Western tradition, the military who serve are members of the society they protect. Therefore, the societal disruptions that climate change will encourage are as relevant to the military as they are for the rest of society. These disruptions have the potential to create additional calls on the military for their support, both domestically and internationally. Therefore, the military must understand the broadest possible definition of climate change-driven disruption so they can prepare properly for a host of new or additional contingencies. What may prove the bigger challenge is the frequency and intensity of the disruptions. In a world warmer by a global average of 1.5º C, the minimum likely increase in temperature based on international action, the coming challenge for the military will be to prevent exhausting personnel and equipment on tasks other than warfighting and, hence, not core business.

The next chapter examines climate change disruptions that will create challenges for the military's core business, which is to apply violence on behalf of the state.

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Chapter 5
Military-Focused Disruptions of Climate Change

As the previous chapter demonstrated, climate change will directly disrupt aspects of a state's security environment and place a society's organization at risk. Since a military is a part of its parent society, the disruptions will apply to the military, too. This chapter will discuss climate change-induced disruptions that are directly applicable to how a military thinks about and prepares for war, as well as how it operates.

For soldiers and other military personnel, the onset of the Anthropocene will require a rethink on nearly everything they do. Since the environmental foundation on which civilization is built is changing, it should come as no surprise that a disruption of such magnitude will require adjustments in all aspects of society, the military included. The military will need to appropriately realign its capabilities with the new environment to ensure continued advantage over potential rivals. The extent of the required changes will vary with a military's particular circumstances and the desires of its government. However, no military will be able to avoid rethinking its art of war, if it is to remain capable into the future.

Climate-Inspired Terrorism[1]

When individuals or groups perceive that the government is not listening to their needs, they may take steps to be heard. Such actions may include participation in party politics, organized lobbying, social media interaction, peaceful protest, subversive activities, violent activism, and finally terrorism. There is rationality to this progression; terrorism is one of the oldest forms of warfare. The acts of violence that the Romans experienced in Judea at the hands of the Sicarii would be recognized as terrorism to anyone today. The Sicarii were a Zionist group, perhaps the world's first terrorist organization, who sought to expel their Roman occupiers from Jerusalem. In the decades before AD 70, the Sicarii carried out assassinations and kidnappings with the goal of inciting a Jewish uprising against the Romans. They succeeded in generating a rebellion; unfortunately for the Sicarii, Rome crushed them. The Sicarii movement came to an end in AD 73. As the Romans prepared to storm their fortress at Masada, the remaining Sicarii committed mass suicide.[2]

Terrorism, for which there is no universal definition, could be considered a politically inspired act that deliberately targets civilians with violence or threat of violence. Its goal is often to provoke the government into a disproportionate response that further inflames the people. It is a

tactic of groups that lack the strength to directly confront the government. Those who pursue terrorism seek political change.[3] As was the case with al-Qaeda actions, terrorist attacks can be transnational and target a government (or governments) other than their own. In a globalized interconnected world, national boundaries do not represent the impediment to action that they once did.

While environmental protest and activism are widespread across the wealthy West, ecoterrorism is not a major movement at present, unlike other forms of terrorism such as those inspired by religious fundamentalists of various stripes. Ecoterrorism attacks are not unknown in the United States, however. In 1998, the Earth Liberation Front claimed responsibility for burning down a ski resort and various other structures; additionally, the Animal Liberation Front, although not strictly an ecological movement, released farmed minks destined for the fashion industry.[4] Both were US-based groups. The US Federal Bureau of Investigation even designated the Earth Liberation Front as one of the country's top domestic terror threats.

Still, if humanity does not act more quickly and with greater resolve on climate change, ecoterrorism likely will become a much greater threat than it has been to date. There is growing and what some view as understandable anger within certain parts of the community. This is particularly true among the young, who see themselves as powerless and dispossessed of their future by those unwilling to act decisively against climate change.[5] Even before the Glasgow COP26 meeting ended, a crowd consisting largely of young people packed the city center to protest the absence of a tangible or sufficiently ambitious outcome. The protestors accused the world's political leaders of continuing to allow the exploitation of people and nature, indicating that their only accomplishment was more "blah, blah, blah."[6] This is not to suggest that the protest was anything more than a peaceful gathering of people concerned with their future and the future of their children. Still, it was a very large gathering and could easily have included some individuals who were ready for eco-radicalization.

For the West, there are two potential sources of climate change-inspired terrorism: locally grown individuals and groups, and movements from outside the West that conduct attacks on any territories or representations of wealthy countries or wealthy people. Internal radicalization represents those who no longer accept what they perceive as their government's slow progress on climate change; they see the inaction as life-threatening to themselves, their families, and their community. If not successful at changing government policy through peaceful means, they may eventually channel their activism into other forms. A recent psycho-

logical study of 10,000 young people from countries including the United States, Australia, India, and Nigeria found increased levels of anxiety with perceived inadequate action by adults and the government to address climate change. Nearly 60 percent of respondents were very or extremely worried about climate change and 84 percent were at least moderately worried. More than half the survey's participants reported they felt sad, angry, powerless, helpless, and/or guilty. Nearly half reported their feelings about climate change negatively affected their lives. Those respondents from the developing world showed the greatest negative effect on personal functioning. The respondents also rated government action on climate change in negative terms and indicated they were being betrayed by their political and societal leaders. The researchers' conclusions dealt with an increased potential for psychological distress and moral injury, potentially opening the door for violent radicalization of some youth.[7]

A 2021 incident in Australia illustrates how a peaceful protest might transition to terrorism. Australia is a major coal producer, and the City of Newcastle is the country's largest port for its export. Two young protesters gained entry to the port, climbed a coal-handling machine and suspended themselves from it high above the ground. The protestors from the group Blockade Australia brought loading operations to a halt. Another protestor chained herself to the rail line that brought coal to the port. The protestors filmed their actions and posted the video online. This protest was peaceful; no people were harmed or infrastructure damaged. The situation, however, could have escalated to ecoterrorism. In the face of increasingly urgent calls to transition away from coal due to its high emissions, the Australian Prime Minister has countered that the coal industry will be operating in the country for "decades to come."[8] The government's loyalty to the coal industry and its lack of urgency to transition away from burning the mineral is increasingly spurring protestors to act. One of the protestors stated, "This is us responding to the climate crisis. This is humans trying to survive. . . . We are trying to induce the social tipping points, which will give us a chance at another generation."[9] As an indication of official priorities, a local police official described the protest as "nothing short of economic vandalism."[10] What occurred in Newcastle was political protest in the face of government refusal to address the fear that current policy will take away young people's future. There is still some way to go before the line between legitimate protest and terrorism is breached, but as tensions escalate, it is not a matter of if but when.

International climate change terrorist movements are likely to target the West out of a sense of victimhood and anger, in addition to trying to

influence policy changes to address needs such as decarbonization of the global economy and greater international willingness to assist mitigation. As the people of poorer nations are not responsible for climate change, it is probably too much to expect that all of them will be content with their fate and not want to strike back at those responsible.[11]

Since the goal of terrorism is to effect political change, it is an act of war, or of civil war if undertaken by domestic perpetrators. The US military and its Coalition partners have much experience in fighting terrorists in the long wars in Afghanistan, Iraq, and elsewhere. As ecoterrorism grows, the military should expect to be on the front line of their nation's defense. While police and intelligence agencies may manage the domestic aspects of ecoterrorism, it is likely that local law enforcement agencies will require military backup. As is the case with some other Western militaries, the US military currently does not have the statutory authority to apply violence against the domestic population. Normally, the use of force against domestic terrorism is a policing function. If ecoterrorism becomes a major threat, it may be necessary to revisit legal authorities that govern the use of the armed services for domestic security tasks.[12]

Prohibitions against the domestic use of force by the military are based on statute and tradition, and a government can change them. This already happened in Australia. Following a 2018 terrorist attack in Sydney, the federal government amended the Defence Act in order to authorize the use of the military in response to domestic violence when requested by the state government. Unlike the United States, Australia does not have a national guard, so the amended law provides the states with military backup if a domestic terrorist attack exceeds the capacity of local police forces.

Despite prohibitions, there is precedent for using military force on American streets. Various governments have called out troops to suppress riots, assist at civil rights desegregation protests, and contain Vietnam War protests. Usually, National Guard troops undertake such intercessions in their state soldier capacity, but this is not always the case. In 1992, President George W. Bush mobilized 4,000 federal troops under the Insurrection Act and sent them to Los Angeles to help quell the Rodney King riots.[13] Pitched battles between protestors and military troops have been fought. In 1787, the Commonwealth of Massachusetts enrolled 4,400 volunteers to put down Shay's Rebellion. In a January 24–25 battle at Springfield Arsenal, Massachusetts volunteers overwhelmed 1,500 rebels, breaking the back of the uprising. A similar situation happened in Australia at Eureka Stockade in 1854. Miners at the Ballarat Goldfields, objecting to the government's regulation of mining fees, and their cost, built a crude forti-

fication called the Eureka Stockade. Flying their own flag, the rebels were subdued by elements drawn from two infantry regiments. Five soldiers and twenty to thirty miners died.[14] In the United States and Australia, both federal and state troops have been called out during industrial actions, either to break a strike or to serve as replacement labor for essential tasks.[15]

Ecoterrorists are likely to target entities they feel are most responsible for greenhouse gas emissions or individuals/organizations that have failed to act on the climate threat. Although everyone is at fault—particularly residents of wealthy countries with habits of conspicuous consumption—and therefore possible targets, terrorists tend to strike at symbols so they can garner the greatest visibility for their actions. This is one reason why Osama bin Laden chose to destroy the highly recognizable World Trade Towers in New York City. Ecoterrorists may target major emitting industries through attacks on smelters, coal mines, power plants, or oil infrastructure, as well as banks, insurance companies, and investment funds that finance their operations. Other targets might include places where large numbers of Westerners gather, such as cruise ships, resorts, theme parks, or sport stadiums. Chief executive officers of offending companies, other business leaders, financiers, and politicians—and their families—may find their names on assassination or kidnapping lists.

There will be no shortage of targets, personal and structural, and the military should expect to help protect communities by tasking soldiers to guard vulnerable sites. In the United States, the National Guard already assists in the community. However, with the broader ecoterrorism threat, a federal response will also prove necessary in a large country such as the United States, if only at the coordination level. Moreover, in the aftermath of a major terrorist attack, federal troops may be called out to protect key infrastructure and facilities. Not all nations have a national guard with which to assist the community in times of need.

Military leaders must recognize that countering terrorists or assisting law enforcement could consume the entire force because of the need to protect so many critical infrastructure sites, twenty-four hours a day, year-round. It may become necessary to distinguish between critical, somewhat less critical, and unimportant facilities to ensure the security of sites where failure could cause severe damage, if not chaos. Trade-offs will need to be made, such as protecting drinking water reservoirs or power grid connectors while a crowded sports stadium receives lower priority. Because the military is such a large emitter of greenhouse gases, and has many facilities in all parts of the country, it may also be vulnerable to terrorist attack.

Additionally, the military may be called on to protect national company assets in overseas locations.

The overwhelming number of sites requiring protection may also prompt an increase in the use of private paramilitary forces. This unwelcome escalation of something that is already widely practiced would threaten the state's monopoly on the right to employ violence.[16] Private armies potentially could threaten society's stability and the military's primacy as the guarantor of sovereignty, as Niccolò Machiavelli warned in *The Prince*.[17]

For the military, the possibility of ecoterrorism presents additional profound issues that are enormously relevant to those who serve and which require exploration, no matter the degree of discomfort the exercise may occasion. The first issue is terrorists in uniform. On 5 November 2009, Maj. Nidal Hasan went on a shooting spree at Fort Hood, Texas, that left thirteen people dead and more than thirty injured. Subsequent investigation suggested that Hasan had been radicalized by al-Qaeda.[18] A 2011 Congressional report revealed that authorities disrupted five insider terrorism-related activities in the past decade, and eleven involving veterans.[19] Religious fundamentalism is not the only cause for concern for military leaders. In recent years, white supremacist behavior in the ranks has been increasing. The US Department of Justice recently charged a soldier under terrorism laws after he planned a mass attack on his unit.[20] There is growing evidence that far-right groups and other hate organizations, such as the *RapeWaffen* Division, have deliberately attempted to recruit military personnel to take advantage of their weapon skills.[21] The Australian Army has warned its ranks that anyone displaying a white supremacist symbol will be dismissed from the force.[22] The US and other militaries are well aware of the danger of radical Islamists and white supremacists within their ranks. Ecoterrorism, by contrast, is not yet on the horizon. As climate change worsens, it will likely become a future radicalization risk which the military should prepare to counter.

For the military, the danger posed by insider terrorists is more than just the potential carnage. Insider attacks threaten trust, a core value of all who serve, and cohesion, which is a critical requirement for combat capability. At every level, soldiers are members of teams whose lives depend on each other. Those who become radicalized by ecoterrorism will fracture or corrupt the team, resulting in loss of trust, cohesion, and, ultimately, capability. Again, white supremacy suggests a path forward for the corruption of the military. In 2020, the German Army disbanded a Special Forces company whose culture had become imbued with white supremacist beliefs.[23]

If environmental protest morphs into ecoterrorism, it may find a ready home in the military community because of a military's sense of duty to the state and citizens. If a community is under threat, and climate change does indeed pose a threat, some within the ranks may embrace ecoterrorism. They will see radicalization as aligning with their core responsibility as the people's protectors. Though arguably misguided, such a conclusion would appear legitimate from the individual point of view.

The second deeper issue on which climate change will require reflection is even more challenging. There is a widely stated cliché that "one man's terrorist is another man's freedom fighter."[24] This statement has a kernel of truth at its core. Terror, like other forms of war, involves two opposing parties with differing interests, views, and objectives. When British regulars marched out of Boston for Concord in 1775, the Minutemen who opposed them were later lionized in the history of the United States; the regular soldiers they shot at would have held a different opinion. Moreover, terrorism has not always had the negative connotation it does today. When Maximilien Robespierre initiated the terror phase of the French Revolution, the violence was initially associated with fostering virtue and justice.[25] Similarly in 1922, Air Marshall Hugh Trenchard of the Royal Air Force emphasized the psychological value of strategic bombing against civilian populations. He saw terror bombing as a means to shorten war and insisted that the enemy "would probably squeal before we did."[26]

If the government fails to provide for the security of its citizens, does that failure abrogate the social contract between the state and the people? This is a critical question that may gain significance if governments continue to avoid addressing climate change with the necessary ambition and urgency. Some members of society likely will make a case that they must take drastic action, individually or in groups, because failure to act will threaten their future and that of their children. At some point, protest and activism may not be enough for some; embracing terror is a rational outcome of this logic. The survival instinct is a powerful motivator. Some people will see it as a means to justify a resort to terrorism. If they succeed in forcing the government to change its policy, or bring about a change in government, they will likely be considered heroes, as the Lehi and Irgun terror groups are seen in Israel, and Nelson Mandela in South Africa.[27]

The situation is one of profound philosophical consequence for those who serve, far greater and graver than the operational challenges ecoterrorism may generate. This is because climate change strikes at the fundamental principles of soldiering: duty, honor, and service to the nation. A few soldiers may decide that a failure to address climate change releases

them from military discipline because the government has broken its social contract with the people. Some soldiers may resign their commissions if government officials fail to act on their professional advice regarding the risks that climate change poses to national security. Is the place of the military in liberal democracies to oppose actions that have widespread support in the community? Major cataclysms, such as climate change, reshape society. The military will not be able to escape the forces that strike as societies come under stress from a climate in transition. Climate change is an extreme event, and the Anthropocene is new territory for which humanity has no experience. The values that bind soldiers to their oaths may prove insufficient, even among those who serve in more stable countries.

Tactical Changes

While lowering the threshold for war due to climate change will result in more conflicts, the tactics employed will only be marginally different from those used in the past. A military, and a people, will always fight with what they have at hand and the skill level they possess, ranging from the primitive-yet-lethal machete to the most modern weapons system produced by a nation's military-industrial complex. Combat will also occur within a context which will favor different types of tactics; for example, the tactics of fighting in the open will differ from combat in an urban setting. Also informing the context will be the experience of the combatants and the existing doctrine of the forces involved, assuming one exists.

How a professional military prepares for a climate-induced war will also be little different from how it prepares for war in general. Planners will need to perceive the future operational environment; identify capability gaps and opportunities; and raise, train, and sustain a force to efficiently provide the government with effective options that best address climate change-generated threats. The implementation of tactical adjustments to the future force begins with trying to describe what the operational environment will look like in five, ten, or more years. This will differ from military to military because of the particular situational context. The United States, for example, may want to retain the ability to apply force globally and will, therefore, need capability to operate under varying environmental conditions. Sweden, by contrast, may decide to optimize its forces to operate in the Baltic and the Artic regions against a smaller range of potential adversaries.

The US Department of Defense is already attempting to define the future operational environment. Figure 5.1 outlines the anticipated threat profile resulting from multiple disruptions under warming conditions of increasing scale.

To project power worldwide, the United States also will need to understand the future operational environment elsewhere in the world. In general, the world will get hotter and wetter in parts, and hotter and drier in others, making it more suitable for reptilian and insect life forms rather than large mammals such as humans. Paradoxically, some places may get cooler. If the Atlantic Meridional Overturning Circulation (the Gulf Stream) slows down or stops as fresh water enters the Atlantic from the melting of Greenland's vast ice sheet, much of Europe will see plummeting temperatures. Significantly, if environmental changes become extreme due to runaway climate change, soldiers may end up fighting in what seems like an alien world,

Current and Project Climate Change Effects and Impacts

Climate Change Effect	Current at 1.1°C Warming	1.5°C Warming	2°C Warming	Impacts to Human Security
Heat	5% of global population exposed to severe heat waves once in 20 years	14% of global population exposed to severe heat waves once in five years	37% of global population exposed to severe heat waves once in five years	More intense and frequent heat waves will reduce labor productivity, increase frequency, and intensity of wildfires, undermine human health, and lead to loss of life
Heavy Precipitation and Flooding	25% of land with significant increase in once-in-a-century floods	17% increase frequency of precipitation extremes over land	37% increased frequency of precipitation extremes over land	Increased flooding will lead to economic losses, increased calls for humanitarian assistance, and loss of life
Drought	Observed increase in frequency and intensity of droughts in S. Europe, N. Africa, and Near East	Around 132 million more people exposed to severe droughts	Around 194 million more people exposed to severe droughts	More frequent, intense, and longer droughts will undermine food security in developing countries, cause more extreme wildfires, increase political instability, and drive migration
Sea Level Rise	8 to 9 inches higher with the rate of increase doubling in the last 30 years compared to the 20th century	Total projected rise of between 11 and 32 inches, with a median of 19 inches	Total projected rise of between 11 and 38 inches, with a median of 22 inches	Rising sea levels will increasingly imperil coastal cities and exacerbate storm surges that damage infrastructure and inundate water systems
Arctic Ice Melt	13% decline per decade of sea ice extend since 1979 90% decline of at least five-year-old thick ice.	Probability of an ice-free summer—defined as less than 15% ice concentration— is one every 42 years	Probability of an ice-free summer—defined as less than 15% ice concentration—is one every 5 years	Accelerated melting of Arctic ice sheets will affect ocean circulation and salinity, threaten local ecosystems, and increase competition over resources and transit route access
Tropical Cyclones	Global annual average has remained level since 1980 but geographic distribution has shifted, with more cyclones in the North Atlantic and northern Indian Oceans	Additional 2.1 category-4 hurricanes per year, compared to 2018 Additional 1.2 category-5 hurricanes per year, compared to 2018	Additional 1.4 category-4 hurricanes per year, compared to 2018 Additional 1.2 category-5 hurricanes per year, compared to 2018	More frequent, destructive, and shifting tract of cyclones will lead to trillions of dollars in economic losses in tropical zones, increase calls for humanitarian assistance, drive population displacement and migration, and lead to loss of life
Coral Reefs	33% threatened with loss	Projected long-term degradation of 70–90%	Projected long-term degradation of more than 99 %	The disappearance of coral reefs will eliminate an ecosystem that serves 500 million people, impacting economic and food security
Biodiversity	50% of terrestrial mammals and 25% of birds already under threat are affected by climate change	8% of plants, 6% of insects, and 4 percent of vertebrates will lose at least half of their geographic range	16% of plants, 18% of insects, and 8% of vertebrates will lose at least half of their geographic range	Loss of species will increase human health risks and threaten food security

Source: National Intelligence Council, "Climate Change and International Responses Increasing Challenges to US National Security through 2040," 2021.

Figure 5.1. Future Threat Profile. Created by Army University Press.

a world not designed for them. There will also be less land and more water; some land, such as low-level islands, will cease to exist altogether, although a government-in-exile may continue to exert claim to its exclusive economic zone. Coastlines will change as advancing seas inundate low-lying land. The lack of clarity on who controls and profits from the resources of a submerged state is likely to become a point of contention, contributing to wars as countries and corporations try to secure unprotected riches.

The thawing Antarctic continent could also prove a temptation to some states, creating a new operational environment in which no military has any experience. Since 1961, international relations in Antarctica have been regulated by the Antarctic Treaty, and related agreements. The treaty establishes the continent as a research preserve and forbids any military activity or resource exploitation until 2048 when the provisions can be reviewed and changed for the first time.[28] At present, seven countries claim parts of the continent, some overlapping: Australia, New Zealand, Argentina, Chile, Norway, the United Kingdom, and France. Though not claimants, the United States, Russia, China and others maintain research stations there. See Figure 5.2 for an illustration of the Arctic claims. As the Antarctic's ice disappears, particularly after 2048, the current peaceful arrangement may change as resources become more exploitable under the new climatic conditions. Countries that lay claim to the continent may need to back up their title with force (or the threat of it), and militaries will need to decide how to support their state's interest in what is for them largely virgin territory. The US military and the forces of other states will need to start considering how they will conduct and sustain operations on this distant continent.

Because of the changing environment, all militaries will need to re-examine their uniforms, weapons, equipment, and platforms for different circumstances. Training regimes will need to be modified to acclimate personnel to more extreme operating conditions. Bases and infrastructure designed for the Holocene will need to adapt to the differing conditions of the Anthropocene. Some bases, such as Naval Station Norfolk or those built on the permafrost, may prove impossible to operate without significant and expensive hardening against climate events.

Tactics, therefore, will have to evolve as climate change impacts become known. In some situations, combat may need to be limited to the night because the day is simply too hot to survive. Troops would then spend daylight in the relative cool of underground bunkers or air-conditioned vehicles. New maps and charts will need to be drawn as the physical world changes due to rising seas. New vaccination protocols may be

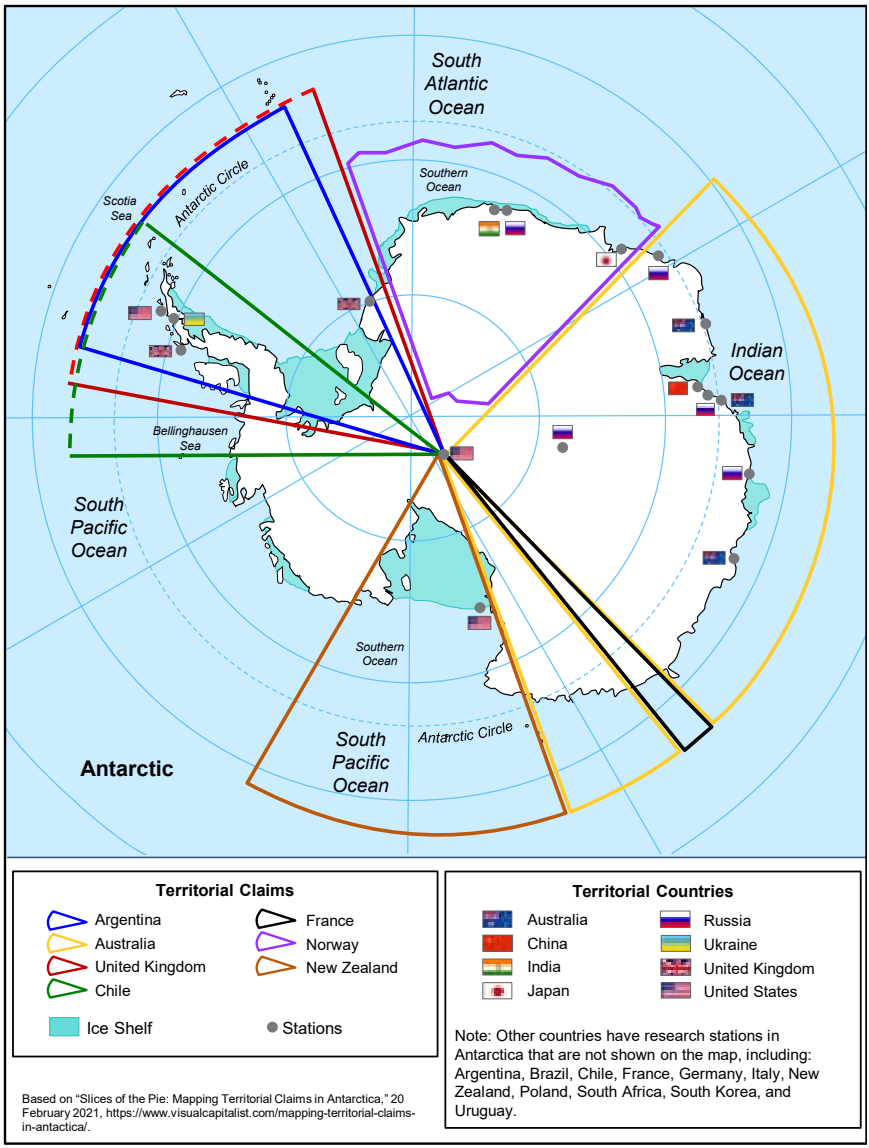

Figure 5.2. Map showing territorial claims to Antarctica. Created by Army University Press.

necessary as diseases spread or evolve with the changing environment. However, none of these changes go to the heart of tactics, namely the waging of battle. For the most part, climate change effects on tactics will require a degree of evolution not revolution. For soldiers, combat will remain the dangerous, violent, and terrifying act that it has always been.

Recalibrating Logistics

Logistics, as defined by Israeli military historian Martin van Creveld, is the "practical art of moving armies and keeping them supplied."[29] No matter the time period or context, van Creveld's words ring true. In brief, logistics make war possible. When the internal combustion engine appeared, logistics became easier in some ways and harder in others; horses and fodder were no longer needed, but engines required maintenance and gasoline. The mechanization of war resulted in a re-examination of all aspects of war and even led to the exploitation of a new dimension, the air. Humanity's transition to the Anthropocene will also change the context in which humanity fights. This transition will leave few aspects of human organization unscathed as the world adjusts to a less benign environment. As they have in the past when other significant transitions modified the art of war, military logisticians will need to re-examine how they do their job.

As discussed earlier, the military is the single largest emitter across all sectors. In the wealthy West, militaries operate large fleets of naval vessels, ground vehicles, and aircraft, most of which run on liquid fossil fuels. These militaries also maintain vast numbers of diesel-powered generators to run electronic equipment such as radar, communication, and battlefield management systems. As of 2014, the US military was the largest consumer of oil in the world, with the US Air Force easily producing the most emissions of the services.[30] The reliance on fossil fuels is also likely to grow; in Australia, new capability purchases are expected to double the military's energy requirements.[31]

Even in less-developed parts of the world, the internal combustion engine—in all its forms—provides militaries with much of their transport requirements. To stop producing greenhouse gases, military organizations will need to rethink how they are designed, how they train, and how they fight. Even more challenging, transitioning to a lighter, renewable energy-powered force may not be possible without a large degree of trauma—cultural and physical—as well as accepting greater casualty risk at the expense of battlefield knowledge, force projection, command control, speed of maneuver, and casualty minimization. A nation such as the United States which wants the ability to intervene anywhere in the world with speed may need to rethink how it achieves this goal from an energy expenditure perspective. The military may need to adopt a different mentality to adjust successfully to operations in the Anthropocene.

Yet despite the urgency, the world's militaries have not done a great deal to reduce energy consumption or mitigate emissions. Weapons con-

tinue to increase in size, weight, and energy requirements. There has been some experimentation with green fuels, such as sailing a US Navy carrier strike group powered by a blend of petroleum and liquefied beef fat. However, these initiatives are easily exaggerated: the beef fat content was only 10 percent, whereas the remaining 90 percent was petroleum. Basing is the one area where some degree of progress is being made. The US military, in particular, is committed to meeting its base power needs from renewable sources.[32]

The reality is that the world's militaries are all designed for an age dominated by the internal combustion engine and powered by petroleum. Yet, like the wind- and steam-powered ships of yore, the age of petroleum is passing and the age of electrification is beckoning. In 2021, electric car manufacturer Tesla ranked eighth in market capitalization of all companies worldwide. The largest traditional petroleum-powered car manufacturer, Toyota Motor, was less than a third the size of Tesla ($710 billion versus $219 billion). Of course, market capitalization is only one metric. Ford Motor Company, for example, remains the world's number one car manufacturer in terms of revenue, four times that of Tesla in 2021; but while Tesla's revenue surged by 28.3 percent, Ford's declined by 18.4 percent.[33] In response to a clear market signal from consumers, car manufacturers have announced intentions to switch production to electric vehicles. Volkswagen plans to field seventy electric models by 2030, and estimates that 40 percent of its car sales by then will be zero emission.[34] Car manufacturers are redesigning their companies to survive in the new age. The military might even want to lead the transition.

The military can justify its acquisition of heavy, powerful platforms because it needs the muscle to beat its adversary. With force protection prioritized, the miliary needs to add weight and, therefore, emissions to protect a force's most important asset—its people. Yet as COP26 in Glasgow demonstrates, reducing greenhouse gas emissions is becoming an increasingly urgent desire, and the transportation sector will need to make dramatic reductions to meet the goals of the Paris Agreement. As other sectors of the economy sacrifice to reduce emissions or as existing vehicles are redesigned or electrified, it is unlikely that society will allow the military to remain unchanged.

To guide its transition to a reduced or even zero emission future, the military should start to explore what war will look like in a greenhouse gas-constrained battlespace. It must develop concepts, doctrine, training regimes, and weapons to succeed in war, but with less reliance on fossil fuels and high energy expenditures. This is not an argument to abandon

technology, or return to soldiers wielding swords and spears. To remain a valued member of society and an organization held in high esteem, the military cannot remain the biggest emitter of greenhouse gases. Therefore, the transition to a different means of transport and less energy-intensive weapon systems must start soon. The climate change crisis requires adjustment by all parts of society, including the military.

The other major logistics area that will be affected by climate change is the military's ability to access the global market. Globalization has allowed the world's militaries to mimic the corporate sector and exploit the efficiencies of distributed manufacturing, rapid shipping, and just-in-time supply chains. For example, Lockheed Martin assembles the F-35 Joint Strike Fighter in the United States from parts manufactured in nine countries and then shipped to Texas.[35] Globalization also throws up odd situations. Despite tensions between the United States and China, many components that the US military requires, or their precursor ingredients, come from China. The US military uses the global trade system to buy items manufactured on the other side of the world and the global distribution system to deliver the purchased item when and where it is needed. Other militaries do the same.[36]

This is not the first time the military has relied on a global supply chain. During the Second World War, a global network of resource allocation, manufacturing, and troop movement linked the Allies. The national support base for the United States and the United Kingdom was a global one; materials were sourced from around the world and shipped where they were needed. Both nations allocated resources centrally according to strategic need. They also prioritized military requirements while cutting back on civilian consumption, especially in the United Kingdom where there was rationing on many essential foodstuffs. To manage this global network, the Allies placed all shipping under centralized management and specified cargoes and destinations for every ship. This system benefitted the major powers that carried the load in the fight against the Axis. Remote elements of the network tended to fare less well unless they possessed a resource that was essential to the war effort. For example, the inhabitants of Mauritius, a small and out-of-the-way British colony in the Indian Ocean barely avoided starving to death. During the war, hardly any ships stopped at Mauritius; the island was effectively cut off and its people suffered for being too small and too irrelevant to matter to the Great Powers.[37]

Still, as one author states with tongue wedged in cheek, "What could possibly go wrong?" with a globalized network that contains many moving parts and requires complex coordination.[38] In World War II, the imperatives of war kept the system focused on victory; governments enforced

compliance. By contrast, the COVID-19 pandemic showed what could go wrong. While the global supply chain did not break completely, it certainly was under enormous pressure. Lengthy delays in delivery and at transfer points became the norm; for Westerners, shortages or non-availability of desired consumer goods is now commonplace.

The COVID-19 supply crisis has gradually eased, but perhaps its most lasting effect will be to expose weaknesses in the global system. Unless much greater resiliency is built into the global supply chain, climate change may generate ongoing and repeated crises in both production and transportation of resources. For most nations accustomed to and dependent on interconnectedness, sudden severing of access to the world could accelerate social disruption. Nations dependent on global resources to meet the needs of their people will need to become self-sufficient, if they can. Resource-rich powers, particularly those that provide a sufficiency of food for their populations, will be able to manage; those that do not will have to seek the resources they need from somewhere or someone else, or face internal collapse.

The military's ability to influence or assist the global distribution system should not be exaggerated. Compared to consumers, the military's share of the global supply chain is a small one. To ease 2021 fuel shortages at the pump, the British government deployed two hundred military drivers to deliver gasoline. While the effort provided a public relations boost for the British Army, the additions did not help close a civilian driver gap that numbered in the tens of thousands.[39] The military also cannot expect for its needs to be spared from future disruption. Instead, the military will be a victim of the global economic system much the same as other sectors. Therefore, building resilience, identifying alternate supply sources, and increasing stockholdings may be the only option for the military in a more unsettled world. US military planners also may want to re-examine the work of the committees that controlled the movement of goods and personnel during the Second World War.

While relying on global acquisition for equipment and consumables may be economically efficient, it also complicates a military's ability to move, sustain, and maintain military power. This has been a risk willingly taken to date because of the efficiency of the global supply system and a belief in neo-liberal economic ideals. Yet, as Morris points out, the price of complexity is fragility. He believes that as a society becomes larger and more complicated, it creates more threats to itself.[40] The global supply chain certainly qualifies as a complex system. The military is seeing what could happen when its global supply chains come under stress. In a short

period, the COVID-19 virus became a major threat to global trade. The disruption to commerce continues to reverberate through the international system, and the volume of goods and people transported by sea or air has declined dramatically. As of this writing, the system is reviving, but how well and for how long?[41]

For the military, dependence on a global supply chain introduces a vulnerability to their ability to operate. This is a risk that will likely worsen because of disruptions linked to climate change. If a super hurricane struck Norfolk, the damage might render the port inoperable, reducing the US military's ability to project power across the Atlantic. Mitigating the threat will require hardening military logistic systems to shocks. This will necessitate a shift to shorter and less complex supply chains, greater reliance on the national support base despite the likelihood of higher costs, and a willingness to warehouse greater stocks of materials, particularly those that are sourced from a distance or from a region of the world that is subject to more frequent climate shocks. It might also necessitate reducing the number of items that an advanced military possesses and simplifying manufacturing and sustainment even at the cost of a loss in capability. Logistic systems will need to evolve if the military is to retain its ability to protect sovereignty in a more disruptive and unpredictable age.

Strategic Change

If climate change-related modifications to tactics will be relatively minor, those at the strategic level will be profound because of the willingness of states or other entities to accept greater risk in their calculus for war. Rather than being quarantined from violence as has been the case for most civilians of the West, humanity may revert to something more akin to the brutal state of nature that Hobbes warned against if major emitter nations do not stop the ongoing rise in greenhouse gases in the atmosphere.

The reason for such strong language is that the benign civilization-encouraging conditions of the Holocene ended with the onset of the Anthropocene. Since the 1950s, human development and population growth have accelerated, rapidly increasing greenhouse gas emissions; meanwhile, consumerism has taken hold, causing demand for resources such as gasoline to soar.[42] Human actions have caused the breaching of tipping points in the Earth System and there is no going back—at least not in a timeframe useful for our species. We now face a likely hostile global environment future as the Earth System responds in unpredictable ways to the changes humanity has made to the atmosphere.[43]

Since the Enlightenment, Western civilization has been on a path it will struggle to maintain in the harsher, more violent, more resource-constrained, and less stable world of the Anthropocene. Those of us in the wealthy West have grown comfortable with the idea that war can be divided into two categories: Wars of Choice, which are entered into at a country's discretion, and Wars of Existence, which must be waged for survival. The distinction has always been unsatisfactory because it is point-of-view dependent: what might be discretionary for one adversary may not be for the other. For example, the Vietnam War was an optional fight for the United States; but for the North and South Vietnamese, the very existence of their countries was at stake.

Because climate change will reduce the availability of critical resources, future wars for many states and other actors will be seen by their members as less of an option and more of a necessity. Climate change will raise the stakes for survival, particularly as an expanding population increases demand, while adverse weather reduces the supply of critical resources. According to archaeologist Stephan LeBlanc, humanity's response to such situations dates back to the species' origin: "When resources were critically short, fighting for them has been an option for humans for more than a million years."[44]

Due to climate instability, human production systems will not be able to integrate with the Earth System as efficiently as they did in the Holocene. This instability will generate stressors that will test society's ability to adapt. As noted earlier, the great majority of the world's population resides in countries that are unlikely to withstand multiple shocks.[45] This does not mean that the wealthy West be complacent. Climate shocks will play out in unpredictable ways, and the poor world may not be willing to go quietly. The future for those who enjoy life in the developed world may rest on decisions by the inhabitants of the less fortunate parts of the world. In his analysis of how civilizations renew themselves, Canadian political scientist Thomas Homer-Dixon concluded:

> In a world where billions of people are tightly coupled to a steady stream of services from a stable climate—depending closely on regular rainfall to grow their food, for example—a sudden flip to a new climate regime would be a prescription for chaos.[46]

In addition to greater probability that stressed states will choose war to meet their people's desires, these wars likely will be more decisive. This is because the political objective for going to war will be survival, and war aims will reflect this extreme desire. In the past, wars commonly

ended when the participants negotiated a conclusion, even if it only put off the underlying dispute to a later date. For example, Spain and the Dutch Republic were exhausted from their lengthy war and in 1609 agreed to a 12-year truce. Twelve years later, they resumed their contest.[47] This is often the outcome in wars where existence is not at stake. In wars driven by climate change factors, a negotiated settlement remains possible; societies may find ways to compromise, but there will also be a greater need for war to produce a clear winner and a clear loser. In some cases, these wars will be initiated by a people intent to migrate because their homeland is no longer able to support their needs. History is replete with mass movements of people seeking a better way of life, whether they were Germanic tribes that overthrew Rome, the Norse who moved beyond Scandinavia into richer lands to the south, or Europeans settling the New World. Although our cultural biases may find it uncomfortable to admit, European settlement of the Western Hemisphere, Australia, and elsewhere was essentially genocidal conquest. In a similar manner, climate refugees may simply make the decision to move to a place with better conditions. Whether these people, who are likely to be in the tens or even hundreds of millions, are welcomed or opposed, will determine the role of the military. Migration pressures will be inexorable as sea levels rise, temperatures increase, glacial water flows decrease, and rainfall patterns shift, making once-fertile territories uninhabitable. War is the traditional response in such circumstances.[48]

It should be clear by now that climate change is likely to bring about wars against or between desperate opponents for whom victory is the only option and where military failure means a slow death from starvation and disease as their societies are unable to provide the resources needed. For the military, such a context has implications for how they fight. The West has gradually codified laws that limit war's barbarity and which its militaries instill in their personnel. These policies have largely held, even against opponents who did not follow these rules and were willing to commit, film, and broadcast acts of barbarism against prisoners and civilians. As climate change spawns wars for which there can be no survival in defeat, Western militaries will need to hold true to their code, while their troops are hardened to killing and being killed in larger numbers than the West has seen since the end of World War II. Civilization can only be preserved if war is fought ethically and within rules; otherwise the escape from the state of nature that Hobbes described will be fleeting.

Avoiding the descent into barbarism will also protect the members of the military from a condition that has become known as Moral Injury. Moral Injury results from a perceived moral or ethical transgression which

produces a sense of shame or guilt. It is debilitating, as those affected question their ability to continue to apply violence on behalf of their society. Moral Injury can sap the strength of a military as troops become long-term casualties who require care and treatment to recover and become stable members of society.[49]

How states respond to mass migration could be a prime cause for widespread Moral Injury. At present, migration is managed as a human security issue. If migration becomes viewed as a national security issue, some states might consider it a threat to their sovereignty. In such circumstances, governments would order their military to halt the movement of refugees, presumably by force if necessary. Those peoples who perceive they have no other choice but to move may decide that the risk of violence is worthwhile to ensure a future for themselves and their children. They may also decide from the start that they will migrate and seize what they need for survival, in the manner of the Germanic tribes that invaded, conquered, and settled in the Western Roman Empire during the fourth to sixth centuries, or settlers pushing westward across the North American Plains.

There are different options on both sides for how societies react to mass migration. In the 2013 Syrian crisis, most European countries welcomed refugees, though the large majority only went as far as Turkey or Jordan. There is no guarantee that the next major movement of people will be as peaceful, and there may be consequences for the health and well-being of those who serve.

Related to Moral Injury is another aspect of barbarism that has been widely practiced in the past, including by Western forces. In earlier times, combatants deliberately dehumanized their adversary to make them easier to kill or deny their basic human rights.[50] Through information operations that created hate and portrayed the enemy as different, somehow sub-human, a state made it easier for their military personnel to fight them and the civilian population to provide support. In doing this, a state made mass murder and the debasement of the human spirit palatable as part of war. In World War II, for example, both the Axis and Allies undertook information operations to portray their adversaries as less than human.[51] The pinnacle of this dehumanization was Nazi Ideology, which legitimized genocide on the basis of race.

Climate change, therefore, poses a risk to the humanity and moral code of those who serve. It will be necessary for the military to guard against climate change-induced barbarism, because preserving the human spirit is essential for creating Anthropocene systems of economic, polit-

ical, and social interaction. What makes us human will be placed under tremendous pressure by climate change, but that can be no excuse to surrender civilization and our moral code.

The Weaponization of the Climate

Human ingenuity will make possible the geoengineering of the climate; that is, the applications of different technologies will cause a targeted change in the systems that control the climate. On a very limited scale, geoengineering is already happening. Cloud seeding, a weather modification technique in wide use around the world, encourages raindrops to form in clouds to be released as rain. A five-year study of cloud seeding conducted in Australia yielded a 14-percent increase in snowfall in the Snowy Mountains, the location of Australia's largest hydroelectric network. A similar project in Wyoming saw an increase of between 5 and 15 percent in the depth of the snowpack.[52] Across the American Southwest, states are examining the use of cloud seeding to ease the present drought.[53] Yet without any doubt, the world leader in cloud seeding ambition is China, which plans to have a weather modification system in place by 2025 that will encourage rainfall over a 2.1-million-square-mile area.[54]

Numerous scientists and engineers have proposed a variety of geoengineering technologies to modify the climate.[55] The military have also begun considering geoengineering as a weapon. In *Unrestricted Warfare*, Chinese colonels Qiao Liang and Wang Xiangsui explain "ecological war," which involves a state deliberately triggering an Earth System reaction to harm an adversary's military and homeland. They specifically refer to using a human-induced El Niño or La Niña as a kind of super weapon. Both weather systems affect precipitation and temperature over affected regions. El Niño causes reduced rainfall over Australia, Indonesia, and India while higher-than-average rain falls on California and Peru. La Niña causes the opposite. In an El Niño cycle, Australia is at much greater risk of drought and larger and more powerful bushfires, while California may receive floods. In the La Niña phase, California firefighters experience a tenser-than-normal summer.[56]

Of course, weaponizing nature comes with risks; governments and their militaries need to understand the potential for unforeseen consequences.[57] Yet when the opportunity to employ nature was suggested in the past, soldiers did not hesitate to leverage its potential to seek an advantage. In fact, historical literature references various examples of states exploiting the attributes of naturally occurring substances, viruses, and bacteriological agents to help defeat an adversary. Germ and chemical

warfare date back to the earliest days of recorded history; accounts of their use appear on cuneiform tablets. Tactics included poisoning wells, catapulting diseased carcasses—human and animal—over a city's walls, and application of animal venom and plant toxins to arrows and spears. The Mayans weaponized bees and wasps, using them in booby traps while other cultures put insects into specially designed clay containers that could be thrown as a projectile and shatter when they hit the ground.[58]

The massive bush fires of the 2019–2020 Australian summer may suggest to adversaries a way to employ nature to attack an opponent's homeland. Had these fires broken out as a result of the actions of another state, would the Australian Government have considered it an act of war? Would terrorists, after seeing images of Australians standing in the ocean while their homes burned to the ground, see an opportunity to plan a deliberate arson attack on the nation?

An attack on dry forest that climate change has primed for burning would have a morale effect on the homeland and a physical effect on the national support base's ability to sustain operations, as well as providing an enormous distraction for the nation's political and military leaders. In the Western United States, Pine and Spruce beetles killed vast tracks of timber as warming temperatures allowed these pests to extend their range and survive winter in greater numbers. Similar levels of destruction are occurring across European and Siberian forests. Millions of acres are ready to burn from a lightning strike or perhaps an imaginative adversary employing incendiaries. In the Second World War, the Japanese unsuccessfully attempted to use balloon-borne incendiaries to set Pacific Coast forests ablaze.[59] Perhaps a future adversary will try again with greater success. The challenge for the military is to secure these vast areas from threat; for the government, it is how to respond to such aggression, assuming the culprit can be identified.[60]

To ignite a forest as a form of aggression may be effective, but it lacks subtlety. Of potentially greater relevance for the military is growing scientific and engineering community interest in employing geoengineering to adapt to the Anthropocene and limit climate change risks. Instead of reducing emissions of greenhouse gases, some experts advocate implementing technological solutions, such as deploying space mirrors to reflect some of the sun's radiation back into space, thereby reducing the amount of heat that reaches the planet's surface in the first place. Using such geoengineering techniques would reinforce humanity's belief in its right to manage nature to fit the needs of its own species. Nature provides an ex-

ample of how geoengineering could work. Following a major volcanic eruption, the material blown into the atmosphere reflects some of the sun's radiation back into space, causing a global cooling effect. The immense 1883 eruption by the Indonesian volcano Krakatoa sent such quantities of ash and dust into the atmosphere that global temperatures were below average for the next several years. The 1991 eruption by Mount Pinatubo in Central America had a similar effect.[61] Scientists and engineers are exploring a variety of ways to mimic such eruptions.[62]

Already underway are efforts to develop climate mitigation technologies, including carbon capture and storage (burying carbon), carbon sinks (iron fertilization of the ocean), solar shields (orbiting reflectors), and solar aerosols (shooting aerosols into the high atmosphere). These highly speculative technologies are unproven; no one really understands how the Earth System will react. All geoengineering suggestions are essentially experimental, not unlike the current "experiment" of adding vast amounts of carbon dioxide, methane, and other greenhouse gases to the atmosphere. All of these speculative solutions also treat global warming as a mechanical problem instead of a social and cultural one.[63] Lastly, use of geoengineering does not eliminate the need to stop adding further greenhouse gases to the atmosphere.[64]

No geoengineering idea is without risk, particularly since our knowledge of the Earth System is incomplete. American climatologist Alan Robock identified twenty-seven things that could go wrong with geoengineering, including its militarization.[65] Unexpected or detrimental outcomes include disruption to seasonal weather patterns, with consequential changes in rainfall amount and location. There are no geoengineering-related regulations in international law.[66] However, befitting a new area of inquiry, some scientists believe the risks are overstated and some geoengineering ideas will be part of the climate change solution.[67] One individual unilaterally sowed the Pacific Ocean with iron dust to promote plankton growth that would absorb carbon dioxide from the air.[68] Some climate scientists are strongly opposed to geoengineering: "Attempting to counter the damage we've done by pouring stuff into the atmosphere and oceans by pouring more stuff in . . . is too fraught with potential unintended consequences."[69]

While climate scientists debate the risks and rewards of climate geoengineering, this has been less the case among military practitioners. Although geoengineering may result in some winners, it likely would also create losers. Geoengineering initiatives, such as cloud seeding, might shift precipitation from one region to another but might also cause the arrival of rain that is too much, too little, or not at the right time. Each out-

come brings consequences for the growing of food and the lives of those affected. Some countries may view a state's geoengineering action as a hostile act, particularly if it was done without international agreement. A state that was negatively affected by geoengineering might respond with violence or even a countervailing geoengineering project of its own. Because scientists cannot predict with certainty how the Earth System will react, any geoengineering initiative may produce the unexpected and the undesired, adding tensions to already tense and disruptive situations. One unintended consequence of any geoengineering initiative may be war, particularly if the initiative is taken outside the international system.

Of course, limited weather manipulation in wartime has already occurred. During the Vietnam War, the United States seeded clouds over Vietnam and Laos to increase rainfall on enemy supply lines, creating mud and thereby making supply movement more difficult. The success of this effort was unclear; after the war, weather research was abandoned due to criticism by Congress and the public.[70] As part of its weather modification program, China installed thousands of cloud-seeding guns across Tibet to increase the amount of rain falling on its territory.[71] Its neighbors were not consulted.

Still, if climate change threatens the survival of a people and the state possesses the technical ability to pursue geoengineering, the government will face irresistible pressure to take the gamble. Advocates may see it as a "Hail Mary" option, or even the only option. Because of the immense costs, only the United States, China, the European Union, and possibly Russia would have the money or skills required to undertake such an effort on the scale required. For the military, this irresistible pressure creates two problems that will need to be managed. First, if the state undertaking the geoengineering succeeds and saves humanity, the resulting prestige would make it the de facto leader of the world, thereby recalibrating the world order. For example, the United States might find itself displaced by China as other countries rally to the world's savior. Second, geoengineering will necessitate a reinterpretation of deterrence theory from the Cold War mindset of the nuclear age to the climate change environment of the Anthropocene. Geoengineering must be seen as a global weapon system which could eliminate a state's ability to resist through destruction of its local environment. United States and Soviet Union acceptance of the idea of Mutually Assured Destruction helped prevent nuclear annihilation. The major states may well need a similar deterrence policy to prevent an environment-focused first strike that would trigger a different form of global destruction of the human race.[72]

Environmental Stewardship

The consequence of the actions taken by humans to interact with and force changes in the Earth System means that humanity has acquired a degree of power over the future course of life on the planet that has never been seen before. As a result of two and a half centuries of adding greenhouse gases to the atmosphere, humanity has modified the planet's balance and caused the global warming that is now driving climate change. Humans now play a role in defining the future evolution of the planet and managing the environment in which life flourishes or dies. Because of this gained ability, geologists call Earth's current epoch the Anthropocene and note that the Holocene has ended.

The last time a species gained such apocalyptic power occurred with the evolution of Cyanobacteria about 2.5 billion years ago. Cyanobacteria are a type of aquatic microorganism capable of photosynthesis, commonly known today as blue-green algae. Because they can photosynthesize, the algae release oxygen into the atmosphere. Their appearance in the distant past caused a buildup of oxygen in the atmosphere and brought the Archean Eon to an end. This event also had consequences; it made extinct most of the dominant life forms of the time: the anaerobic—non-oxygen breathing—microbes whose ancestors only survive today under extreme conditions of temperature, acidity, alkalinity, or chemical concentrations, such as the hot sulfur gas vents on the ocean floor.[73]

Humanity has reached this point because it did not think through the consequences as it began adding greenhouse gases to the atmosphere with the onset of industrialization. Individuals who raised early concerns, such as US climate scientist James Hansen, were ignored. As recently as the COP26 meeting in Glasgow, a global policy to halt the emission of greenhouse gases continues to elude humanity. Now part of the governing process of the Earth System, humans have acquired a responsibility for stewardship of all life on the planet, even if most do not realize it. As one of humanity's key institutions, the military must take on part of this stewardship responsibility, at least for those actions that sit within the national security remit.

Most militaries are already involved in environmental stewardship through their ownership and management of large tracts of land across a range of ecological niches. In the Western tradition, militaries are subject to environmental laws as much as any entity. United States Department of Defense ecological niches range from Anderson Air Force Base on tropical Guam to Fort Greely in arctic Alaska to everything in between. In the Anthropocene, however, the military's responsibilities for environmental

stewardism will extend far beyond simply care of plants and animals that live within the confines of a base. Militaries will need to include environmental stewardism considerations in the determination of how to operate.

Because of its contribution to humanity's role in environmental stewardship, the military will need to add another level to the strategic thinking it employs to pursue national goals: Deep Strategy. The US Department of Defense accepts that "the objective of strategy . . . is to serve policy."[74] Strategy must work toward attaining a state's policy objectives. Related and superior to military strategy is national strategy, which the US Department of Defense considers as the means to advance "a nation's long-term, enduring, core interests over time."[75] National strategy, which involves the contribution of multiple agencies to attain national goals, is better known as grand strategy.

For non-American readers, less parochial definitions of strategy may prove more useful. According to British military historian and strategist B. H. Liddell Hart, strategy is "the art of distributing and applying military means to fulfill the ends of policy."[76] The role of grand strategy, he continues, "is to coordinate and direct all the resources of a nation, or band of nations, toward the attainment of the political object of the war—the goal defined by fundamental policy."[77]

Such definitions by the US Department of Defense, Liddell Hart, and other authors remain relevant, but the onset of the Anthropocene has made them inadequate. More information is needed—beyond the existing elements—for strategy to work in the Anthropocene. The author defines Deep Strategy as the broadest and most complex level of strategic thinking:

> Deep Strategy is the level of war, or its planning, that considers the integration of a nation's security policy with the Earth System and the consequence such integration holds for the future of life on the planet.

What sets the Anthropocene Epoch apart from previous human history is our species' ability to leave a human imprint on the geological record. This power is both a blessing and a curse, and it requires judgment and responsibility in execution. Now that humanity can provoke the Earth System to react, as global warming demonstrates, political, military, and defense leaders must develop personnel who understand the risks and rewards of prodding nature. Of course, this oversight extends beyond the scope of the military to include all aspects of human ambition, as well as non-military organizations and agencies. In fact, it is a whole-of-government if not

whole-of-society responsibility; the military is accountable for only a small part of the potential situations deep strategists will need to consider.

Deep strategists who serve in the military must understand the range of Earth System responses to human stimuli, including waging of war and the implications such reactions hold for intrastate and interstate relations. Their most important task is to alert decision-makers to potential Earth System responses to dangerous geoengineering interventions. In addition, deep strategists can help inform policymakers about the effect a planned environmental stimulus could have on potential adversaries. Thus, the deep strategist needs to be involved with strategic level planning at the highest levels.

Factoring in human activity's potential effect on the Earth System also will help decision-makers with a true cost-benefit analysis of contemplated actions in the military space. If manufacturers and distributors include the cost of removing a type of pollution, such as disposable plastic bottles, the higher price might help discourage consumers from using such materials. Calculating the true cost of an operation could be extremely useful. Deep strategists could also apply the total cost rationale to future equipment acquisitions, assessing their potential to interfere with Earth System stability. Those that are too risky would need to be redesigned, reconsidered, or scrapped.

Deep Strategy is more than weather prediction. In a sense, it is climate and ecosystem prediction. This means that the military and others will need to take a longer-term view of how their actions will affect the Earth System in future years or decades. At first, most military personnel might consider such an extended timeline as beyond their responsibility. This would be a short-sighted conclusion, particularly when equipment such as the B-52 aircraft remains in service for decades, and bases and other infrastructure are active even longer. The US Army established Fort Leavenworth, Kansas, in 1827.

When a military develops a new capability or plans an operation, commanders should have a sense of how the Earth System might respond so they can understand whether the potential effect on nature supports the mission objective. If a mission is to help stabilize a region, it would not make sense to undertake actions that destabilize the environment in a way that increases pressure on the local society. Deep Strategy will also help reduce the potential for Earth System surprise, since the surprise might not be a pleasant one. For all these reasons, Deep strategists will need to feature in future planning, decision-making, and coordination across government initiatives.

There are previous instances of scientists undertaking a Deep Strategy assessment in a warfighting context, even if they did not employ this term. During the Cold War as humanity faced the specter of nuclear destruction, a number of scientists examined the possible extinction of most planetary life that could result from a nuclear exchange between the United States and the Soviet Union. As nuclear bombs primarily would target cities and military facilities, most of the population of both countries likely would be spared a horrible death from immediate blast or subsequent radiation poisoning.[78] However, the scientists concluded that even a relatively modest number of nuclear detonations would trigger a nuclear winter, a period of year-round intense cold that would last for years before warming resumed. The bomb blasts and resulting fires would send so much dust into the atmosphere that little of the sun's radiation would reach the earth's surface. As a result, temperatures would decline by about 25ºC (45ºF) and plunge the entire planet into a Siberian deep freeze. The freeze would be too cold to plant crops; most humans, and much of the natural world, would starve. Few, if any, humans would survive such an extinction-level event.[79]

In making their grim assessment, these scientists were saying that any attempt to use nuclear weapons would end in disaster. Among national policy goals, state survival is the most fundamental. Had the United States, the Soviet Union, or any minor nuclear-armed power unleashed their nuclear weapons, the result would be catastrophic. None of the vast array of books and policy papers written on nuclear deterrence policy addressed the effect of such a war on the environment and the Earth's ability to sustain life in the aftermath of a nuclear exchange. The absence of Deep Strategy thinking created the possibility of the destruction of civilization.

Besides aligning with a state's policy goals, there is a moral reason to incorporate Deep Strategy into national security planning. In forcing the Earth System out of the Holocene and into the Anthropocene, humanity has taken responsibility for the moral stewardship of nature. This is the end result of human societal and technological development and is what sets humans apart from all other animals. We, therefore, have an obligation to accept the mantle of stewardship and work with the Earth System to preserve an environment that provides the best quality of existence for all life on the planet, including human life.

The final reason for the military to invest in understanding Deep Strategy is to get ahead of a growing international movement to establish an international crime called "ecocide." The term dates to 1970 when professor Arthur W. Galston used it at the Conference on War and National

Responsibility in Washington DC. He applied it to describe US use of defoliants in the Vietnam War and the effect these chemicals were having on the environment. The United States sprayed a variety of defoliants—Agent Orange was the best known—on the Vietnamese and Laotian jungle to destroy the cover under which the Viet Cong hid. Between 1962 and 1971, the United States dispersed more than 17 million gallons of defoliants over the war zone, destroying 6.5 million acres of vegetation.[80] In 1978, a United Nations report considered adding ecocide to Geneva Convention prohibitions. The report accepted that the term referred to "measures of devastation and destruction which have in common that they aim at damaging and destroying the ecology of geographic areas to the detriment of human life, animal life, and plant life."[81]

While initially developed in response to the Vietnam War, the proposed crime of ecocide now has a broader definition which can be summed up as mass damage to or destruction of ecosystems. One of the leading international organizations pushing to make ecocide a crime is the Stop Ecocide Foundation. In a 2021 report, the foundation made the case for including ecocide as a crime under the Rome Statute, the founding treaty for the International Criminal Court (ICC). If adopted, ecocide would be just the fifth crime that the ICC prosecutes; the others are genocide, crimes against humanity, war crimes, and the crime of aggression.[82] The definition of ecocide proposed by the Stop Ecocide Foundation is "unlawful or wanton acts committed with knowledge that there is a substantial likelihood of severe and either widespread or long-term damage to the environment being caused by those acts."[83]

At the time of this writing, ecocide has not been criminalized, and there is no guarantee it ever will. However, climate change is prompting increased awareness of and concern for the natural world and recognition that humanity's wellbeing depends on a healthy biosphere. Advocates of criminalizing ecocide believe the public's awareness of the environment is changing and people increasingly understand that the human sphere cannot be separated from nature.[84] There is a strong likelihood that ecocide will at some point be included in international law under the ICC. The military should seek to understand the motivation behind the anti-ecocide movement and the ambition of those leading it. While international law will not outlaw war, a large number of statutes and conventions already set limits on what is permitted. Limits on damage to the biosphere may become the latest prohibition on what military commanders and planners can legally undertake in future operations.

The military, and other government agencies, need to incorporate Deep Strategy into the planning for and conduct of their operations. To avoid making a bad situation worse, the military will need to understand how human actions affect the biosphere in an age of climate change to avoid creating risk not just to an operation but also to humanity's survival. At the moment, Deep Strategy is necessary for operational effectiveness and morality. However, if anti-ecocide advocates are successful, it may be necessary from a legal perspective, too. The military should start adjusting to this regime now rather than risk damaging its reputation through unintended consequences resulting from actions that harm the biosphere.

Conclusion

Climate change-related disruptions to how the military operates will vary from country to country, the requirements of an operation, and the desired political goal. Moreover, like war itself, these disruptions will evolve and become more frequent and intense as climate change reshapes the parameters of life on this planet. To optimize operational capability, the military will need to understand and anticipate such disruptions and implement mitigations that allow its forces to remain effective.

Two of the disruptions identified in this chapter are novel to war, and military leaders have little experience with these circumstances. Geoengineering is well known but largely at the theoretical or laboratory level. With the exception of cloud seeding, its practice is virtually unexplored. If climate change becomes acute, the government will find it hard to avoid turning to geoengineering as a "Hail Mary" solution. No matter how it is used, a geoengineered solution is likely to have unintended or unforeseen consequences. Other states may interpret its use as an attack on their interests or even survival. How the Earth System responds to a geoengineered stimulus is simply unknown. Deep Strategy is the other novel disruption. To remain a responsible member of society, the military will need to gain a better understanding of how its actions affect the biosphere.

This work has discussed how climate change will create more risk for humanity as well as the challenges it will bring for the military. It has also proposed innovative ideas to manage the crisis and set up the military for success in the Anthropocene. Chapter 6 addresses the critical issue of when—or to use the military term, warning time—and proposes a rough timeline for likely events. The discussion also shifts to the business end of war and what climate change means for how armies and the other services fight.

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Chapter 6
Timeline to Catastrophe

It is useful for a government to have an idea of approximately how far off a threat lies so that it can make preparations—military, diplomatic, economic, or other—in a timely manner to address or prevent it. This planning usually requires coordination across government agencies and private industry to shape international opinion, engage with allies, and develop and manufacture new weapons. Traditionally, for the military, the context in which such planning takes place is a perceived threat to national security from a potential adversary.

Military planners would prefer to have sufficient warning time to decide the best means to meet a coming challenge, and to ready the force accordingly. Unfortunately, pre-emptive action is not possible with climate change. The climate crisis is already upon us and humanity must deal with climate-driven events that are already unfolding. By failing to address climate change over the past decades, humanity has put itself in the position of needing to catch up if it is to address the growing climate threat. Humanity's situation today is not dissimilar to the one that the British military faced at the start of World War II. In 1919, after the end of World War I, the British Government established the Ten-Year Rule as its defense policy. It advised the three services that they were not to anticipate or prepare for a major war for the next ten years. After 1928, the British Government modified the rule so that the ten-year period advanced forward every year. Since war was a distant possibility, the British Government used the Ten-Year Rule to justify severe cuts in the military budget. The policy remained in place until 1932. When war did come in 1939, British armed forces were fundamentally unprepared, as the defeats they suffered in the opening years of World War II attest.[1]

Climate change warning signals are everywhere, but this has not prevented political leaders from delaying decisive action to address the threat. Therefore, the problem for military planners is not to anticipate the threat and prepare for it, but to adapt to a threat that has already begun to make its effects felt. Any climate change timeline must start with the fact that it is already affects humanity. What remains for our species to discover is the extent and range of the threats as they become apparent, and begin building resilience and promoting adaptation. Much of this work belongs to other government agencies. However, as this book has maintained, the

military will experience a greater call for their skills as society struggles to adjust to climate change.

The "When" of Climate Change

As a child, one of my favorite cartoons was "The Road Runner Show." I knew that at some point, without fail, the road runner's nemesis, Wile E. Coyote, would end up running at full pelt off the edge of a cliff. He would briefly freeze in mid-air as realization of his plight took hold, and then plummet helplessly downward to his inevitable impact with the ground. "Beep beep" was the road runner's insouciant response. Wile E. Coyote provides an illustration of the point humanity is at today when it comes to climate change—off the cliff and at the point of frozen realization. The pain of impact is unavoidable and, like the road runner, the Earth System does not care. What is yet to be determined is the force of the impact—in other words, the effect climate change will have on humanity's ability to sustain itself and maintain its civilization.

For soldiers involved in planning for climate change, my road runner analogy illustrates that it is now too late to avoid at least some climate change pain. The evidence that climate change has begun is overwhelming, as is the conclusion that the global environment will become less stable, reliable, and generous in its support of the human experiment. The energy we have already added to the oceans as a result of the rise in greenhouse gases must result in more powerful storms. The melting of glaciers will change the water supply available to downriver states and farmers. The rising of sea levels is a documented fact, and the rate of the rise increases each year means some coastal zones will be abandoned. Unprecedented droughts are becoming more common, forcing farmers to leave their land and thus reduce the amount of food grown, while forests are more likely to burn. The biosphere is under strain worldwide: reefs are dying, deltas are becoming more saline, and some species have begun to move, seeking cooler places to live. These outcomes are not dependent on theoretical modeling; they are observable measurements and basic physics. The mass movement of peoples and climate wars are coming, and soldiers will need to prepare for them.

For those who need a timeline for planning purposes, year zero has already passed. Further, it will be many decades before there is any hope of the climate reaching a new stable, but hotter, point. Indeed, what humanity must now do is plan to mitigate the pain while bringing our emissions to net zero as fast as possible. The greater the concentration of greenhouse gases in the atmosphere, the greater the disruptions to the Earth System

will be. Humanity, therefore, has a powerful incentive to bring the degree of pain it will experience to the lowest level possible by halting the addition of more greenhouse gases to the atmosphere.

Beyond these facts, it is not possible to provide a precise timeline for climate change and its effects.[2] In part this is because the Earth System is extremely complex and researchers do not fully understand how its increasing instability will interact with human systems, although modeling is making impressive gains in discerning how it works. There are now a number of reports that project how climate change will affect sea levels, temperature, precipitation, fish availability, ice melting, and other essential natural services. These reports also anticipate the consequences such changes hold for humans. None predict a positive outcome for us, and the timelines tend to become ever more dire with further research.[3] An IPCC 2018 report makes it patently clear that we are nearly out of time.[4] James Hansen, one of the first climate scientists to warn of climate change, is more pessimistic than ever. He believes that within decades the fabric of human civilization will be under threat.[5]

For soldiers, predictions of the future are even more complex than for climatologists. This is because war will remain a choice made by humans on both sides within a decision-making process that is shaped by emotion, foibles, and interests. Moreover, those making the decision will do so in an information-poor environment; militaries cannot deduce the intent of a potential adversary with any degree of accuracy. Lastly, leaders will make this choice in the midst of a chaotic climate transition.

In 2016, the US Department of Defense issued an intelligence assessment that considered three phases for when certain climatic events will take place:

• **Now**—Trends in extreme weather suggest that climate-related disruptions are underway.

• **Next five years**—For the United States, climate change-related security risks will be largely from extreme weather events and the exacerbation of existing strained conditions, such as droughts leading to water shortages.

• **Next twenty years**—In addition to extreme weather events, the United States will begin to experience the consequences of systemic changes, such as sea level rise affecting coastal habitation.[6]

This timeline focuses exclusively on the effect of climate change on the United States directly. Its authors provided US decision-makers with the best possible prognosis of what will happen and when. As discussed, how-

ever, climate change is a global event that cannot be contained by borders. While this timeline is useful in its applicability to US security, it is not as relevant for the security of the global commons.

Elsewhere in the report, the authors unpacked how climate change events that take place outside its territory will impact US security. They noted that climate change will create situations where demand for essential services outstrips supply and, as a result, will prompt increased migration and overwhelm a state's capacity to respond or recover. As the temperature rises, the world will see more migrants, more inequality, and more instability—which translates into more conflict as social cohesion fractures. The report explains, "Countries with weak political institutions, poor economic conditions, or where other risk factors for political strife are already present will be the most vulnerable to climate-linked instability."[7] The report's conclusions apply to many countries in the Western Hemisphere and elsewhere in the developing world. The consequence of climate change-related strain on such countries is starkly laid out in the report, mirroring the future predicted in this book: "In the most dramatic cases, state authority may collapse partially or entirely."[8]

To get a better sense of the global chaos that all of humanity is facing will require a broader timeline that considers the global community. The 2021 IPCC report provides some guidance on the anticipated range of temperature rise. The IPCC derives its forecasts from the analysis of five scenarios that track five different trajectories of greenhouse gas emissions. The starting point is 2021 and each period is twenty years long. The details of the science are not required here, but each scenario starts with emissions rising, at different rates. In the most favorable scenarios, humanity reduces its emissions to less than zero. To achieve an emission rate of less than zero, humanity would take action by the 2060s, beginning to withdraw some of the greenhouse gases already present in the atmosphere. The technology to suck carbon dioxide from the atmosphere does exist, but only at the experimental stage; no one knows if it will work at the required scale. At the other end of the scale, in the most dangerous scenario, humanity continues to produce greenhouse gases at an increasing rate.

For the scenarios shown in Figure 6.1, the temperature increase is held to within the goals of the Paris Agreement of less than 1.5ºC (2.7ºF) only if humanity reduces greenhouse gas emission to less than zero, with the steepest cuts coming before the end of the decade. The graphic also shows that if humanity does not make a determined and concerted effort to reduce the rate of emissions, dangerous temperature increases of 2 or more

Scenario	Very Likely Temperature Range		
Lowest to highest emissions added to atmosphere	Near-term: 2021–2040 (°C)	Mid-term: 2041–2060 (°C)	Long-term: 2081–2100 (°C)
1	1.2 to 1.7	1.2 to 2.0	1.0 to 1.8
2	1.2 to 1.8	1.3 to 2.2	1.3 to 2.4
3	1.2 to 1.8	1.6 to 2.5	2.1 to 3.5
4	1.2 to 1.8	1.7 to 2.6	2.8 to 4.6
5	1.3 to 1.9	1.9 to 3.0	3.3 to 5.7

Source: IPCC Sixth Assessment Report, "2021:Summary for Policymakers," in *Climate Change 2021: The Physical Science Basis* (Geneva: Intergovernmental Panel on Climate Change, 2021).

Figure 6.1. Predicted Temperature Rise by Scenario. Created by Army University Press.

degrees are possible before mid-century and an extinction-threatening rise of more than 5ºC (9ºF) degrees is possible by the end of the century. To illustrate the risk for humanity, the IPCC report notes that the last time the average global temperature was 2.5ºC higher than in 1900 was more than three million years ago, long before our species evolved. The 2021 IPCC report also considered the projected changes in extreme climate events. Figure 6.2 on the next page outlines the report's findings regarding the increasing frequency of ten- and fifty-year extreme heat and precipitation events. The IPCC data clearly predicts much more frequent extreme weather events than was the norm in the 1850–1900 baseline. The data also shows that the higher the temperature, the more frequent these events. The chart confirms that such increases are already taking place with the current rise of just over one degree.

While it is not possible to provide a year-by-year prediction of the threats that climate change will generate, a future risk profile suggests the future threat dynamic would look like this:

• **Present**—Climate change is already causing humanitarian disasters and is a factor in human decision-making for war. Extreme weather events have noticeably increased in frequency; an unusually large number of very powerful storms have struck in a short time period. Between 2000

Type of Event	Baseline (1850–1900)	+1°C (now)	+1.5°C	+2°C	+4°C
10-Year Extreme Heat Event Over Land	1 time	2.8 times	4.1 times	5.6 times	9.4 times
10-Year Extreme Precipitation Event Over Land	1 time	1.3 times	1.5 times	1.7 times	2.7 times
10-Year Agricultural and Ecological Drought Event	1 time	1.7 times	2.0 times	2.4 times	4.1 times
50-Year Extreme Heat Event Over Land	1 time	4.8 times	8.6 times	13.9 times	39.2 times

Source: IPCC Sixth Assessment Report, "2021: Summary for Policymakers," in *Climate Change 2021: The Physical Science Basis* (Geneva: Intergovernmental Panel on Climate Change, 2021).

Figure 6.2. Increases in Extreme Heat and Precipitation Events. Created by Army University Press.

and 2019, the Northern Hemisphere experienced twenty-five Category 5 storms. Typhoon Haiyan, which struck the Philippines in 2013 and killed at least 6,300 people, was the second most powerful storm on record at the time. It was exceeded in strength by Typhoon Goni in 2020. The drought in the American Southwest continues, as does the advance of the Sahara Desert into the Sahel region to its south. Adverse climatic factors already influenced the onset of the Syrian Civil War and the Arab Spring. The storm is building. Indications of aquifer depletion and water stress are more common, and the world's frozen waters continue to disappear. Political action remains anemic.

• **Near Future (five to twenty-five years)**—As climate change intensifies, the interaction between the Earth System and human production systems will become less generous, leading to greater human suffering. Island states will start to disappear, with the smaller ones ceasing to exist, resulting in migration emergencies. The run-off from glaciers will become less reliable, leading to a reduction in the amount of water available to grow food in densely populated areas of China, South East Asia, and South Asia.

A seasonally open Arctic will become the norm, possibly leading to territorial disputes between Arctic states, two of which—the United States and Russia—possess nuclear weapons. Aquifers in South Asia and East Asia as well as in the Sahel will be depleted to the point of petering out and agricultural yields in the affected areas will collapse, triggering widespread famines. Crop failures will become more common in California due to less snow melt and the drying up of the Colorado River. The result will be greatly increased prices for vegetables across the United States, prompting protests and food riots in American cities. Bangladeshi civilians will overwhelm the fence separating them from India's higher ground as the Bay of Bengal submerges their country. The Mekong, Nile, Indus, and other deltas will become more saline, significantly reducing food availability in these once-highly productive agricultural regions. The decline of such deltas will increase the strain on affected countries. The social contracts of weaker states will become untenable, and they will unravel under the pressure of too many stressors. The decision for war will become easier for states as the relative cost shifts in war's favor. Operations at coastal bases will be routinely disrupted by inundations, and more powerful storms will damage infrastructure, causing a retreat to safer ground.

• **Next Generation (mid- to end-century)**—Widespread collapse of social contracts will occur as regions lose their ability to meet inhabitant basic needs in the face of a hostile Earth System. Mass migrations will become the norm as people attempt to escape worsening conditions. It will become increasingly difficult to maintain infrastructure as massive storms wreak havoc. The wealthy world will become the target of widespread hatred and retribution from the poor world, leading to terrorist acts and periodic invasions. For many people, war will be the only option for survival. A mass loss of life will occur, and much of the planet will no longer be able to support humans at anything beyond a pre-industrial level. In many parts of the world, population and societal organization will crash to levels not seen for hundreds of years, while those living in more secure regions will struggle to halt the decline in their standards of living. Africa, the Middle East, and South and East Asia will be particularly hard-hit, and the world will fracture into competing zones.

According to all three risk profiles, tropical diseases will expand into temperate zones, exposing new populations to their depredations. The COVID-19 outbreak demonstrated the world was fundamentally unprepared for the rapid global spread of a serious infectious disease. Public health professionals believe a disease outbreak has the potential to cause "sudden, extraordinary, widespread disaster with tens to hundreds of mil-

lions of fatalities."[9] COVID-19 showed that while a pandemic is a burden for rich countries, it can be catastrophic for poor or war-torn ones. The outbreak of a major pandemic, or a series of pandemics, will increase the strain on countries trying to meet the needs of their people in a climate-disrupted future. Not all will succeed.[10]

The risk profiles presented here may read as pitches for a disaster movie. Indeed, some films have already used similar scenarios. However, Hollywood is not being imaginative enough; the existing trend lines point toward such disasters becoming the future reality. The scenarios are also meant to suggest that climate change will not affect all regions evenly; some areas may be subject to a disproportionate number of climate-related stressors. Nor are all societies equally resilient. Depending on a society's weaknesses, it may not take much to push it into chaos and break its social contract, whereas stronger states may endure a similar level of turmoil without collapsing.

The Character of War in the Anthropocene

In recent years, military theorists have identified numerous special forms of war for which they have coined descriptive labels such as "war in the grey zone" and "new wars." Similarly, there may be a temptation to ascribe particular attributes that set "climate war" apart from other types of war. Such a step would be a mistake. The fundamental nature of war has not changed and there is nothing to be gained by describing climate wars as a "special" form of war with unique traits and rules that are distinctive from other "styles" of war. As Anglo-American strategist Colin S. Gray observed in *Another Bloody Century*, "That which seems new in its conduct will be balanced by the importance of features that are timeless."[11] Like all wars, the climate wars of the future will be driven by human wants and needs, and fought for a political objective with the weapons that a particular society has at hand, whether they are machetes or nuclear bombs or something in between. There will be no overarching climate "way of war."

Still, there are a few factors about war in the Anthropocene that will require a military to modify how it fights. Of first importance is the challenge of fighting in a hotter climate. The United States and its Coalition partners have had nearly two decades of experience in operations under the hot conditions in the Middle East. But no military has yet experienced operations where 50ºC (122ºF) is the overnight norm, as will be the case in future combat zones in the equatorial region.

To operate in a dramatically hotter environment, militaries will need to reimagine a soldier's kit, nutrition, and equipment. The ability to assess

a soldier's hydration levels in real-time would be useful to maintain health and ensure that decisions are not affected by the debilitating effects of heat stress. The human body, as with most equipment, has a limit on what it can tolerate before systemic failure occurs. Greater investment in training as well as sensors to detect the onset of heat stress or material failure will need to be incorporated into routine procedures. As operational conditions become more heat-extreme, militaries will have to revise doctrine and procedures. As for many animals that survive in very hot locations, the future battlefield may be a nocturnal one.

Increasing temperatures are also expected to expand the range of tropical diseases. Of particular note is the ancient scourge of malaria. In the tropics during the Second World War, mosquito-borne malaria and other diseases such as beriberi, scrub typhus, and dengue fever were more dangerous than Japanese bullets to the Australian, American, British, and Indian soldiers. In the early stages of the campaign in New Guinea, before the Allies enacted preventive measures and raised specialized health units, casualties from sickness reached alarming levels. For Japanese soldiers, whose medical and logistic systems were inferior to that of the Allies, and for whom evacuation to medical facilities in Japan was impossible, the situation was even worse.[12]

Militaries will need to redouble their prevention efforts as soldiers encounter these encroaching pathogens. Militaries may also need to consider re-establishing the malarial control units which were once commonplace across South East Asia and Pacific battlefields, as well as forming other specialist pathogen-focused units. These units were critical in controlling endemic diseases, and their contribution to a soldier's preventative health was vital for maintaining combat capability. Of course, this is not just a military concern. Expanding ranges will also bring civilian populations into contact with diseases that were not previously in their locales, a problem which may reduce the capacity of the national support base to support the military. The military will need to share its experience with other government agencies to assist in protecting civilian populations.

Climate change will not affect the major tenets of war, however. The decision to go to war will still be decided after a risk-versus-need calculation. The non-aggressor must still choose whether to fight or accept the aggressor's demands—in other words, prostrate themselves before their conquerors and hope for the best. War will also remain a human activity waged against a living opponent and expressed primarily as a violent act. As Prussian officer and strategist Carl von Clausewitz observed, war will

continue to be a collision between two living forces and only end when one side accepts the will of the other.[13]

What climate change will do is increase the odds that a nation will decide for war rather than seek or accept a negotiated solution. As discussed in Chapter 3, when societies come under pressure from various climate change "threat multipliers," an overwhelmed international system may not be able to close the gap between the need for and the availability of essentials like food. Without an international safety valve, more countries and non-state actors will accept war as the best option to secure the needs of their people. In the distant past, societies that were no longer able to meet basic needs from their existing territory simply moved to an unoccupied area. Unfortunately, unclaimed land has not been available for several millennia; with the world's population expected to reach 10 billion by 2050, receiving nations likely will not tolerate any mass migration. The decision, therefore, will be the traditional one—take what is needed from someone else by force against their will.

A 2021 US intelligence report does not offer any doubt that climate change will drive an increase in conflict as the security situation of many states worsens. The report's authors anticipate that water shortages and migration represent particularly severe risks for conflict. They also identify a thawed Arctic Ocean as a significant threat vector as nations attempt to transit the Northern Sea Route which Russia seeks to control. As early as 2013, the United States issued an Arctic Strategy that identified the potential for confrontation over resource extraction, fishing, tourism, and scientific research. The strategy called for international cooperation and building common interests across the region.[14]

Even nations that are in a relatively good position to meet their most critical needs will see a reduction in their security. Such favored countries include the United States, the European Union, and the rest of the developed world. The National Intelligence Committee anticipates that by 2030, these countries will face geopolitical tension resulting from a global perception that they have made an insufficient contribution to reducing emissions and mitigating climate change. The outcome of the 2021 COP26 meeting in Glasgow may have kept alive hopes of meeting the Paris Agreement's emission targets, but that is a highly optimistic interpretation. The reality is that key countries like the United States, the European Union, China, India, and Brazil continue to under-prioritize what needs to be done.[15] At COP26, Australia entrenched its position as a climate change recalcitrant by using the meeting to spruik its fossil fuel exports.[16] By any

measure, the National Intelligence Committee's appreciation seems appropriate; the near future will be riskier, less secure, and more violent.[17]

Not only will wars be more frequent, their nature will be more intense. In the past, most wars were fought for limited goals and displayed a degree of constraint. Wars in the mode of World War II, for example—which sought absolute victory—were quite rare. One hallmark of limited war is a desire to affect an opponent's will, not to crush it.[18] However, for a people facing extinction through famine, a limited goal will be insufficient. Governments will not be able to remain idle as their state's social contract collapses. Instead, they will do all in their power to preserve their society and their position and will seek absolute victory so they survive, even if others do not.

The potential fate of Egypt helps illustrate the way climate change will intersect with the modern world and increase the odds that future decisions will favor a violent and absolute resolution to a shortage of essential materials. Since the settling of the Nile Valley, the amount of rain that falls on the Ethiopian Highlands has determined whether Egyptians enjoy a time of plenty or one of famine.[19] So important was the Nile flood that as early as 5,000 years ago, the Egyptians built a measuring device called a Nilometer to track the height of the river.[20] The country's rulers knew the size of the flood would determine the size of the coming harvest.

For farmers tending fields in the Ethiopian Highlands, an El Niño year means the annual East African Monsoon will be weaker than average or even fail totally. It also means hunger for many as yields decline. For Egypt, it means a less bountiful Nile and not enough water to irrigate Egyptian crops. The consequences of a failed Nile flood can be significant; following the small flood of AD 967, 25 percent of Egyptians starved to death.[21]

Adding considerable risk to Egypt's flood prospect is Ethiopia's decision to construct a large hydroelectric dam on the Nile. The Ethiopian Government plans to use the dam's reservoir to generate electricity for its power-starved citizens. The dam is finished and filling has commenced. Once the dam is operational, Ethiopia's priority will be to produce electricity, a year-round activity rather than a seasonal one like farming. This means that water which would have arrived with the monsoon and irrigated fields for the growing season will instead head downstream progressively over twelve months. Moreover, in an El Niño event, there might be less water available. The Ethiopian government might be tempted to prioritize the power needs of its people rather than the irrigation needs of Egypt's farmers.[22]

Egypt's population is now more than 100 million, with nearly a third under the age of fifteen. Already, one-third of this youth bulge is developmentally stunted from childhood malnutrition, a percentage that will only worsen as the population continues to grow and food supplies become less reliable.[23] The country is food-insecure and dependent on international markets to meet its population's caloric needs. Since the mid-1990s, Egypt has consistently been one of the top three grain-importing countries in the world, which makes it highly vulnerable to price and supply shocks. Modern-day Egypt is just as dependent on the Nile flood for its food supply as was the Old Kingdom in ancient times. When the Nile flood failed in 2150 BC, the Old Kingdom dissolved into anarchy. The difference today is that Egypt can blame Ethiopia for its water shortages and may thus resort to war to get the water its farmers need.

Egypt is not the only developing county whose future food security may become even more at risk as climate change accelerates. The IPCC and other experts expect climate change to reduce global food production. The summary to a 2019 IPCC Report predicts grain production will decline across large parts of the world, while global fisheries will see large reductions in catches. If the temperature rise exceeds 1.5°C (2.7°F), global food losses will be even greater. Global food-exporting nations are also expected to see productivity losses which will result in international system shortages. Research suggests that Australia, one of the world's major food exporters, could become a food importer as climate change reduces the quantity of arable land. Australia's grain and livestock yields are both expected to decline in line with warming temperatures and changes to rainfall patterns. According to agriculture experts, the prospects for US yields are not much rosier. A 2015 US Department of Agriculture report described a worsening situation that would see food security become acute. The report concluded that climate change was "very likely to affect global, regional, and local food security by disrupting food availability, decreasing access to food, and making utilization more difficult."[24]

If a state cannot feed its people from domestic or international sources, what are its options for survival? This is a situation that has occurred with some frequency throughout history. In his book *Collapse*, American academic Jared Diamond identifies a consistent pattern in how societies break down from the ancient world to the present:

> When people are desperate, undernourished, and without hope, they blame their governments, which they see as responsible for or unable to solve their problems. They try to emigrate at any cost.

> They fight each other over land. They kill each other. They start civil wars. They figure that they have nothing to lose so they become terrorists, or they support or tolerate terrorists.[25]

People starve if they have no other option, but war provides an option, one which offers a chance—perhaps the only chance—for survival.[26]

Conclusion

This chapter has not spelled out the future of climate change in explicit detail, but there is a sufficiently clear picture to indicate that humanity's future will be more dangerous, violent, and risky than it has been for some time. The Anthropocene will see nations tested by a more hostile Earth System whose actions will affect human systems, particularly the most essential: food and water production and distribution. Under pressure, states will struggle to survive. Many may not succeed in keeping their social contracts intact. For the military, as is always the case, the ongoing survival of its state will be the focus.

Scientific evidence is clear that humanity cannot escape the present climate change event whose length, extent, variability, and intensity are all unknown. If the emission of greenhouse gases into the atmosphere is not halted in a matter of a few years—a decade at most—a 2ºC (3.6ºF) rise in average temperature is all but certain. Such an increase in heat will be disastrous for humanity. Even the strongest, most developed states will feel the strain of a hostile 2ºC-plus world. For those who serve in the military, therefore, the future is likely to be one of near-constant efforts to safeguard the nation, whether it is from extreme weather or the conflicts that climate change will generate.

Wile E. Coyote and his encounters with the cliff-edge again serve as a useful metaphor of what is to come. Unlike his nemesis the road runner, Wile E. constantly sought innovations from the Acme Corporation to shift the odds in his favor. He never hesitated to change his operational methods. As far as viewers could tell, he never succeeded in besting the road runner, but we can still learn from Wile E. There is no besting of nature; there is only understanding, accommodation, adaptation, and acceptance. When considering its climate change future, the military will need to accept that what is coming will go on for a long time, but that it can be endured and survived.

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Chapter 7
Recommendations and Final Thoughts

At this point in most climate change-related publications, authors swerve from their convincing book-length argument that humanity's future is doomed, to a final few pages of optimism; humanity will be all right if we do this or that. This work will continue this tradition, but only to a certain point. In fact, there is no going back; there is no returning to climate normal. Our species is in for a rocky ride no matter what action it takes to minimize the consequences of climate change. The magic bullet that can reverse time and bring humanity back to the relative calm of the Holocene Epoch does not exist. The Earth System has changed, which means there is no choice other than learning to live in the more tempestuous Anthropocene.

This chapter has two parts: first, a few recommendations and then final thoughts. The recommendations will include a number of suggestions to help the military contribute to the preservation of society by adapting its thinking and organization to an environment undergoing climate change. The recommendations are not prescriptive, nor are they dogmatic. Rather, they are the starting point for military leaders to think on the complex situations that climate change will create, for which there are no easy solutions. Additionally, the answers will vary from country to country because of different local environmental conditions and organizational cultures. Each military will need to find its own path, and the sooner leaders start to work through these issues, the quicker the organization can evolve into a climate change-capable force. Then my final thoughts outline the future that humanity faces and include a final appeal to adjust how the military prepares.

Recommendations

As discussed previously, two key factors will determine whether the nations that make up humanity's political establishment survive as intact polities or collapse into disorder as the bonds of social contracts are put under stress by climate change disruptions. First, the international community must reduce greenhouse gas emissions as quickly as possible to minimize future damage and risk. This factor can be termed preservation. The second is willingness to adapt to the more dangerous and disruptive environment which the Anthropocene will bring. This can be termed acceptance.

By taking action such as the recommendations outlined below, the military will play a critical part in helping its society recognize the need

to incorporate preservation and acceptance into future planning and decision-making. This book has painted a brutal and unpleasant picture, but the future is not without hope. By the nature of their job, those who serve in the military are managers of crises. These recommendations are not presented in priority order, nor are they comprehensive:

• **Redistribute effort.** The United States presently spends far more money on its military forces than it does to address climate change, a funding relationship which is mirrored by other countries. For 2021, the US Department of Defense budget topped $700 billion; by comparison, the 2017 allocation for climate change activities by all US Government departments was just $13.2 billion. Although figures for the same years were not available, the comparison is still astonishing; traditional defense funding was nearly 54 times greater than that for climate security. Moreover, the US Government 2020 budget slashed climate adaptation programs by 46 percent and research by 30 percent, further widening the gap. Secretary of Defense Lloyd Austin called climate change an existential threat, indicating the funding gulf between defense and climate is untenable.[1] Yet, despite Austin's assessment, a five-year Department of Defense budget forward projection for 2021 through 2025 makes no reference to climate change. As climate change events accelerate, more money will be needed to improve coastal and riverine defenses, relocate vulnerable communities, enhance forest fire protection, and fulfill a host of other security priorities. Additional monies will be needed to meet the needs of a more disruptive and dangerous age. Politicians may decide to reallocate part of the defense budget to climate change, requiring the military to do more with less. The military may be forced to cancel or reduce expensive platforms and make do with what exists and not invest in new and expensive technologies. Instead of steady increases in defense budgets, climate change may require military leaders to adjust to a new and tighter fiscal era.[2]

• **Understand emissions.** The first step in reducing emissions is to understand which capabilities generate emissions and in what quantity. The US military should audit its activities, programs, and systems to identify the rate of emissions produced under different conditions. This data will help the military prioritize changes in how the force operates that will result in fewer emissions. NATO has already begun a greenhouse gas emissions mapping project that will allow member nations to set goals for reducing emissions. The project information will help inform investment decisions, particularly on sourcing alternate low carbon means to achieve the desired effect, as well as training procedures.[3]

• **Redefine the meaning of security.** Military professionals, national security thinkers, and defense policymakers usually approach national security from the perspective of conflict with another state or non-state actor. Consequently, soldiers, sailors, and aviators serve to protect the citizens of their state from attack by the soldiers, sailors, and aviators of another state. Today, this dualistic relationship could be expanded to include potential attacks by or defense from an adversary's cyber and information warriors. Yet while threats from another state persist, many climate change-related threats will be non-traditional. Climate change is likely to make a state's current definition of national security inadequate or obsolete if it does not include protecting its people from a host of climate change events, such as inundation from sea level rise and extreme weather events, starvation from prolonged drought, illness and death from spreading diseases, and potentially even war. Military professionals and national security thinkers need to incorporate protection from adverse events into their risk assessments; such results triggered by the environment would prompt a major change in the definition of national security to include human security. For example, soldiers may find themselves tasked to help relocate American citizens from coastal zones that have been subject to repeated inundations, just as they have been repeatedly deployed to regional states on lifesaving missions. Future training programs may need to include not just warfighting scenarios but also practice managing climate-related disruptions that pose a threat to human security. Additionally, such a redefinition of security would throw a different light on the need to acquire weapons that are superior to those of an adversary. Those who work in the national security space are responsible to keep their state's people safe. Since future security threats will be dramatically different, they will need to reinterpret what is considered a threat.[4]

• **Consider the existing mission priority.** Armed forces exist for only one reason: the application or threat of state-sanctioned violence to achieve a political objective. In brief, to wage war. While waging war is the reason the military exists, and the justification for its budget, the state also call on its armed forces for a host of other tasks such as aid to the civil community, disaster assistance, and peacekeeping. Such tasks fall under the rubric of "military operations other than war" (MOOTW) missions. In the face of increasing climate change disruptions, there may be a call to reprioritize the military's missions. This reprioritization has already occurred in Australia; following the Bush Fire disaster of 2019, the government amended defense legislation to include mandatory callout of

reservists for climate-driven domestic disasters. As well, the government modified the Australian Defence Force's strategic priorities—elevating domestic deployments to equal footing with its warfighting mission. So far, more than 21,000 Australian soldiers have received training in domestic response operations.[5] Some might even argue that warfighting should be secondary to climate change event assistance. Such a reprioritization would be a mistake. Still, the military cannot dismiss the possibility that state and local authorities and community groups—tremendously pressured by chronic climatic events—will seek a different remit for the military with a flow-on effect to force preparation and training. The Army may include disaster response and cooperation with local agencies as a part of a unit's annual fitness assessment, in addition to combat effectiveness. In light of this experience, and the likely increase in the number and scale of climatic events, all militaries should prepare themselves for a greater domestic operational focus and the potential they will need to justify their continued prioritization of warfighting.

• **Challenge the existing force structure.** Most militaries contain two subsets, the regular force and the reserve force. The United States has a third military structure, the National Guard, which can consist of state or federal troops depending on circumstances. Because of climate change, the US Department of Defense anticipates natural disasters will strike with greater frequency and increased severity than in the past. The military can expect to play a role in such emergencies: protecting property and safeguarding lives. However, while such tasks have some operational utility, they are also a distraction from training, and serve to exhaust personnel, wear out equipment, and consume stores. Because insecure communities will look to the military for assistance—even demand assistance through locally elected officials—the armed forces risk being caught between two pressing demands: preparing for war and helping communities. In fact, the National Guard may become more of a domestic disaster response force rather than a deployable branch of the combat army. Increasing climate change risks may see the Guard reorganized and trained as disaster response formations and units rather than as armored or mechanized ones, providing those who serve with very different career trajectories and requirements. Obviously for the Army as a whole, this change would result in a smaller land force with significantly reduced warfighting capability. It would also see the severing of important ties between the military and the community. Some countries already have emergency response forces. In Australia, they are volunteers; in contrast, the United States has both full-time and volunteer organizations. What should be discussed is raising

a third (in the case of the United States a fourth) arm of the military; members of this uniformed organization would be subject to military discipline, but their purpose would not be warfighting. The main focus for this paramilitary force would be national assistance. Members would have lower fitness requirements than active-duty soldiers and a higher age allowance. The positions could be part-time and full-time, and personnel could be called up for prolonged periods to assist with a natural disaster. Importantly, such an entity would have its own equipment and stores, eliminating the need to rely on and wear out military stocks. Such an organization could be, depending on how a state decides to define the term, "national security" rather than part of the Department of Defense. In any case, the military must be ready to participate in a debate on providing personnel and equipment to help protect the community.

• **Learn to love nation-building.** As the social contracts of weak states collapse due to climate change-driven events, parts of the world are at risk of becoming ungoverned, or at least ungoverned by institutions recognized as legitimate by today's policymakers and military commanders. Canadian historian Gwynne Dyer anticipates a future in which many people live in large ungoverned spaces. The United States and its partners tried and failed to restore governance to Somalia. How would the US cope with twenty or more similarly ungoverned places? Could it cope? Some of these future "Somalias" might contain critical international infrastructure such as a canal through which much of the world's trade passes or an important geographic feature like a maritime choke point or a resources concentration for critical minerals such as lithium or rare earths. Such ungoverned spaces may already host an overseas base that the United States considers vital to its ability to project and sustain power, for example Diego Garcia. Driven by the need to better understand how to intervene in and govern an ungoverned area, the US military may need to gain expertise in a mission that it currently does not prioritize, namely nation-building. The military may also be required to aid residents of ungoverned regions to re-establish their social contracts and resume their place as nations. If such a future scenario becomes the reality, civil affairs would become a more prominent and core role for the Army. The flow-on effect for career paths is that the competition for command of a civil affairs battalion or brigade may become more intense than for the combat arm equivalent, leading to a change in the force's culture.[6]

• **Aggressively reduce greenhouse gas emissions.** As discussed in Chapter 3, the military is a major producer of greenhouse gases—the larg-

est emitter for the United States. As other sectors are called on to reduce emissions, the military will have to do likewise. The US Department of Defense has released a Climate Adaptation Plan, but progress needs to accelerate beyond planning to implementation.[7] Efforts to date have targeted facilities and installations, a focus that is likely insufficient and too slow if governments decide to proactively work to reduce emissions in order to meet the terms of the Paris Agreement. The military's vast consumption of petroleum products to power ships, aircraft, and vehicles would be an obvious target, particularly as the civilian transport sector embraces electrification. The US military needs to proactively work to reduce its use of petroleum products before such reductions are imposed by a government reacting to domestic and international pressure. One approach might be to train in an entirely online environment. Simulation training is already widespread, particularly for trades that have high maintenance costs. In the future, all training may need to transition to a synthetic environment to reduce greenhouse gas emissions linked to transport and ordnance expenditure. Moreover, by helping the nation reduce greenhouse gases, the military will help limit the carnage that climate change will cause and, at the same time, help achieve the nation's security objectives.

• **Implement Deep Strategy.** As discussed in Chapter 6, the military needs to understand how the environment responds to human stimuli. Global warming is the environment's response to humanity adding carbon dioxide and other greenhouse gases to the atmosphere. Operationally, if another state was to unilaterally commence a geoengineering program, it would be important to have personnel already in place responsible for understanding how the Earth System will react to such stimuli. Neither the military nor any government agency has the requisite skill sets to conduct Deep Strategy. Therefore, the military will need to grow the required capability, creating new career options at the colonel and lieutenant colonel levels. The present staff system also needs to be modified, adding Deep Strategy responsibilities to the G2, G3, G4, and G5 levels (as well as S2, S3, S4, and S5) or even creating a new number focused exclusively on Deep Strategy. In the area of strategy, the US Army already has experience in growing a trade to meet a requirement: the Functional Area (FA) strategist (formally Strategic Plans and Policy officer). A deep strategist is simply the next step in evolving strategic requirements and developing expertise. At one time, the military did not have any diesel mechanics, or cyber operators for that matter; the need to fashion a new skill set is not unusual. Of the many adaptations that climate change will require, this is

perhaps the most direct—and the most important to help prevent further harm to humanity's earthly home.

• **Build deeper ties.** In the Western tradition, the military is accepted as a part of the surrounding community. A wise base commander is aware of local concerns and engages with community leaders. The military needs to build on and formalize this foundation. During Australia's 2019–2020 Bush Fire Emergency, the Australian Defence Force (ADF) liaised with the national emergency organization, appointing a two-star to lead engagement. To do this, the ADF first had to extemporize a staff, promote a one-star to the new position, and determine terms of service conditions for its personnel. At the local level, the headquarters of regional reserve brigades liaised with the state-level emergency organization. There was no standing organization to take responsibility. As climate change intensifies and climatic events become more common, it would be useful to have a standing organization with which to coordinate the military's response to federal, state, and local needs. This requirement could be met by creating a liaison office at the base level; at the state level, the National Guard headquarters could raise a small staff responsible for maintaining ties with state and local emergency organizations. The military should also recognise that there is a degree of self-interest in enacting this recommendation. Many military bases are vulnerable to climate change events such as floods, coastal inundations, or out-of-control fires. During such an emergency, the military may need the assistance of local authorities to shore up a levee in a flood or help extinguish a forest fire that is threatening a base. Maintaining an ongoing relationship will help minimize the time lag in providing or receiving assistance.

Final Thoughts

The optimist in me hopes the world's political leaders, especially those from critical countries like the United States, China, India, Brazil, the European Union, Australia, and Russia, do what is necessary to reduce greenhouse gas emissions to zero, or lower, and do so with haste. Unfortunately, the emphasis at the most recent international climate change meeting was more on talk than concrete commitments. The critical countries still lack the political will to do what is necessary. At COP26 in Glasgow, the High Ambition Coalition issued a statement calling for more aggressive action to reduce greenhouse gas emissions. The Coalition includes the United States, many European Union members, New Zealand, and a number of island states. Australia, a key player in the fossil fuel economy, is not a member and did not sign. The High Ambition Coalition also called for

a halt to the construction of coal-fired power plants and the end to fossil fuel production subsidies. The statement recognized that what is currently being done is not enough to keep the planet's temperature rise to below 1.5ºC (2.7ºF). In fact, the trajectory is far worse, and the consequences for environmental and societal disruption are far graver.[8]

The likely result of a general failure to act decisively will be cascading climate events that destabilize states and tip societies into a Hobbesian world of turmoil and violence. Recent climate data shows humanity is still far from solving the problem of climate change. Despite all efforts, cumulative emissions have surged over the past few decades. Americans are the leaders from the perspective of contributor responsibility, although the Chinese are quickly catching up. In the last decade, United States total emissions increased by 15 percent while China's jumped 74 percent.[9] Figure 7.1 illustrates the cumulative carbon dioxide emissions by nation.

Those whose business is war recognize that, in a very real sense, humans built civilization from war. The goal of all war is to make a better peace, and this will be the end point of any military operation in the Anthropocene. In his book *War! What it is Good For?*, British historian Ian Morris shares his belief that humanity uses war to create larger states which are strong enough to impose peace. Humanity likely will continue to manage the climate crisis by resorting to war; after all, war is one of the oldest and most effective problem-solving tools invented by humans.

If humanity does not contain climate change, a large percentage of those now living or soon to be born will die as a result of the chaos brought on by our modifications to the Earth System. Climate change-induced stressors will place tremendous strain on the fabric of all states, and when their citizens' needs can no longer be met, many states will collapse into chaos and social contracts will be breached. To survive, people will choose war because they will calculate that it is their best option. More resilient societies that have the will and leadership to adapt are better positioned to continue. Weaker and less fortunate states whose social contracts fail will re-enter a Hobbesian state of nature where violence is the norm and no one is safe. If global warming is not limited, this is our future.

French philosopher Paul Valéry offered: "We are aware that a civilization has the same fragility as a life."[10] We have the fortune to live in "interesting times," but humanity has also bounced back from previous "interesting times." There is no reason to think our time will be different. As British historian Michael Howard has pointed out, a society that has lost its stability can only be restored by adjusting to the new conditions.[11]

The new condition is the Anthropocene, and humanity will need to create a renewed civilization that is fit for its climate. Soldiers will play a significant part in that renewal.

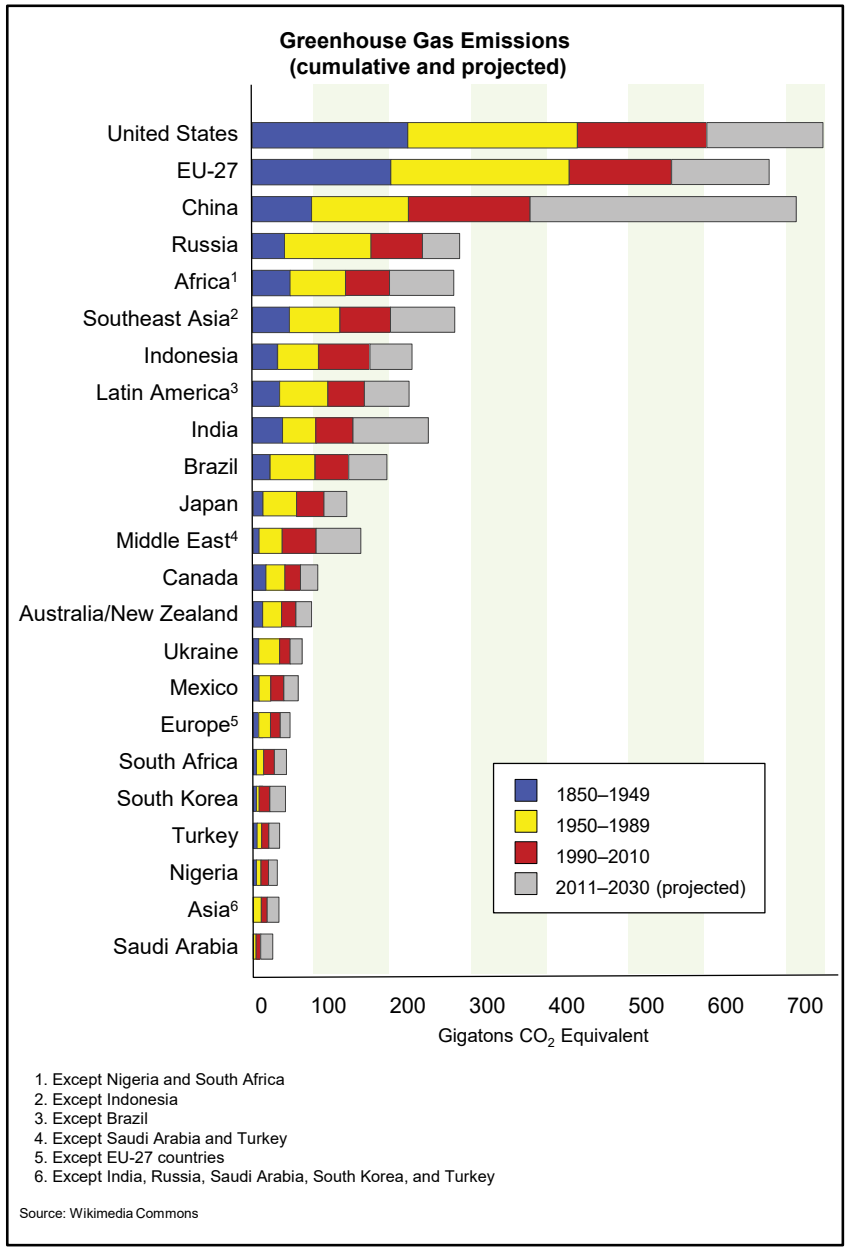

Figure 7.1. Cumulative and Projected Greenhouse Gas Emissions, 1850 to 2030. Created by Army University Press.

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Glossary of Technical Terms

Atlantic Meridional Overturning Circulation (AMOC) – The AMOC is the key circulation system of the Atlantic Ocean. It transports warm water northward at the surface. When the water reaches the Arctic, it cools and sinks. The water then heads southward at the bottom of the ocean. The pace of the AMOC is affected by the quantity of fresh water flowing into it from Greenland and Labrador. Too much fresh water weakens the AMOC, which lessens the amount of warm water flowing north. The result is a lower temperature in northern Europe.

Biosphere –The biosphere is the region of the surface and atmosphere of the earth, including the oceans, in which living organisms exist.

Carrying Capacity - Carrying capacity is a limit of the production capability of the land. It is the amount of resources, such as food, that a population is able to produce from its territory at a point in time. A population is considered to exceed its carrying capacity when its food requirements cannot be met by the territory it controls.

Climate – Climate is conditions such as temperature, precipitation, and wind that are expected in a particular place at a particular time of year, expressed as an average developed through observations taken over a long period. In the words of NASA, "Climate [is] the average weather for a particular region and time period, usually taken over 30 years. It's really an average pattern of weather for a particular region."[1]

Coral Bleaching – Coral bleaching refers to the whitening of coral as it expels the symbiotic algae that lives in its tissue. This occurs when the coral is under stress as a result of changes in the environment, usually a temperature deviation from its preferred range. Without its symbiotic algae, the coral turns white. If the temperature remains too hot, or less often too cold, the coral dies and looks as if it had been bleached.[2]

Deep Strategy – This is the level of war, or its planning, which considers the integration of a nation's security policy with the Earth System. Its aim is to perceive how the Earth System will react to human stimuli. Deep Strategy includes an understanding of the consequence such integration holds for the future of life on the planet.

Earth System – These are systems through which energy and matter circulate around the planet. These systems regulate and maintain the makeup and energy levels of the atmosphere, oceans, land, and other parts of the planet. For example, the AMOC is part of the Earth System.

Ecocide – Ecocide is defined as unlawful or wanton acts committed with foreknowledge that there is a substantial likelihood they will cause severe and either widespread or long-term damage to the environment.

El Niño – El Niño and La Niña are a recurring Pacific Ocean climatic pattern with a cycle of approximately two to seven years. El Niño events are triggered by changes in the temperature of the water of the Western Pacific. El Niño and La Niña events affect weather across the Indian Ocean, Pacific Ocean, Australia, and the Pacific side of the Western Hemisphere.

Epoch – An epoch is a geological measurement of time. Epochs are shorter than a period but longer than an age. The Holocene and Anthropocene Epochs, along with the Pleistocene Epoch, make up the Quaternary Period. The Quaternary, Neogene, and Paleogene are periods in the Cenozoic Era. The Cenozoic, in turn, is part of the Phanerozoic Eon. Humanity, through its ability to act on the Earth System, has brought the Holocene Epoch to an end. The current epoch is the Anthropocene.

Five Eyes – Cooperative association of five English-speaking militaries consisting of the United States, United Kingdom, Canada, Australia, and New Zealand.

Greenhouse Gases – Greenhouse gases are molecules which prevent the earth's infrared radiation from escaping into space; this warms the atmosphere. Common greenhouse gases are carbon dioxide, water vapor, methane, and nitrous oxide.

Human Systems – Organizational systems created by humanity to manage complex activities such as power distribution, banking, and farming.

Intergovernmental Panel on Climate Change (IPCC) – The IPCC is an intergovernmental body of the United Nations whose mission is to advance knowledge of human-induced climate change. It was established in 1988 and has, to date, produced six assessment reports. Its membership includes thousands of scientists. The IPCC does not conduct original research. Instead, its mission is to review all existing climate change research and render conclusions in terms that are understandable for policymakers.

Malthusian Trap – The Malthusian Trap occurs when a population expands to the point that it cannot produce enough food and maintain economic stability—that is, it exceeds its territory's carrying capacity. When this occurs, famine and social strife reduce the population to a level that can be met by the territory's carrying capacity. It is also possible to escape a Malthusian Trap by recourse to international markets, if such exist,

through technological innovation, or by taking what is needed from another population group.

Net Zero – Net-zero emissions is a state where the sum of all greenhouse gas emissions from human sources is matched by mechanisms that effectively remove such gases from the atmosphere. The net gain, therefore, is zero.

Paris Agreement – The Paris Agreement is a binding international treaty that was a product of the Paris COP21 meeting. It calls for states to reduce their greenhouse gas emissions so that global warming does not exceed 1.5ºC (2.7ºF).

Social Contract – A social contract is an actual or implicit agreement between a ruler and the ruled to govern the exercise of power by the state. It defines the rights and duties of each party and underpins the organization and maintenance of a society.

Notes

1. “NASA—What’s the Difference Between Weather and Climate?,” NASA, 1 February 2005, https://www.nasa.gov/mission_pages/noaa-n/climate/climate_weather.html.

2. “What is Coral Bleaching,” NOAA, 1 December 2021, https://ocean-service.noaa.gov/facts/coral_bleach.html#:~:text=When%20water%20is%20too%20warm,and%20are%20subject%20to%20mortality.

Select Bibliography

The purpose of this bibliography is to offer suggestions for further exploring the threat climate change poses to national security. The works listed were included due to their utility, accessibility, and availability. They represent a small fraction of the works used in the research and writing of this book. The bibliography is arranged by theme.

Introductory Works on Climate Change

Literature on climate change has become vast and continues to grow at an accelerating rate. Fortunately, there is no shortage of introductory works that offer useful starting points for an exploration of the subject. Perhaps the best author with which to commence is American environmentalist Bill McKibben. He has been writing highly readable and informative books on the environment for thirty years. McKibben is also the founder of 350.org, an early people-power environmental movement focused on the battle to combat climate change. His works provide a great resource for those new to the subject of climate change as well as more experienced readers who want frank but compelling ideas on how to make a difference. His *End of Nature* (Random House: New York, 1989) is considered a classic work on the coming cataclysm. Also of note is *Eaarth: Making a Life on a Tough New Planet* (Henry Holt: New York, 2010), in which McKibben outlines the challenges humanity will face surviving on a future planet so different that it is beyond recognition. For an analysis of the effects of climate change on human civilization, anthropologist Brian Fagan has written a number of introductory works on different aspects of the way the environment has shaped society through the ages. He provides a useful overview in *The Great Warming: Climate Change and the Rise and Fall of Civilizations* (Bloomsbury Press: New York, 2004). For a historian's perspective on the causation of climate change, and the rapidity with which it is occurring, J. R. McNeill's and Peter Engleke's *The Great Acceleration: An Environmental History of the Anthropocene since 1945* (The Belnap Press of Harvard University Press: Cambridge, 2014) is very worthwhile. The science of climate change is extremely complex because it involves the interaction of a number of complex environmental systems that are being affected by human actions. Most works require specialist knowledge. For those lacking a scientific background, palaeoclimatologist William F. Ruddiman's *Earth's Climate Past and Future*, 3rd ed. (W. H. Freeman and Company: New York, 2013) distills climate complexity into manageable sections which are well supported by numerous illustrations.

Important Reports on Climate Change

The most important reports on climate change are produced by the Intergovernmental Panel on Climate Change (IPCC), an international body of scientists supported by the United Nations. In 2022, the IPCC released its *Sixth Assessment Report* (https://www.ipcc.ch/report/ar6/wg2/). Every successive IPCC report since the first in 1990 has described a riskier and more dangerous future if humanity does not curtail greenhouse gas emissions. The IPCC also produces extremely useful and detailed themed reports such as the *2019 IPCC Special Report on the Ocean and Cryosphere in a Changing Climate*. Such reports are major efforts and involve the work of hundreds of scientists from around the world. These definitive documents are written by scientists for scientists. Fortunately, each publication contains a highly readable Summary for Policymakers that is easily accessible by the non-specialist. Other agencies also issue important climate change reports, including the National Oceanic and Atmospheric Administration (NOAA). NOAA's monthly report on the state of the climate is at https://www.ncei.noaa.gov/access/monitoring/monthly-report/. NOAA also maintains a database of interactive weather maps (https://www.climate.gov/), as well as providing educational materials to support teaching on climate change. The Pentagon has issued or commissioned a number of reports that are essential reading for the military professional who wants to understand the threat climate change poses to national security. Some of the most important are from the CNA under the authorship of its Military Advisory Board. For a particularly compelling example, see CNA Military Advisory Board, *National Security and the Accelerating Risks of Climate Change* (CNA: Alexandria, VA, 2014). The US Department of Defense has produced several internal reports and assessments of note, including *Climate Related Risk to DoD Infrastructure: Initial Vulnerability Assessment Survey (SLVAS Report)*, 2018; and "Report on Effects of a Changing Climate to the Department of Defense," January 2019, https://www.documentcloud.org/documents/5689153-DoD-Final-Climate-Report.html. Additionally, the US Army War College sponsored a report produced by a team led by military strategist Max Brosig: *Implications of Climate Change for the U.S. Army* (US Army War College: Carlisle, PA, 2019). This paper is essential for understanding the gaps in US Army readiness for climate change. Think tanks in the private sector have also produced numerous reports. Among the best are from the Climate Council, an Australia-based non-profit research organization focused on climate change. The Council routinely issues reports that discuss the costs

of inaction, climate change-induced disasters, and pathways to reduce the use of fossil fuels, available at https://www.climatecouncil.org.au/.

Climate Change Denial

The fossil fuel industry and its supporters have made a determined effort to undermine climate science and distract from the need to take action to stop greenhouse gas emissions. Numerous works discuss these self-serving efforts. Scientists have not avoided the wrath of climate deniers; for example, leading climate scholar Michael Mann has received particularly harsh, if inaccurate and unjust, criticism. In *The New Climate War: The Fight to Take Back the Planet* (Scribe: New York, 2021), he exposes the role lobbyists, corporate spokespeople, and political donors have played in undermining any effort to advance a pro-climate agenda or develop government policies to reduce greenhouse gas emissions. In *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco to Global Warming* (Bloomsbury: New York, 2010), authors Naomi Oreskes and Erik M. Conway explore fossil fuel industry patterns and tactics to fund scientists, usually ones with no expertise on climate, who are willing to speak out against the need to address climate change—much as the tobacco industry paid its own researchers and spokespeople who showed no hesitation in deceiving the public. Taking a somewhat different tack, Australian ethicist Clive Hamilton sees resistance to effective action on climate change not only in terms of a fossil fuel industry conspiracy, but as a moral failure of humanity. In *Requiem for a Species: Why We Resist the Truth About Climate Change* (Allen & Unwin: Sydney, 2010), Hamilton explains why, in light of overwhelming evidence and increasingly frank and unassailable reports, many people refuse to accept the facts and take action. He sees this failure in terms of hubris, greed, and society's inability to prioritize the greater good over the long-term against the immediate pleasure of the individual. For Canadian author Naomi Klein, the reluctance to take action is a function of our economic system. She explains in *This Changes Everything* (Penguin: New York, 2014) that effective action against climate change requires a rethink of human systems, particularly capitalism.

The Threat of Climate Change-Induced War

That war is the result of climate change-induced instability and resource shortage is well established in literature. It is why researchers and policymakers have termed climate change a threat multiplier. A number of works detail how climate change is expected to increase the incidence

and intensity of intrastate and interstate conflicts. The most accessible is Canadian historian Gwynne Dyer's *Climate Wars: The Fight for Survival as the World Overheats* (One World: Oxford, 2011). Dyer brings his eloquent writing style to the story of climate geopolitics in a way that alternates between scary and simply terrifying. An early convert to the security threat posed by climate change is researcher James R. Lee. In *Climate Change and Armed Conflict: Hot and Cold Wars* (Routledge: Milton Park, UK, 2009), he outlines a grim prognosis, but also the opportunity for sound policies to lessen the worst of the coming conflicts. Environmental security analyst Jeffrey Mazo takes a similar approach in his International Institute for Strategic Studies book, although he focuses on the causes and consequences of state failure. See *Climate Conflict: How Global Warming Threatens Security and What to Do About It* (IISS: London, 2010). In *Environmental Security: A Guide to the Issues*, international relations professor Elizabeth L. Chalecki (Praeger: Santa Barbara, CA, 2013) examines the intersection between climate and security and how changes in environmental systems will destabilize both. The potential for resource shortages to trigger war is the subject of German social psychologist Harald Welzer's *Climate Wars: Why People Will Be Killed in the Twenty-First* Century (Polity: Cambridge, 2012). For Welzer, war is almost an inevitable outcome as climate change reduces the availability of essential resources. How militaries are to prepare for war in the midst of climate-driven change is a largely unexplored topic. The one exception is author Michael T. Klare's excellent *All Hell Breaking Loose: The Pentagon's Perspective on Climate Change* (Metropolitan Books: New York, 2019). Klare examines how climate change threatens the way the US military currently operates and suggests how the military will need to adapt to remain useful in the future.

Resource Insecurity and Conflict

Throughout history, one of the more common events has been conflict sparked by resource shortages, usually food, as people fight to secure what they need. This issue received renewed attention with the onset of the environmental movement as population experts explored the link between a healthy environment and providing the resources humanity required. As the global population grew in the twentieth century, concerned voices became more explicit. One of the leading thinkers on the potential threat underlaying population growth and resource security was American biologist Paul R. Ehrlich and his classic work *Population Bomb* (Ballantine Books: New York, 1968). Although humanity has to date avoided the fate Ehrlich wrote about, he is not alone in perceiving the ongoing risk. Re-

cently, scientist Stephen Emmott speculated on the challenge of supporting the mid-century's expected population of ten billion in a short book of the same name (Penguin, New York, 2013). *10 Billion* does not make for comfortable reading. In *Food or War* (Cambridge University Press: Cambridge, 2019), author Julian Cribb is explicit about humanity's limited options when climate change causes food production to decline. Author Roy Woodbridge pursues a similar theme in *Tribes, Cities, Nations, and Ecological Decline* (Toronto University Press: Toronto, 2004). He sees a future in which humanity either fights successfully for a better world or ends up fighting over the scraps. The struggle to secure the last easily accessible resources is the theme of Michael T. Klare's *The Race for What's Left: The Global Scramble for the World's Last Resource*s (Picador: New York, 2012). Klare expects the need for resources to become more intense and expand into new territories, such as a thawing Arctic Ocean, which will provide states with technological and political challenges to their peaceful extraction. As extraction expands, and as population growth increases pressure on natural systems, strategists Anders Wijkman and Johan Rockström (*Bankrupting Nature: Denying our Planetary Boundaries*, Routledge: Milton Park, 2012) see the prospect of humanity exceeding the level of resource generation that the planet can safely sustain. They conclude that if states and industries continue with business-as-usual, disaster is the only possible outcome.

Climate Change and Societal Collapse

As societies come under stress from climate change, some likely will be unable to survive the pressure and will collapse. Researchers concerned with the potential for climate change-induced collapse have an existing theory of how societies collapse on which to build their thinking. The work of American anthropologist Joseph A. Tainter is a particularly relevant resource regarding societal collapse. His *The Collapse of Complex Societies* (Cambridge University Press: Cambridge, 1988) remains the go-to work on the topic. When a society is at risk of collapse, its total destruction is not ordained. Canadian political scientist Thomas Homer-Dixon maintains in *The Upside of Down: Catastrophe, Creativity, and the Renewal of Civilization* (Text Publishing: Melbourne, 2006) that a collapse often contains the opportunity for renewal. While Tainter and Homer-Dixon provide generalist accounts of how collapse comes about, a number of works examine the prospect of humanity's future as a result of climate change. Writing as if from 2393, American historians Naomi Oreskes and Erik M. Conway posit a future that bears no resemblance to the present. Their book's title suggests its theme: *The Collapse of Western Civilization: A View from the*

Future (Columbia University Press: New York, 2014). In fewer than ninety pages, the authors present a searing account of a civilization that would not change and paid the ultimate price. In *Empires of Food* (Free Press: New York, 2010), authors Evan D. G. Fraser and Andrew Rimas look to the past to explain how cycles of food production underpinned the rise of civilizations, as well as how food shortages were responsible for their collapse. Journalist Eugene Linden ranges from the deep past to the present in his explanation of societal decline and disappearance—*The Winds of Change: Climate, Weather, and the Destruction of Civilization* (Simon & Schuster: New York, 2006). Redoubtable author Jared Diamond examines collapse from the perspective of choice, that a society has the capability to moderate or even prevent a collapse depending on the policies its leaders and people implement. *Collapse: How Societies Choose to Fail or Succeed* (Penguin: New York, 2011) is a tour de force which examines a number of past and contemporary societies, identifying patterns that lead to survival or disappearance.

Climate Change and International Relations

International relations scholars have been slow to appreciate the effect climate change will have on relations between states, as well as on the stability of affected regions. The best work to date is British author Anatol Lieven's *Climate Change and the Nation State: The Realist Case* (Allen Lane: London, 2020). Lieven makes a very convincing argument that today's states are far more threatened by climate change than by each other; he provides an entirely new point of view for examining climate change's potential to disrupt the way people interact across and within borders. Echoing Lieven's theme is Australian academic Mark Beeson in *Environmental Anarchy? Security in the 21st Century* (Bristol University Press: Bristol, 2021). Beeson sees a future in which the primary risk facing states is climate change-induced disruption, a threat which the international relations community has ignored for far too long. A subcategory of international relations study is migration resulting from climate change's potential to destroy environments on which humans depend. Journalist Todd Miller looks at mass migration from the perspective of the refugee and identifies gaps in existing international law covering such events. Writing in *Storming the Wall: Climate Change, Migration, and Homeland Security* (City Lights: San Francisco, 2017), he sees climate change refugees as a threat to destination states, as well as to the states that generate these desperate people. A multi-author consideration of climate change-driven migration is provided in a collection of essays edited by human rights advocates Scott Leckie, Ezekiel Simperingham, and Jordan

Bakker. *The Climate Change and Displacement Reader* (Earthscan: New York, 2012) contains more than thirty-five essays addressing the legal and institutional framework, human rights, and the effect of climate disruption on social stability. The collection also includes a variety of nation-based case studies on some of the states that are most at risk from sea-level rise, such as Bangladesh, the Maldives, and numerous Pacific island countries.

Climate Change and Humanity's Past

Historians, archaeologists, and anthropologists have recognized how the climate shapes human development. Consequently, a large outpouring of works integrate climate change events into explanatory narratives of societal turning points, including the disappearance of civilizations. Of particular note is American historian John L. Brooke's groundbreaking tome, *Climate Change and the Course of Global History* (Cambridge University Press: Cambridge, 2014). This book is not for the faint-hearted or the beginner climate scholar; his sweeping-yet-detailed account explains how climate underpins the development of societies from the emergence of humanity to the present. Easier to read but no less detailed is English historian Geoffrey Parker's study of how the Little Ice Age affected global society. A *Sunday Times* Book of the Year, *Global Crisis: War Climate Change and Catastrophe in the Seventeenth Century* (Yale University Press: New Haven, CT, 2013) explains that climate change was the underlying, and heretofore unexplored, cause for the particularly bloody nature of the seventeenth century. The lower temperatures of the Little Ice Age prompted a reduction in agricultural production that placed increased stress on societies. When the strain became too much, war or migration was the result. Not every society faltered during the Little Ice Age, as Dagomar Degroot observes in *The Frigid Golden Age: Climate Change, the Little Ice Age, and the Dutch Republic, 1650–1720* (Cambridge University Press: Cambridge, 2018). Degroot establishes that decisions matter, providing a case study of how the Dutch people managed to avoid the worst traumas of this period of global cold, unlike most of Europe. Rome's fall, a favorite topic for historians, benefits greatly from a new climate change explanation as presented in historian Kyle Harpers's *The Fate of Rome: Climate, Disease, and the End of Empire* (Princeton University Press: Princeton, NJ, 2017). Bringing an anthological perspective to climate change is very productive British author Brian Fagan, who has written a series of targeted and accessible books on the subject. These include *Floods, Famines, and Emperors: El Niño and the Fate of Civilizations* (Pimlico: London, 1999); *The Little Ice Age: How Climate Made History, 1300–1850* (Basic Books: New

York, 2000); and *The Long Summer: How Climate Changed Civilization* (Basic Books: New York, 2004).

Environmental Warnings

The modern environmental movement grew out of the numerous challenges to existing authority that marked the 1960s. Contemporaneous with the civil and women rights movements, as well as anti-war protests, environmentalists drew attention to the damage being done by humans to the air, water, and land. The galvanizing work of environmental protest was American conservationist Rachel Carson's *Silent Spring* (Houghton Mifflin: Boston, 2002) on the damage being done to nature and humans by the indiscriminate use of pesticides. Another critical work appeared in 1974: *Limits to Growth* by authors Donella Meadows, Jorgen Randers, and Dennis Meadows, which argued that unlimited growth was not sustainable on a planet with finite resources. Thirty years later the team provided updated information in *Limits to Growth: The 30 Year Update* (Chelsea Green: White River Junction, VT, 2004), which reiterated the risks of maintaining economic systems that reward continuous growth and ignore the needs of future generations. A number of other books have explored the idea that humanity's survival will require industry to consider the effect of unbridled production. Among the accomplished thinkers on this theme is American environmental analyst Lester R. Brown of the Earth Policy Institute. In *Plan B 2.0: Rescuing a Planet under Stress and a Civilization in Trouble* (W. W. Norton: New York, 2006), he makes the case that continued unsustainable growth will create a planet that would no longer sustain life. Human population growth and a Western lifestyle have resulted in people becoming the dominant species on earth, a status achieved at the expense of other creatures. Numerous commentators fear that if humanity continues to take a disproportionate share of resources, the result will be another mass extinction—the sixth in the planet's history. This is the subject of American journalist Elizabeth Kolbert's highly readable *The Sixth Extinction: An Unnatural History* (Picador: New York, 2014). Bill McKibben, a repeat *New York Times* bestselling author, continues the theme of extinction but includes the end of humanity as a consequence of its failure to take risk into account when making decisions with planet-wide effects. *Falter: Has the Human Game Begun to Play Itself Out?* (Henry Holt: New York, 2019) is the latest from this noted environment author.

About the Author

Formerly the long-serving Director of War Studies for the Australian Army, Dr. Albert Palazzo is currently an Adjunct Professor at University of New South Wales-Canberra. He completed his PhD in military history at The Ohio State University, his dissertation subsequently published as *Seeking Victory on The Western Front: The British Army and Chemical Warfare in World War I*. Born and raised in Brooklyn, New York, he migrated to Australia in 1996 and commenced his career in the School of History at the Australian Defence Force Academy. He has written more than twenty books and monographs on the art of war, including *The Australian Army: A History of its Organisation, 1901–2001*, *The Australian Army and the War in Iraq, The Battle of Crete*, *From Moltke to Bin Laden: The Relevance of Doctrine in the Contemporary Military Environment*, and *Planning to Not Lose: The Australian Army's New Philosophy of War*. His next book will examine the need to reinterpret Australia's defense policy in light of the security challenges posed by climate change and an increasingly assertive China.

PALAZZO

CLIMATE CHANGE AND NATIONAL SECURITY: IMPLICATIONS FOR THE MILITARY

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Climate change poses a major threat to US national security and the survival of the American people. The US military will need to prepare for a more dangerous and disruptive future, both domestically and internationally, to safeguard the nation's citizens. In *Climate Change and National Security: Implications for the Military*, the former Director of War Studies for the Australian Army and current Adjunct Professor at the University of New South Wales, Dr. Albert Palazzo, examines the risks and challenges the military will face in providing for the nation's security, and the effect climate change will have on the character of war. Additionally, this book provides recommendations for what the military will need to do to prepare for a climate-affected future.