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Technology and Security

Governing Threats in the New Millennium

Edited by

Brian Rappert

Technology and Security

New Security Challenges Series

General Editor: **Stuart Croft**, Professor in the Department of Political Science and International Studies at the University of Birmingham, UK

The past decade demonstrated that threats to security vary greatly in their causes and manifestations, and that they invite interest and demand responses from the social sciences, civil society and a very broad policy community. In the past, the avoidance of war was the primary objective, but with the end of the Cold War the retention of military defence as the centrepiece of international security agenda became untenable. There has been, therefore, a significant shift in emphasis away from traditional approaches to security to a new agenda that talks of the softer side of security, in terms of human security, economic security, and environmental security. The topical *New Security Challenges series* reflects this pressing political and research agenda.

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Part III In Focus

List of Abbreviations

ABM	Anti-Ballistic Missile
ACh	Acetylcholine
BTWC	Biological & Toxin Weapons Convention
BW	Biological Warfare (or Weapons)
CCW	Certain Conventional Weapons Convention
CEP	Circular error probable
CIA	Central Intelligence Agency
CW	Chemical Warfare (or Weapons)
CWC	Chemical Weapons Convention
DCI	Director of Central Intelligence
DHS	Department of Homeland Security (US)
DIA	Defense Intelligence Agency
DoD	Department of Defense (US)
DoE	Department of Energy (US)
EBO	Effects Based Operations
EU	European Union
GBL	Ground-based laser
GPS	Global positioning system
IC	Intelligence Community
ICBM	Intercontinental ballistic missile
ICRC	International Committee of the Red Cross
ICT	Information and communication technologies
IHL	International Humanitarian Law
IMF	International Monetary Fund
INR	Bureau of Intelligence and Research (US)
IR	International Relations
MoD	Ministry of Defence (UK)
MRBM	Medium-range ballistic missile
NATO	North Atlantic Treaty Organisation
NGO	Non-Governmental Organization
NIE	National Intelligence Estimate
NMD	National Missile Defence
NPT	Non-Proliferation of Nuclear Weapons
PGM	Precision-guided munition
R&D	Research and Development
RMA	Revolution in Military Affairs

S&T	Science and Technology
STS	Science and Technology Studies
SBL	Space-based lasers
SIPRI	Stockholm International Peace Research Institute
SDI	Strategic Defense Initiative
TRP	Technology Reinvestment Project
UK	United Kingdom
UN	United Nations
UNMOVIC	United Nations Monitoring, Verification & Inspection Commission
UNSC	United Nations Security Council
UNSCOM	United Nations Special Commission
US	United States of America
USAF	United States Air Force
WMD	Weapons of Mass Destruction
WTO	World Trade Organization
WWI	World War I
WWII	World War II
XSS	Experimental Spacecraft System

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Introduction

Brian Rappert and Stuart Croft

The study of international security has always been a very controversial field. Contestations over issues as important as war and peace, liberation and subjugation, invasion and non-intervention are to be expected. But over the past twenty-five years, there have been not only normative struggles over these key issues – illustrated most dramatically recently by the arguments over the war in Iraq – but also arguments over what counts as 'security' itself. Security for whom, and from what, has been at the forefront of academic texts in international relations in the English-speaking world, and also throughout continental Europe.

From these various arguments, one can detect different schools of thought on international security, bounded by the answers the group itself has agreed upon concerning those core questions of what comprises security, for whom, and from what. Realists of various hues focus on state threats, and on power and freedom from threat. Neo-liberals, while also focusing on states, emphasise the cooperative possibilities in the international system. Constructivists focus on norms, very often at the inter-state level, and on issues such as security cultures. Many perspectives on security derive their titles from particular geographies. The Copenhagen school looks at the way issues become securitised. The Welsh school emphasises the demand of examining security issues for their emancipatory possibility. The Paris school stresses the totally constructed nature of social life from a Foucaudian perspective. The Toronto Group has examined the propensity of environmental scarcity to lead to conflict. And peace studies experts stress the normative importance of choices about the use of violence.

Yet these complex dimensions to the way in which security is conceived of is, perhaps, less than half of the story of understanding the intellectual nature of modern security studies. And here already we have an important change of terminology – from international security, with its apparent emphasis on the state level, to security studies, with the possibility of considering security beyond the state at group levels, whether this be violence between ethnic and other groups, or between genders. Security studies – and the different schools of thought outlined in the preceding paragraph – have developed and grown within the (sub) discipline of international relations; all of the schools outlined in security studies relate in some form or other to broader sets of thinking in international relations theory. But is security studies the preserve of the study of international relations?

Of course that is not so. In sociology, economics, geography, urban studies and planning; area studies, history and other disciplines in the social sciences; and the humanities scholars have given some consideration to the use or threat of use of organised violence for particular ends. And those examinations may or may not relate to the conceptualisations and language used by the various schools of security studies that have developed in international relations.

In this intellectual world, where a 'thousand flowers (or schools) are blooming', one of the means of drawing together different strands is to focus on particular themes. Thus, when thinking about violence in Africa, for example, expertise from international relations can be brought together with that in economics, geography, gender studies, language, and cultural perspectives. Another theme that can be analysed from a variety of different perspectives is that of the role of technology in security; and that is the purpose of this volume.

Within the study of international relations, technology has always been a theme in the examination of security. During the Cold War, technology was a vital component of thinking about the threat of war. The development of nuclear weaponry and missile technology were translated into fears of missile gaps and into strategic thought contained within the concepts of nuclear rollback, mutually assured destruction, escalation dominance, arms control, and strategic defence. Age-old debates about the relationship between the offence and defence were transformed by new technological possibilities. Of course, this is not to argue that international security was driven by technology alone: what was important was the way in which particular sciences were constructed and understood. *Strategy* became the code word for political debate about technology and security, even while at the same time it constructed *experts* who were often accorded special status to decide upon these contentious political and ethical issues.

It would be tempting to claim that, with the collapse of the Soviet Union and the Cold War superstructure, issues of technology and security became less relevant. With the nuclear threat gone, security could be more 'social' than military in its meaning. Certainly international organisations such as North Atlantic Treaty Organisation (NATO) started to commit themselves to a 'broader' notion of security, one that would include societal, political, economic, and environmental threats, and challenges alongside military ones. But a dichotomy of this sort would be misleading. On the one hand, it suggests that security was less 'social' in the Cold War than in the contemporary world. Yet violence in the Congo or over Biafra, for example, rather suggests that this is not so; indeed, revolution in Latin America and much of the developing world throughout the 1960s and 1970s would add to that sense. Yes, in the English-speaking world and in much of Europe, international security meant mostly the Cold War and its technology; but this owing to a whole host of factors, from government research funding to the impact of decolonisation on European intellectual endeavour. On the other hand, such a conceptualisation – that technological factors are less important after the Cold War – itself underplays the importance of technology in the study of international security and security studies in the contemporary world.

One area of this continued importance of technology relates to the military. The Cold War may be over but in Asia, nuclear diplomacy – and the consequent construction of the role of technology – is a vital and high-profile theme. Since the abolition of the Soviet state, India and Pakistan have developed nuclear weapons and are in the process of developing a complex nuclear relationship. America, and through the United Nations, other states, worry about Iran's nuclear developments, and what the construction of an Iranian bomb might mean for the international security of the region. North Korea has detonated some sort of a nuclear weapon, putting into question the nature of security policy in China, Russia, Japan, Taiwan, and that broader region. Nukes still rule the game in the most heavily populated parts of the world.

Of course, this is not the totality of the military-technology issues in the contemporary world. Since the Persian Gulf War, indeed in some ways because of the dominant reading of the Persian Gulf War, states have focused on the technological possibilities inherent in American military force. The ability to precisely bomb targets with limited collateral damage has been constructed as the ideal in the use of force – no casualties to the user, only the guilty killed amongst the targeted. Bombing over the former Yugoslavia, cruise missiles flying across the world to targets in Afghanistan, and the lightening military march to Baghdad in the 2003 war, have contributed to this sense that with military technology comes previously undreamed of possibilities. Indeed, the US decision to invade Iraq in 2003 was in some ways a high point for this belief – that technology would solve nearly all security problems. Wrongdoing could be swept away by military asymmetry, and new popular political structures would grow in its place. Maybe, in the mire of post-invasion Iraq, with suicide bombing and improvised explosive devices being at the same time both highly effective and at the opposite end of the technological spectrum from the United States, the Iraq war will seem the zenith of this belief in military technology solving security problems and in the force of arms leading to normatively better worlds. Perhaps that is so, but it is still unlikely. Isomorphism rules because with technological sophistication comes a sense of the apex of the profession. That is, even if a military does not see itself being involved in transformatory wars, it will still want to be taken seriously, and that implies owning expensive and advanced equipment, and the ideas that go along with it.

The so-called 'war on terror' has more fully shown the limitations of the reliance on technology: in Afghanistan, American Special Forces have resorted to horses as well as stealth technology. The ability to manufacture and kill by anthrax in the United States in the aftermath of 9/11 undermined still further the confidence of the superpower in its security, and still remains a crime that in public is unsolved. But these aspects are not about the failure or otherwise of technology; rather, they are about what is understood by technology, how it can be used in particular places at particular times and for particular reasons, and how it is often used in particular places and times for reasons others than those widely anticipated.

It is not only in the area of military security, though, that technology is an important theme in security. Could there be an argument that climate change is a security challenge – a threat to the future of humanity – without the complex science and technology (S&T) that goes with it? The scientific community – in many countries, if not all – have been called upon to 'prove' the claim of climate change, and this has been only possible with complex observations of the atmosphere, and of regions in the Arctic and Antarctic, amongst others. Our whole notion of threat in this field is constructed through scientific experiment and debate.

Another area of the continued importance of technology in security relates to surveillance in social order and control. In the developed world, more and more people are watched both physically through closed circuit television, and practically through computerised databases and increasingly, biometrics and identity cards. Are these infringements of civil liberties? And if so, is that important? The London bombers of 2005 built home-made devices with which to kill; they were filmed many times on CCTV, and yet were not stopped ahead of time. Does this mean more viewing and more monitoring is required of all citizens?

Technology remains an important theme in the way in which both international security and security studies are understood and pursued. The technological possibilities forward today challenge all the schools of thought in the academic study of international relations. More importantly, they open possibilities for discussions and collaborations across the disciplinary divide(s) to address practical problems. This volume is a contribution to that wider debate.

Technology

While, broadly conceived, 'technology' enters into many of the aforementioned shifting security dynamics, specifying just how it helps constitute environments and perceptions of security is less than straightforward. While technology is readily sought as a means of guaranteeing safety and protection, the pace and breadth of scientific and technological developments are often said to challenge the prospects of achieving such ends.

These competing tendencies suggest the need for careful attention. One way to begin this is with the basic question 'What is technology?'. Despite (or rather perhaps because of) the ubiquity of the term, in popular, academic and policy discussions, 'technology' is not often well defined. A commonplace understanding though is that it consists of equipment based on applied science that is employed to fulfil some particular functions. As scientific understanding grows, so too does the ability to engineer instruments to manipulate the world. This way of thinking suggests a rather unidirectional and linear relation between knowledge and hardware. The popular understanding of the development of the atomic bomb during World War II (WWII) in the Manhattan Project is perhaps the most prominent example where emerging science of the time was turned into a novel device. Yet, history would suggest a rather complex relation between the knowledge and skills associated with engineering and science, even in the case of the bomb. Each has feed off of and given impetus to the other at different points in time. In addition, many analysts contend that technology should not be thought of as 'hardware', but rather that the term should cover the practical skills, organisational competencies, and training associated with the operation of devices.[1]

Consideration of the question 'What is technology?', however, can quickly turn stale when asked in the abstract. Consider it in relation to the now well-celebrated and disputed concept of the 'Revolution in Military Affairs' (RMA). The suggestion that technology can lead to significant changes in war is not a new one. The introduction of chariot, machine gun, tanks, and airplanes have been linked to major alternations in the conduct of combat.[2] The Soviet Marshall Nikolai Ogarkov is often cited as a source of inspiration for much of the recent attention to the potential for radical shifts. Ogarkov's notion of the 'Military Technical Revolution' (MTR) was meant to signal how the integration of information and communication, sensor, and other technologies would afford capabilities with profound implications. In recent years, much discussion has taken place regarding whether militaries are in the midst of a transformative revolution or mere evolution in capabilities as well as who has or will gain from any change.[3]

Yet, the manner in which technology is conceived is essential in understanding the likelihood of a revolution, its character, how it can be realised, as well as who can take advantage of it. Metz and Kievet's original formulation of the revolutionary potential at hand as 'RMA' rather than 'MTR' was meant to move away from a preoccupation with integrated technology to include its synergy with changes in organisations, systems, and operational methods.[4] In a recent twist to the story of RMA, however, the language of perception, choice, and leadership has mixed in an uneasy fashion with language of certainty, determinacy, and inevitability. So as Metz has written that:

> Today technology is an enabler of the revolution in military affairs, allowing changes that political and military leaders would like to make as they respond to political, economic, and social changes. But it can also be an independent variable, forcing uncomfortable changes and, sometimes, eroding stability and order. New technologies or new combinations of technology have the potential to alter not only tactics and operational methods, but military strategy itself.[5]

When treated in the manner suggested in the previous two sentences, the technologies of cyber war, precision weapons, military robots, and so on can themselves force significant, if not revolutionary, changes. In such a formulation of independent variables there appears little scope for affecting the impact of change and few barriers that can be erected to halt its spread.[6] Attention to the difficulty of attaining the necessary skills or organisational competencies is marginalised. Herein the whole language of 'choices' or 'decision-making procedures' seems misplaced if not misleading. Technological developments – presumably driven to achieve even more efficiency and effectiveness in achieving agreed ends – are in some non-trivial sense going to take place. This way of thinking about technology in RMA contrasts sharply with other analyses, such as Freedman's examination of information technologies in war.[7] For him the character and relevance of such technologies depends on highly contingent political and strategic developments.

Even this brief consideration of the place of technology in military transformations evokes a sense of how questions about the character, origins, and implications of technology are at once bound up with long-standing concerns in the social sciences regarding the rationality and goal directedness of action, the scope for human agency and determinacy, as well as the relation between individual choices and institutional outcomes. Considering how technology relates to the (itself problematic) notion of security then is an undertaking whose demands should not be underestimated.

Technology and security

The remainder of this chapter furthers the previous discussion by surveying some of the specific topics in which the relation between security and technology has been investigated. As will be argued, each technology occupies a rather problematic space, seen as both enabling and undermining conditions of security.

Mobilising technology for national security

Much of the relevant academic and policy literature has focused on how S&T (often treated as synonymous) could best be harnessed for national defence. Research and development (R&D) are meant to yield concrete outcomes that confer an advantage of one sort or another. Perhaps particularly in the United States since WWII, as mentioned previously, the notion a 'technological fix' to security threats has been quite prominent and successful in justifying the expenditure of public funds. The search for such a 'fix' extends well beyond military matters to include political and economic security more generally.[8]

Yet, it has also been recognised that marshalling S&T is not a straightforward process. Many advanced technologies – be they major platform weapons such as jet fighters or information and communication devices – are complex systems whose procurement and management is fraught with difficulties. Military requirements are often ill defined[9] and the decision-making is situated within a host of strategic, institutional, and budgetary uncertainties.[10] How to promote innovation and avoid bureaucratic forms of nepotism (e.g., as in concerns about the 'Military Industrial Complex') have been perennial policy concerns.[11]

How expenditure on military-related R&D might be best organised so as to secure wider civilian benefits has been another area of long-standing concern. For instance, this can be seen in debates about the advisability of relying on unplanned and unpredictable 'spin-offs' versus trying to fund areas with apparent dual military and civilian potential.[12] Responses to such questions are often tied-in with evaluations regarding the advisability and appropriateness of the military steering the research agenda of universities and other public agencies.[13]

But harnessing technology in aid of security is not only recognised as a complex and uncertain undertaking, but also as one that can set up destabilising dynamics. Mobilising technology is not a one-off achievement, but rather a continuous process of innovation, re-innovation, and planned obsolescence. The pursuit of means of security goes hand in hand with worries about the insecurity that will later be afforded by those very same means when used by others. The continuing pursuit of technological advantage can bring second order problems too. For instance, with the sustained, substantial, and increasing funding of military R&D in the United States, for example, questions are being asked about not only whether European commercial and military firms are at a competitive disadvantage but also about whether European militaries are becoming incompatible with US armed forces.[14]

Traditional policy and academic concerns about how to harness technology for national security though have been given a fresh analytical twist in recent years with the wider turn to culture, ideas, and identity in disciplines such as international relations.[15] As part of this turn, consideration has been given to the role of norms in regulating behaviour and constituting identity.[16] Norms have been said to factor into a variety of topics mentioned so far in this introduction. For instance, it has been contended that conventional power or interest-based approaches cannot explain the pattern of weapons procurement in many developing countries. These states acquire high-tech weaponry not because of strategic calculations, but because of identity considerations about what it means to be a modern state.[17] Studies of the taboos against using nuclear weapons by Tannenwald[18] and the development of chemical weapons by Price[19] have elaborated how particular weapons became stigmatised to such an extent that few seriously contemplate their use – whatever their benefits. The formation of these taboos – largely forwarded by Western highly industrialised countries – has been part of constituting what it now means to be a 'civilized' state. In a related fashion, elsewhere it has been maintained that the uptake of certain technologies – such as precise aerial bombing – requires that they be 'congruent with preexisting cultures of their institutions'.[20] Such claims strongly challenge any suggestion that technology is simply an independent variable forcing change.

One common theme of these norms analyses is that norms and related cultural factors cannot be resigned to a residual role in political affairs, such as explaining lags in states pursuing their interests, irrational decision-making or the choices made in highly ambiguous situations.[21] While norms might have been acknowledged in the past as a simplifying mechanism that enabled actors with pre-existing interests to maximise utility in a complex world, in recent analyses they are not simply intervening mechanisms. Rather actors' identities (and therefore interests) and norms are mutually constituted. This has important implications for the relation between norm and traditional international relations power and interest explanations.[22] In considering the emergence of the taboo against the use of nuclear weapons, Tannenwald does not portray norms and interests as exclusive categories. She argues norms 'enter into, and change, the cost-benefit calculations of interests (constraining), but they also help to constitute those interests, identities and practices in the first place. Interests and international norms may coincide, but this coincidence does not render norms superfluous'.[23] Thus the relation between technology, identity, and security is an important one.

Arms dynamics

The established policy and academic concern about mobilising technology, however, is only one prominent area. The recognised destabilising dynamic associated with the pursuit of technological superiority alluded to in the previous sub-section has been a fairly long-standing consideration itself. Much of this has focused on the drivers for the continuing search for new forms of weapons and other technologies. Models offered have varyingly centred on the 'action-reaction' dynamic of inter-state competition, the internal political, economic, and social factors of a state that result in certain technologies being pursued, as well as the imperatives associated with technological possibilities.[24] As with the points made about technology in the RMA above, the reasons identified for the development of arms also involve thorny issues about the place of human agency, rationality, and institutional structures in behaviour. Because of this, how the models for arms dynamics relate in practice is often not thoroughly specified. This dynamic is regarded as an important one because of the potential for an unplanned and socially undesirable arms racing between competitors.

Some analysts though have sought to provide a wide-ranging (and critical) analysis of why certain technologies are developed or pursued. Here the attempt is made to move beyond a consideration of military procurement systems, technological capabilities, and inter-state rivals of immediate relevance to instead consider how basic social fears are nurtured, sustained, and exploited for political ends.[25] Lyon, for instance, has argued that fears about terrorism post-9/11 are being used to frame public health in security terms and to justify greater expenditure on surveillance technologies.[26]

In a more historical analysis, Jenkins examined perceptions of the threats in the United States from aerial bombers capable of delivering chemical weapons after World War I (WWI).[27] As contended, post-WWI, elite US statesman, industrialists, and scientists presented themselves as the avant-garde of humanity through their efforts to develop chemical weapons. The extent of funding of chemical weapons-related R&D during and after the war in turn led to developments in bomber aircraft, pesticides, and tear gas – all of which in turn facilitated the possible further development of chemical weapons. Instead of seeking political alliances with post-war Germany, the country was isolated and dealt with through security measures. The collective result of these actions was a self-fulfilling cycle of the production of fear where chemical weapons become increasingly regarded as an appropriate and necessary component of national defense.

In considering how technology becomes forwarded as a solution to a certain definition of the problem, Jenkins also examines alternative understandings of security and how these were or were not incorporated into prevailing policy discussions. For instance, after WWI those campaigning for arms restrictions generally took as their starting concern the question of how America's military and diplomatic power should be developed so that the United States could carry out the task of being the leaders of the civilised world. Those that departed from this line of reasoning (such as those calling for outright disarmament) were systematically ignored or labelled as dangerous subversives.

The role of scientific and technical expertise

The above consideration of how technology can best be harnessed to enhance security suggested attention should be given to the matter of *who* makes the decisions. Here the place of scientific and technical experts is an important issue. It is widely recognised that since WW II in Western countries scientists and engineers have played a significant role in defining national security problems and advising about solutions. A concern with this has been whether scientists and engineers' professional and individual priorities have inappropriately influenced the framing of problems and responses. Rather than simply being knowledgeable experts that provide objective facts and advice, many analyses have contended these experts advocate particular and sometimes questionable options in line with their professional interests or assumptions.[28] For instance, Eden argues that assessments of the damage of nuclear attacks in the United States have focused on blast rather than fire damage and least in large part due to the particular concerns of the types of scientific advisers utilised by the military.

Just how much influence scientists and engineers exert is alternatively conceived and often poorly specified. Following on from previous points made in this chapter, however, this is hardly unexpected or unprecedented. The question of what influence scientists and engineers have in any particular area cannot be resolved without contending with difficult issues about agency and institutional decision-making. In addition, Edgerton argues that in the case of the United Kingdom, the historical role of scientists and engineers in warfare has been ignored because the warfare footing of the British state has been downplayed.[29] This historical blindness makes it difficult to comment on the shifting importance and influence of certain professions. The question of what influence scientists and engineers *should* have in defining security priorities and responses in Western countries depends on similarly complicated assessments about the role of expertise in democratic decision-making.

Limits and security

One area in which scientists and engineers have played a significant role in recent decades is in the development and enforcement of arms control. Yet, attempts to limit the means of war have a long history, dating back to the ancient world. Since then arms control has been agreed or imposed for reasons as varied as to curb the threat posed by defeated powers at the conclusion of conflicts, to strengthening strategic stability in times of unsettled peace, to introduce humanitarian norms, and to restrict the proliferation of technology.[30]

As long as such controls have been proposed there has been debate about whether they would ultimately further or undermine security'.[31] The scope for deception about adherence has lead to concerns about a false sense of protection being engendered. Much doubt has been expressed as well about the ultimate effects of certain states foregoing certain technological options. So the turn away from developing antiballistic-missile system decades ago by the United States is credited with giving greater impetus to the development of multiple, independently targetable reentry vehicles (MIRV) for nuclear weapons as well as other forms of delivery such as Trident submarines.[32] In a comprehensive critique informed by realist preoccupations, Gray argued that attempts at arms control are fundamentally flawed and only feasible when otherwise irrelevant.[33]

Of course, when it comes to considering the merits of selective limits on technology, the question of 'security for who?' looms large. Another line of criticism regarding attempts to place limits on war has been that they reflect and reinforce the hierarchical power relations of the time. As such, certain forms of violence are put out of the reach of certain states (e.g., chemical weapons); while others are free to pursue their technological superiority elsewhere (e.g., conventional weapons, nuclear capabilities).[34] It is not just weapons themselves that are put out of the reach in some agreements, but any precursors and capabilities needed to produce them (e.g., as in the Australia Group export controls on materials and equipment). Such limitations then can reinforce disparities in civilian capacities. Another concern with reinforcing hierarchical relations is that attention to the rules of the conduct of war itself is said to distract from attention to whether wars should be fought in the first place, a move that favours certain (warfighting) nations.

Whatever the desirability of limitations on who has what sort of capabilities, their feasibility is another matter. To return to the RMA, the impending or arrived transformation in the conduct of war is said by some to severely limit the prospects for arms control.[35] One reason offered for this is that the development and proliferation of civilian commercial technologies that underlie such a transformation (e.g., telecommunications, computing, and sensors) are said to be beyond control through international agreements.[36] Also, it has been argued that because of the RMA, the destructive potential of conventional weapons will equal that posed by many unconventional weapons of mass destruction (WMD). This prospect is said both to undermine the rationale for agreements (such as the Biological and Toxin Weapons Convention (BTWC) and the Chemical Weapons Convention (CWC) that are based on limiting classes of technology rather than those with certain magnitudes of effects) and to provide incentives for those states without the significant resources to seek unconventional forms of force capabilities.[37]

Vulnerability

An area of recently renewed attention to the relation between technology and security is the vulnerability to attack of critical technological infrastructures, particularly in those countries highly dependent on large-scale integrated systems associated with electronic banking, transportation, food supply, and energy delivery. Although such large-scale integrated technological systems provide many essential functions for modern societies, they are generally highly open and vulnerable. While the possibility of sabotage or disruption of critical infrastructure systems is hardly new to the twenty-first century, the extent and depth of reliance on technological systems (particularly those employing information and communication technology) combined with the threat of terrorism is said to pose major issues for technologically sophisticated countries. The very systems which once ensured numerous forms of security now appear relatively obvious targets to jeopardised security.

Just what those key issues are though, varies between analysts. Winner, for instance, argues that Western societies face a crucial choice in light of potential threats: whether to attempt to 'harden up' existing vulnerable technological systems through further technological means such as sensors, barriers, or surveillance measures, and so on, or whether to reconsider those policies that lead to a dependency on tightly coupled large-scale systems in the first place.[38] The former, for instance, would lead to carrying on with large-scale energy systems with reinforced nuclear plants and power grids while the latter would move away from the dominant forms of energy production and distribution to instead embrace smaller scale, locally produced forms of renewable energy. The choice about which path to pick is a fundamental one for Winner because it involves basic issues about how to foster trust in government, and scientific and technical experts in modern society. For Metz, the prevalence of integrated infrastructure might well offer opportunities for countries such as the United States to defeat adversaries without the inefficiencies and collateral damage associated with conventional weapons and in addition it might make the United States highly susceptible to disruptive attack.[39]

The previously examined topics are just some of the most prominent ones where the interaction of technology and security is now a matter for intense discussion. In general there seems little room for doubt about the heightened attention to security post-9/11. And also, there seems little room for doubt that thoroughly addressing the issues being posed will require addressing long-standing concerns in the social sciences. Against these varied and complex issues and contexts, questions can be asked about the responses of academic analysts and, specifically, whether the varied disciplines that might contribute to understanding the relation between security and technology are prepared for the breadth of the task at hand. As has been argued, studies of security (here rather narrowly conceived of as national defence and warfare) have often been marginal to the mainstream of many academic disciplines, even those such as history with a long running attention to the military matters.[40] War, conflict, and violence are often seen as exceptional events that are not part of the normal functioning of society and thus not of central importance to understanding it.[41] The attention to security widely conceived today then provides an opportunity and a challenge to traditional academic disciplines.

The chapters

This book advances the understanding of the inter-relation between security and technology. Its principal objective is to assess the contemporary security challenges posed by emerging scientific and technological developments while understanding how perceptions of security are themselves formed in relation to scientific and technological developments. In this, the place of technology in fostering and undermining security is examined, as is the way the definition of security transforms over time. Doing so requires addressing a complex mix of issues about the intentions of actions, their consequences, the characteristics of technologies, organisational structures, and international dynamics that are best approached through a range of disciplinary traditions. The contributions in this book stem from political science, security studies, international relations, history, sociology, and S&T studies. Examining the place of technology in fostering and undermining security also requires making decisions about what should be questioned and what should be taken for granted as part of analysis. As will be apparent in the chapters that follow, each contributor has made choices about when and how to question what is meant by 'technology' and 'security'. These decisions were taken to address particular concerns against a particular disciplinary background. Attending to the diversity of such choices and their implications is important in understanding the utility and limits of analyses in this area.

The chapters in Part I share a focus on how fields of study regard the security–technology relation. All three pose significant challenges to certain prevalent presumptions and agendas. They differ, however, in the way their arguments are advanced. Andrew James begins with a historical overview of security-related S&T policy since WWII, mainly with reference to the United States and United Kingdom. As part of this, attention is given both to *policy for science* (the strategies and procedures established to harness S&T for national defence) and *science for policy* (the incorporation of scientific and technical expertise into policy-making processes). James details how perceptions of the international security environment and the appropriate policies for S&T have mutually formed over time. Further he considers how this process was part and parcel of an enduring (if not fully harmonious) relation between scientists, engineers, and the military planners during the Cold War. With the end of the Cold War, various attempts have been made to establish new rationales for S&T policy, most recently in combating international terrorism. James does not just chart changing rationales, but ends with a warning about the failure of S&T policy analysts in Europe today to assess how determinations of the international security environment are influencing policy as well as how S&T policies are contributing to international (in)security. In response, he outlines areas for future research.

In Chapter 2, Rappert and Balmer unpack the notion of 'technology' through reviewing themes from the field of science and technology studies (STS). While hardly united in their thinking, in recent decades analysts associated with this emerging field have attempted to progressively open up the innovation and use of technology to social analysis. In relation to matters of security and the military, this has meant going beyond the long-established concerns of S&T policy. In particular, this chapter assesses what STS suggests for understanding threats from WMD. As argued, central to this field is treating scientific knowledge and technical innovation as forms of practice rather than simply abstract knowledge or material products. This has significant implications for assessments of the ease in producing and proliferating WMD, the effectiveness of control measures, the negative consequences of controls, and the way in which secrecy and openness should be seen to function.

Continuing with the questioning of the status of technologies, in Chapter 3 Boudeau examines a specific attempt to assess WMD threats. As she underscores, traditionally in intelligence studies 'threat' is taken as a function of capabilities and intent, wherein these two are treated as separate factors that are independently determinable. Through examining US intelligence efforts to assess WMD threats from Iraq in the build-up to the 2003 invasion, she details how – in the practical efforts undertaken by intelligence analysts – capabilities and intent were co-defined. Just what a technology is and what 'it' does then are not simply determinable through noting their physical properties. Instead, such properties are the upshot of interpretations.[42] Boudeau's analysis draws on insights from the field of ethnomethodology, whose central concern is the contingent methods individuals employ to make meaning of the world. She contends that recourse to a partition between capabilities and intentions in intelligence studies bears little connection with how intelligence analysts orient to threats in their work. The implications of this chapter extend far beyond the specific concern about WMD-related threat assessments to the general hindrance posed by the inclination of many analysts to conceptualise practical activities.

Part II then moves into the governance of security. In contrast to the case based approach in Chapter 3, Whitman considers the prospects for the global governance of converging technologies. This question is motivated by a concern that the long established national and international systems of governance might not be able to meet the challenges posed by today's global threats and the increasing intersection of major areas of technology – such as information, nano- and bio-technology. The said growing convergence of such areas has been taken by some as implying that disarmament efforts are ill-fated if not futile.[43] Whitman seeks to identify the fault lines in existing regulatory systems that are likely to be visible in the future if they are not today. In doing so, his argument evokes a sense of large-scale macro developments in a time of globalisation that are difficult to capture in narrowly focused analyses. While this chapter provides numerous traditional-securityrelated examples, the argument forwarded clearly demands and provides attention to other areas such as environmental hazards. Although Whitman offers a number of reasons for concern regarding our ability to predict or control future negative implications of technologies, recent efforts to develop and renew global governance mechanisms provide some reason for hope regarding the effectiveness of our political systems.

Moving from the governance of diverse converging technologies to one security area in particular, Farrell addresses the mix of rules, networks, norms, and organisations established to govern when, how, and what kind of force is used in conflict. As contended, the web of such measures already provides significant constraint on warfighting and war preparation. Chapter 5 considers the barriers to achieving further international co-operation. The problems of multilateral agreements in this regard are many, not least the competition between states in pursuing superiority. While interstate competition has been examined already in some detail in international relations, Farrell identifies three other barriers: the uneven pace of military and legal change, the multiple and conflicting levels of pertinent norms and interests, and the uncertainty associated with the developmental direction of military technologies. The consideration of the last of these provides an opportunity to revisit some of the themes of Chapter 2 and their implications for the governance of technology.

In Chapter 6, Stone turns away from matters of choices in the co-ordination of and co-operation between states towards the strategic combat options of particular ones. Special reference is given to how Western nations, especially the United States, deal with 'rogue states'. In contrast to much of current strategic thinking, Stone takes issue with the continuing pursuit of enhanced military means to render rogue states defenceless – what he refers to as the pursuit of technical fixes to problems of political order. As argued, no matter how accurate bombs and bullets, if the goal in war is to render certain states defenceless then civilians are likely to suffer greatly because of the damage to a country's basic infrastructure and instability engendered. A clear message is offered about the limitations of new and improved technologies to secure security without the wisdom to know how they should be used. For Stone, the pursuit of ever more sophisticated technologies threatens to marginalise alternative options that may have the net effect of reducing security. Instead of handling rogue countries with ever more technical innovations, he counsels that the strategic notion of 'limited war' should be revised – in essence that decisive political control should be brought to bear on goals served by force.

The chapters in Part III share in the effort to examine certain aspects of the technology – security relation in detail.

In Chapter 7, Dando asks whether the prohibition against chemical (and biological) weapons can sustain given developments in science and the desire by states to pursue technological options. Specifically, his concern is how civilian research in neuroscience might combine with the interest in major state powers into so-called mid-spectrum incapacitating agents to lead to a re-evaluation of the acceptability of chemical weapons. The promise of weapons that have only temporary effects has long been forwarded by certain states and individuals as a justification for leaving certain chemical and biological weapons options open.[44] The concern for Dando is that the pursuit of such options might lead to complete erosion of the prohibition against chemical weapons. He ends with a call to for greater involvement of civil society in disarmament debates to prevent this outcome.

The possible deployment of space-based weapons is the focus for Chapter 8. Particularly (but not exclusively) because of prominent voices in the United States calling for the weaponisation of space, much concern has been expressed in recent years regarding whether any such move would initiate an expensive arms competition and undermine space as common heritage. Despite claims that just as the air, land, and sea have been weaponised the space must follow, Hilborne argues this outcome is neither inevitable nor imminently foreseeable. A major danger of recent attempts to play up the prospect of weaponisation though is that they may well undermine the fragile, but highly consequential, standard formed over many decades that space should not be weaponised. Somewhat counter-intuitively, it is argued that the indeterminacy and unspecificity of the existing array of international treaties and agreements has been their major strength. Should the largely non-formalised and non-institutionalised agreements be breached, they would be long in repairing. Hilborne does not just bemoan and dismiss interest in space weapons by major powers though. Instead, he recognises the possibility for legitimate reasons for pursing this path and offers suggestions for multilateral action that reflect this acknowledgement.

Whereas Dando ends with such a plea for great civil society involvement in disarmament debates, in Chapter 9 Durodié examines the conditions that structure the possibilities for public participation and political action in relation to matters of security. Here the focus is not so much with defining the severity of particular threats or recommending specific policy directions, but instead, examining the contingent processes whereby threats become defined in specific ways and a limited number of responses become seen as viable. In focus in this analysis is a consideration of the inter-relation of the place of scientific and political elites in contemporary security debates and the networks of social bonds in the public. The chapter sets out a broad vision of historical transformations that poses diverse questions. Durodié offers a highly critical analysis of how threats and risks are handled today, one that contends that current practices are significantly undermining social reliance. As with Stone in Chapter 6, he questions how narrow technological solutions are proffered for should be understood as wide ranging problems.

Through such contributions, this book seeks to stimulate further attention to the relation between security and technology. While it does not pretend to cover all germane issues in that relation, by focusing on a wide range of theoretical approaches and practical agendas it does seek to illustrate what work has already been undertaken into the relation, emerging areas of research, and avenues for future investigation. Technological aspects of security are crucial to understandings of how violence and threat are communicated in world politics and in local societies, but they are also crucial to the communication of reassurance and commitment.

How technologies are understood, in terms of possibilities and dangers, very much depends upon the social context and the nature of local political debates and cultures. Some polities are more likely to rely upon the reassuring possibilities of technological solutions than others. However, there are always a series of tensions in these contentious issues of the technological aspect of security: between threat and reassurance; freedom and restriction; control and proliferation. These dilemmas – at both national and international level – are themes underlying all of the analyses that follow.

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Part I

Technology and Disciplinary Approaches

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1

Science and Technology Policy and International Security

Andrew D. James

Political scientists talk about the 'securitisation' of public policy: the process by which organisational or political actors use security rationales to support claims for funding particular activities or where the 'security state' uses the rhetoric of external (or internal) threat as a pretext for entering into new policy fields or for developing new powers.[1] Such ideas should be familiar to historians of science and technology (S&T) policy because the very notion that governments should intervene to fund and direct science was largely a product of the Cold War security environment. Since 9/11 a new threat has been constructed: the threat of international terrorism. We are said to be living in 'a new anti-terrorism era' that has widespread implications for public policy – including S&T policy.[2]

In considering S&T policy, this chapter will follow the traditional distinction between *policy for science* and *science for policy*.[3] *Policy for science* questions focus on the collective measures taken by a government to encourage the development of research activities and have tended to consider policy rationales for public spending, the appropriate level of public funding, allocation mechanisms for public spending; and (since the 1980s) policies to promote institutional relationships between government, universities, and industry to create innovation 'systems' or 'networks'. *Science for policy* questions concentrate on the exploitation of discoveries and innovations in various sectors of government concern and have tended to focus on such matters as the status of scientific advice in the policy-making process and its organisation and institutionalisation.

This chapter surveys the relationship between S&T policy and international security during the Cold War as well as how the response to 9/11 has raised new issues for the 'securitisation' of S&T policy. In doing so it provides a broad context for the subsequent contributions in this book. The argument begins by examining how changing perceptions of the international security environment have shaped S&T policy and the way in which the Cold War security environment led to a mutual embrace between the military and the science community. Attention is then given to how science for policy (in the form of scientific advice as well as weapons systems) had a profound influence on the Cold War security environment by creating new strategic possibilities, altering doctrine and influencing policy-makers' perceptions of international security threats. Next, the chapter discusses how the end of the Cold War saw a search for a new rationale for S&T policy and an attempt to re-cast it in the image of 'new' economic, health related, and environmental 'security threats'. Consideration is then given to how, since 9/11, a new threat has been constructed in the form of international terrorism and the implications of this new securitisation of S&T policy for the governance of science both in the United States and, increasingly, in Europe. Finally, the chapter argues that despite the obvious importance of these issues, 'mainstream' S&T policy academics have given surprisingly little attention to the relationship between science (policy) and international security. Instead this has been left to others – not the least to those from the science and technology studies (STS) community. It is argued that this lack of scrutiny has potentially serious consequences, not least the ill-judged policy decisions. The chapter ends by proposing a research agenda for the academic S&T policy community.

Policy for science: the international security rationale

The very notion of governments having a formal policy for S&T was the product of the Cold War. Of course, the first-half of the twentieth century and before saw some state intervention in science with governments acting as protector, patron, or client. As well, connections between science and the military have a long history.[4] However, it was during World War II (WWII) that the relationship between science and war reached new levels of intimacy. Scientists, engineers, and mathematicians were mobilised to use their knowledge as part of the war effort. They developed new weapons, created novel drugs, and used their mathematical skills to break codes. Most dramatically, the Manhattan Project mobilised the physics, chemistry, and engineering communities to develop the atomic bomb.

This was to mark a turning point not only in the relationship between science and war but also in the relationship between science and the state.[5] Science was now widely recognised as a resource of strategic significance and this led governments to intervene in the direction and range of research activities.[6] During the Cold War, military objectives were to provide the justification for the institutionalisation of S&T policy and a huge growth in public spending on Research and Development (R&D).[7] Freeman and Soete observe how the WWII and the Korean War played an important role in habituating government agencies to large-scale R&D funding.[8] The Cold War was to set the conditions for post-war S&T policy. Vannevar Bush's *Science – The Endless Frontier* marked the emergence of formal S&T policy in the United States. The relationship to national security concerns was explicit: national welfare and military security depended upon research strength and required a system of permanent federal funding of research through universities and research institutes.

Competition for military supremacy between the two superpowers was to become manifested in the development of weapons of increasing technological sophistication. As a result, scientific and technical research became a powerful strategic and diplomatic resource.[9] Salomon notes the link between international crises (Berlin, Korea, Cuba, and Vietnam) and increases in public spending on R&D. The Berlin Crisis and the Korean War saw a rearmament programme in the United Kingdom that included a huge R&D intensive effort to develop atomic and then hydrogen bombs. In the 1950s, Sputnik prompted many other Western countries to increase spending on military, nuclear and, space research as the core of the competitive struggle with the Soviet Union.

Science policy was given institutional expression through new policies, procedures and, a bureaucracy specifically concerned with such questions.[10] In the United States, new institutions such as the Office of Naval Research, the National Science Foundation and, the Atomic Energy Commission were established to oversee those budgets. The National Laboratory system, a network of services laboratories, as well as laboratories established by universities oversaw the complex and resource intensive business of new weapons development.[11] Networks of scientists in the military, universities, and industry coalesced around weapons programmes, often continuing relationships forged during WWII.[12] In the United Kingdom, the Cold War saw the rapid growth of government defence research establishments that at their height employed over 30,000 scientists and administrators.[13]

David Edgerton talks of the emergence of a British 'warfare state' arguing that after 1945

> The Labour government created out of the wartime warfare state a peacetime machine of great significance. This warfare state had various ministries concerned with the forces, and also an industrial and research ministry, known first as the ministry of supply, then the ministry of aviation, and then the ministry of technology. All these labels are misleading, for these ministries were at the core not only of military technological but also of civil technological policy.[14]

As Jeff Hughes points out, these developments represented a fundamental shift in government funding of science.[15] The military became a strong political supporter of science and military agencies that were among the main sponsors of basic research in the United States in the 1950s and 1960s. Indeed, the WWII experience not only legitimised public funding of S&T but also changed the nature of science.[16] The Manhattan Project had a demonstration effect for a particular kind of science and scientific organisation – largescale, bureaucratically administered and goal-directed – that became known as 'Big Science'.[17]

The scientific and industrial communities quickly recognised that military justifications were almost always more likely to get support for R&D spending than were other justifications. Public funding of Big Science was institutionalised in a large part because scientists were able to convince the military of its role in supporting Cold War military objectives.[18] Brooks observes that in the 1950s even the National Science Foundation was forced to justify basic research budgets by their contribution to improving US military capabilities.[19] As Salomon notes that 'Any appeal to the public powers, whichever the field of research, was in duty bound to point out the economic, social, military or political advantages. Even subjects basically far removed from any application were included in this game: high energy physics for instance'.[20]

Science for policy: the impact on international security during the Cold War

The outputs of Cold War S&T policy and this mutual embrace between science and the state were to have a profound impact on the international security environment.

Superpower status was to become measured not simply by the quantity and quality of fielded weapons systems and the number of men at arms. Instead, national security now required the extensive scientific and technological capabilities necessary to stimulate innovation in weapons systems. This was to become an important element in the Cold War balance of power calculus. Scientific and technological developments were important because they altered strategic possibilities. Science and technology was harnessed to create whole new classes of weapon systems with previously unimagined performance, accuracy and, lethality. Technological innovation was to have a profound impact on military doctrine and international relations. The most dramatic expression was to come with the development of the hydrogen bomb and the emergence of the doctrine of Mutually Assured Destruction (MAD): the costs of direct conflict became so high that innovations had the effect of deterring large-scale aggression between the Superpowers.

At the same time, however, scientific and technological advances were also to become a significant factor in Cold War *insecurity*. The classical security dilemma now had a technological dimension and innovation (and even the threat of innovation) in armaments prompted response and counter-response from the Superpowers. Thus, the permanent military scientific infrastructure of the Cold War was to become an important contributor to the arms race.[21] To those living during the Cold War it was clear that rivalrous nations 'live in the constant fear – real or imaginary – of being surpassed on a technological level by their opponents'.[22] Harvey Brooks observed how the existence of large and permanent military R&D establishments on either side of the Iron Curtain meant that 'neither can afford not to remain abreast of basic technological developments, to be at least in a position to accurately assess their possible military implications'.[23] As Buzan and Herring put it,

> the establishments become mechanisms that set ever higher standards of expense and complexity, increase the pace of technological advance, and work relentlessly to make their own products obsolete. … Thus what starts as a response to a problem becomes part of the process by which the problem is continuously re-created and even exacerbated.[24]

The influence of science for policy extended far beyond the exploitation of technological innovation in new and improved weapon systems. Scientific advice was to achieve a new status and influence in the policy-making process and was to play a significant role in structuring threat assessments and influencing international security policy. The real policy influence of scientists during the Cold War has been a matter of intense debate but – whilst recognising this – Sapolsky says ‘Previously confined to the periphery of power, scientists and engineers came in the years immediately following WWII to enter the highest councils of government in both the East and the West’.[25]

In the British context, David Edgerton notes that the role of scientists such as Sir Solly Zuckerman questions the cliché that scientists in Whitehall were ‘on tap, not on top’.[26] Bud and Gummett emphasise how the British defence research establishments were a critical source of technical advice to government, evaluating proposals from defence contractors, assessing the technical dimensions of intelligence data, and providing assessments on the future of technology for strategic assessments. In the context of Britain’s biological warfare effort, Brian Balmer observes the central role of scientific research in structuring threat assessments as

> advice is as much a ‘product’ of scientific and technological research as the more obvious products of new knowledge and artefacts. Expert advisors in the biological warfare programme were called on to guide research, but equally the scientific findings emerging from research entered into deliberations over the future of policy and the nature of the threat.[27]

The limitations of Cold War intelligence on Soviet capabilities and intentions were to have a significant impact on the nature of those assessments. Bud and Gummett observe how this lack of reliable intelligence meant that the working Cold War assumption in the United Kingdom’s defence research establishments was that the Soviet Union either already had or would soon develop capabilities equivalent to those being developed in the West and that pre-emptive steps should therefore be taken on that basis.[28] In a similar vein, Agar and Balmer observe in a chapter on British scientists and the Cold War, that

> the remarkable lack of intelligence about Soviet science meant that the formulation of western defence research programs was insulated and self-contained. The flow of friendly information outstripped that of intelligence on enemy powers. Lack of reliable intelligence meant that British programs were based on knowledge of *internal* capabilities … (emphasis in original).[29]

Increasing attention was to be paid to what was argued to be the malign influence of this military – scientific – industrial complex. High levels of peacetime defence procurement and R&D funding and the institutionalisation of a permanent scientific infrastructure in government laboratories, defence contractors and universities created a large constituency of interest for defence funding and individual programmes. As Sapolsky puts it

> Competing for scarce resources, proponents of particular weapon systems, including scientists and engineers who are often the initiators of new weapon projects, tend to exaggerate the military benefits that are likely to accrue from the developments they propose and to depreciate the technological and political risks that are likely to be involved in such developments.[30]

The proper role of experts and expertise was to become the subject of growing debate during the Cold War. Vannevar Bush saw an inherent tension between the increasingly complicated technical problems facing government and the functioning of liberal democracy. The solution, he argued, was a body of civilian technocrats who had both specialised knowledge and a detachment from politics.[31] President Eisenhower famously warned of 'the military-industrial complex' and cautioned that, 'in holding scientific research and discovery in respect, as we should, we must also be alert to the equal and opposite danger that public policy could itself become the captive of a scientific-technological elite'.

A nice illustration is provided by Brian Balmer who shows how – in the mid-1950s and facing the threat of the near closure of the chemical and biological warfare programme at the United Kingdom's Porton Down research establishment – scientists not only endured the threat but also rejuvenated the programme by deploying 'a measure of conceptual opportunism'. Balmer notes how 'as biological warfare moved down the policy agenda and Britain once again adopted a defensive stance in the mid-1950s, scientists began to agitate about the horrible possibilities of biological agents spread as an aerosol across large tracts of land'.[32]

Expressing a contrasting assessment, Graham Spinardi questions the argument that it was scientists and engineers who drove the nuclear arms race. Looking at the case of British nuclear weapons development, he argues that although scientists at the Aldermaston nuclear research establishment may be seen as partners in the setting of military requirements, there is little evidence that they were able to force unwanted weapons on to the military services. As Spinardi observes 'That an institution like Aldermaston constitutes an interest group with political influence cannot be in doubt, but to suggest that it is all-powerful or constant in this influence would be misleading.'[33] There is another objection that has been offered regarding the influence of technical experts, namely that the 'military-industrial-scientific complex' is not (and never has been) a single interest group. Within it there are strong competing constituencies. Brooks observes how the scale of the Reagan Strategic Defense Initiative (SDI) in the 1980s was far from popular with certain scientific and military interest groups because it was seen as a competitor for funds – both with other science projects – and also with other military programmes. [34]

Policy for science: the implications of defence objectives for science and the economy

Inevitably, the dominant position of defence-related objectives and funding within policy for science was to raise significant questions as to their implications for science and the economy. The model of military-funded and Big Science-orientated S&T policy was to come under attack from both the left and the right.

The Vietnam War exposed the limits of US military technological superiority and prompted growing questions about the relationship between military funding of Big Science and innovations in weapons systems. Congressional pressure mounted to stop US Department of Defense (DoD) R&D spending on basic research that was not linked to specific military objectives. The DoD Project hindsight sought to evaluate the value of its basic research prompting a counter study TRACES sponsored by the National Science Foundation. Sapolsky notes the change in policy direction – in the United States the military reduced its support for basic research and sought to focus its research sponsorship on work that had an obvious link to military operational needs.[35]

Some parts of the scientific community expressed concern about the implications of military funding for scientific research: its potential to distort priorities and the course of scientific and technological developments; the constraints it imposed on the freedoms of those engaged in such funded research; and its impact on the nature of research universities.[36] At the same time, the Vietnam War prompted those on the left to attack the role of scientists and universities in the military industrial complex.[37]

The economic benefits and costs of defence R&D was also to become a matter of growing debate. David Edgerton reminds us how, in the United Kingdom, the Wilson Governments of the 1960s sought to harness defence S&T and procurement to forge 'The White Heat of

Technology'.[38] In large part, this reflected the European anxiety about the growing 'technological gap' between the United States and Europe. Europeans feared a 'brain drain' to the United States and were acutely aware of the growing transatlantic S&T gap – a gap that was explained in large part by huge US spending on defence and space technology.[39] European anxieties about a defence driven transatlantic technology gap have reappeared time and again: the SDI programme in the 1980s was to generate concern in Europe about the implications for European high-technology industry as has increased spending on defence and homeland security R&D under the Bush Administration.[40]

At the same time, however, critics of defence R&D spending in the United States and Europe were arguing that far from being a stimulus to economic prosperity it was in fact damaging to innovation and economic competitiveness. Questions mounted as to the extent of spin-off from military and space programmes. The spin-off argument had been used as a justification for defence R&D spending since the 1960s. Simply put, it argued that defence R&D spending generated benefits for civilian innovation and, by extension, for national competitiveness. The role of military R&D and procurement in stimulating civilian technological developments in the aerospace industry, semiconductors, the US computer software industry, and the US computer hardware industry were cited in support of the benefits of defence R&D.[41] Critics were far from convinced questioning the extent of these spin-offs to the wider civilian economy, arguing that defence funding of research was distorting S&T policy priorities and pointing to the 'crowding-out effects' of defence R&D on the wider scientific, technology, and engineering base. A declinist literature emerged that unfavourably contrasted the economic performance of the United States and United Kingdom with that of Germany and Japan. The role of defence R&D spending in National Innovation Systems was one factor that was singled out.[42] This is a topic that has generated intense controversy and the evidence on the economic effects of defence R&D is partial and inconclusive.[43]

The end of the Cold War: a search for new science and technology policy rationales

There are those who argue that it was the very economic and scientific scale of the West's Cold War arms programme that was to ultimately lead to the Gorbachev reforms and the final collapse of the Soviet Union. Whether or not this was the case, with the end of the Cold War, government spending on defence R&D fell sharply and a search began for a new rationale for S&T policy. Bozeman and Dietz emphasise how the prospect of deep cuts in US defence R&D was viewed with undisguised alarm by the DoD, the National Laboratory system and large parts of the science and engineering community as much for the potential consequences for the overall US R&D effort as for their military implications.[44]

The response was an effort to redefine the 'security threat'. In the place of the military threat from the Soviet Union emerged the economic threat from Japan (in the case of the United States) and the United States (in the case of Europe) and there was an attempt to re-cast S&T policy in the image of these new security threats. Writing in 1998, Buzan and Herring observed that: Since the end of the Cold War, the justification for the enterprise of R&D has shifted significantly (but not entirely) towards trade rather than interstate rivalry.[45]

The change in US national priorities after the fall of the Berlin Wall is captured by Greenwood:

> We began to think about broader ways to use our science and technology talents to advance our own national interests … *Science in the National Interest*, published by the White House Office of Science and Technology Policy in 1994, crystallized that way of thinking. It began to change the nature of the discussion. We went from characterizing R&D as defense R&D and nondefense R&D to speaking about R&D for broader national interests. National security was expanded to include economic security, environmental security, health security, and personal security … .[46]

In the United States, and for a relatively short period, there was an effort to shift towards what became labelled a co-operative policy model.[47] Rationales for S&T policy focused on the military mission were replaced by co-operative models that emphasised the role of government in developing technology for use in the private sector. Defence R&D and 'dual use' technologies were sought to achieve economic and industrial policy objectives.[48] In its first term, the Clinton administration sought to use 'dual-use' funding to enhance US industrial competitiveness. The Technology Reinvestment Project (TRP) passed by the Congress in 1992 was the largest and most high profile of these programmes. The TRP was seen by the DoD as a way of integrating its military technology base with that of the commercial sector through support for the development and exploitation of dual-use technology.

The most dramatic expression of this change was the rapid increase in funding for the life sciences through the National Institutes of Health. The National Laboratory system in the United States became a key element in the Human Genome Project. In the late 1980s, the US Department of Energy seized on the genome initiative 'as a way of revitalizing its national laboratories, whose bomb-making activities were in less demand as the Cold War wound down'.[49] The role of the Los Alamos, Livermore, and Lawrence Berkeley National Laboratories was not universally welcomed in the biomedical community and was denounced by one as 'a scheme for unemployed bomb-makers'.[50]

In the United States, this co-operative model did not last long. From 1995, the Republican controlled Congress began to roll-back dual-use programmes because of concerns that they were diverting scarce DoD R&D resources away from their primary mission of national defence. As Bozeman and Dietz put it: 'This period marked the abrupt end to Congress's fascination with defense conversion, defence downsizing and the redesign of the weapons and defense laboratories as potential partners for industry'.[51] Congress abolished the TRP and replaced it with the more modestly funded and more explicitly defence-orientated Defense Dual Use Technology Initiative.

The late 1990s saw a concerted lobbying campaign from universities and Congress to increase DoD funding of basic research, applied research and, advanced technology development (what is called the 'S&T program').[52] Even before the events of 9/11, the incoming Bush Administration was already committed to an increase in defence research, development, test & evaluation (RDT&E) spending.[53] The Soviet Union may have disappeared but the core of Cold War military S&T policy remained: the necessity of sustaining US global technological leadership in the means of war.

The consequences of the new security environment for the conduct of science

Since the events of 9/11 a new threat has been constructed: the threat of international terrorism. The said 'new anti-terrorism era' is argued to have widespread implications for public policy – including S&T policy.[54] Technology is seen as a key element in the response to international terrorism, whether that technology is in the form of new border protection systems; intelligence gathering and analysis systems; sensors for biological agents; or biometric ID cards. The funding of security-related S&T has increased dramatically. The US Department of Homeland Security

(DHS) which was established in 2003 has become one of the major sources of federal R&D funding in the United States. The DHS R&D budget increased to $1.25 billion in 2005 with substantial sums allocated for R&D directed at countermeasures to potential biological terrorist threats ($363 million), border and transportation security ($178 million), and radiological and nuclear counter terrorism programmes ($123 million) (see Table 1.1).

The new security environment has also had significant consequences for the governance of S&T in the United States. They are seen as part of the security threat as well as part of the security response. The anthrax letter incidents in the United States reinforced concerns about the diffusion of scientific and technological knowledge related to Weapons of Mass Destruction (WMD) and the implications of such diffusion for security. The response on the part of the US government has been to adopt new powers and procedures that have direct implications for the conduct of scientific research in the United States and – by extension – scientific research in the rest of the world.

Table 1.1 US Department of Homeland Security R&D budget for FY 2005 (million US $)

Total DHS R&D	**1243**
Border & Transportation Security	178
Science & Technology	
Biological countermeasures	363
Chemical & high explosives	73
Radiological & nuclear	123
Threat & vulnerability assessments	66
Standards/state & local	40
Critical infrastructure	27
University programs	70
Emerging threats	11
Rapid prototyping	76
Counter MANPADS	61
Conventional missions of DHS	55
National Biodefense Analysis & Countermeasures Center construction	35
Cyber security	18
Other	31
Coast Guard	19

Source: K. Koizumi, *Congressional Action on Research & Development in the FY 2005 Budget* (Washington, DC: American Association for the Advancement of Science, 2004).

Since the 9/11 attacks, new laws such as the USA PATRIOT Act as well as tougher enforcement of existing regulations have had an impact on scientific research and higher education in the United States. Foreign student numbers have fallen; new regulations have been put in place governing controls over laboratory use of chemical and biological agents; and some government agencies have sought to control the dissemination of socalled 'sensitive but unclassified' information.[55] There have been warnings from the US scientific community that this is hampering international scientific cooperation. There have also been warnings that the new security regulations may stifle creativity, drive the best scientists away from research in sensitive fields and ultimately weaken the anti-terrorism S&T effort.[56]

During the Cold War, military funding of scientific research prompted concerns amongst those who feared its potential to distort scientific priorities and the course of scientific development. In the post-9/11 security environment, such concerns are being voiced again. Fears have been expressed that the new security environment presents risks to research universities by placing limitations on researchers' access to data, challenging their commitment to openness and the free exchange of information, and imposing controls on foreign students.[57] Concerns have been expressed that the growth in biodefence funding may well alter the direction of training and research in the life sciences in particular and that the increased emphasis on biodefence may change the character of scientific meetings and publications. As a leading figure in the US microbiology community has observed that 'Abundant new funds are available for biodefence research, and many researchers are racing to enter the field … The proposed US biodefence research agenda is likely to change the face of microbiology for many decades'.[58]

As Rappert and Balmer elaborate in Chapter 2, claims about the impact of recently introduced measures on the actions and agendas of science deserve close scrutiny regarding their underlying premises. However, there is little doubting that since 9/11 fields of study hitherto deemed as peripheral to national security are being encouraged, and indeed compelled, to examine practices in a new light.

The securitisation of European science and technology policy?

What about Europe? On the whole, the response at the national level in Europe has been more cautious than that in the United States. There has been some modest increase in the funding of counter terrorism S&T in the United Kingdom and the establishment of a new Ministry of Defence (MoD) Counter Terrorism Technology Centre. The German government has announced funding for a new security research programme. There have been some fairly modest calls in the United Kingdom for tighter restrictions on bioscience research.[59] Overall, however, there have been little of the kinds of debates and problems that have arisen in the United States. One study suggests that the implementation of biosecurity controls in the United Kingdom has had a limited negative impact on the UK scientific community and has been less disruptive in the United Kingdom than in the United States.[60]

Arguably, more significant development has been at the European level where 'security' was included in the list of priority research themes in the proposal for the seventh Framework Programme for Research & Development issued to the European Parliament and Council by the European Commission. Security research forms part of the Security and Space thematic priority and the European Commission has asked for roughly €250 million a year for its European Security Research Programme. The Commission says,

> Security Research is needed to increase levels of security for European citizens. In addition, it will help in creating a favourable social and business environment for prosperity and development. Business will gain, not only within the security industry, but also in many other economic sectors, leading to higher growth and employment in Europe.[61]

In some senses, we are seeing the first steps towards the securitisation of S&T policy at the European level. Certain actors within the European Commission and especially within the European defence industry have used international terrorism (and especially the Madrid train bombings) as rhetorical devices to support their case for funding of these activities. Equally, the wider securitisation of European Union activities in the fields of Home Affairs, Justice, and so forth has also been used as justification for the securitisation of the Framework Programme.

Whatever the drivers, this represents a significant new guiding rationale for European S&T policy. Parts of the European Commission's DG-Research have long sought to fund defence-related research. They have observed that whilst the Framework Programme has never formally allowed the funding of defence-related research it has been acknowledged that over the years it has increasingly funded research that could be regarded as 'dual-use'. Nevertheless, many member states, European parliamentarians and indeed some commission officials have always opposed such moves. Some are concerned that defence as guaranteed by

Article 296 of the Treaty of European Union is a national prerogative. Others argue that the European Union (EU) is a civilian and not a military power and that it would therefore be inappropriate to fund defence-related research. The outcome has been a semantic debate over the definition of 'security' that has seen the European Parliament insist on the exclusion of research on offensive weapons and member states seek to curb the scope of the programme.

There are some Europeans who will welcome such efforts to extend the Framework Programme in this new direction and these are likely to include some within the S&T policy community. Some Europeans have sought to find a new 'public engine of innovation' to improve Europe's lacklustre economic performance and are looking to public procurement to take up that role.[62] There are those within the European defence industry, some parts of the European Commission and some European governments who have argued that defence R&D can help stimulate the European economy and that the huge transatlantic gap in defence R&D is adding to the competitive threat posed by the United States. Defence R&D, it is argued, is strengthening US competitiveness in strategic industries – commercial aircraft in particular but IT, electronics, software, and nanotechnology are often mentioned – and the lack of equivalent programmes is hampering technological progress in Europe.

S&T policy and international security: a research agenda

Clearly then, the perceived new security environment raises major issues for the 'securitisation' of S&T policy on both sides of the Atlantic and has the potential to change European policy in a quite significant way. However, there are very few (if any) academics in the S&T policy community in Europe who are considering either how perceptions of the international security environment are shaping policy or how S&T policy is itself influencing international security (and insecurity).

Instead, the policy-security relationship has been at the margin of academic agendas. The role of the military mission in legitimising S&T policy and the dominant role of military R&D in post-war government spending on research is an issue that is frequently noted in passing in the 'mainstream' S&T policy literature but is seldom the central focus of study.[63] Indeed, in a paper published in 1990, Philip Gummett, bemoaned the fact that defence science and technology policy is surprisingly understudied, in view of the volume of spending on defence R&D in such countries as the United States, the United Kingdom and France.[64]

Instead, such questions have been left to others – not least those from the STS community. In turn, that community too has bemoaned the lack of attention given to the issue.[65]

This lack of attention on the part of S&T policy academics is surprising given the on-going significance of national security in structuring policy for science. There are potentially serious practical consequences for European policy. What is striking is that the rationales being used for policy developments such as the European security Research Programme have been subject to little or no critical analysis. Such analysis is desperately needed before the character of European activities change in ways that many may find unpalatable. There are many issues that seem worthy of further research, three will be highlighted here.

First, there are a set of *science for policy* questions, not least the proper role of the scientific community in advising on the scientific and technological risks and opportunities in this new security environment.

Second, there is the question of the impact of security on *policy for science*. How are perceptions of the international security environment shaping policy for science in Europe? Are we seeing evidence of a securitisation of science via new regulation of science?

Third, what is the economic impact of government spending on defence and security R&D? The economic rationale for increased spending in this field has been put strongly by the European Commission and others but does it make sense? Those who study US science, technology, and innovation policy are far from convinced that spending large sums on defence R&D in this way has been an efficient means of stimulating commercial technology development in the United States.[66] Rather than welcoming the rapid growth in defence R&D there are many in US S&T policy community who worry whether the United States is investing in the right kinds of R&D to enhance economic competitiveness. Ultimately, the scale of US defence R&D spending means that it would be remarkable if there were no benefits to the wider economy but the efficiency of such an approach is open to serious question. These matters are worthy of further serious analysis.

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2

Rethinking 'Secrecy' and 'Disclosure': What Science and Technology Studies Can Offer Attempts to Govern WMD Threats

Brian Rappert and Brian Balmer

It is often remarked that post-Cold War, and particularly after 9/11, a 'new security environment' has emerged. This is characterised by transnational threats to the West, numerous failing nation states, the proliferation of armaments along with the know-how to manufacture them, and continuing pressures for societal openness. All of these issues intersect in relation to the threats of 'weapons of mass destruction' (WMD). Indeed, the danger posed by such weapons has been identified as 'the key issue facing the world community'.[1] The topics of global terrorism and the proliferation of WMD now dominate many national security forums. With these developments a number of questions are being posed with a renewed vigour in policy, academic, and popular discussions: How easy is it to produce and proliferate WMD capabilities? What would count as compelling evidence of their acquisition? What initiatives – such as the imposition of further secrecy restrictions – are likely to limit the spread of WMD? What negative consequences might follow from any such responsive measures?

Among other things, the answers to such questions crucially hinge on the status accorded to scientific knowledge and technological artefacts. Should these be regarded as readily available, easily transferable, and practically un-containable, then this would add significantly to the possible dangers.

Over the past few decades the emerging interdisciplinary field of science and technology studies (STS) has taken as its focus the character of science and technology (S&T).This examination has often been characterised as questioning an orientation to S&T as mere 'black boxes' about which analysts are able to comment on the inputs and outputs but not on the inner workings. Rather, in STS they are treated as topics of substantive and conceptual study in themselves. Herein, science is not simply regarded as consisting of a formalised method for investigation that leads to the growth of a body of abstract knowledge, and technology is not simply treated as science applied to fulfilling some goal. The language in STS is often one that speaks of the *construction* of knowledge and artefacts, wherein the boundary between what is social, technical, political, and scientific are actively problematised.

For instance, MacKenzie's socio-historical account of the development of inertial inter-continental ballistic missile-guidance systems in the United States and elsewhere, entitled *Inventing Accuracy*, remains a seminal work in the field of STS.[2] While enhancing the accuracy of inter-continental ballistic missiles has long been a preoccupation of politicians, strategic planners, and weapon developers, MacKenzie questions precisely how the goal of accuracy should be understood as implicated in the development of guidance systems. So, the specific activities undertaken to enhance the accuracy of missiles were argued to be a contingent result of organisational and political interests (such as inter-departmental and inter-service competition), rather than matters dictated solely by technical considerations. While in the past, those studying the weapons-acquisition process have often drawn attention to competing bureaucratic and domestic political interests,[3] MacKenzie pushes further in tracking the detail to which such factors bore on the specific systems adopted. As part of this, determining the accuracy of missiles was explained as an activity that did not simply revolve around narrowly conceived technical choices and calculations. Debates about the relative accuracy of competing guidance system designs or actual devices turned on extrapolations and assumptions, including such 'non-technical' factors as strategic and political goals (for example, criteria for what counted as accurate turned, in part, on whether or not it was strategically desirable to be able to hit Soviet missiles in silos prior to their launch). The overall upshot of MacKenzie's analysis was not to replace 'technological determinism' with 'social determinism', but rather to document the inter-connectedness of 'social' and 'technical' through a critique of technological development as 'goal driven'.

Likewise, Collins and Pinch's analysis of the US Patriot missile system during the 1991 Gulf War indicated considerable scope for the social negotiation of what counts as technically 'effective', 'useful', and 'needed'.[4] Analyses such as these demonstrate that measurement should be understood as a socio-technical activity. Orientating to technology as a product of negotiation, those in STS avoid explaining the success or failure of a technology by whether it 'works' or through appeals to its intrinsic superiority or inferiority. Instead, the orientation adopted is to explain what 'working' means, and how this can be varyingly defined and settled.

The purpose of this chapter is to ask how analyses and orientations in STS might help reframe many of the assumptions in current popular and policy discussions about the governing WMD threats. As will be argued, many current perceptions of security threats are underpinned conceptions of S&T that upon closer inspection prove questionable. In doing so this chapter surveys a number of key themes within the field that bear on the development, operation, and spread of science-based technologies: the importance of conceiving of S&T as forms of practice rather than simply abstract knowledge or material products; the need to approach technologies as heterogeneous socio-technical systems; the community and cultural dynamics of scientific research; and the significance of attending to accomplished status of science as being 'open' or 'closed'.

Beyond formalised knowledge (or why the genie may not be out of the bottle)

As alluded to in the introduction, many of those in STS have abandoned simply treating science as an impersonal and cumulative body of knowledge which has universally applicability. Instead, it has been orientated to as an accomplished activity that in significant respects must be treated as local and personal in character. A stark example illustrating both the need for, and the security implications of, such a distinction is provided through considering the role of 'tacit knowledge' in advanced science-based technologies. Whereas viewing science as an impersonal and cumulative stock of knowledge is highly aligned with treating it as consisting of abstract, explicit, and specifiable propositional knowledge, tacit knowledge refers to skills, understandings, and competencies involved in 'doing' that cannot be easily codified or therefore exchanged. The embodied knowledge necessary to ride a bike is a classic instance of mundane tacit knowledge. No matter how many instruction manuals are read by someone who has never ridden a bike, it is impossible to learn how to do this through reading alone.

The philosopher and scientist Michael Polanyi was one of the first to assess the significance of tacit knowledge in scientific experimentation. Polanyi stressed the importance of 'learning by doing' and 'learning by example' in what he described as the master-apprentice relationship between experienced and novice researchers.[5] In the 1970s and 1980s, Collins extended the examination of locally held tacit knowledge in science. As part of this, for instance, he examined attempts in British and North American laboratories to recreate the Transversely Excited Atmospheric (TEA) laser from work originally conducted in a Canadian defence laboratory.[6] Despite having access to the formal design plans and the ready availability of requisite components parts, those attempting to 'copy' the TEA laser experienced significant difficulties. In the end, reproducing the laser required extended periods of contact with and the transferring of skills from those who had already successfully constructed one. As part of the case for the pervasiveness of tacit forms of knowledge, Collins has since gone to consider how this type of knowledge limits the possibility for achieving artificial intelligence through programmed software as well as its role in other areas of scientific investigation.[7]

These points about the place of tacit knowledge have a direct bearing on concerns about the proliferation of WMD. Treating the capabilities required for the science-based WMD technologies as simply relying on universal, cumulative, and formal knowledge would justify a much greater concern about the likelihood of their proliferation than if they were deemed significantly reliant on hands-on experience, skills, and know-how that only spread through costly and time consuming personal exchange or extended training. MacKenzie and Spinardi conducted a detailed study of tacit knowledge for national security in their 1996 chapter entitled 'Tacit Knowledge and the Uninvention of Nuclear Weapons'.[8] As implied by the title, they take as their topic the question of whether the degree of reliance on tacit forms of understanding in the production of nuclear weapons means that, in nontrivial ways, these weapons could be 'uninvented'. In doing so, they take as their focus of criticism widely taken for granted assumptions that it is not possible to lose the ability to create nuclear weapons.

In making a case for the importance of tacit knowledge, MacKenzie and Spinardi document the frustrations experienced in variety of historical and contemporary attempts to develop nuclear weapons despite the accessibility of the necessary physical understanding and details on the design of fission or fission/fusion weapons. One such effort was the original construction of the atomic bomb at the Los Alamos national laboratory. Initial presumptions that moving from a basic understanding of physical processes of fission and agreed design schema would be relatively clear-cut proved ill-founded. Attempting to devise a working prototype threw up many vexing and largely unforeseen practical problems, requiring new materials, skills, and instrumentation that could not easily be marshalled. This, in turn, forced reconsideration of the design of the weapons. But even when a working bomb had been realised, the later 'copying' of it was far from straightforward. Although the Soviet programme benefited from access to many design plans, data, and other forms of formalised knowledge from the American one, it faced numerous practical problems that required far more resources than initially envisioned. Perhaps even more startlingly, despite the contribution of a number of British scientists to the Los Alamos project and dedication of some one thousand workers to the effort at its height, the United Kingdom required five years to recreate the bomb.

The proportion of tacit to formalised knowledge required is key in determining the 'hardness' of reproducing science-based technologies. This mix though is not static over time. Since the early days of the development of nuclear weapons, the availability of high speed computing, sophisticated electronic circuitry, and diagnostic equipment means that many of the practical difficulties experienced in the past which necessitated highly skilled expertise have been technically overcome. However, despite this, MacKenzie and Spinardi maintain that tacit knowledge is still essential in contemporary attempts to (re-)construct nuclear weapons. The case of the 1980s Iraqi programme is said to illustrate the continuing need for skilled, hands-on expertise. Likewise, through interviews with American nuclear weapons designers, the argument is made that becoming a designer today still necessitates a process of apprenticeship that involves years of practical training. While high speed computing has greatly aided predictive abilities and much effort has been expended in recent decades to formalise relevant knowledge, MacKenzie and Spinardi argued that such efforts have not eliminated the need for US designers to spend years of engaging with diverse practicalities before they become proficient.

An upshot of the previous argument is that if the production of nuclear weapons requires various forms of hard to obtain tacit knowledge and skills, then with the passage of time, the lack of the continuing honing such competences may result in an unlearning. Even with the ready availability of various forms of relevant knowledge in the public domain, if the requisite skills are not renewed, this can lead a real loss in the ability to undertake certain activities. Just how and when skills might deteriorate has major implications for current policy discussions regarding the proliferation of WMD.

Until at least the late 1980s, and against international declarations to the contrary, the Soviet Union had an advanced offensive biological weapons programme that at its height employed tens of thousand of engineers, scientists, technicians, medics, and others. To fund the dismantling of this programme and to prevent the proliferation of WMD, in 1991 the US government passed the Threat Reduction Act which eventually covered nuclear, chemical, and biological programmes. Since then European countries, Japan, and others have contributed to efforts to destroy stockpiles of dangerous weapons and convert former defence establishments in the newly independent states of the Soviet Union into civilian operations. With the continuing costly funding of such demilitarisation activities, questions are being asked about how long the support should continue and how its benefits can be measured.

Vogel argues that considerations of tacit knowledge should be at the centre of such funding debates.[9] She examines the case of the Stepnogorsk Scientific and Experimental Production Base (SNOPB) established in 1982 and located in Northwest Kazakhstan, which among other activities was responsible for weaponising anthrax. The sorts of difficulties experienced in the successful mass weaponisation of anthrax[10] despite extensive research on a weapon design and previous work with the causative agent are said to illustrate the salience of tacit knowledge for the past and therefore future capabilities of SNOPB employees to produce biological weapons. So despite members of SNOPB receiving detailed formal descriptions regarding how to cultivate and produce anthrax based on previous experience elsewhere in the Soviet Union, translating such initial work into a practical production process proved extremely complicated. These complications included difficulties in scaling up from laboratory efforts and integrating equipment and infrastructure at SNOPB. Both of these 'involved a trial-and-error process utilising knowledge and skills obtained through previous hands-on experience in working with fermentation, biosafety, drying, and milling equipment.' In this respect, it is instructive to note that the transfer to SNOPB of 65 staff members with previous experience in weaponising anthrax was regarded as crucial in enabling successful weaponisation. As Vogel summarises, turning the initial

> concept into a working technology required the indigenous development of new materials, protocols, equipment, infrastructure, as well as the hiring of several hundred additional personnel and coordination of these elements within a large, complex technological system. As the SNOPB case shows, it was difficult to develop the new [anthrax]

weapon to operate in a new context, even with generous funds, resources, critical infrastructure, and experienced personnel at SNOPB's disposal.

Following from such assessment, she contends that the permanence of the 'hands-on' skills and knowledge of former biological weapon employees should be a crucial consideration in funding decisions. Making such determinations in practice would not be easy, not at least because former employees would have a vested interest in maintaining that they still possessed the necessary know-how. Bearing such difficulties in mind, she suggests that future research should be undertaken to catalogue and differentiate between various forms of tacit knowledge (including individual versus communal knowledge) required for R&D, production, and testing of biological weapons and then assessing the potential that such knowledges might degrade with the passage of time.

The analytical understanding of the role of tacit knowledge in the production of WMD, let alone the development of science-based technologies in general, remains preliminary in important respects. The argument in the previous paragraphs though does suggest the need to move away from thinking about the proliferation of WMD in terms of the spread of formalised knowledge and materials to instead attend to the practical issues associated with weaponisation. Of course, much depends on the level of sophistication required. The demands of producing relatively crude nuclear or biological weapons vis-à-vis consideration about tacit knowledge has proven much more difficult to assess than the sophisticated state programmes that have been the main focus of the studies discussed in this section.

Weapons of mass destruction programmes as socio-technical systems

As mentioned earlier, the STS literature eschews thinking about technologies as merely applied science or simply as artefacts.The STS instead recognises that what would, ordinarily, be regarded as the 'social, cultural, economic, and political context' of the technology is usefully thought of as *constitutive* of technology. In this respect, the term *socio-technical system* has been adopted to signal that any technology will be embedded in a network of other technologies, social groups, symbolic and material environments, practices, and so on.[11] Of course, literature in security studies recognises that technologies amount to more than simply 'things'. Buzan and Herring, for instance, state that any technology consists of hardware, software, and skilled people (or wetware), noting by way of example that 'without software, a modern aircraft is just pieces of metal and other components rather than a usable weapon system'.[12] The concept of *socio-technical systems*, however, opens up discussion and empirical investigation beyond the impact of technology on its wider context; it additionally allows us to pose questions about how the characteristics of technological artefacts are socially shaped.[13]

As an example, Abbate studied the development of the predecessor to the Internet, the militarily sponsored ARPANET.[14] Research in the United States led to innovative 'distributed networks' – where computer networks have no central node but have lots of nodes with many links between them – and 'packet-switching' where a message is split and routed through a variety of nodes in a network and then reassembled at the end point into the original message. This was a military response to a military problem: avoiding a nuclear 'Achilles heel' where an entire communications network was endangered by one vulnerable central computer node linked to peripheral nodes. As an important addendum, Abbate adds that the idea of packet-switching was also conceived independently in the United Kingdom outside of military influence at the National Physical Laboratory. Here, in a non-military context, the idea was not developed because it was not well funded and met with scepticism from other technical experts. So, in this instance, the military context, rather than simply surrounding the research activities, actively influenced and shaped the development of this technology by presenting particular problems for solution.

What happens if we construe WMD programmes as socio-technical systems? Certainly this perspective shifts the focus of analysis when asking which groups have dominated in driving forward research and development (R&D) on WMD. In this respect, following the points made in the last section about tacit knowledge, McKenzie has argued that weapons research and development can usefully be construed as an example of *heterogeneous engineering*, where participants attempt to build a socio-technical system of 'things and people' together. He notes that

> A successful weapons programme can indeed plausibly be seen as a network linking physical artefacts and human beings. Weapons systems developers have often to spend as much time constructing and maintaining their relationship to human actors (politicians, industrialists, senior officers, the multifarious forms of 'bureaucratic politics') as they do forging physical artefacts.[15]

Such heterogeneous engineering is evident in the interaction of science and politics in the history of the nuclear weapons programme at Aldermaston in the United Kingdom.[16] In the past the driving force of weapons innovation has been variously attributed to weapons scientists or politicians, and military planners. Spinardi has challenged this polarisation, claiming that in Aldermaston's case influence did not reside entirely with one group – something that would not be unexpected of *heterogeneous engineers* within a *socio-technical system*. Nuclear weapons designers had some influence over service requirements, particularly as they laid claim to technical judgements about what it might be possible to create. This said, the scientists did not operate in isolation. Political goals for Britain to maintain world status, for example, or the support of key civil servants during the 1960s and 1970s when the future of Aldermaston was uncertain, were equally important for driving and shaping nuclear weapons development.

Similarly, the history of the UK biological warfare programme reveals a complex heterogeneous engineering exercise that affected the changing ideas of what constituted a feasible biological weapon.[17] Post-WWII UK research efforts aimed to produce an anti-personnel biological bomb, comparable with the atomic bomb. As Britain acquired its own nuclear deterrent, and post-Korean war defence cut-backs dug into the research budget, the priority of biological warfare fell. In the mid-1950s the United Kingdom adopted a defensive policy. Within a few years, UK biological warfare scientists revisited data on the so-called Large Area Concept, where a biological weapon was envisaged not as a bomb or missile, but as a wide-coverage cloud sprayed from an aircraft. The scientists argued, in line with the new defensive policy, that the United Kingdom needed to carry out research to guard against such an attack. As Balmer has argued, the change in research agenda, along with the definition of a biological weapon, was not simply the result of new or revisited scientific discoveries, but a consequence of changes of policy that had altered the relationship between biological warfare researchers, scientific advisers, politicians, and the military.

The contrast between technologies construed as artefacts or as socio-technical systems is not simply an analytic one reserved for social scientists. Social and political actors can adopt versions of these approaches in debates about WMD. Hence, to the United Nations Monitoring, Verification & Inspection Commission (UNMOVIC) and United Nations Special Commission (UNSCOM) weapons inspectors in Iraq prior to the second Gulf War, the notion that they were seeking out a socio-technical system would be a commonplace working assumption. One former

UNSCOM inspector, without adopting the academic jargon, noted that

> A weapons programme is more than just the weapons themselves: it includes the entire management, organisation, staffing and funding as well as research and development, production of chemical and biological agents and stockpiles and finally weaponisation … What was sought was not simply a complete weapon ready to be used but also an understanding and account of its life-cycle – the capability and intent behind it.[18]

And, while the media-orientated rhetoric possibly oversimplifies the thinking behind the post-Gulf war approach of the Iraq Survey Group, its head David Kay's comment that as of October 2003 they had 'not yet found shiny, pointy things that I would call a weapon' is nonetheless telling in the way it played on common notions of weapons as isolated from their context.[19] Elsewhere, Kay has presented an assessment of Iraqi WMD capabilities much more in line with socio-technical systems thinking and the quote by the UNSCOM inspector.[20] Just whether evidence of WMD capabilities or the intent to produce them required inspectors (or their political and media audiences) to be able to identify 'pointy things' or to allude to more ambiguous evidence of programme-related activities – that is whether WMD capabilities should be understood as artefacts or socio-technical systems – became a matter informing debates about the significance of what had been found in Iraq.

In addition, conceptualising WMD weapons programmes as socio-technical systems shifts analytical focus and problematises the boundary between the technology (normally construed as the exclusive realm of the scientist and engineer) and its social context (usually the territory of social scientists). A socio-technical systems approach also challenges everyday assumptions about the capacities and properties of technologies. Rather than construing such properties as dangerousness, risk, or lethality as inherent in technologies, an STS-inspired approach invites their re-conceptualisation as *relational* properties. This point has been illustrated by sociologist Diane Vaughan, who points out that 'a butcher at work, for example, does not see the same immediate danger in the tools of that trade as does a parent catching a preschooler … pulling a carving knife out of a drawer'.[21] Risk does not reside in the carving knife, but in this instance is constructed from the relationship between the knife and its potential users.

Likewise, while it seems intuitive to base a judgement of dangerousness on the effects of weapons, in practice weapon effects are contestable and so any assessment 'begs questions about what options are being compared, by what criteria, in relation to what circumstances and by whom'.[22] Governments, Non-Governmental Organizations (NGOs) and others can, at times, be highly adept in pointing to various contingencies and relational considerations to counter generalised statements about the effects of weapons, so as to support or undermine particular calls for prohibitions (as in debates by the World Court regarding the legal permissibility of nuclear weapons).[23]

These observations become especially pertinent in debates about WMD proliferation when considering whether particular scientific and technical publications (or other potential elements of a weapons programme, such as dual-use technology) are dangerous or not. This overall issue is discussed in depth later in this chapter. At this juncture it is sufficient to note that judging the danger depends on more than just that publication (or artefact) in question. It will also depend on such matters as the resources, know-how and intent of potential abusers. Moreover, it will depend on complicated assessments about the novelty of the contribution made by one element of research set against the background of the previous understanding of what was known. Yet, making such relational assessments is often difficult in theory and contested in practice.[24]

Cultures of secrecy in research and development

One of the main aims of STS has been to understand the culture of scientific research, the shared beliefs and practices of scientific communities. Pioneering studies of research culture focused on university laboratories as sites of knowledge production.[25] More recently, a number of analysts have used ethnographic methods and archival sources to examine the distinctive cultures of military research establishments and, to a lesser extent, of defence research policy. The usual presumption in such studies is that military science is not just civil science behind closed doors. Indeed, what might be termed 'weapons cultures' have been identified as constituted by relations of secrecy. Secrecy, while not confined to military institutions, permeates the research culture in ways ranging from the ubiquity of such mundane elements as locked doors, restricted zones, and access privileges, through to techniques of control, such as compartmentalisation, surveillance and, classification, which embrace entire organisations.[26]

In relation to helping understand the proliferation of WMD, it is unremarkable to state that secrecy can encourage research and development programmes through concealment. All major state programmes on WMD, not to mention sub-state terrorist activities such as those of the Aum Shinrikyo sect that attacked the Tokyo underground with sarin in 1995, have been carried out within a veil of secrecy. Studies of military research cultures from an STS perspective though, have added that secrecy is not simply a 'passive' negative phenomenon, concealing and suppressing, but it is also part and parcel of producing different practices, moral frameworks, and particular definitions of situations.

At a relatively straightforward level, secrecy in military research establishments leads to particular institutional practices. Westwick has argued that during the Cold War, the closed culture of the US Atomic Energy Commission laboratories encouraged scientists to develop a separate shadow community, modelled on a sense of the academic scientific community and sustained through institutions such as closed conferences, restricted circulation publications, and systems of peer review.[27] Authorship conventions may also change under conditions of secrecy, as authors may not even be named in some documents. Along with authorship, notions of ownership of intellectual property may also be reconfigured.[28] At a more anecdotal level, one of the authors of this chapter (Brian Balmer), in his research on the history of chemical warfare was informed by a former UK defence researcher that although applications for patents may sometimes be held secretly in abeyance for security reasons, scientists still felt it was worthwhile to file applications. This, he explained, was because the application would still count in a closed culture, where scientists may not have the same open publications as civil scientists when going for promotion. While these examples point to differences in the institutional organisation of secret science through novel mechanisms for reward and communication, they also suggest some more fundamental changes to scientists' sense of identity within clandestine environments. As Gusterson has argued, on the basis of his ethnographic research at the Lawrence Livermore National Laboratory, they 'become weapons scientists rather than, simply, scientists'.[29]

Distinguishing between 'all scientists' and 'weapons scientists' points to a further productive role for secrecy: the creation of distinctive moral economies. Kohler uses the term moral economy in science to refer to how 'unstated moral rules define the mutual expectations and obligations of the various participants in the production process'.[30] A moral economy is both a component of the weapons culture, and a part of the distinctive identity of weapons scientists. This distinction stands in opposition to the orthodox, but problematic, view of a single scientific community working within a universal normative framework. Besides appealing to widespread caricatures of how scientists behave, such a view was also prevalent within academic sociology of science until the 1970s. The scientific community, it was argued most notably in the early writings of Robert Merton, was bound by the norms of communalism, universalism, disinterestedness, and organised scepticism. The violation of the norms through excessive secrecy or judgements of research based on anything other than their methods and findings would endanger the production of valid scientific knowledge and therefore encourage sanctions against transgressors.[31]

In contrast, studies within an STS framework have long pointed to the lack of a universal normative framework that regulates science, drawing attention to the absence of institutionalised links between norms and the reward system in science.[32] Whatever norms do, it does not appear that adhering to them underwrites the epistemological status of knowledge or that breaking norms inevitably provokes sanction. In empirical studies of how scientists put norms to use in everyday practice or during scientific disputes, it has been argued that norms are flexibly invoked to defend or condemn colleagues' behaviour.[33] So, the secrecy involved in withholding results from publication, for example, can be condemned by some scientists because it violates supposed norms of sharing within the scientific community. Yet, the same behaviour can be defended by those withholding publication because it gives time to check results, thus conforming to norms such as disinterestedness. Norms, in this sense are less regulatory principles and more strategic resources.

In the past some analysts have gone on to contend that norms function as part of a scientific professional ideology that paints a positive image of science in order to achieve goals (funding, prestige, trust, etc.) in relation to other scientists, patrons, and the public.[34] Whether or not one subscribes to this position, norms cannot simply be taken as an unproblematic description of the behaviour, or even ideals, of all scientists.

More recent studies of 'weapons culture' have demonstrated that far from entering some sort of moral void or psychological denial, weapons scientists readily articulate arguments to defend their work. To be sure, this does not always occur. For instance compartmentalisation, and the strict organisation of time within the Manhattan Project, arguably closed off opportunities for scientists to reflect on ethical concerns as they were quite simply kept too busy.[35] Nuclear weapons scientists interviewed by Gusterson though, were able to provide arguments in defence of their work, while a historical study of the UK biological warfare community revealed the scientists defending their work in terms of patriotism, potential benefits to medicine and the possibility of developing 'humane' weapons.[36] These studies are not simply attempting to introduce a capricious moral relativism into debates about WMD or dual-use research, they remain silent (to a greater or lesser degree) rather than agnostic on the validity of the arguments advanced in defence of weapons research.

A key point follows in relation to contemporary discussions about ethical codes of conduct. For instance, following a recommendation by the Policy Working Group on the United Nations and Terrorism, in September 2002 the United Nations (UN) General Assembly and the Security Council endorsed the recommendation that codes of conduct should be established across those areas of research relevant to WMD. It is unlikely though that the activities stemming from this could act as a straightforward, universal 'moral compass' to regulate the behaviour of varied scientific communities by defining where one steps outside of the moral framework of science. Such a view depends on scientists knowingly engaging in deviant behaviour; where that is the case, then codes of conduct may have some moral force. Where instead scientists construct alternative moral economies that legitimate their practices – for example in terms of patriotism or simply the irrelevance of their dual-use work to WMD – the situation becomes more complex. Against the compass view of codes of conduct, the alternative moral economies view suggests that, while codes of conduct may yet have some use, there also need to be more active measures for dismantling certain worldviews and persuading some scientists that research on banned weapons is inappropriate.

Why the 'public' status of science is a negotiated accomplishment

The previous section suggested that attending to scientific and technical developments as (heterogeneous) collective, social activities in a manner suggested by those in STS enables a rethink of common assumptions about secrecy in military innovation, in particular by pointing to its productive aspects. Conversely, attending to R&D as a socio-technical activity also suggests the need to rethink the meaning of terms such as 'public' or 'disclosure'.

For instance, since the attacks of 9/11 and the mailing of anthrax-laced letters, media and policy attention to the threats of biological weapons have increased significantly. With that, questions are being asked whether the data, findings, and methods generated through civilian research in areas such as virology, immunology, and genetics might enable the development of biological weapons. This, for instance, by helping to make bacteria resistant to existing antibiotics and diagnostic procedures, reducing the ability of the body to defend itself, improving the survivability of bioagents, making non-pathogenic organisms pathogenic, or enabling the production of novel threats.[37] Mainly in the United States, but also elsewhere, questions are being asked about what novel threats might stem from biological research and whether some lines of investigation are too 'contentious' to pursue or publish. This concern has taken a number of forms. In 2003, a group of prominent scientific journal editors agreed voluntary procedures for vetting submissions with a view to requiring their modification or even rejecting them outright if it is deemed that their societal harms outweigh their benefits.[38] Following recommendations made by the US National Research Council,[39] in 2005 the National Science Advisory Board for Biosecurity was established which has within its remit the establishment of guidelines for the pre-project assessing the costs and benefits of proposals. The possible creation of new category of research activity between classified and open, so-called 'sensitive but unclassified' results has been mooted.[40]

With such fairly unprecedented scrutiny to the security implications of the results and methods of the life sciences (as opposed more conventional concerns about the physical safekeeping of dangerous pathogens), many are voicing worries about the implications of restriction or oversight measures on the character of science. This applies both to government bodies facilitating movements towards further scrutiny as well as organisations representing practitioners. With a view to possible response measures, John Marburger, Director of the US Office of Science and Technology Policy, has commented that science only flourishes

> in an environment where ideas can be freely exchanged, criticized, and interpreted by others. For a nation that would lead in science, national security includes securing the freedom to engage in open scientific discourse. Science can never be successfully dictated by a science czar, or conducted by a closed elite. Where the marketplace of ideas is regulated, the quality of thought diminishes, and science suffers.[41]

In an editorial in the journal *Science*, the former president of American Society for Microbiology remarked that

> In the aftermath of last fall's bioterrorism attacks, the wisdom of imposing restrictions on scientific publications has been widely

> discussed in the US press. Debate about US security interests and scientific communication is timely and worthwhile. It is critical, however, that we not overreact to these issues, especially if that overreaction puts scientific progress and the public health at even greater risk in any future bioterrorist action …
>
> Communication of research results forms a foundation for rapid and effective response to infectious diseases as well as to bioterrorism.Censorship of scientific communication would provide a false sense of protection. For example, deleting methods sections from scientific publications, with the rationale that a terrorist could benefit from knowing the methodology, would certainly compromise our ability to replicate results, one of the cornerstones of scientific research. Scientific colleagues' scrutiny and replication of research studies reduces the likelihood of errors that can misdirect scientific activitiesThe best protection against the possibility of future bioterrorism incidents is the unfettered ability of our scientific community to collaborate openly and move forward rapidly in the conduct of scientific research. Timely communication of new knowledge and technological innovation accelerates the rate of scientific progress. For example, the rapidly accumulating new information from microbial genome sequences points toward new targets for therapeutic agents. With open access to these sequences, scientists can now translate the information into products that benefit human health.[42]

As evidenced in the above statements and many others, in security deliberations scientific research is often characterised as involving the free exchange of information in an unfettered 'marketplace of ideas', where the publications supported through peer review and replication ensures the validation of knowledge claims. The idealised notions of science expressed in these statements have been thoroughly critiqued in STS through empirical examination of the practices of researchers. While such criticisms do not thereby imply restrictions that are advisable, they do suggest the need for a much more nuanced approach than evidenced in many policy debates.

To elaborate, and as alluded to in the previous section of this chapter, the characterisation of science, even university-based science, as involving nothing besides free and open exchange is problematic. Some of the reasons for this are matters of considerable policy debate elsewhere. In the past few decades, universities in the United States, United Kingdom, and elsewhere have steadily encouraged more and more links between universities and industry, especially in the life and medical sciences.

Although this has been a source of consternation for some commentators,[43] there is little doubt about the importance and acceptance of commercial relations for many research universities today. As part of this, the increasing proprietary ownership of research techniques has been topic of considerable attention in science policy.[44] Working within STS theoretical traditions, Hilgartner studied the varied and often subtle practices that genomics researchers engaged in to limit access.[45] These arose because of reasons related to both commercial and academic competitiveness and owed much to the organisation of research. Herein, for instance, the division of scientific labour between types of researchers (e.g., those that map chromosomes and those which search for genes) meant that they often simultaneously experienced pressures to both release data and to restrict it, which in practice resulted in strategic decision-making regarding the release of *particular* materials and information at *specific* times. An implication of the points in this paragraph is that the status of research as a public or open should not be taken for granted.[46]

The central role accorded to publications in the dissemination of scientific knowledge in security debates is another matter on which STS would counsel caution. Empirical studies of science-in-the-making give reasons to suggest that written publications are not the final, ultimate culmination of research, but rather what goes into them and how significant they are regarded very much depends on relations within (often international) research communities. So, detailed ethnographic studies of sub-disciplines in physics,[47] for example, indicate that much of the circulation and validation of leading edge research takes place orally. By the time results get written up in journals, they are likely to already have been distributed to other specialists through pre-publication 'grey literature'. While such considerations are only relevant for life science research insofar as it parallels physics, they do point to a complex relationship between publications and the development of science. In addition, these studies and others indicate that what appears in scientific press should not be regarded as valid within a given scientific domain simply in virtue of appearing in print. Peer review is not, and in practice is not regarded as, an absolute guarantor of quality or novelty.[48]

These claims about publication should not be read as simply supporting the potential for, say, deleting sections of contentious experiments. It could well be argued that the extent of informality in exchange relations means information will circulate even if it is blocked at the publication stage. Yet, the argument above does suggest that any considerations about what is done vis-à-vis publishing should be done with a view to asking what specific functions articles fulfil, when and for whom, and what controls would mean and for whom.

Related to these points, the prominence given to claims of the extent to which articles function as codified information resources that enable the replication of research results should not be taken for granted. The earlier discussion in the second section of the importance of tactic knowledge in developing science-based technologies applies to basic scientific experimentation.[49] Herein, replication is not treated as a straightforward process because of the situatedness of experimental work. As formalised summary accounts of complex processes, whether articles (or patents) contain enough information to enable (expert) others to repeat experiments should not be taken for granted. Even by scientists, the contention that the scientific article is a 'fraud' has long been voiced this in the sense that it presents a highly artificial, idealised, and partial account of research.[50] More goes into the execution of research than is or can be detailed.

Further, as has been noted for leading edge areas of research,

> It is very difficult to resolve a scientific controversy through replication of experiments alone. This is because a scientist whose paper has been negatively replicated will argue that the second experiment was not properly carried out. This view can be supported almost indefinitely because experimentation is a skilful practice; there are no direct measures of the proper execution of a skill except getting the right result.[51]

Just how publications play a part in the 'replication' of research depends on the 'evidential culture' in research communities, that is, the criteria and methods for validating claims.[52] As well, empirical studies of science in practice would suggest that scientists rarely try to 'exactly' replicate each others' experiments. In part this is because of the difficulty of achieving replication, and in part because scientists seek to take forward claims or combine lines of research in novel ways. This paragraph and the previous one together suggest that scientific articles can usefully be orientated to in terms of their symbolic functions as markers of competencies and skills rather than just simple bearers of scientific fact. This should be taken into account in thinking about any possible restriction on what gets published and how.

Conclusion

By rethinking many of common assumptions about the status of S&T, including their constitutive relation with society and politics, this chapter has suggested how STS analyses might justify a rethinking of secrecy and disclosure in the governance of WMD. Central to this reconsideration has been developing a more refined sense of the socio-technical richness of scientific and technical practice. Doing so enables a much wider range of thinking about options and threats. Such thinking is in the main designed to enhance rather than replace traditional disciplinary assessment. It is only antithetical to 'mainstream' approaches about governance insofar as it confronts 'off-the-shelf', unreflective, and over-simplistic conceptualisations of S&T.

We have specifically argued for the utility of ideas about tacit knowledge, socio-technical systems, moral economies of science; and the accomplished status of public (and published) knowledge. Tacit knowledge enables us to reflect on the otherwise relatively ineffable, practical skills, and competencies necessary to produce or repeat WMD capabilities. Construing the development of weaponry as a heterogeneous process of engineering socio-technical systems challenges narrow focuses on technical and scientific advancements or the properties of physical artefacts. Thinking through cultures of secrecy breaks monolithic conceptions of a single heterogeneous scientific community into more localised communities, each with discrete moral frameworks that affect how particular research agenda – including work on WMD – are justified and normalised. Finally, attending to how scientists and others communicate and make use of publications in practice, produces a more complex and differentiated picture than that often given in idealised models of science.

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3

Producing Threat Assessments: An Ethnomethodological Perspective on Intelligence on Iraq's Aluminium Tubes

Carole Boudeau

Introduction

Post-9/11, heightened concern has been given to the dangers posed by 'weapons of mass destruction' (WMD) in many Western countries.[1] Some have gone so far as to suggest that such dangers require the pre-emptive use of force to avoid those intent on causing harm to acquire weapon capabilities. Central to the attempts to impede the development and spread of WMD is the detection of their proliferation. Detecting proliferation, however, is not a minor task, not least because the materials and means necessary to devise WMD can serve multiple ends, some of which may not be illegal or related to mass destructive ambitions. In this context, an important challenge consists of determining the intentions that states have in acquiring certain technologies.

The question of the detection of WMD proliferation was at the heart of the debate preceding the 2003 Iraq war. In the run-up to the war, the US administration made a number of declarations concerning the threat posed by Iraq's efforts to develop WMD.[2] With regard to nuclear weapons, Secretary of State Colin Powell made the following statement to the United Nations Security Council (UNSC)on 5 February 2003:

> We have more than a decade of proof that he [Saddam Hussein] remains determined to acquire nuclear weapons. … Saddam Hussain already possesses two out of the three key components needed to build a nuclear bomb. He has a cadre of nuclear scientists

> with the expertise, and he has a bomb design. Since 1998, his efforts to reconstitute his nuclear programme have been focused on acquiring the third and last component: sufficient fissile material to produce a nuclear explosion. To make the fissile material, he needs to develop an ability to enrich uranium. Saddam Hussain is determined to get his hands on a nuclear bomb. He is so determined that he has made repeated covert attempts to acquire high-specification aluminium tubes from 11 different countries – even after inspections resumed.[3]

According to Powell, the Iraqi regime's intentions to acquire nuclear weapons were manifest given its efforts to procure certain high-strength aluminium tubes. The detection of nuclear weapons proliferation was not, however, a straightforward matter. Later in his speech, Powell indicated that the end use of these aluminium tubes was a moot topic among intelligence analysts. While some argued they were intended as rotors in gas centrifuge to enrich uranium, others suggested they were better suited as the main body for conventional rockets. However, Powell closed the debate by referring to the tolerance and tight specifications of the tubes: these two characteristics revealed that the Iraqi regime intended to use the tubes in a uranium enrichment programme. The tubes were mobilised to support both gas centrifuge and rocket use positions and were situated at the heart of the debate about Iraq's nuclear weapons intent.

This chapter examines the debate surrounding the acquisition of these aluminium tubes and considers how intelligence threat assessments of Iraq's nuclear weapons were produced. Specifically, considering the conventional and non-conventional end uses identified for these tubes, it explores how intelligence analysts came to determine what the Iraqi regime's intentions regarding these tubes were. This chapter moves away from the public claims on Iraq's WMD – such as Powell's presentation – towards their intelligence underpinnings in order to scrutinise detection in the making. Building on the partial publication of intelligence assessments of these aluminium tubes in the post-Iraq war context,[4] it argues that assessments of intentions were, to a large extent, achieved in and through interpretations of the technical properties of these aluminium tubes. In other words, it suggests that capabilities and intentions were not established separately but rather mutually constituted (see Chapter 2). In doing so, this chapter furthers one of the central concerns of this book: how perceptions of security threats are formed in relation to the way technology is understood.

To make this argument, this chapter draws on a particular sociological perspective, namely ethnomethodology. One of the central tenets of ethnomethodology is that the intelligibility of social activities and settings is made available as they are produced and this research programme proposes to investigate the ways in which this intelligibility is contextually organised. Adopting an ethnomethodological approach, this chapter focuses on the discursive methods whereby appraisals of the intended use of the aluminium tubes were accomplished. By contrast with other sociological approaches, ethnomethodology does not seek, for example, to retrieve the hidden or to deconstruct the ideological meanings of actual uses of language. Rather, it is interested in people's contingent methods for constituting contextually meaningful worldly activities. As will be made apparent, this approach differs from the way in which the study of the production of intelligence threat assessments is usually tackled in the field of intelligence studies. This chapter first presents a brief overview of how intelligence studies approach questions of threat assessments. Then, relevant ethnomethodological themes are introduced and what this perspective offers to the analysis of threat assessments is contrasted with ideas from the field of intelligence studies. Finally, an ethnomethodologically informed analysis of intelligence assessments of the intended uses of the high-strength aluminium tubes is offered.

Assessments of security threats: capabilities and intentions

In intelligence studies, 'intelligence assessment' refers to one stage of the work through which intelligence is processed. Among other idealised characterisations of this process, Walter Laqueur suggests that the production of intelligence comprises five major phases: first, policy-makers indicate to the Intelligence Community (IC) what information is needed; second, intelligence agencies collect the information and write 'intelligence reports'; third, information is processed when applicable (e.g., documents are translated); fourth, intelligence analysts assess agencies' reports resulting in 'intelligence assessments'; and finally, these assessments are disseminated to relevant users.[5] Intelligence assessments are not to be confused with intelligence reports. The latter, otherwise known as 'raw intelligence', provides patchy pieces of information about aspects of the world and include, for example, records of intercepted communications, satellite images, and information passed on by contacts on the ground. The former – intelligence assessment – contextualises the fragmented snapshots using a range of materials in order to obtain relatively ordered pictures of the world.

The next sub-sections briefly review the literature on threat assessments in intelligence studies. First, an explication of the notion of threat is provided, and, second, some fundamental assumptions about assessments of security threats are described.

Defining security threats

In intelligence studies, understandings of the production of intelligence assessments of security threats largely stem from the meaning of the notion of threat itself. For those working with or studying intelligence, it is only possible to speak of security threats when two conditions are met. Speaking in the context of the Iraq war, John Morrison and Brian Jones, former Deputy Chief of Defence Intelligence at Defence Intelligence Staff (DIS)[6] and former Head of the Nuclear, Chemical, and Biological Branch at DIS respectively, have recalled that a threat exists if, and only if, both capabilities and intentions are detected so that the possession of weapons without the intention to use them and, symmetrically, the intention to attack without the means to do so are two situations where no threats actually exist.[7]

This conception of security threats not only indicates that the conjunction of the two elements is essential to evidence their existence, but it also suggests that capabilities and intentions are distinguishable. For some, capabilities consist of what an enemy *can* do whereas intentions are about what it *will* do,[8] a difference which is related to the dichotomy between 'hard facts' and 'soft' human faculties.[9] To take an example, nuclear weapons capabilities encompass, among other things, raw materials, technical infrastructures, and personnel, while intentions are the plans that a country has for acquiring or using these weapons. In other words, the distinction between capabilities and intentions is one of visibility. Materials, infrastructures, and personnel possess a concrete and physical dimension that designs do not; intentions are cognitions located in people's minds.

Assessments of capabilities and intentions

This dual conception of the notion of threat bears significant implications for how the production of assessments of security threats is understood in intelligence studies. Two different sets of skills appear necessary for assessing both capabilities and intentions. The following analysis of biological warfare (or weapons) (BW) threats by James Petro and

Seth Carus of illustrates this point:

> Unlike information that provides insight into foreign capabilities, which is targeted toward the identification and characterization of personnel, equipment, and materials and can be collected from a variety of sources, insight regarding foreign intentions can be obtained only from people – individuals actively engaged in using foreign personnel, equipment, and materials for BW. Thus BW analysts generally rely on scarce information from individuals associated with foreign bioweapons programs to provide insight regarding the intentions of their organization's programs. Such individuals are rare, and the insights they provide are often dated, incomplete, contradictory, or lack sufficient detail for analysts to reach definitive conclusions about the threat facing the US.[10]

This analysis exemplifies the idea that capabilities are inherently easier to apprehend than intentions. The material and visible dimension of capabilities renders them more comfortably identifiable than the seemingly more intangible character of intentions.[11] As a result, capabilities and intentions are identified separately. On the one hand, capabilities are what 'scientific intelligence' aims to determine. In his pioneer work, Reginald Jones recalls how scientific intelligence developed as a special type of intelligence in the United Kingdom during the World War II (WWII) when he was asked to identify German weapons, and he argues that scientific intelligence is primarily directed to the discovery of the enemy's arsenals.[12] Scientific intelligence is a special product that requires scientific and technical expertise.[13] While assessments of capabilities have been framed in terms of scientific and technical knowledge since Jones' pioneering work, assessments of intentions, on the other hand, have been portrayed as the work of accessing 'what is going on in your opponent's mind'.[14] Assessments of intentions differ from those of capabilities because they involve guess work. 'To predict what a foreign nation will do', Abbott Smith contends

> is a necessary and useful pursuit, albeit dangerous; it rests on knowledge, judgement, experience, divination, and luck. To set forth what a nation can do is a different matter. One still needs judgement, experience and luck as well as knowledge, but soothsaying is reduced to a minimum. There is an element of the scientific. The job can be taught, and its techniques refined.[15]

Although this dual approach to intelligence assessments of security threats still enjoys support in intelligence studies, some researchers and practitioners have adopted more intuitive views on the production of threat assessments. At one level, it has been argued that assessments of capabilities and intentions occur in a single move. Raymond Garthoff contests the idea that in practice capabilities may be assessed independently from intentions because estimates of capabilities always incorporate implicit judgements about intentions.[16] Robert Clark also suggests that knowledge of capabilities goes hand in hand with knowledge of intentions in such a way that '[o]nce you know the characteristics of an enemy weapon system, then his tactics and strategy for using the weapon system follow naturally.'[17] Thus, efforts at isolating capabilities from intentions are misguided because, in practice, one does not come without the other.

Moreover, it has been proposed that assessments of capabilities and intentions cannot be separated because intentions, at least as far as WMD are concerned, are actually made *observable* in the materiality and concreteness of capabilities. 'Intelligence agencies', writes Sir Rodric Braithwaite, 'occasionally get hold of mouth-watering documentary evidence – a military order, the briefing papers of your negotiating partner, internal policy documents', thereby suggesting that intentions may not be confined to people's mind but may in fact be substantiated in documents that render them visible. Likewise, discussing the use of intelligence to detect WMD proliferation, John Lauder suggests that

> Our efforts to deal with all this [the challenges and uncertainties of proliferation] are complicated by the fact that most weapons of mass destruction programmes are based on technologies and materials that have civil as well as military application, and that is a particular special problem for intelligence. The difference between a pharmaceutical plant and a biological weapons facility, or between a fertiliser plant and a chemical weapons facility, is often just the arrangement of the turning of a few valves within that facility. National Technical Means cannot reliably tell the difference, and *in such cases analytical judgements about capabilities are essentially the same as analytical judgements about intentions*.[18]

Lauder challenges the conception of assessments of threats presented above that posits the independence of capabilities and intentions. As he explains, the dual-use character of some technologies involved in

WMD-related activities blurs the distinction between capabilities and intentions and between their respective appraisals. In fact, he perceptively claims that, where dual-use equipments are employed, intentions are assessed in relation to capabilities.[19]

Both arguments – that assessments of capabilities and intentions are produced in a single move and that intentions are manifested in capabilities – are promising proposals about the work of producing intelligence assessments of threats that destabilise ideas that capabilities and intentions belong to two different orders of thing and that they are assessed separately. These proposals are, however, either retracted or not pursued. Thus, having shifted the site of intentions from minds to documents, Braithwaite relocate them into minds as he indicates that documentary evidence 'is only a shaky guide to what is going on in your opponent's mind'. Symmetrically, having laid out the foundations of the material visibility of intentions, Lauder withdraws from this insight by immediately adding that '[s]uccessfully divining intent is the hardest thing for any of us in intelligence to do' – suggesting that intentions can only be guessed and cannot be seen. Intentions, for these authors, are now reassigned the cognitive status that commentators of security threats maintain and the possibility to discover them in capabilities is abandoned.

The remainder of this chapter takes up these intuitions and seeks to demonstrate, drawing on intelligence assessments of Iraq's acquisition of aluminium tubes, that assessments of the Iraqi regime's intentions towards nuclear weapons not only were established in relation to assessments of these tubes (as components of a nuclear weapons capability) but also, more importantly, were achieved as intentions were *discerned* in the tubes. Therefore, it departs from conceptions of the notion of threat and of assessments of threats that rely on a division between capabilities and intentions. The difficulty with these conceptions (and with the alternative views) is that they are exactly that, *conceptions*, that move away from the phenomenological properties of the practical production of intelligence assessments of security threats. In fact, this chapter suggests that the approaches presented above end up advancing misleading ideas about what is involved in the production of threat assessments because they do not recognise that this production is an accomplishment that can be described. When this is acknowledged, however, new insights on security threats and on the relations between capabilities and intentions may be gained.

Towards an ethnomethodological approach to the production of threat assessments

The difficulties inherent in the approach of intelligence studies to the production of assessments of security threats may be avoided with an approach guided by ethnomethodology's research recommendations. Although ethnomethodology has no specific interest in intelligence work as a topic of inquiry, it can nonetheless fruitfully aid in the study of the production of threat assessments. Ethnomethodology considers that the social world is an ongoing practical accomplishment.[20] This implies two points: that any social activity takes some work – that is some practical methods – to become what it is and that this work is contextually bound. Ethnomethodology argues that this contingent work needs being detailed; that the phenomenological properties of the production of social activities are to be recovered. Thus, it investigates how exactly in *this* context and through *these* procedures *these* social activities are produced. The emphasis put on the accomplished character of the social world is an injunction to attend to its production by examining the practical procedures by which it is constituted. A consequence of this interest in the accomplishment of the social world is that ethnomethodology moves away from concerns about context-free concepts to make sense of the world.[21] For ethnomethodologists, the problem with devising concepts as means of rendering practical activities lies in the disengagement from their phenomenological details that it entails. It is not relevant to start a study of, for example, suicide by defining in the abstract (i.e., without reference to concrete situations) what suicide is; instead, an ethnomethodological study of suicide should examine the work of identifying whether or not a person has committed suicide.[22] In this sense, ethnomethodology's rejection of conceptualisation is less the expression of a commitment to an objective world that could be known empirically than a consequence of its encouragement to examine the *praxiological* accomplishment of worldly practices.[23]

Ethnomethodology's research orientation to the accomplishment of the social world rests on one of its central tenets, that the intelligibility of social activities is made publicly available for others to witness. The witnessable intelligibility of the social world depends on the practical procedures by which it is constituted. Precisely, ethnomethodology argues that the intelligibility of social activities is 'incarnate'[24] in the methods whereby they are produced, so that these methods make observable and describable the meaning of the activities that they organise. Ethnomethodological studies of forensic activities are particular cases in point. To take an example, the work of identifying suicide is made intelligible as just this work through the ways in which coroners go about formulating a judgement about the cause of cases of sudden death, ways that include searching for 'remains' such as suicide notes, psychiatric records and medications, scrutinising bodily injuries so as to decide whether or not they were self-inflicted, and tying the outcomes of this inquiry work into a coherent and justifiable account that describes just how the deceased died.[25] These and other procedures exhibit the identity of the work being done. That coroners are engaged in the identification of the causes of sudden death is observably so because the intelligibility of this activity is embodied in the practical procedures by which it is achieved.

An interesting development of ethnomethodology for the present purpose is the extension of the suggestion that the public intelligibility of social activities is an accomplishment to questions of subjectivity. According to Jeff Coulter, 'intentions' also possess a public character in the sense that they are made observable and assessable in practical contexts and this is so because one 'must *live up to* the public standards and public circumstances' if ascriptions or declarations of intentions are to be found appropriate and intelligible.[26] The possibility of declaring 'he intended to do this' rests on the transparency of such intention. In other words, the intention is always somehow rendered tangible. Thus, in contrast to the received wisdom of intelligence studies, Coulter objects to the view that intentions are private phenomena, located in people's mind. This does not imply that people may not conceal their intentions; rather, it suggests that some circumstances permit the description of hidden intentions and that this is achievable on the basis of certain public criteria that reveal exactly what these intentions are. Coulter illustrates this point with a fictive situation where a husband discovers his wife's intentions to make an attempt on his life when he finds poison and entries in her diary about the preparations for the intended murder. The discovery of the wife's secret intentions does not involve the husband's efforts to access what is in her mind; more mundanely and materially, the discovery hinges on his interpretation of certain material objects that make transparent her intentions. Put differently, intentions are embodied and materialised in public ostentations, which render them available to observation and appraisal in social situations.[27]

By treating the intelligibility of social activities as witnessable accomplishments, ethnomethodology encourages us to detail the procedures by which they are thus constituted. As far as the work of producing assessments of security threats is concerned, following this approach entails attending to the work by which judgements about these threats are formulated, with specific reference to how capabilities and intentions are identified. Furthermore, the objection to the tendency to conceptualise practices enjoins us not to begin with a characterisation of the notion of threat and with ideas about how capabilities and intentions may be assessed. Instead, and following Coulter's work, when a cognitivist understanding of intentions is put aside, a space is open for apprehending their practical materialisation into objects and discourse.[28] In the case of practical detection of WMD proliferation, this suggests looking at how intelligence analysts use what is materially available (e.g., documents or objects) in order to formulate defensible judgements about intentions. In other words, it is a matter of examining how intentions are practically addressed, embodied as physical objects. The following analysis seeks to demonstrate this point by reference to the debate about intelligence on Iraq's acquisition of high-strength aluminium tubes.

The intelligence on Iraq's high-strength aluminium tubes

In autumn 2002, the Bush administration repeatedly claimed that the Iraqi regime had made several attempts to acquire 60,000 high-strength aluminium tubes. As the director of the Institute for Science and International Security, David Albright, indicates, these tubes were manufactured from

> 7075-T6 aluminium, which makes it a dual-use item with both nuclear and non-nuclear uses. Aluminum alloy with a 7000-series designation is very strong and hard, difficult to weld, and subject to corrosion from moisture. ... The T6 refers to specific tempering or heat treatment. These tubes had an outer diameter of 81 millimetres and were 900 millimetres long. They had a wall thickness of 3.3 millimetres and were anodized. On the inside, the finish was not specified. As a result, on at least the first tubes manufactured, the inner surface was rough.[29]

As illustrated by Colin Powell's speech to the UNSC mentioned in the introduction to this chapter, the Bush administration presented these tubes as key evidence of Iraq's intent to possess nuclear weapons since, allegedly, they were to be used as rotors in gas centrifuges for uranium enrichment.[30] Underpinning most of these declarations was a National Intelligence Estimate (NIE) published in October 2002 that also placed the aluminium tubes procurement activities at the heart of its judgements on nuclear weapons. In the 'Key Judgements' section, it stated that

> Although we assess that Saddam [Hussein] does not *yet* have nuclear weapons or sufficient material to make any, he remains intent on acquiring them. ... Most agencies believe that Saddam's personal interest in and Iraq's aggressive attempts to obtain high-strength aluminium tubes for centrifuge rotors – as well as Iraq's attempts to acquire magnets, high-speed balancing machines, and machine tools – provide compelling evidence that Saddam is reconstituting a uranium enrichment effort for Baghdad's nuclear weapons program. (DOE agrees that reconstitution of the nuclear program is underway but assesses that the tubes probably are not part of the program.)[31]

NIEs are the most authoritative judgements of the IC on matters of security. They need not express consensual judgements and, when applicable, space is provided for dissenting views. Of the ten agencies that contributed to the October NIE, two – the Department of State's Bureau of Intelligence and Research (INR) and the Department of Energy (DOE) – recorded alternative assessments of the procurements of aluminium tubes in separate boxes, indicating that they were to be used in a conventional weapons programme.[32] INR clearly encapsulated this alternative,

> In INR's view Iraq's efforts to acquire aluminum tubes is central to the argument that Baghdad is reconstituting its nuclear weapons program, but INR is not persuaded that the tubes in question are intended for use as centrifuge rotors. INR accepts the judgment of technical experts at the US Department of Energy (DOE) who have concluded that the tubes Iraq seeks to acquire are poorly suited for use in gas centrifuges to be used for uranium enrichment and finds unpersuasive the arguments advanced by others to make the case that they are intended for that purpose. INR considers it far more likely that the tubes are intended for another purpose, most likely the production of artillery rockets.[33]

The above extracts from the October NIE give a sense of the disagreements between some agencies regarding the Iraqi regime's intentions concerning these high-strength aluminium tubes. Yet, this declassified extract does not include the details of how judgements about these intentions were developed, and it does not indicate that the intended uses of the aluminium tubes had been the object of an ongoing debate within the IC since April 2001 when the Central Intelligence Agency (CIA) had received the original intelligence report about a shipment of these tubes.[34] The agencies involved in this debate (mostly the CIA and the DOE) produced their own individual assessments from 2001 onwards. The following analysis focuses on those individual assessments produced between April and December 2001 in order to highlight how the debate became more and more technically detailed as the controversy increased. As will be made clear though, that although the debate became more 'technical' it did not make it any less relevant to 'political' matters. Indeed the increasing technical character was part and parcel of establishing the political intent of Iraq.

On 10 April 2001, the CIA initiated the first assessment of Iraq's procurement activities based on the expertise of a centrifuge analyst in the Director of Central Intelligence (DCI)'s Center for Weapons, Intelligence, Nonproliferation and Arms Control and noted that the tubes 'have little use other than for a uranium enrichment programme'.[35] The following day, the DOE published a *Daily Intelligence Highlight* in which its nuclear weapons experts suggested that the tubes were more likely intended for a conventional weapon programme, without identifying a specific end use:

> While the gas centrifuge application cannot be ruled out, we assess that the procurement activity more likely supports a different application, such as conventional ordinance production. For example, the tube specifications and quantity appear to be generally consistent with their use as launch tubes for man-held anti-armor rockets or as tactical rocket casings. Also, the manner in which the procurement is being handled (multiple procurement agents, quotes obtained from multiple suppliers in diverse locations, and price haggling) seems to better match our expectations for a conventional Iraqi military buy than a major purchase for a clandestine weapons-of-mass destruction program.[36]

In May 2001, while still accepting the possibility of a gas centrifuge end use for the aluminium tubes, the DOE identified a specific conventional purpose – the chambers for a multiple rocket launcher – based on previous similar procurement and manufacturing efforts.[37] The following month, in another assessment, the CIA reaffirmed its original judgement but mitigated it by indicating that the tubes 'could be used as rocket bodies for multiple rocket launchers',[38] thus acknowledging the DOE's assessment. To bring this preliminary presentation of the debate to a temporary close, on 2 August 2001, the Defense Intelligence Agency (DIA) circulated an internal paper on the high-strength aluminium tubes that accepted the CIA's assessment and stressed that 'The tubes have specifications very similar to the gas centrifuge rotor described in the German scientists, Gernot Zippe's publications: the material was 7075-T6 aluminum with an outer diameter of 74.2-81.9-mm, an inner diameter of 68.6-76.3-mm, a wall thickness of 2.8-mm, a length of 279.4-381-mm and a tolerance of 0.1-mm.'[39]

These initial assessments of the intended usages of the high-strength aluminium tubes already highlighted that they could be used for either conventional or non-conventional purposes. Despite their lack of details, they began to show that the debate surrounding these tubes mainly revolved around their technical properties. In particular, as illustrated above, the specifications of the tubes – that is their dimensions and the tolerances for these dimensions – were seen to embody and thereby display the regime's designs for these tubes. As the debate unfolded, however, analysts attempted to settle the tensions by delving further into the technical details of the tubes. Assessments of the Iraqi regime's intentions to acquire nuclear weapons were partially organised in and through exegesis of the aluminium tubes, which were thus oriented to as 'revelatory objects' of the regime's strategic intentions; that is, these tubes 'simultaneously analyze[d] what they reveal[ed]'.[40] 'Revelatory' is to be understood in its ethnomethodological sense: it stresses the fact that, in the analysts' hands, the 'witnessability' of these intentions hinged on the technical properties of the tubes in such a way that they were apprehended as being materialised by these objects.[41]

This was already apparent in the DIA assessment published on 2 August 2001. The similarities DIA analysts established between the Iraqi tubes and the materials and dimensions of the Zippe centrifuge rotors furnished the base that supported the view that the tubes were to be components of the gas centrifuge uranium enrichment programme. On 17 August 2001, DOE analysts published another assessment that responded almost point by point to this DIA assessment by challenging the associations between the Iraqi tubes and the characteristics of Zippe centrifuge rotors. This DOE assessment is available in the US Senate Select Committee on Intelligence's report both verbatim and rephrased by the committee:

> (U) Regarding the tubes' utility in a gas centrifuge program, the DOE assessed that the tubes could have been used to manufacture centrifuge rotors, but were not well suited for that purpose. The DOE assessed that 7075-T6 aluminum 'provides performance roughly half that of the materials Iraq previously pursued.' Prior to the Gulf War, Iraq had pursued rotors made from maraging steel and carbon fiber composites, which both offer better uranium separtative capacity. If Iraq were to pursue a rotor of 7075-T6 aluminum instead, it would need twice as many rotors, as well as twice as many other centrifuge components, such as end caps, bearings, and outer casings.
>
> [redacted] According to the DOE assessment, the tube diameter was smaller than that of any known deployed centrifuge machine and was about half the diameter of Iraq's pre-Gulf War prototype machine. DOE noted that a small diameter would have presented 'various design and operational problems that veteran engineers of Iraq's prior program should readily understand.' In addition, 'the tubes are too thick for favorable use as rotor tubes, exceeding the nominal 1-mm thickness of known aluminum rotor tubes by more than a factor of three. … Additionally, various tolerances specified in contract documents … are looser than the expected precision callouts for an aluminum rotor tube by factors of two to five.' The DOE also noted that the anodized surface, requested by Iraq in its tube procurements, '… is not consistent with a gas centrifuge application.
>
> [redacted][42]

In this assessment, the DOE maintained that a gas centrifuge application for the Iraqi tubes was possible but explained at great technical length the reasons why their incorporation in a conventional rocket programme was technically sounder. DOE analysts contested the view that the type of aluminium alloy was suitable for gas centrifuge use for three reasons. First, they remarked that it did not ensure best performance. Second, they stated that Iraq had previously manufactured rotors using other materials which were technically better. Finally, a greater quantity of these tubes as well as other related components would be necessary.

DOE analysts examined the technical details of the tubes to support their assessments of the Iraqi regime's intentions. Building on what was known about the pre-1991 Iraqi nuclear weapons programme and about gas centrifuge technologies, and contrary to what DIA analysts had claimed, the DOE remarked that the diameter of the tubes Iraq sought to acquire was smaller than that of known centrifuge machines and that such specifications would entail some 'operational problems' should they be used for centrifuges. The DOE made a similar point with regard to the wall thickness of the tubes Iraq sought to acquire. It stated that by exceeding 1-mm thickness, they could not be favourably used as rotors. By the same token, DOE analysts contested the judgement implicit in the DIA assessment that the Zippe centrifuge used rotors with a 2.8-mm wall thickness arguing that no known gas centrifuge used rotors whose thickness was greater than 1-mm. Finally, DOE analysts remarked that the tolerance required for the Iraqi tubes went beyond that which was required for aluminium rotor tubes.

This DOE assessment illustrated that the intended uses of the tubes were determined on the basis of what was considered not so much technically *feasible* – since it appeared that two alternatives were possible – but rather technically *sounder*. What was presented as technically best served as a basis to ascertain the intentions regarding acquiring this type of aluminium tubes. The discussion of the technical details of the aluminium tubes demonstrates how these specifications became a forum where the judgements on the Iraqi regime's intentions regarding these tubes were obtained. These intentions were discovered in and through close inspections of the aluminium tubes which thereby embodied and rendered accessible these intentions.

However, it should not be concluded that the debate surrounding the intended usage of the aluminium tubes could be settled by reference to what was technically (un)feasible or (un)sound. That is, although analysts from the DOE and the DIA called on what was technically possible in order to formulate their judgements regarding the intended uses of the aluminium tubes, it did not allow for settlement of the debate about the Iraqi regime's intentions. The disagreement between the agencies was kept alive as they mobilised different views on what was or was not technically sound. Thus, although, the various agencies mobilised technical arguments to make visible the regime's intentions, their respective technical bases became rather unstable. In November 2001, the DIA published another assessment of the aluminium tubes, pursuing its original stance. It stated that

> Although 7075-T6 aluminium could be an acceptable metal for small rocket motor bodies, the 3.3-mm wall thickness and overall weight

> would make these particular tubes poor choices for rocket motor bodies. The thickness is roughly twice that of known small rocket motor bodies, and … the 0.1-mm metal thickness tolerance along the 900-mm length is excessive for both rocket motor bodies and rocket launch tubes.[43]

This new assessment detailed some points hinted at in the previous assessment. DIA analysts focused on the dimensions of the tubes which they judged pointed at a nuclear weapons end use. In an analysis symmetrical to that which was produced by the DOE, DIA analysts indicated that the wall thickness of the tubes made them unsuitable for use as rocket casings. At the same time, the tolerance for this thickness and the length of the tubes went beyond the requirements for the conventional end use identified by the DOE. By contrast to what DOE analysts had concluded, the DIA judged that the specifications of the tubes rendered them consistent with a gas centrifuge end use and inconsistent with a conventional weapon programme. That is to say, the specifications of the tubes became both compatible and incompatible with a nuclear weapons end use as well as both compatible and incompatible with a conventional weapon end use. The DOE, however, challenged once more the DIA assessment of the tubes by undermining part of the technical basis on which it rested, namely the comparison with the Zippe centrifuge: the wall thickness is three times greater than that for metal rotor designs used in high-speed centrifuges. This would increase the weight and the energy of the spinning rotor by a factor of three:

> The design which the Iraqi tubes most resemble – that for a tube used by centrifuge pioneer Gernot Zippe for laboratory experiments in 1960 – has never been tested at production levels. … And again, the specifications of the Iraqi and Zippe tubes differ in some important ways: while the inner diameter [redacted] of the Iraqi tubes is similar to the inner diameter (74.1) of Zippe's, the tube used by Zippe had only a 1 mm wall thickness and was only 332 mm long. Zippe noted that the low efficiency of his laboratory machine would prevent its practical use. If Iraq attempts to use these tubes in a Zippe centrifuge, the efficiency could be further reduced due to complications with the damping and suspensions systems as a result of thicker walled tubes.[44]

There, DOE analysts challenged the view that the dimensions of the tubes sought by Iraq were similar to the requirements of the Zippe-type gas centrifuge. In particular, the DOE stated that the wall thickness recommended by Zippe was 1-mm and not 2.8-mm as suggested in the DIA assessment published in August 2001. In addition, the length of the tubes, here specified as 332-mm, was not recognised as similar to the length of the Iraqi tubes.

Thus, judgements about the Iraqi regime's intentions were not only intimately connected to the descriptions of the tubes but also, more importantly, they were revealed *as* the ambiguities related to the purpose of the tubes were contingently settled. The problem posed by the potential dual usage of the tubes was more than a technical one. There was more at stake than a mere identification of the technical specifications of the tubes and the likelihood of their integration into nuclear centrifuges or their use as the bodies of conventional rockets. The debate around these ambiguities informed judgements about Hussein's intentions. The attempts to link certain specifications with certain usages led to detailed scenarios depicting the political and military environment in which the tubes best fitted. In this sense, the likely usage of the tubes provided the means to ground judgements about intentions.

Conclusion

This chapter has sought to delineate the possibilities offered by an ethnomethodological approach to the production of assessments of security threats in relation to the intelligence debate on Iraq's procurement of high-strength aluminium tubes. In particular, it has been an occasion to explore intelligence detections of intentions to acquire nuclear weapons. It has been argued that intelligence analysts evidenced how the Iraqi regime's intended to use the aluminium tubes in and through the technical characteristics of these tubes in such a way that they formed a material basis that embodied the regime's intentions. In other words, intentions were revealed and rendered observable within the tubes. By showing that assessments of intentions were accomplished through assessments of capabilities, this ethnomethodological perspective has therefore allowed a description of intelligence assessments of security threats that significantly departs from research in intelligence studies. As indicated, this field is best characterised by conceptual renderings of intelligence matters. In light of the analysis of the debate on the aluminium tubes, however, it appears that this aspiration for theorisation not only risks overlooking exactly what constitutes the particulars of compiling intelligence assessments in each context, but it is also in danger of constricting an understanding of the practical combinations that intelligence analysts perform when assessing security threats. Accordingly, this chapter has illustrated how indifference to the interpretative procedures constitutive of threat assessments can result in misapprehensions of how they work in practice, and, how an approach concerned with practical action may contribute to the development of intelligence studies.

Notes

1. I would like to thank Philip Davies and Brian Rappert for their comments on earlier drafts of this chapter. I am also grateful to Catherine Lee and Brian Rappert for their editorial suggestions.
2. See, for example, G. W. Bush, Address to the United Nations General Assembly 12 September 2002. Available at: http://www.whitehouse.gov/news/releases/2002/09/20020912-1.html (Accessed: 21 October 2003); G. W. Bush, 'State of the Union' Address to the United States Congress, 28 January 2003. Available at: http://www.whitehouse.gov/news/releases/2003/01/20030128-19.html (Accessed: 21 October 2003); C. Powell, Address to the United Nations Security Council, 5 February 2003. Available at: http://daccessdds.un.org/doc/UNDOC/PRO/N03/236/00/PDF/N0323600.pdf?OpenElement (Accessed: 21 October 2003). In terms of documents, see, White House, *A Decade of Deception and Defiance*, 12 September 2002. Available at: http://www.whitehouse.gov/news/releases/2002/09/20020912.html. (Accessed: 13 May 2006): 9; Central Intelligence Agency, *Iraq's Weapons of Mass Destruction Programs*, October (2002). Available at: http://www.cia.gov/cia/reports/iraq_wmd/Iraq_Oct_2002.htm (Accessed: 3 November 2004): 5.
3. C. Powell, Address to the United Nations Security Council, op cit. 12.
4. The US Senate Select Committee on Intelligence's (SSCI) report on its inquiry into pre-war intelligence on Iraq's WMD constitutes the best source where such assessments have been partially published. See, SSCI, *Report on the US Intelligence Community's Prewar Intelligence Assessments on Iraq*, 7 July 2004. Available at: http://intelligence.senate.gov/iraqreport2.pdf (Accessed: 15 November 2005).
5. W. Laqueur, *World of Secrets: The Uses and Limits of Intelligence* (London: Weidenfeld and Nicolson, 1985).
6. DIS is a British intelligence agency based in the Ministry of Defence.
7. See, BBC 1 *Panorama* 'A Failure of Intelligence' 11 July 2004; BBC Radio 4 *Today*, 29 October 2004.
8. A. Smith, 'Notes on "Capabilities" in National Intelligence' *Studies in Intelligence* 1 (1956): 1–18.
9. R. Braithwaite, 'Assessment and Analysis: Building an Accurate Picture', in H. Shukman (ed.) *Agents for Change. Intelligence Services in the 21st Century* (London: St Ermin's Press, 2000): 101.
10. J. Petro and S. Carus, 'Biological Threat Characterization Research: A Critical Component of National Biodefense' *Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science* 3(4) (2005): 296.
11. R. Posner, *Preventing Surprise Attacks. Intelligence Reform in the Wake of 9/11* (Lanham, Md.: Rowan & Littlefield Publishers and Stanford, CA.: Hoover Institution, 2005): 102.

12. R. Jones, *Most Secret War* (London: Hamish Hamilton, 1978): 74.
13. R. Jones, 'Scientific Intelligence' *Studies in Intelligence* 6 (1962): 55–76; R. Jones, 'The Scientific Intelligencer' *Studies in Intelligence* 6 (1962): 37–48.
14. R. Braithwaite, 'Assessment and Analysis', op cit. 102.
15. A. Smith, 'Notes on "Capabilities" ', op cit. 4.
16. R. Garthoff, 'On Estimating and Imputing Intentions' *International Studies* 2 (1978): 24.
17. R. Clark, 'Scientific and Technical Intelligence Analysis' *Studies in Intelligence* 19 (1975): 39.
18. J. Lauder, 'Discussion: Intelligence and Weapons of Mass Destruction in a Changing World', in H. Shukman (ed.) *Agents for Change*, op cit. 225, my emphasis.
19. Lauder's claim could be challenged on the basis that he treats detection of WMD proliferation as if it were only a matter of technical intelligence (e.g., satellite imagery), which National Technical Means deals with, when in fact human intelligence such as espionage may also be useful to that effect, especially for the identification of intentions. While the relative value of the different types of intelligence is an ongoing debate, the point here is that with this claim Lauder envisages assessments of capabilities and intentions as mutually constituted.
20. H. Garfinkel, *Studies in Ethnomethodology* (Cambridge: Polity Press, 1984): 1–34; H. Garfinkel and H. Sacks, 'On Formal Structure of Practical Action', in J. McKinney and E. Tiryakian (eds) *Theoretical Sociology: Perspectives and Developments* (New York: Meredith Corporation, 1970): 342; M. Lynch and W. Sharrock, 'Editors Introduction', in M. Lynch and W. Sharrock (eds) *Harold Garfinkel* (London: Sage, 2003): xix–xxii.
21. See, for example, G. Button, 'Introduction: Ethnomethodology and the Foundational Respecification of the Human Sciences', in G. Button (ed.) *Ethnomethodology and the Human Sciences* (Cambridge: Cambridge University Press, 1991): 1–9; H. Garfinkel, *Studies in Ethnomethodology*, op cit. 1–34; H. Garfinkel, 'Respecification: Evidence for Locally Produced, Naturally Accountable Phenomena of Order*, Logic, Reason, Meaning, Method, etc. in and as of the Essential Haecceity of Immortal Ordinary Society (I) – An Announcement of Studies', in G. Button (ed.) *Ethnomethodology and the Human Sciences* (Cambridge: Cambridge University Press, 1991): 10–19; H. Garfinkel and L. Wieder, 'Two Incommensurable, Asymmetrical Alternate Technologies of Social Analysis', in G. Watson and R. Seiler (eds) *Text in Context. Contributions to Ethnomethodology* (London: Sage, 1992): 175–206.
22. M. Atkinson, *Discovering Suicide: Studies in the Social Organization of Sudden Death* (London and Basingstoke: The Macmillan Press, 1978); H. Garfinkel, *Studies in Ethnomethodology*, op cit. 11–18.
23. This does not mean, however, that ethnomethodology is free from theoretical presuppositions, but that it is not 'theory-laden in the sense of being framed by a professionally fashioned nexus of definitions, propositions and a priori expectancies' (see, M. Lynch and D. Bogen, *The Spectacle of History* op. cit.: 273). In addition, it should not be inferred from ethnomethodology's reluctance to theorise that it is another empiricist approach because it refuses the idea that 'facts' populate the world 'out there'; instead, it strongly argues

that phenomena are contingently constituted through people's methods (see e.g., M. Lynch, 'Silence in Context: Ethnomethodology and Social Theory' *Human Studies* 22 (1999): 211233).

24. H. Garfinkel, *Studies in Ethnomethodology*, op cit. 1.
25. M. Atkinson, *Discovering Suicide*, op cit.; H. Garfinkel, *Studies in Ethnomethodology*, op cit. 11–18.
26. J. Coulter, 'Studies in Ethnomethodology and Linguistic Philosophy' *The Social Construction of Mind* (London and Basingstoke: Macmillan, 1979): 43, original emphasis.
27. Ibid.: 41.
28. Lucy Suchman makes a similar point in relation to expert systems: the intentions of the designers are incorporated in the machines that make them available to users. See, L. Suchman, *Plans and Situated Actions. The Problem of Human-Machine Communication* (Cambridge: Cambridge University Press, 1987).
29. D. Albright, 'Iraq's Aluminum Tubes: Separating Fact from Fiction' Institute for Science and International Security, 5 December 2003. Available at: http://www.isis-online.org/publications/iraq/IraqAluminumTubes12-5-03.pdf (Accessed: 3 June 2006), 4. The SSCI report also indicates that the inner diameter was 74.4 mm and that, given the aluminium alloy used, these tubes were controlled by the Nuclear Suppliers Group; see, SSCI, *Report*, op cit. 88.
30. The aluminium tubes procurement activities were cited in all major declarations that members of this administration made in the run-up to the war. See, note 1.
31. This quotation is taken from the original NIE which was partially (only 14 out of 93 pages) declassified in July 2003; see, National Intelligence Council, *National Intelligence Estimate: Iraq's Continuing Programs for Weapons of Mass Destruction* October 2002. Available at: http://www.gwu.edu/~nsarchiv/NSAEBB/NSAEBB129/nie.pdf (Accessed: 11 February 2006): 5–6.
32. The SSCI report indicates that five agencies had been involved in the nuclear weapons section of the October NIE: the Central Intelligence Agency (CIA), the Defense Intelligence Agency (DIA), the National Ground Intelligence Center (NGIC), the Department Of Energy (DOE) and the Department of State's Bureau of Intelligence and Research (INR); see, SSCI, *Report*, op cit. 87.
33. National Intelligence Council, *National Intelligence Estimate*, op cit. 9.
34. SSCI, *Report*, op cit. 88. David Albright's extensive research into intelligence on Iraq's efforts to procure these tubes indicates that Australian intelligence played an important role in uncovering this shipment, and information was subsequently passed to the CIA; see, D. Albright, 'Iraq's Aluminum Tubes', op cit. 4.
35. Cited in SSCI, *Report*, op cit. 88. The committee remarked that the CIA provided justification to support its judgment neither in this assessment nor in the subsequent ones.
36. Ibid.: 89.
37. Ibid.
38. Ibid.: 90.
39. Ibid.: 91.

40. M. Lynch, 'The Externalized Retina: Selection and Mathematization in the Visual Documentation of Objects in the Life Sciences', in M. Lynch and S. Woolgar (eds) *Representation in Scientific Practices* (Cambridge, MA: The MIT Press, 1990): 154.
41. To say that the aluminium tubes were oriented to as revealing the Iraqi regime's intentions.
42. Ibid.: 91–92.
43. Ibid.: 92–93.
44. Ibid.: 112.

Part II
Governance

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4

Global Governance and Twenty-first Century Technology

Jim Whitman

Introduction

All technologies entail risks of varying kinds and degrees; and all systems created or adapted for the regulation of technology are minimally concerned with reducing risk to what is deemed an acceptable maximum, even if that is essentially a calculated balance against real or expected benefits.[1] There is nothing new in this: many basic considerations (most notably public safety) that attended once-novel technologies are as pertinent for nuclear power stations as they were for steam trains. Similarly, large-scale social disruptions arising from or amplified by technological advances are hardly a late arrival, even in respect of globalisation.[2]

Although systems for technological regulation and control are sometimes belated or frustrated (as is the case with weapons of mass destruction (WMD), there appears to be a general confidence that our legal and other regulatory and control systems will keep pace with the wider currents of scientific discoveries and their technological outcomes.[3] In addition, the very considerable political, industrial, and financial support currently being invested in technological systems convergence – combining nanotechnology, biotechnology, information technology, computing, and robotics[4] – carries with it at least a tacit confidence that regulation of its products and processes will minimise dangerous and undesirable outcomes to what are deemed acceptable levels.

But are we correct to suppose that the most considerable differences between technologies of earlier eras and the possibilities now before us are essentially matters of *degree* rather than of *kind*. In other words, are the differences largely a matter of increased complexity, of wider distribution or of relatively novel, low probability/high consequence events for which our mechanisms of governance are adequate?

Instructive in this regard is a largely forgotten social and legal transition that came about through the first intense period of industrialisation and the establishment of modern technologically-supported infrastructures. The steep rise in accidents arising from industrialisation in nineteenth-century America led to a crisis in its legal system:

> … [I]n larger factories, and in more densely populated urban centers that were made possible in large part by steamship and railroad travel (which were themselves prime sources of accidental injury), accidents increasingly took place between people who had never met before and between whom there was no pre-existing sense of obligation. In this new, highly industrialized and technologized climate, where the causes of accidents were uncertain, and the perpetrators and victims of accidents unknown, decisions about liability for accidental injury required both a new theory of liability, and a new calculus for distinguishing between a primary cause and a potential host of others.[5]

Interpreting and treating issues of blame and responsibility in human environments that had been transformed physically and vastly extended relationally required a fundamental re-consideration of what comprises agency, and of the parameters of negligence in cases of injury. In a world now familiar with concepts such as 'product liability', the nature and seriousness of these themes are not readily apparent, but they are more than of historical interest, especially for those concerned with technology and risk and the governance of both. In the twenty-first century, profoundly important matters of public policy rooted in technologically-assisted behaviours and technologically altered natural dynamics extend well beyond the compass and application of Tort Law: they are also raising questions of agency and of predictability on a scale and of a complexity that is unprecedented in human experience.

However, it could be countered that what is also unprecedented is the existence of a single, inclusive state system; a vast and intricate network of international law to which most states conform, most of the time; well-worked mechanisms for regulating highly complex systems of world-wide exchange (trade, airline traffic, global finance); and good levels of cooperation between governments, industries, and professional bodies that balance forward drive (the development of new products and processes) and oversight on matters such as public health and safety – such as those, which can be seen in the pharmaceutical industry, for example. While it is true that states are competitive with one another, even this requires a good deal of cooperative endeavour (as explored by Farrell in the next chapter); and it is in the interests of most states that 'rogue' behaviour is tempered or contained. Of course, the rapid advance of globalisation brings with it some nasty surprises, but globalisation is not a force of nature, rather the outcome of our conscious decisions and defaults. Taken as a summative phenomenon, globalisation might well be unstoppable, but its particulars are subject to political consideration, negotiation, risk/benefit calculations, and the possibility of regulatory strictures at national, regional, and international levels.

So it might fairly be asked: Is there anything inherent in recent and now-possible technology or in technological applications that suggests the need for something other than extensions or adaptations of already existing national and international modes of governance? If there is a problem with the regulation of twenty-first century technology, in what does the problem inhere? In the nature of certain technologies themselves? In their proliferation, or in unanticipated combinations and applications? In the limits of what internationally agreed regimes can control? In the many ways in which a variety of globalising forces seem able to undermine or out-manoeuvre international agreements?

This chapter situates the technology–security relation against such wide-ranging governance questions. A central starting point for the argument that follows is that prospects and problems with technology–security governance should not be understood separate from the governance of technology more generally. Considering the questions posed in the previous paragraph provides a useful corrective to the assumption of an 'out of control' technological determinism. At the same time, though, the questions are derived from a changed and changing regulatory environment in which many of the most important and best-established fixtures of national and international governance – the predominance of state-based power structures; the exercise of authoritative 'reach'; identifiable and predictable lines of causation – can no longer be taken as givens. It is against this background that a good deal of hope has been invested in the possibilities of global governance. We will return to a consideration of global governance after a review of several themes pertaining to technological developments and their place in a globalised and still globalising world. These, singularly and in combination, confront us with regulatory problems not only of a familiar and practical sort, but also with the question of whether in our attempts to transform our world, we might also supplant our ability to manage it. In the analysis that follows, the comparisons and contrasts are drawn between security-related technology challenges and others.

The regulatory environment transformed

All national and international forms of technology regulation require quite substantial social and political functions, such as broadly recognised sources of state authority and legitimacy; general adherence to the rule of law; conceptions of the public good; legal, managerial, and administrative systems to ensure that regulations are promulgated and adhered to; statistical and scientific means of gauging risk; and, in democratic states at least, a degree of responsiveness to public pressures of various kinds. More fundamentally, regulatory systems themselves require an enabling environment: stability and predictability within manageable bounds (in the physical environment no less than in social, political, and economic arenas); a calculable and practical number of variables for the estimation of risk and benefit; and clear and effective lines of authority for the practical exercise of agreed regulations. It is in the latter, most basic requirements for effective and coherent governance that we can see the extent to which globalising dynamics not only pose practical challenges *within* our systems of governance, but also challenges *to* them.[6] Many of these entail the direct and indirect consequences of the introduction, dissemination, and uses of technological systems, so a review of these challenges is particularly important for a consideration of the prospects for their governance.

The outcomes of our technological systems are considerably more than linear, and often in excess of what is planned or anticipated

When modern technological systems are introduced into society, their capacity to bring about large-scale change is now rarely limited to a single locale, or to a single sphere of activity. 'Information technology'(IT) is a remarkably bland characterisation of a range of systems that have had a transformative effect on national defence, international finance, and education, to say nothing of less welcome activities including money laundering and the facilitation of criminal and terrorist networks. New technologies and substantial technological advances can quickly affect relations within and between human groups; alter significant lines of causation in the physical environment – locally and/or further afield; and change how other human systems (including other technologies) are understood and adapted (consider the way that computing and IT have combined). While the cumulative effects of technologies can be highly problematic (the advent of human made climate change through countless carbon-emitting technologies), from the perspective of anticipating and governing threats, the cascading effects of a technology-rich human environment are considerably more perplexing.

What informs the dependence of all human systems on a viable natural world and has brought 'sustainability' to the forefront of world politics is continuous, complex exchanges between human and natural systems. The introduction of powerful technologies radically alters the dynamics of these interactions, with consequences that cannot always be grasped. For example, the synthetic chemical industry has introduced more than one hundred thousand synthetic chemicals into the planetary environment, with incalculable additive, cumulative, and synergistic effects – for ecosystems, plants, animals and, human health. Now, in addition to the world-wide introduction of genetically modified crops, industrial and commercial applications of nanoscience are already well advanced; yet as the Royal Society report pointed out 'There is virtually no information available about the effect of nanoparticles on species other than humans or about how they behave in the air, water or soil, or about their ability to accumulate in food chains.'[7] By what means, then, were the risks of nanotechnology deemed acceptable? And how, in a world of complex interactions between human and natural systems, shall they be governed?

As technologies proliferate and disseminate, lines of causation multiple, generating outcomes both unanticipated and unwelcome, which themselves pose governance challenges. Climate change is but one example. There is a further element in the exchanges between open, complex systems: altered biological and inert processes capable of generating change beyond human intention or oversight. Note how even climate change and ozone layer depletion interact, accelerating an already threatening condition: warmer temperatures are melting Arctic tundra, which releases ozone-depleting methane. Such large-scale environmental changes may well lead to profound societal and security disruptions as populations migrate in response to environmental changes and compete for resources. Indeed, climate change may well set the agenda for national security in the twenty-first century.[8]

Complex interactions within human systems can also greatly frustrate assumptions about the regulation of the structures we create for ourselves. A clear case in point is that the sheer volumes of data and speeds of transmission which underpin global financial trading mean that this system of systems cannot be overseen in any human, managerial sense.

Our dependence on such complex computing and communications technologies is for many purposes greatly enabling, but it also creates surprising new vulnerabilities:

> [We have] increased the reliance on machines for the collection of data, for its analysis, and for the transmission of a response. Technology is the primary means for dealing with the problem of compression of time (as well as its cause). That is, technology makes it possible to reduce, process, and analyze information and to implement decisions much more rapidly than in the past. The dependence on machine-generated data and analysis thus grows stronger, with added vulnerability to the unavoidable imperfections of the equipment, and to the built-in biases and assumptions of those who design or program them.[9]

Serious threats can also arise from human inventiveness, opportunism, malicious intent and, perversity: widely dispersed computing and communications technologies and the competence to use, combine, and adapt them has led to innumerable governance conundrums – in intellectual copyright, pernicious, and destructive activity (malign hacking) and criminal activity.

There is a danger that the speed of scientific and technological advances will outpace our deliberative systems

Other chapters in this volume detail the ways in which scientific advances (most notably in biology) are likely to find expression in unwelcome forms, even as our governance systems – and our arms control regimes in particular – struggle to reach consensus on halting the proliferation of security-threatening processes and products. But threats to security in the widest sense are not confined to a single science, or to particular weaponisation programmes. This is because technological advances of many kinds (often competitively driven) are produced much more quickly than the kinds of negotiated, consensus-building processes that generally feature as part of governance mechanisms, especially at the international level (see Chapter 5).

Determining and agreeing the regulatory necessities for any technology is not a mere technocratic exercise, but also entails a consideration of values. Unsurprisingly, values form a large part of the substance of current controversies about such matters as the technologically-assisted outsourcing resulting in diminishing of jobs; the acceptability of civilian deaths in combat from certain types of weapons; and – as the biotechnology revolution begins to impact matters ranging from genetically-modified food to quite startling reproductive interventions – the appropriateness of developments or proposals that offend cultural beliefs and ethical standards. Of course, fear, doubt, and disquiet of many sorts have long accompanied the introduction of technologies with transformative potential, even after the event.[10] However, it is not difficult to detect that the tensions are becoming more numerous, profound, and pervasive. This is the case not least because technologies operate at both ends of globalisation – furthering its dynamics (especially through transportation and communications infrastructures) and in turn being adopted, adapted, and combined by ever-widening constituencies. As some of the most affective technologies (such as mobile phones and computers) become objects of mundane consumerism, they can quickly achieve a 'critical mass', bringing about social changes that are undeliberated by societies as a whole.

But there are deeper currents to technologically-propelled globalisation and the globalisation of new technologies: a widening and intensification of all forms of human relatedness.[11] While this is celebrated by the proponents of globalisation, especially those interested in new wave entrepreneurship and business competitiveness,[12] such arguments are often abstracted from less attractive and tractable matters. This includes the ease and speed with which technologically amplified behaviours have undesirable world-wide effects. And as the resilience of the biosphere continues to decline, the affective power of established ways of life are creating multiple physical and social impacts. This trend – the movement away from the mediated interdependence of all societies towards a tangled, common plight – was observed by Geoffrey Vickers more than twenty-years ago:

> The environment of each society and of each individual in each society is becoming increasingly a human environment, created by other societies and other individuals. The interdependence of all of them mounts but the means of regulating their mutual relations, even including markets for commodities, products currencies, skills and 'labour' is breaking down. Even the relations between the human species and its habitat are becoming problematic, not through failure of technological inventiveness but through the failing responses of the patient earth.[13]

In addition, the biotechnology revolution has ushered in a capacity to fundamentally alter life processes. This has implications that can scarcely be grasped in advance, even as scientific discovery and new techniques in this and other fields with transformative potential (nanotechnology especially), drive forward relentlessly, particularly through powerfully-supported programmes for technological convergence. The primary European Union document on technological convergence at least opens with a sober reflection: 'Each [of the likely characteristics of converging technology applications] presents an opportunity to solve societal problems, to benefit individuals, and to generate wealth. Each of these also poses threats to culture and tradition, to human integrity and autonomy, perhaps to political and economic stability.'[14] How will societies (or, come to that, a political union of the size and diversity of the European Union [EU]) come to deliberate on such profound matters? The workings of legal systems, of ethical debate within and between communities and of the social consideration and reconciliation of values, interests and opportunities are necessarily slow and can hardly be sped – unlike scientific discovery and its technological outcomes. As the constituencies affected by many new technologies become global, the possibilities for truly comprehensive and well-considered consensus diminish, even as the pressures increase. Once again, the looming problems were foreseen by Geoffrey Vickers, in a passage that pertains as much to developed societies as to underdeveloped ones

> [T]here are limits to the possible rate at which human history can change without disintegration, since coherent change involves change in the whole set of cultural standards by which a society interprets its situation; and these standards are related to the life experience and hence the life span of individuals.[15]

States act as both poacher and gamekeeper; and realist fears and powerful interests inform perceptions of risk

States are both senders and receivers of globalising dynamics – in aggregate, a matter which is never wholly determined by a single state's particular calculations of risks and benefits but which in good measure arises from the fact that the largest number of other states are also racing to globalise. This can and does place states in an ambivalent position: anxious to accrue the benefits of technologies that also carry with them grave security risks, here given direct expression in a US Central

Intelligence Agency (CIA) report

> The genomic revolution is pushing biotechnology into an explosive growth phase. […] [T]he resulting wave front of knowledge will evolve rapidly and be so broad, complex, and widely available to the public that traditional means for monitoring Weapons of Mass Destruction development could prove inadequate to deal with the threat from these advanced weapons.[16]

There is no suggestion in this judgement that the biotechnology revolution could or should be curtailed or inhibited for the purpose of keeping the development and proliferation of WMD within manageable parameters. Indeed, the biotechnology that can fuel a new generation of dreadful weapons also now provides the foundation for the world-wide pharmaceutical industry. The issue of misuse also applies to the ordinary functioning of other technologically-based systems of communication and transportation – our disseminative systems,[17] often at quite 'low' levels – individuals and small groups.

The advent of nanotechnology is unlikely to prove any different. Indeed, even as nanoparticles have begun to appear in a range of consumer products, the work on military applications is well advanced.[18] The militarisation of technologies is at the heart of the realist disposition of states and where fear-driven and/or survivalist impulses are engaged, calculations of risk are unlikely to be linear, comprehensive, or wholly objective. The realist cast of mind also extends to economic prosperity (or dominance) in a fiercely competitive international system. The primary US document on technological systems convergence contains a succinct expression of this

> Technological superiority is the fundamental basis of the economic prosperity and national security of the United States, and continued progress in NBIC technologies is an essential component for government agencies to accomplish their designated missions. Science and engineering must offer society visions of what is possible to achieve through interdisciplinary research projects designed to promote technological convergence.'[19]

At a still more fundamental level is the wilful misreading or discounting of scientific evidence, clearly evident in the reluctance of the US government to seriously engage climate change as well as the privileging there of politically favoured 'sound science' over scientific research that has costly or otherwise embarrassing political implications.[20] Clearly, acknowledging threats is at times no more straight-forward than governing them. And nor is the path from acknowledgement of risk to regulation entirely straightforward. As one study concluded

> Differences in international regulation are seldom a function of differential threats posed by different risks. In fact, risks of similar proportion all deriving from globalisation can generate quite distinct international regulatory regimes, suggesting that risk assessment and regulation are neither as technocratic nor as politically neutral as they sometimes appear.[21]

The problem of misuse of scientific knowledge and technological expertise and of the malign uses that can be made of already embedded technological systems are worsening

The existence of transnational epistemic communities – scientists and technologists freely cooperating and sharing information – is a continuance and a consolidation of the centuries-old scholarly tradition. Peer review, open-access journals and data bases and the free exchange of research results, ideas, and personnel are properly regarded as global public goods. However, the world-wide dissemination of expert knowledge, easy availability of raw materials and very low start-up costs for research/production requisites in fields that were only recently leading-edge also has a dark side.

Unlike the hugely expensive and easily detectable infrastructures for making fissile material and producing nuclear weapons through the period after World War II (WWII), quite routine scientific expertise and off the shelf laboratory equipment can be turned to making harmful biological agents.[22] Moreover, a number of other developments have heightened alarm: the internet publication of simple experimental manipulation to make mousepox highly lethal that suggested similar possibilities for smallpox;[23] the creation of synthetic polio[24] (with the time required to synthesise viruses constantly shrinking);[25] and news that synthetic biology companies do not all run background checks on their clients.[26] Whether scientific data with high-risk potential can be restricted without disabling the kinds of transnational links on which so much current scientific and technological development now depend remains open to question.[27]

And the long-standing problem of risks inherent in dual-purpose products or processes is likely to become more entrenched, thus further complicating estimates of threat – and regulatory decision-making:

> Two key lessons emerge from the experience relating to weapons of mass destruction in Iraq. First, that an aggressor state seeking to use chemical or biological weapons is likely to choose to develop a mobilization capability based on and embedded in dual-purpose technology and equipment. It likewise follows that, by adopting such a mobilization approach when agents will be produced as required to be used so obviating the needs for storage and stability characteristics, chemical and biological materials may well be chosen that are *not* normally regarded as candidate chemical or biological agents. This lesson has important consequences for any future inspection regime in that the organization engaged in such inspections has to be trained to look out for indications of unusual chemical or biological materials of types and quantities that are inconsistent with peaceful permitted purposes.[28]

And further to unanticipated adaptations of one of more technological systems, some of the most embedded and familiar were readily employed by al-Qaida – routine passenger airliners most dramatically, but also electronic systems to transfer funds. In fact, al-Qaida itself is most probably less an organisation in the familiar sense than a loose network of affiliates,[29] a form made possible by what we routinely regard as benign technologies.

We are adding to the burden of already inadequate and/or incoherent regulatory systems

This perspective is not Malthusian or doom laden; instead, it is clear enough in at least two already-extant, large-scale threats to security for which the relatively small number of states directly responsible have been unable to frame comprehensive and effective control or remedial measures: WMD and climate change. As another two billion individuals stand on the brink of full participation in the world economy, what the world is faced with is not merely an enlargement of existing governance issues, or their intensification in a number of particulars, but a vast expansion in the complex interaction of human and natural systems that will become immensely more difficult to predict and discern, let alone adequately control. The introduction of new technologies and the eager adoption and adaptation of existing ones will add to these difficulties.

The political obstacles that continue to stall progress to halt the decline in the resilience of the earth's life-support systems mean that what would once have been incremental additions to environmental burdens will now have disproportionate weight (a matter that features as a justice issue in international environmental negotiations). Likewise, many indirect forms of human relatedness – mediated through such channels as world trade, cheap, instantaneous means of communication, and world-wide transport systems – will intensify, creating many new regulatory demands and pressures. (The struggles over intellectual copyright in everything from recorded music to pharmaceuticals – and now, genetic materials, are an indicator of what is probably in store.)

In addition, it is not at all exaggerated to describe as 'transformative' the potential impacts of biotechnology and nanotechnology. Indeed, the strongest proponents of technological convergence routinely use this adjective positively, with what appears to be a blithe confidence in our ability to accommodate, ameliorate, or otherwise cope with 'changes' after the fact that,

> It may be possible to influence the ways convergent technologies will change economics and society, on a national scale, by providing leadership and support for a nationwide, collaborative development effort. […] This effort should have many stakeholders in education, healthcare, pharmaceuticals, social science, the military, the economy and the business sector to name a few.[30]

The *possibility* of 'influence' instead of the determination to 'direct' or 'govern' is highly significant – as are the named agents: 'stakeholders' – largely, those with the strongest interest in the promise of profitable deliverables, rather than a government charged with ensuring the public good. The emphasis here is on forward momentum on the largest, national scale – for which these actors are appropriate – rather than on deliberation and a cautious estimate of possible threats – for which they are clearly not. Add realist perceptions and reactions which few, if any, states are likely to ignore, and the stage is set for retroactive governance negotiations – in all likelihood, once a pervasive threat has manifested itself.

The inclusion of non-state actors in what could be described as a quasi-governance role is significant in another respect, since it reflects a broader theoretical debate and practical development in what has hitherto largely been the province of governments' governance. As technologies and globalisation continue their mutual reinforcement, generating both transnational and global dynamics, it is important to review whether the growing interest in global governance holds any promise for the regulation of twenty-first century technology – and its vast array of security implications in particular.

The global governance concept

Two theoretical concerns drive an interest in *governance* as a concept that includes but extends beyond the activities of governments. The first is 'uncovering' the informal relationships and norms which underpin global order, arising in part from the belief that 'international anarchy' (the absence of an overarching world government) is not a vacuum. The second is the extent to which some combination of state and non-state actors (one form of which, 'governance without government'[31] has become something of a watchword) can in their totality suffice to ensure that managing and controlling mechanisms are in place for all of the world's more important dynamics.

A contributing factor to the surge of interest in governance and its possibilities was the perception that state power is on the wane; that an enlarging 'world' or 'global' politics was becoming less of a context for the primacy of international relations, but an important arena in its own right. While few observers either predicted or hoped for a stateless world, the 'retreat of the state' was thought to be an observable and in some respects, quantifiable phenomenon.[32] In addition to the changing context in which individual states act, other observers noted a combination of external pressures on states (largely a result of globalisation), a range of stresses acting on governmental bodies and functions, and the growing strength and importance of non-state actors – all of which appear to combine (at least in some instances) to a 'hollowing out' of the state and an increasing degree of autonomy and self-regulation of various non-state bodies:

> The control capacity of government is limited for a number of reasons: lack of legitimacy, complexity of the policy processes, complexity and multitude of institutions concerned, etc. Government is only one of many actors that influence the course of events in a societal system. Government does not have enough power to exert its will on other actors. Other social institutions are, to a great extent, autonomous. They are not controlled by any single superordinated actor, not even the government. They largely control themselves. Autonomy not only implies freedom, it also implies self-responsibility. Autonomous systems have a much higher degree of freedom of self-governance. Deregulation, government withdrawal and steering

> at a distance ... are all notions of less direct government regulation and control, which lead to more autonomy and self-governance for social institutions.[33]

Whatever one judges to be the level of self-governance and autonomy actually enjoyed by non-governmental bodies and other social institutions, the problem with the exercise of governance in *any* system that is highly plural as well as highly complex is not merely a matter of engineering forms of power-sharing:

> The peculiar difficulty of governments, whether political or industrial, in Western democracies at present is clearly due to the rise in power of organized sectoral minorities, each with an effective power to veto the others and thus to curtail the area within which the system which they constitute can in fact act as a whole, despite the fact that it has the authority and resources to do so.[34]

This problem persists – visible, for example, in the delays occasioned to large public works projects in almost all democratic countries. And what is true of governance within states is of course vastly more complicated in international and global arenas. It is these global arenas – in many respects, co-extensive with international ones, but not identical with them – that opportunities for cooperative, or at least summative governance are thought to be possible and extensible, as in the following depiction:

> [S]ystems of rule can be maintained and their controls successfully and consistently exerted even in the absence of established legal or political authority. The evolution of intersubjective consensuses based on shared fates and common histories, the possession of information and knowledge, the pressure of active or mobilizeable publics, and/or the use of careful planning, good timing, clever manipulation and hard bargaining can – either separately or in combination – foster control mechanisms that sustain governance without government.[35]

It is arguable that the progress of universal human rights – and in fact, human rights *as* a form of global governance –has in good measure progressed by this means; certainly the passage above could stand as a description of the way in which Amnesty International and other international non-governmental human rights organisations have operated.

However, states (or as in the passage above, governments) have most often been the object of human rights campaigns – in other words, human rights campaigning organisations' overarching aim is not the governance of human rights in the *absence* of government, but governmental *conformity* to an internationally shared norm. The human rights norm is well established in popular expectation, but it derives a great deal of its power from its embodiment in international law. Much the same could be said of those Non-Governmental Organizations (NGOs) concerned with the conduct of war and ensuring some standards of conduct through the rules of international humanitarian law. In these as in any other trans-national issue areas, it is difficult to think of comprehensive governance that could be accomplished in the absence of state endeavour and the power that states can bring to bear on the issues that reach the threshold of their security interests – and leading-edge technologies routinely meet that criterion. Moreover, many of the particulars in the characterisation above would also fit the profile of groups with malign intent. In any event, the kind of vacuum created by the absence of established legal and political authority is rarely filled immediately by actors of a benign and inclusive disposition.

A variant on the 'governance without government' outlined above is this characterisation of global governance: 'Global governance is governing, without sovereign authority, relationships that transcend national frontiers. Global governance is doing internationally what governments do at home.'[36]

What is puzzling about this definition is the way in which it privileges process over agency – that is, who or what will be 'doing' global governance? More directly, concern has been expressed in the global governance literature about democratic controls and accountability of 'non-authoritative' actors.[37]

Related to the kinds of groupings described as 'intersubjective consensuses' above, some analysts see in a less ad hoc, albeit nascent 'global civil society' and 'global public policy networks' possibilities for more inclusive and accountable transnational goal-seeking and policy-making – and that these will inform and/or strengthen existing (largely internationally-based) forms of global governance. The UN Vision Project on Global Public Policy Networks draws on the abundant evidence of non-state actors' participation in and influence on international forums; and also on the expanding literature on networked forms of advocacy and other forms of political engagement. The Project report's characterisation of the missing elements of global governance is notable for its assumption of good faith; and of a public policy-making process that is essentially linear:

> The negative effects of [liberalization and the technological revolution] may be characterized in terms of two *governance gaps*. First, an *operational gap* has opened up wherever policy makers and public institutions have simply found themselves lacking the information, knowledge and tools they need to respond to the daunting complexity of policy issues in a liberalizing, technologizing, globalizing world. Second, but related to the first, a *participatory gap* has manifested itself as this same increasing complexity thwarts common understanding of, and therefore agreement on, critical policy issues. This has sometimes led policy makers, intentionally or not, to exclude the general public from their deliberations.[38]

Without dismissing the importance of accountability, participation, or timely information, when applied to the global governance of technology, the report leads to an essentially 'missing pieces of the puzzle' or 'global governance tool box' understanding of complexities. Yet the problems at stake are neither so directly discernible (by policy-makers or members of the public) nor tractable. More recently, an admirable attempt in the United Kingdom to 'move public engagement [with science and technology] upstream'[39] is very unlikely to have global impact, even though most breakthroughs in nanoscience – the subject of this initiative – are being pursued in countries throughout the world, rendering the 'upstream' metaphor curiously abstract. It is also far from clear that 'global civil society' could in practical terms become more than an arena for normative and political contestation like any other or that its purposes would necessarily be benign or inclusive.

Yet combinations of state and non-state actors employing national and international laws, agreed standards, codes of conduct, and norms developed through both direct and networked relationships do achieve a notable degree of coherence in certain sectors of globalised endeavour. The study by John Braithwaite and Peter Drahos of global business regulation is quite instructive in this regard.[40] In addition, the shared interests of the powerful and wealthy – governmental and non-governmental alike – are on full show at the annual Davos gatherings, the reverse side of which is that Davos lends itself to depictions of global governance as forms of domination and control by elites. Despite this, non-governmental actors can act as powerful advocates at national and international levels for matters which, though clearly self-interested, are also of more far-reaching import, such as the insurance industry urging active political engagement with climate change. According to Bruno Porro, chief risk officer of the reinsurance company Swiss Re, 'The world is entering a future in which risks are more concentrated and complex. That is why we are pressing for policies that reduce risk through preparation, adaption and mitigation. That will be cheaper than covering tomorrow's losses after disaster strikes.'[41] Significant though this is, it is nevertheless a response after the fact: although the risks of climate change are uncertain, the likely parameters are sufficient to concentrate the minds of those likely to be impacted earliest and most critically. It is not an encouraging indicator of the prospects for a global governance that is anticipatory in respect of risk, even sectorally. In fact, the most detailed studies of global governance to date are sectoral studies – of global finance and the global environment, for example. Many of these works are essentially studies of the international politics of the named sectors, acknowledging that the scope and implications of the issues under examination extend beyond the interests of states and the configuration of the international system, but they are not directly instructive about the prospect of one or more forms of global governance as it might apply to recent technological advances.

Likewise, extended forms of multilateralism are the largest, most inclusive organisational forms for the exercise of what might reasonably be termed the global governance of various sectors, such as the World Trade Organization (WTO) for world trade. These forums have all of the considerable strengths of the international system – and its drawbacks, but in respect of anticipating and controlling threats from the introduction, dissemination, and adaptation of technologies as described above, they are remarkably blunt instruments. To the extent that they facilitate the extension and/or acceleration of globalisation (and especially advances in technology) they are likely to trail new or extended risks. Still less heartening are recent attempts to consolidate and advance multilateral arms control, especially with respect to biochemical weapons, where the threats are both formidable and explicit, and further malign possibilities are in view through further scientific advance and possible terrorist activity.[42]

For all the differences across the many conceptual understandings of 'global governance', they converge around an understanding that a top-down global governance is no more possible than a world government; and that the order or orders of the world that do ensure degrees of stability and security (at least for some) are the outcome of contestations and accommodations between the full range of political, social, economic, and other actors – thus: 'Governance … encompasses the activities of governments, but it also includes the many other channels through which "commands" flow in the form of goals framed, directives issued and policies pursued'[43]; and: '[G]overnance [comprises] patterns that emerge from the governing activities of social, political, and administrative actors. … [Thus], modes of social-political governance are always an outcome of public and private deliberation.'[44]

But when public and private deliberation – and perhaps more frequently, contestation and competition – take place on a global scale, it is far from clear that broad consensus and effective outcomes will routinely come about. After all, governance and global governance deal with power and the purposes of power – the same as any other form of politics. For all the possibilities of inclusion and representation implicit in generic definitions of governance as it applies to the global scale, we might best keep in mind that the world's many structural injustices come about and are sustained by means of public and private deliberation; and that in determining risk and setting regulatory frameworks, the two are not necessarily either antagonistic or motivated by a compelling interest in global public goods.[45] The hope that new forms of human relatedness and solidarity might deliver a 'multilateralism from below'[46] – that is, normatively responsive and responsible outcomes from a wide span of public and private actors – is a noble idea, not in spite of but because of the high stakes and powerful interests actively promoting the convergence of technological systems have already been declared, risks notwithstanding. And with the threats posed by a number of very serious, unbidden, and unwelcome developments arising from technologically- assisted behaviours (many of them quite mundane, such as cheap air travel), it would appear that the sum of our innumerable governances are wanting in many small particulars as well as its larger fixtures.

Conclusion

Identifying threats, reaching consensus, and establishing and maintaining regulatory controls will always struggle to keep pace with science and technology (S&T), for at least three reasons. First, 'technology' is not a homogeneous set of processes and products: technologies include the organic and the inert; the large-scale and the molecular; and objects both advanced and mundane. In all their variety, these arise from and open out onto a vast array of interests and purposes – first in design, but also in adaptive uses, all matters that have a bearing on what is perceived as a threat. The ease with which copyrighted electronic materials can be copied and shared is relatively minor in the scale of technology and security, but it provides a clear illustration of this point.

Second, globalisation is not only multiplying the number of stakeholders and interested parties involved in the governance of technology; it is also intensifying the interaction of human and natural systems, which can manifest themselves in unanticipated crises on the largest scale (ozone layer depletion, biodiversity loss), or, within human systems, creating or exacerbating social tensions. As technological development and globalising dynamics continue to fuel each other, it is difficult to see how our slow-moving public policy machinery can combine global consensus-making and an anticipatory disposition at a commensurate level – a point which leads to the third reason: in many respects, our means of identifying and curtailing technologically-driven threats are already at full stretch. Because state-based and other powerful interests remain fully operative even in the face of planet-threatening dynamics, both extant (environmental) and urgent 'fire-fighting' activities (new frontiers in WMD) will continue to absorb a considerable portion of our best global-governance talents and energy.

The bright spot in this is that, 'By definition, global governance implies that individuals take charge of matters that concern them by sharing the management and responsibility of them with public authorities.'[47] The surge of interest in the ethical implications of new technologies (not least biotechnology), the creation of bodies and forums to highlight and discuss issues of political and moral substance within and between epistemic communities, and a more widely shared appreciation of the darker sides of globalisation are key elements in restoring the profile and vitality of our deliberative systems, both within states and as part of emerging patterns of global governance. Efforts devoted to a more cautious and considered approach to the introduction of technologies which will in all probability (as their proponents cheerfully proclaim) transform our current understanding of human condition are up against very considerable momentum, shared by nations, private interests, and individuals throughout the world. But there is also common cause: the avoidance of threat; and a power in standards and humane values that is all too easy to discount. Perhaps the single most profound shift in global norms which occurred within living memory is the advent of universal human rights, given formal expression even as several states were still determined to remain colonial powers. Threats from new and established technologies cannot wholly be anticipated or eradicated, any more than politically-driven human suffering. But the threat posed by wilful ignorance, blinkered self-interest and sheer momentum can be confronted – and the resulting forms of political engagement, for all that they will remain difficult and contentious – will provide a platform for the twenty-first century global governance of technology.

Notes

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5

The Limits of Security Governance: Technology, Law, and War

Theo Farrell

War is intensely regulated by law. There are laws on who can fight, when, and how. Indeed, the legal restrictions on war are considerable. In general, use of force is prohibited under article 2(4) of the United Nations (UN) Charter – the keystone of modern international law. The only two exceptions to this general prohibition are use of force in self-defence, and use of force authorised by the UN Security Council (UNSC) for the purpose of protecting international peace and security. Modern humanitarian law also prescribes who are lawful combatants and what is lawful in combat. Essentially, combatants must be organised, led, and look like the regular armies of states (thus, insurgents may be lawful provided they have uniforms and carry their arms openly). This legal rule on who may fight contrasts sharply with the historical norm, which permitted all manner of actors – including, mercenaries, mercantile companies, privateers, and even religious orders – to lawfully use force. From the seventeenth century onwards, these various actors were outlawed and state monopoly on the right to use force developed.[1] Humanitarian law also requires that use of force not be excessive to military necessity and not to cause unnecessary suffering. To this end, humanitarian law regulates the treatment of prisoners, wounded combatants, and civilians in conflict zones, prohibits the targeting of civilians and civilian objects, and bans the use of specific weapons. These legal restrictions on the conduct of war are rooted in the Western Just War tradition that stretches back through the Middle Ages to antiquity, and were codified in modern humanitarian law in the twentieth century. Particularly noteworthy, in this respect, are the Hague Conventions (1899 and 1907), the four Geneva Conventions (1949), and the two Additional Protocols to the Geneva Conventions (1977).[2]

To my mind, laws such as these – on when, how, and what kind of force may be used – define the outer limits of security governance. Security governance comprises a broad range of rules, networks, and organisations, both inter-governmental and non-governmental, on security matters.[3] The proliferation of inter-governmental and non-governmental security organisations in the late twentieth century is suggestive of the thickening tapestry of security governance, both globally and within specific regions.[4] Included here are various regional security organisations (such as, the North Atlantic Treaty Organisation (NATO), the Economic Community of West African States, the Commonwealth of Independent States) as well as regimes and organisations dealing with security issues in the broader sense (such as, the World Trade Organization (WTO), the World Bank, the International Monetary Fund (IMF), the Kyoto Protocol on climate change, and the Antarctic Treaty). Thus, much of this architecture of security governance covers less competitive areas of inter-state relations, either because it concerns relations between allies or because it deals with non-military aspects of security. Relative gains concerns have less salience here than the absolute gains promised by strengthening an alliance or protecting the environment. But the development of laws that restrict use of force by states is more problematic. Relative gains concerns are uppermost here: no state can afford to support a security regime that confers an advantage on a military rival.[5] In this sense then, we are dealing with the boundaries of the possible for security governance. In exploring these boundaries, this chapter draws on literatures from political science, International Relations (IR), the sociology and, public international law.

There are logics to military restraint, notwithstanding relative gains concerns. Restraint can serve self-interests as well as broader social goods. As John Stone notes in his Chapter 6 in this volume, domestic political support for military campaigns can depend on minimising collateral damage. Stone also points out that restraint has a powerful reciprocal logic in the nuclear age – it is the only way nuclear armed opponents can avoid the utter destruction to their home societies.[6] Nonetheless, international co-operation to restrain war is difficult to achieve. Even in peace, states have difficulty trusting one another, especially when they have imperfect information about the intentions and capabilities of rivals. Co-operation between military adversaries is especially problematic, given the high incentives to cheat and the high costs of miscalculation. Institutional theory explains why states, even fierce rivals, co-operate. Institutions facilitate co-operation in a whole range of policy areas (trade, aid, currency exchange, oil pricing, environmental protection, etc.) by providing formal rules and routines that increase transparency and clarify behavioural expectations between states. In this way, institutions help rivals to build trust and adversaries to guard against cheating. International institutions often have a legal dimension, and may also be supported by an organisational structure or sustained through transnational networks. As noted already, the legal aspect of institutionalised co-operation is much in evidence in the area of military security (and hence is a focus of this chapter).

Stone's chapter explores the problem on unilateral restraint in the use of force, specifically in terms of the limitation of technical fixes to this problem. In this chapter, I consider the limits of multilateral military restraint. I focus on specific barriers to institutionalised co-operation that come from trying to legally regulate a highly technological as well as highly competitive area of state activity. This is another sense in which there are limits to security governance. The most obvious barrier is the intensely competitive nature of state interaction in military security. The problem of military competition for institutionalised co-operation has been discussed earlier and has been well studied by International Relations (IR) scholars.[7] This chapter identifies three other, less studied, barriers – the sheer pace of technological powered military change, the uncertain developmental trajectories of new military technologies, and the complexity of norms that can offer conflicting prescriptions for state action in military affairs. I begin in section one by discussing how institutions facilitate security co-operation, even between military rivals. Sections two to four then discuss in turn each of the barriers to institutionalised co-operation.

Institutions and security co-operation

Institutions are 'formal rules, compliance procedures and standard operating practices' that structure functional communities and social practice.[8] Such rules and routines are usually sustained within socio-technical networks, if not formal organisations. Much of the institutional analysis in political science looks at domestic entities, such as, electoral systems, health-care services, welfare programmes, trade unions, and the like.[9] The IR scholars have also applied institutional theory to the study of international regimes on trade, the environment, arms control, human rights, and so forth. International law is often integral to the form and function of international regimes. Indeed, many regimes are constructed around multilateral treaties, such as the WTO Treaty, the Kyoto Treaty, the Chemical Weapons Convention, and the Convention Against Torture.[10]

The IR scholars working on regime theory readily concede that the anarchical structure of world politics does not make co-operation easy. States face two major collective-action problems in achieving co-operation. First is a *collaboration* problem, where the incentives for collective action are balanced by incentives for individual states to defect. Arms control typically suffers from this problem: collective action provides a common good in terms of restraining the military competition between two or more states, but defection (especially covert) may give one party a military advantage. Second is a *co-ordination* problem, where there is real willingness to collaborate between states on a policy issue but there is no common understanding as to the best way forward. Co-operation on non-military matters – trade, finance, communications, global healthcare, and the environment – suffers from this problem, with states disagreeing over the nature of the problem and the appropriate remedies.[11] Co-operation on less competitive aspects of military security, such as the landmine ban and war crimes tribunals, also may be hindered by co-ordination problems. However, co-operation on security issues that involve competition between military rivals is especially vulnerable to the collaboration problem. The stakes are far greater than in other policy areas, such as trade or finance. The incentives to defect also can be high if it promises military advantage. And, the consequences of defection could not be higher, given the risks to national security.[12]

Institutions address the collaboration problem through a number of ways. They facilitate the increased flow of information between states. This may include explicit monitoring of state compliance with institutional rules. Monitoring mechanisms are essential in arms control regimes, for instance. This increased transparency reduces the fear of defection. The utility of cheating is also reduced by three other mechanisms: issue linkage, sanctions, and reputational effects. Institutional rules are often nested in large normative frameworks creating linkages between policy issues. Thus violating one rule carries the risk of adverse knock-on effects in other issue areas. Rules may also be enforced through specific sanctions. Finally, regime compliance becomes a way of measuring the reliability of states, and so non-compliance can damage the reputation of a state.[13] All three mechanisms operated for those states that have sought to weaponise civilian nuclear programmes in contravention of the Nuclear Non-Proliferation Treaty. Western delivery of aid to North Korea has been explicitly linked to the condition that it should not go nuclear.[14] Pakistan suffered economic sanctions from the United States, Japan, the IMF, the World Bank, and the Asian Development Bank in response to its detonating of a nuclear device in

1998.[15] And Iran's reputation amongst Western states is measured by its willingness to suspend its nuclear programme.[16]

The collaboration problem is about a clash of state identities as well as interests. Put another way, international co-operation is the product of both social and rational action by states. States will co-operate as much to enact particular identities as to realise particular interests.[17] Here too institutions aid co-operation. Formal rules, norms, and routines enable states to recognise social situations, to understand their own roles and the roles of others, and, given these things, to have expectations about appropriate behaviour. Viewed thus, we see that international law is more than a resource for state instrumentality. At a more fundamental level, it constitutes states (as sovereign) and the modes of their interaction.[18] Some of these modes of interaction are destructive; after all, as Hedley Bull famously argued, war is an institution.[19] But even institutions (such as those contained in humanitarian law) that legitimate certain means and modes of warfare do so as a by-product of state co-operation to restrain the worse excesses of war. In addition to sustaining co-operative modes of state interaction, institutions provide states with the social resources to co-operate in reconstituting their social world.[20] Institutions may enable states to engage in progressive re-framing of problems through a process of 'complex learning'. With complex learning, the knowledge acquired from institutional interaction is used to redefine rather than merely advance national interest. In this way, a series of institutions – from the Berlin Agreements, to the Conference on Co-operation and Security in Europe, to the various arms control treaties – enabled the Superpowers to progressively learn about the dangers of their confrontation and the necessity for co-operation to avoid these dangers.[21] Moreover, state identities may be transformed through institutionalised co-operation. Thus, an institution may start out as a vehicle for the advancement of common interests but evolve into the vessel for a common identity. Arguably, this is the case with the NATO, which was formed to counter a common Soviet threat but has outlasted this threat to become the regional promoter of a common, liberal, democratic, ideology.[22]

Thus institutions have cognitive and social benefits for international co-operation. They also typically grow stronger over time. Rules become more powerful as they gain specificity, durability, and wider acceptance. Routines become embedded in social practice. Supporting networks and organisations often grow in size and scope. Underlying institutional growth are two self-reinforcing processes: sunken costs and socialisation. Powerful interests develop around and invest in institutions. Institutional failure would therefore involve significant loss of political and/or economic investment. Also, communities are socialised into accepting rules and routines that, in time, come to be taken for granted and habitually enacted.[23]

When it comes to co-operation on military security, however, they are limits to what institutions can become and do. The highly technological nature of military security creates two specific barriers to institutionalised co-operation between rival states. In addition, a third barrier is created by the density and complexity of normative dimension of military security. These barriers shall be explored in turn.

The uneven pace of military and legal change

Legalisation is crucial to institutionalised co-operation on military matters. But, at the same time, the uneven pace of change between law and war produces a barrier to institutional development and effectiveness in military security. Legal rules are by nature fixed and so resistant to change. Indeed, law gains force through permanency. Were it otherwise, states could change legal rules at whim. Of course, over time international law does evolve. States agree to be bound by rules that have been laboriously worked-out in treaties, and states slowly develop new understandings of lawful customary practice. Thus military restraint has been increasingly institutionalised in international legal regimes, such as humanitarian law and the UN Charter, since the turn of the twentieth century. Change is evident, therefore, in the evolution of legal rules on the use of force, but these legal rules are themselves resistant to further change. Moreover, some rules are recognised as codifying fundamental values of international society. No state may derogate from these peremptory norms of international law, and it follows that they are unusually resistant to change. Peremptory norms include the prohibitions against slavery, torture, genocide, and the use of force.[24] Not surprisingly, perhaps, attempts by some powerful states to revise the non-use of force norm, to permit forcible humanitarian intervention and preventive military action against an emerging threat, have so far failed.[25] Equally, an attempt by the Bush administration to redefine torture to permit the use of degrading and painful interrogation practices on terrorist suspects has been condemned by the UN Human Rights Committee (UNHRC) as violating basic human rights norms.[26]

Against this general trend of evolutionary change in international law are a few cases of rapid change. An example is the *Tadic* Case in 1999, when the Appeals Chamber of the International Criminal Tribunal for the Former Yugoslavia (ICTY) established the precedent that the promotion afforded to individuals under international humanitarian law equally applies to individuals caught in non-international armed conflicts.[27] But it should be noted that international humanitarian law was moving in this direction. Hence, Additional Protocol II (1977) to the 1949 Geneva Convention elaborates the legal rules concerning restraint in non-international conflicts. Another example is international recognition of the lawfulness of the US led war against al Qaeda and the Taliban in Afghanistan in response to the terrorist attacks on the United States on 9/11. The right to use force in self-defence against terrorist attacks has been asserted by Israel and the United States for many decades but had enjoyed little international support. Following the 9/11 attacks, all states (except Iran and Iraq) recognised the lawfulness of the US and UK military response. The right of self-defence was also invoked in a number of subsequent UNSC resolutions on measures to combat terrorism. By these actions, customary law on the concept of self-defence which has traditionally been limited to use of force in response to attack by one or more states was revised to cover terrorist attacks.[28] In both cases, rapid change resulted from authoritative re-interpretation of existing legal rules. Both cases are also remarkable precisely because they represent exceptions to the norm of evolutionary change in international law.

Where international law has slowly evolved, war has undergone a succession of military revolutions in the modern period (roughly from the sixteenth century onwards). The French and Industrial Revolutions, and the experience of the World War I (WWI), re-ordered states, societies, and war-making. This last century has also seen numerous technological and doctrinal innovations that have been said to have produce specific Revolutions in Military Affairs (RMAs). Change is most obvious in the machines of war: humanity has progressed (if progress is the right word) from by-planes to stealth bombers, from cannon to cruise missiles, and from steam to nuclear powered warships. Even machines that appear to have outwardly altered little in a century have, in fact, greatly changed in their internal workings and military capabilities. Tank firepower, armour, and speed have vastly improved over the years, and electronics have transformed the communication and firing capabilities of tanks. These new technologies combined with new ideas about war have produced said RMAs in air, land, and sea war – most notably in aerial bombing, combined arms ground combat, and sub-surface warfare. New information and communication technologies (ICT) are promising yet another RMA, enabling the US military to undertake a self-styled 'Military Transformation.'[29]

Eminent law scholars have recently drawn attention to variance in the pace of change in law and war, and the problems created therein.[30] In so doing, Michael Reisman highlights the role of technological innovation in powering military change.

> For better or worse, participants in a civilization of science and technology are locked in a relentless process of research and a frenzied, competitive drive to apply the results wherever they promise enhanced productivity and profit. Each innovation stimulates further innovations and the juggernaut of development roars on. As for the law that would regulate it all, thanks to its characteristic deliberative and measured methods, it often lags behind innovations, leaving intervals of legal gap in which authority becomes uncertain. Weapons and their delivery systems are no exception to this dynamic.[31]

In their volume on *The Dynamics of Military Revolution*, Murray and Knox also recognise the 'increasingly rapid pace of technological change.' But they see technology as being less important than other factors – such as large-scale social and political change – in shaping revolutionary military change. They conclude that 'the driving force is rarely technology.'[32] Murray and Knox are right to avoid technological determinism. Sociologists of technology have convincingly challenged the notion of technological change naturally following a Darwinian path to ever-greater design efficiency and performance (see Rappert and Balmer's Chapter 2). Social and political forces profoundly affect the fate of technologies and their application. Strategic considerations also impact on the perceived usefulness and actual use of new military technologies.[33]

Nonetheless, Murray and Knox underestimate the impact of technology in powering military change. Technology is not a 'driver' of military change, in terms of determining the outcomes of processes of change. But it is more than a 'catalyst', which is what they suggest it to be. Rather, technology is the *engine* of military change. Underlying the pace of military change in the late modern world, has been what Barry Buzan and Eric Herring identify as 'the revolution of frequent technological change.' Buzan and Herring note that historically the norm was for infrequent technological change. Thus, a new military technology would enjoy a very long shelf-life – for example, galleys used by Ottomans in the Mediterranean were remarkably similar in form and capability to those used by the Greeks nearly 2,000 years before. The Industrial Revolution of the mid-nineteenth century changed all this – both by increasing the frequency and number of changes in military technology, and by vastly increasingly the capacity to reproduce new military technologies.[34]

At the international level, competition and socialisation dynamics reinforce frequent revolutionary change in military technologies. States seek new technologies that will enable them to outperform military rivals. The desire for prestige and recognition may also make trendy military technologies attractive for states regardless of military need. Revolutionary change in military technology is also spurred on by economic and bureaucratic imperatives at the domestic level. New technologies are needed to sustain national defence industrial bases. Military bureaucracies also seek technologies that promise additional resource and prestige as well as new military capabilities.[35]

To be sure, the nature of the national political system can retard home-grown technological innovation. In decentralised and open systems, technological innovation flourishes as scientific ideas are able to travel up through industrial and military bureaucracies and attract the necessary political support to produce a new technology. But in closed political systems, such as the former Soviet Union, home-grown technological innovation is controlled centrally, and is therefore slow, unwieldy, and often unsuccessful.[36] Of course, we ought to note that such polities have gone out of fashion, thanks to the Washington consensus in favour of democratisation and economic liberalisation that has being advanced internationally through institutions such as the IMF and the World Bank. Moreover, centralised and closed polities may still adopt new technologies, albeit from foreign sources, as competition and socialisation processes lead them to emulate the military innovations of more dynamic powers.[37] Thus, international and domestic pressures may interact in advancing revolutionary change in military technology regardless of domestic political structures. This leaves us with gross variation in the pace of military and legal change, which creates a fundamental problem for institutional design – namely, ensuring that rules and regimes are not overtaken by new technologies.[38]

Technological uncertainties

The pace of technological change creates enormous uncertainty as to how specific technologies will develop and what impact they will have on future warfare. This, in turn, makes it difficult for states to create institutional structures that can control the technological dimension of military competition.

Following the industrial revolution, technology began to profoundly alter humankind's experience of space and time. Steam engines made land and sea travel much faster and more reliable. Likewise, the telegraph made possible instantaneous communication over vast distances. Humankind's engagement with technology was forged in the rapidly urbanising societies of the United States and Western Europe, and was cemented in the social and political ideologies of the age – especially Social Darwinianism and Fascism – which celebrated the speed and vitality of the machine. Technology promised great things, but also terrible things. It would enable humans to achieve their full potential, both to create and to destroy.[39] Thus, the engine and the telegraph also transformed the conduct of war, making it possible to rapidly move military forces over great distances and control them from afar. Equally, the arrival of the aeroplane in the early twentieth century captured the hopes and fears of humanity. What we now take for granted was staggering at the time – manned flight. Equally staggering were the possible military implications. It was imagined that in future wars competing sides would be able to dispatched great fleets of bombers to destroy each other's cities. This terrible vision of warfare was realised in the Allied bombing campaigns against Germany and Japan in World War II (WWII).[40]

Much of security governance therefore is about controlling military technology. The codification of humanitarian law was spurred on by the experience of mass industrialised war, from the American Civil War and the Wars of Austrian Succession of the mid-nineteenth century, through to the two World Wars of the twentieth century. The Hague and Geneva Conventions attempted to restrain the destructive forces unleashed by new technologies of war.[41] Control has also been exerted through the outright banning of specific weapon technologies (such as chemical and biological weapons), as well as through multilateral and bi-lateral arms control agreements. A problem dogging all these mechanisms is the uncertainty as to the potential for technological development.

History is littered with examples of where leading military officers, politicians, and scientists have underestimated the potential of new military technologies. Influential doubters dismissed both the aeroplane and the atom bomb as unworkable.[42] Equally in evidence are examples of where the possibilities for new military technologies have been overestimated. Among the more improbable ideas that were funded but failed to work are nuclear powered aeroplanes and an all-atomic army.[43] Of course, a particular technology may attract the attention of both advocates and sceptics. We can see this with the on-going debate about the prospects for the current US led RMA. Advocates make great claims: that the US military will be able to move to 'lift the fog of war', to achieve 'full spectrum dominance', and to make the transformation from platform based to network centric warfare.[44] Sceptics say that digitisation of the battlefield will, at best, provide marginal improvements to traditional modes of warfare and, at worst, undermine the robustness of combat forces by making them dependent on unreliable ICT.[45]

There is a tendency to present this expectations gap in terms of a clash of technophiles and technophobes.[46] It has also been suggested that whole military services vary in their enthusiasm for new technologies, along the lines of the technology-intensive air force versus manpower-intensive army.[47] These notions had more currency before the mid-twentieth century, when individuals could avoid exposure to many technologies in their personal lives, and when armies could credibly prioritise morale over machines. Now, technology is omnipresent in social life, electronics have been integrated into all the major weapon platforms of ground combat, and armies the world over have embraced technology-based warfare.[48] Nonetheless, these perspectives are useful in highlighting the fact that technological capability, both anticipated and actual, is socially constructed. This is true in the sense that ultimately weapons require human agency to be created and to take effect. Sometimes human aspiration exceeds the possibilities of the technology, as in the case of tank technology in the inter-war period. The ideas for tank warfare far exceeded the technological capabilities of tanks in the 1920s–1930s.[49] Sometimes human imagination fails to grasp the full potential of new military technology as in the case of strategic defence technologies, the development of which were abandoned without much effort in early Cold War America.[50] Technological capability is also socially constructed in the sense that what we expect from new military technologies is not down to science alone – political, organisational, and strategic imperatives also determine how technologies are designed, built, and used.[51]

In sum, technology has often amazed and disappointed, and this expectations gap is the product of science, strategy, and social forces. This uncertainty about military technology can discourage institutionalised co-operation. Indeed, one study of the factors that effect co-operation on arms control concluded, 'the uncertainties created by the fear of qualitative technological innovation are possibly the *most* detrimental to co-operation'.[52] This understandable fear leads states to favour short-term self-help measures over long-term institution building, either because they want to realise the potential advantages of a new technology or because they distrust institutional efficiency. Early attempts to regulate aerial bombardment and atomic weapons illustrate this problem. In the Hague Convention of 1899 it was agreed to ban the dropping of bombs from balloons for five years. This ban came up for renewal at the second Hague Conference in 1907. But by this time, France, Germany, Russia, and Italy all opposed a ban because they were looking to developing fleets of military airships – a technology which, ironically, was to become obsolete within a decade.[53] Following the atomic bombing of Japan and the end of WWII, the victorious powers explored the possibility of placing atomic weapons under some kind of international control. But this effort also failed, not only because the Americans and the Soviets wanted to pursue development of this new weapons technology, but also because neither side had confidence that an effective regime could be fashioned to reliably control the bomb.[54]

Technology uncertainty may also undermine the cognitive benefits of institutionalised co-operation. Transparency is reduced if the knowledge being shared, about current and future weapons capabilities, is unreliable. In her Chapter 2 in this volume, Carole Boudeau provides insight into the problems states have in inferring the intentions and capabilities of rivals from intelligence assessments of the military technologies of rivals. Imperfect transparency may facilitate institutional creation but often at the cost of institutional effectiveness.[55] As the US-Soviet Strategic Arms Limitation Treaties (SALT) show, the conclusion of treaties can depend on putting details to one side. But the SALT regime failed to regulate the placing of multiple nuclear warheads on missiles. This, combined with rapid Soviet increases in warhead accuracy, undermined the tenability of the SALT regime from the US perspective.[56]

Finally, technologies may develop in unforeseen ways that undermine institutional co-operation. We can see this with the 1972 Anti-Ballistic Missile (ABM) Treaty. Given the poor prospects for developing effective ABM technologies, both the United States and the Soviet Union were content to agree on this treaty which, among other things, bans the development of space-based ABM weapon systems. However, 15 years on, massive investment in this area under the Reagan administration's Strategic Defence Initiative (SDI) promised to revolutionise space-based ABM capability at the cost of the ABM Treaty. SDI has continued on a reduced scale in the National Missile Defence (NMD) programme. The prospect of a major technological break-through on NMD, combined with a new focus on the threat of 'rogue state missile attacks', led the United States to withdraw from the ABM Treaty in May 2002.[57] Thus, not only can technological uncertainty discourage institution building and undermine institutional benefits, military technologies may also outgrow rules and regimes intended to contain them.

Normative complexity

Institutions are normative frameworks for co-operation. However, they exist in a social world that has high-normative density, and this mediates their normative force. All aspects of world politics are shaped by norms. As noted earlier, legal norms of sovereignty constitute the primacy of states as actors in world politics. State form and function are also constituted and regulated by general norms of good governance (that prescribe bureaucracy and increasingly democracy) as well as international and transnational norms on specific policy areas (healthcare, education, law enforcement, human rights, immigration, environmental protection, and so forth).[58] At the same time, political organisation and action are also shaped by national cultural beliefs, these being norms derived from national historical experiences, geo-strategic imperatives, and socio-economic circumstances. Thus, international norms are not planted in virgin soil but rather interact with and are adapted to suit national culture. In other words, international norms work through domestic systems, and so are often 'localized', in the process of shaping actors and action in world politics.[59]

This has profound implications for institutional design and efficiency when it comes to security co-operation. It points to the fact that institutions must accommodate the national norms as well as national interests of member states. As suggested above, norms also operate at a local level to shape national military preferences. At the level of strategic culture are national communities of policy-makers that share beliefs about the appropriate way to use force.[60] Organisational culture may also encode the beliefs peculiar to military communities about the conduct of war.[61] Co-operation will be facilitated where there is congruence between institutional rules and national norms. But security co-operation will be hindered where there is tension between institutional prescriptions and national preferences.[62]

Jeffrey Legro has examined this relationship in his study on military restraint during WWII. Legro notes that institutional strength (in terms of the specificity, durability, and concordance) does matter, but much more important is the fit between international institution and national military culture. He found that militaries were most likely to observe restraints institutionalised in international law where these legal rules were consistent with organisational culture. But where organisational culture conflicted with international law, restraint was unlikely to last long. Thus, the Royal Navy was slow to unleash its submarines against unprotected shipping because of the battleship bias in its organisational culture, whereas the U-boat centric culture of the German Navy meant that it was quick to break international rules of submarine warfare.[63]

Legro's study is path-breaking in terms of providing multi-level analysis of norm causation. However, given its spatial and temporal confines (namely, Anglo-German co-operation during WWII), it presents a rather static picture of the relationship between international institutions and national culture. When viewed over time, it becomes apparent that the relationship between international institutions and national culture is a dynamic and mutually constitutive one. Some national military preferences are encoded in international security institutions, just as national military culture can be transformed by imported international norms. Thus, the restrictions on guerrilla warfare in humanitarian law reflect the statist military cultures of the Western powers in the modern period, and these legal rules have eroded locally derived non-Western preferences for non-state based military forces.[64] Power and politics do matter to this mutually constitutive relationship. Security institutions will tend to reflect the cultural preferences of the great powers and transform the national cultures of lesser powers.[65] The institutionalisation of great power preference in the UNSC illustrates this. However, might does not always make right. The national interests and cultural preferences of the most powerful have not always determined the formation of security institutions. This may clearly be seen in the 1997 Ottawa Convention banning anti-personnel landmines and the establishment in 2002 of the International Criminal Court, both against opposition from the United States.[66]

The relationship between international rules and national norms is also dynamic in that each may alter in content and relative strength over time. Thus, they may converge or diverge at particular moments. For instance, there was considerable distance between the area-bombing culture of the Allied air forces during WWII and evolving legal norms against unrestrained aerial bombardment. From the 1960s on, there developed a growing strategic cultural preference for greater restraint in aerial bombardment, facilitated by evolving technology for precision bombing and spurred on by growing political sensitivity about civilian casualties. This coincided with a strengthening of the legal institution prohibiting attacks on civilians and civilian objects with the conclusion of the 1977 Additional Protocols to the Geneva Conventions.[67] Of course, convergence may be followed by renewed divergence. And, indeed, the US Air Force is developing new targeting doctrine that codifies a more permissive attitude towards attacks on dual-use objects (i.e., civilian objects which may also have military uses), and therefore is diverging from humanitarian law. Article 52 (2) of Additional Protocol I specifies that: 'military objectives are limited to those objects which by their nature, location, purpose or use make an effective contribution to military action and whose total or partial destruction, capture or neutralization, in the circumstances ruling at the time, offers a definite military advantage'.

Compare this with the definition of a military target in US joint doctrine: 'By their nature, location, purpose, or use, military targets are those objects whose total or partial destruction, capture, or neutralization offer a military advantage.'[68] The US doctrine lowers the bar set in Additional Protocol I in two ways. First, the object need not make an 'effective' contribution to military action. And second, its destruction need not offer a 'definite' military advantage. This lowered bar permits attacks on infrastructure – bridges, roads, and railway yards – that have the potential to be used for military purposes even if they are not actually in military use. It also widens the range of targets to include civilian objects that may contribute in a general, rather than immediate or direct, way to the enemy's war effort – such as, war-supporting economy and media transmitting propaganda. This runs against Additional Protocol I, which sought to firm-up the Geneva Conventions by narrowing the range of military objectives to exclude wholesale targeting of civilian infrastructure and economy.[69] This development is explicable in terms of US strategic culture which emphasises the promise of technological solutions to strategic challenges, and takes a pragmatic approach to international law that allows for legal rules to be read 'purposively' to meet the demands of policy.[70]

Normative complexity presents a barrier to co-operation on military security when local security norms do not fit or grow apart from security institutions. This problem may occur at the level of the state, if state identity or strategic culture is in conflict with institutional rules. The development of nuclear weapons by India in breach of the Nuclear Non-Proliferation Treaty may be explained in this fashion. To be sure, India has strategic reasons for acquiring nuclear weapons given its competition with China and Pakistan (both nuclear powers). Domestic political parties have also tried to use India's nuclear weapons for electoral gain. But domestic discourse and the timing of India's 1998 nuclear weapons tests strongly suggest that the acquisition of nuclear weapons is equally about affirming India's identity as a modern developed state.[71] Even when political and policy elites are supportive of security co-operation, Jeffrey Legro's work shows that military culture may clash with institutional rules and this can result in non-compliant state practice. We can see this in the US practice of nuclear deterrence during the Cold War that was wholly consistent with international legal rules on use of force, whereas US nuclear war planning was not. Civil-military differences are crucial to understanding this variation in US nuclear restraint; US deterrence embodied a civilian norm of nuclear non-use, while US war planning codified a military norm of indiscriminate nuclear use.[72]

Obviously, when institutional rules clash with local norms, then the social benefits of institutionalised co-operation are unlikely to be realised. States will not be open to 'deep learning', but rather will seek to use institutions strategically to advance their own interests. Rules may be followed to the letter, but not in the spirit of the institution. And in developing institutions for co-operation, normative positions will be deployed rhetorically to maximise national interests in institutional design, rather than to engage in 'truth-seeking argument' to use institutions to progressively re-frame a problem to the mutual gain of all.[73] Such rhetorical action was in evidence in the US approach to the negotiations on the Rome Statute establishing the form and function of the ICC.[74]

Conclusion

It is no easy thing for states to co-operate on military security. Allies have to rely on one another rather than self-help. Even more difficult is for enemies to restrain their military competition. Institutional theory points to the co-ordination and collaboration problems that impede international co-operation. It is commonly noted that the latter is particularly acute when it comes to security co-operation given the intensity of military competition by states. By providing set rules and routines, supported by networks and often formal organisations, institutions help states deal with co-ordination and collaboration problems. Institutions improve transparency and trust between states, and they enable states to learn to co-operate and even re-frame problems. However, this chapter has argued that co-operation on military matters is hampered by three additional barriers – the uneven pace of legal and military change, technological uncertainties, and normative complexity – that adversely effect institutional development and efficiency.

The amount of institutionalised co-operation there is in the world on military security is certainly impressive. But there are limits to what can be achieved in security governance. Military change, powered by technological innovation, far outpaces the evolution of legal institutions to restrain the use of force. The uncertain developmental trajectories of new technologies also make it extremely difficult to create institutions that can be seen and are effective in regulating such means of warfare. Finally, institutions must contend with a myriad of local norms operating at national and sub-state (i.e., organisational) levels, that may cause state resistance to institutionalised co-operation. These barriers are not going to ease in the twenty-first century. Unless it is believed that military change will substantially slow down, technology developments are going to become easy to predict, or the social world of military affairs is going to considerably decrease in normative density, then states will have to continue to co-operate within the limits to security governance.

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6
Technology and the Problem of Civilian Casualties in War

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The nineteenth-century military theorist Carl von Clausewitz famously described war as the continuation of politics by other means. The status of his claim remains a matter of great importance today. Western liberals no longer see war as a normal means of settling differences between states. Nevertheless, many of them feel forced to conclude that sometimes war provides the only course of action for upholding international peace and security. It is therefore important that war remains a viable instrument of policy.

From this perspective it is unfortunate that, during the years since the death of Clausewitz, technological innovation undermined war's instrumental status. Rapid developments in the lethality of weapons permitted startling increases in war's destructive potential. As a result, the costs associated with resorting to armed force became increasingly likely to outweigh any conceivable gains. For many, this trend reached its logical conclusion with the introduction of nuclear weapons. As nuclear arsenals grew, it became increasingly difficult to envisage policy goals that could justify the hundreds of millions of casualties – the overwhelming majority of them civilians – that would have resulted from war between the superpowers. In a world characterised by such rivalry, no realistic alternative to peace was evident.

Matters changed dramatically with the end of the Cold War, and the realignment of international politics that followed the collapse of the Soviet Union. This realignment means that the chief threats to Western security now stem from strategic actors who do not possess nuclear weapons. The dangers of nuclear proliferation remain a matter of concern but, as far as the influence of technology on warfare is concerned, attention is currently focused elsewhere. Indeed, it is the developments in information technologies (IT) that are now commanding much attention from those who used to worry about nuclear weapons. And interestingly, these developments are widely believed to be recasting war into a more viable instrument of policy than at any time since 1945. A key reason for this is that the integration of advanced IT into military systems is leading to remarkable improvements in accuracy, which in turn is considered to be producing a comparable decline in the collateral damage associated with their use. In other words, the application of IT to warfare is understood to be producing a technical fix to the problem of civilian casualties in war.

In what follows, I want to suggest that this technical fix is unlikely to yield the kind of positive benefits that are widely anticipated. The destructive potential of contemporary warfare cannot be fully addressed by the application of further technology. What are also required are ways of exerting *political* control over the strategic goals that are pursued with the aid of advanced weapon systems. It seems to me that such control is possible, although prevailing Western views on military strategy constitute a barrier to success in this regard and need to be revised accordingly. In this respect, my position is similar to that advanced by Durodié (Chapter 9) elsewhere in this volume. Whilst we both perceive that technology can make a contribution to international peace and security, neither of us believes that this contribution will take the form of a simple technical fix. On the contrary, if technology is to play an effective role in this regard, its application must be subordinated to robust political processes.

By drawing a distinction between the political and technical domains in this manner, I am committing an act of simplification. Constructivist accounts of technology point to the mutually constitutive nature of the political and technical, which renders efforts to disaggregate them problematic (see Chapter 2). Thus, judgements about whether a weapon 'works' or not – in the sense of destroying its target without causing undue collateral damage – are shaped by the political context of its use (what the war is about) in addition to the weapon's technical characteristics, such as accuracy and warhead size. By the same token, judgements about whether the risks to civilian life are justified by the anticipated benefits flowing from a target's destruction are partly shaped by technical factors. Both the Western Just War ethic and the Geneva Conventions stress the importance of acting proportionately and with discrimination in war. On the other hand, neither provides the kind of 'felicific calculus' necessary to reach absolute judgements about what counts as sufficiently proportionate or discriminating. As such, considerations of technical feasibility enjoy wide scope for shaping notions of what is ethical and legal in war. From this perspective, therefore, hard and fast distinctions between the political and technical are problematic in certain respects. However, as we will see shortly, it is useful to draw such distinctions when discussing the character of strategy.

My argument is divided into four major parts. Part One outlines the challenges associated with using military force against 'rogue states' whilst keeping civilian casualties to a minimum. Part Two discusses the practice of strategy as it has developed since 1945 with particular reference to the United States, which is today's principal Western strategic actor. My goal here is to show how strategy has developed in ways that have reduced the scope for political control over the application of force, thereby leaving the challenge of avoiding civilian casualties to be 'fixed' by technological solutions alone. Part Three examines some of these technological solutions in more detail and discusses certain problems associated with relying on them. Finally, Part Four makes a case for revising the character of strategy so as to accommodate political influence over the strategic goals that force is used to achieve in war.

Civilian casualties and rogue states

In this chapter I focus on the use of force against the so-called 'rogue states', by which I mean states that transgress international norms of acceptable behaviour. Such transgressions may involve acts of aggression against other states, or against groups within the transgressor's own population. They may also involve the provision of support for international terrorism, along with attempts to acquire weapons of mass destruction (WMD). These latter issues have become a particular concern for the United States as the possession of nuclear weapons, especially, provides a potentially effective means of offsetting the otherwise crushing US superiority in conventional military power. In the wake of the 2001 attacks, the suspicion that Saddam Hussein might possess WMD, and provide them to terrorist organisations such as *al-Qaeda*, played a key role in the US decision to invade Iraq.

The use of armed force against rogue states raises a problem in relation to civilian casualties that is implicit in the term 'rogue state' itself. The fact that we are not talking about 'nations' or even 'nation-states', but simply 'states', is symptomatic of the liberal belief that 'roguish' behaviour is the fault of political elites rather than the people they lead. Indeed, in non-democratic states the people have no say over the policies of their leaders and thus cannot be held responsible for them. The use of military force to right wrongs must therefore respect the distinction between the politico-military aspect of the state and the people that merely live within its borders. It must discriminate between guilty rogues and innocent bystanders. Achieving such discrimination is, however, no trivial task because it is often impossible to disaggregate those aspects of a state's infrastructure that support its military effort from those that support the welfare of its people. Moreover, even the most accurate and discriminating application of force risks inducing great suffering if it dislocates a state to the extent that it is no longer capable of imposing basic levels of law and order within its own borders. The challenges associated with using armed force to defeat a rogue state whilst keeping civilian casualties to a minimum are therefore great indeed.

Strategy

Strategy can be defined as the instrumental link between military means and political ends. It is concerned, in other words, with the processes by which violence gets converted into political effects. The traditional position on this issue is quite simple: in order to impose a political settlement on our adversaries we must first deprive them of the ability to contest that settlement. This, in practical terms, demands that we destroy their means of resistance. In the context of inter-state warfare, 'means of resistance' typically includes the enemy's armed forces along with those components of the enemy state that direct and support their operation. Destruction is usually understood to involve a combination of physical damage and psychological dislocation. But however it is achieved there is no room for self-imposed restraint here, because not until our adversaries' means of resistance have been destroyed can we be certain of achieving our political objective. Moreover, adversaries will remain dangerous to us for as long as they possess the capacity to strike back. Ideally, therefore, wars should be fought to a rapid and decisive conclusion.[1] From this perspective war is the continuation of politics, but only in the narrow sense that politics provides the initial rationale for war. The strategic dimension of war itself is understood to be an unpoliticised (purely military) activity, whose character is governed by an overriding requirement to render one's enemy defenceless as efficiently as possible.

In the United States this traditional strategic approach prevailed until the advent of nuclear weapons in 1945.[2] Thereafter, it became impossible to ignore the likelihood that efforts to render one's enemy defenceless would be reciprocated in kind, resulting in mutual destruction. Thus if war were to retain its status as a tool of policy, it would need to be employed in accordance with very different strategic concepts from those that had hitherto predominated. But how otherwise might the United States respond to an act of aggression against itself or its allies, if not by an unrestrained strike with its nuclear weapons?

In answer to this question, a new approach to strategy – that came to be termed 'limited war' – emerged during the 1950s.[3] The basic idea behind limited war was that the goal of strategy should not invariably be the complete destruction of the enemy. Rather, it should more faithfully reflect the importance attached to the political rationale for war. It was recognised that direct threats to the vital interests of the United States would still need to be met by appropriate forceful military action. Yet, it was argued that lesser need only elicit a military response of sufficient magnitude to coerce the enemy into ceasing their aggression. This coercion might be achieved by a carefully measured application of force whose goal was not to destroy the enemy completely, but merely to inflict a degree of punishment. The point of such punishment was to send a message that more would follow until the aggressor complied with US political demands. The aggressor would therefore be faced with the choice of continuing to fight in the face of potentially disproportionate losses, or bringing the war to a voluntary conclusion. Since the aim in such wars would be to dissuade the enemy from continuing to fight, rather than destroying the means necessary to do so, that enemy would retain the ability to strike back against the United States or its forces. It was therefore recognised that coercive operations would involve a test of political resolve for both sides. Indeed, in situations which would involve comparable political commitment between the two protagonists, a great challenge for strategists would be to identify ways of inflicting greater losses on one's enemy than were suffered by one's own forces, or at least of persuading an adversary that this would be the case should hostilities continue.

Another serious problem that went largely unrecognised, however, was that of measuring the extent of an adversary's commitment to their political goals – something that could only be achieved with the aid of a clear understanding of the adversary's character and motivations. In this respect, it was unfortunate that the predominant tendency in the Cold War was to examine regional contingencies through the lens of the Superpower competition, which worked to obscure the need for a nuanced understanding of local dynamics. Thus it was that during the 1960s the United States subjected the theory of limited war to a test in Indo-China that it was singularly ill-suited to meet.

Washington's predilection for viewing the struggle over South Vietnam as an extension of East–West competition fundamentally shaped its approach to resolving the situation. More than capable of razing North Vietnam to the ground, but nervous of precipitating Chinese or perhaps even Soviet intervention on behalf of Hanoi, the Johnson Administration adopted a highly politicised strategy. In true limited-war fashion, the aim of US military action was not to bring about the complete military defeat of the North, but, rather, to inflict sufficient damage to coerce Hanoi into negotiating an end to the war. The sovereignty of the South would thereby be preserved without encouraging Chinese or Soviet intervention along with the escalatory risks this entailed. But after a bloody and protracted struggle, it was Washington's will which broke rather than Hanoi's, and the war ended in US defeat. It emerged that the Johnson Administration had badly misjudged the nature of its adversary. Hanoi was no mere pawn in the Superpower confrontation.[4] On the contrary, its political goal of reunification was the result of a nationalist agenda to which the North was fully committed and was therefore very unlikely to be swayed by the restrained application of US force. In effect, the United States was intervening in a Vietnamese civil war that it could win for the South only by destroying the North. The fact that it would not countenance this course of action meant that Hanoi's victory was only a matter of time.

Defeat in Vietnam was a traumatic experience for the United States, and its effects on strategy have echoed down the years to the present day. For present purposes, the most important result was a pronounced disenchantment with the concept of limited war as it had emerged during the 1950s and was practised in the 1960s. The failure of Johnson's highly politicised use of force in Vietnam was taken as evidence that the basic strategic approach was fundamentally flawed rather than merely inappropriate to the particular context in which it had been tested. As a result, both the US military and its political leaders reverted to the more traditional conception of strategy as an essentially non-politicised (purely military) activity. Politics might provide the rationale for war, but it should not thereafter be permitted to 'interfere' with the conduct of military operations. Vietnam had demonstrated that the only valid strategic goal in war was that of rendering one's enemy defenceless. To depart from this goal was to risk laying oneself open to unnecessary losses and even outright defeat.

The nuclear stand-off of the Cold War permitted little scope for the United States to put its revised approach to strategy to use. Ultimately, however, the demise of the Soviet Union opened the way for the United

States to put theory into practice with a spectacular feat of arms in the Persian Gulf. In 1991 the much-vaunted Iraqi armed forces were resoundingly defeated and bundled out of Kuwait in an operation – 'Desert Storm' – that appeared to validate prevailing US conceptions regarding the application of force. From Washington's perspective, the liberation of Kuwait was a limited political aim. Nevertheless, the US armed forces were permitted to pursue the distinctly *unlimited* strategic aim of rendering the Iraqi state defenceless – a strategic aim they had come close to achieving by the time hostilities were brought to a halt.

Success in this endeavour was the result of numerous factors, but a salient one in the minds of both the military and the television-watching public was the successful harnessing of advanced IT to the task of rapidly defeating the Iraqi armed forces. Cold-war investment in systems capable of acquiring and attacking targets with a high degree of accuracy was deemed to have paid off handsomely in 1991, to the extent that many commentators saw Desert Storm as heralding a 'Revolution in Military Affairs'(RMA) based on IT.[5] Continuing investment in such capabilities, it was argued, would secure for the United States a military future in which wars could be won rapidly and unequivocally by destroying the enemy's means of resistance in a series of highly accurate strikes to which no effective reply could be mounted. Enemies would thereby be disarmed without an opportunity to reply in kind, whilst the accuracy associated with such strikes would ensure that collateral damage was kept to a minimum. The anticipated result was that war would become a rather more viable tool of policy than had hitherto been the case. It would therefore be possible to topple a rogue regime whilst avoiding high levels of casualties amongst the populace at large.

The technical fix

Post-Cold War developments in strategy make heavy demands on technology's ability to deliver victory at an acceptable cost in terms of civilian lives. If the strategic aim is to render one's enemy defenceless, the only course of action open is to develop new military means that are sufficiently accurate to destroy or disrupt an enemy state whilst leaving the nation as unscathed as possible. Great strides have already been made in this regard, with the application of IT to the task of guiding weapons to their targets making them far more accurate than was previously the case. Laser-and satellite-guided bombs epitomise the change here. Unlike their traditional counterparts that fall in an unalterable path once released from an aircraft, guided bombs can change their course in accordance with data fed to them about their position relative to that of a target. Laser-guided bombs home in on the energy reflected by a target when it is illuminated by a laser-beam. Satellite-guided bombs direct themselves to a pre-designated location with the aid of radio signals generated by the Global Positioning System's array of satellites. The resulting increases in accuracy are very considerable indeed.

According to US Air Force statistics, during the World War II (WWII) the destruction of a point target typically demanded 1,500 aircraft delivering between them a total of 9,000 unguided bombs, the vast majority of which would have missed their intended aim point.[6] The standard index of bombing accuracy is known as the 'circular error probable' or CEP.[7] Simply put, the CEP of an attack equates to the radius of the circle within which 50 per cent of the bombs that are released from an aircraft ultimately fall. During WWII, the CEP of the aforementioned attack would have been approximately 1,000 metres. That is to say, around 4,500 of the bombs would have fallen within 1,000 metres of the aim point, with the remainder being scattered further afield. Under such conditions, the potential for collateral damage was very high, especially since the vast majority of targets attacked in such a fashion were located in urban areas. Today, by contrast, the same target might well be attacked by one aircraft delivering just one guided bomb with a CEP of 10 metres or less. Since there is only one bomb involved –and this bomb is very likely to fall either directly on, or very close to, its intended target – the level of collateral damage associated with any given attack will be very low by historical standards. On this point, readers should note that a 100-fold reduction in CEP (from 1,000 metres down to 10 metres) is even more substantial than it first appears because the *area* under risk around the target is reduced by a factor of 10,000 (from 3.14 square kilometres to just 314 square metres) – always remembering, of course, that we are considering only half of the bombs dropped.[8]

It is important not to get too carried away by technical details, however. Great as the improvements in accuracy undoubtedly are, they by no means avoid the problem that the infrastructure of modern states is difficult to separate into military and civilian components. The very same infrastructure that provides civil society with basic functions such as power, transportation, and communications can also serve important military purposes, which renders it liable to attack. And, no matter how accurately such infrastructure targets are attacked, their destruction deprives civilians as well as the military of their benefits. Moreover, collapsed or paralysed states may well be in no position to offer their citizens even rudimentary levels of order and security. Just how problematic issues of this nature can be is illustrated by some of the wider consequences associated with the wars against Iraq in 1991 and 2003.

1991: Indirect casualties

The US plan for the attack on Iraq certainly did not include the civilian population in its target lists. Following the war, Brigadier-General Buster Glosson observed that 'the American people would not have stood for another Dresden' and in the event coalition attacks appear to have been directly responsible for very few civilian casualties by historical standards.[9] Whereas around 35,000 Germans died as a direct consequence of the controversial raids on Dresden in February 1945, the number of Iraqi civilians killed directly by military activity in 1991 was a factor of ten lower at 3,500.

Nevertheless, the strategic goal of shattering Iraqi resistance generated an extensive list of infrastructure targets in 1991. In just the first day of the air campaign, more targets were struck in Iraq than the US Army Air Force had attacked in Germany during the years 1942–1943.[10] It is therefore hardly surprising that the bombing, despite being achieved with a high degree of accuracy, appears to have brought the entire state to its knees. According to the report of a UN mission that was sent to assess the post-war situation in Iraq:

> The recent conflict has wrought near-apocalyptic results upon the economic infrastructure of what had been, until January 1991, a rather highly urbanized and mechanized society. Now, most means of modern life support have been destroyed or rendered tenuous. Iraq has, for some time to come, been relegated to a pre-industrial age, but with all the disabilities of post-industrial dependency on an intensive use of energy and technology.[11]

Damage and disruption on this scale produced baleful consequences for the civilian populace, even though it had not been directly targeted. Without power, it proved difficult to provide adequate supplies of fresh water and basic levels of sanitation could not be maintained, whilst the destruction of roads and bridges complicated the distribution of food and medical supplies. The result was a heightened level of deaths due to disease, particularly amongst the weaker sections of the populace.

The extent of these deaths was revealed in a widely reported 1993 study by demographer Beth Daponte.[12] One of the methods she adopted was to compare extrapolations of pre-war demographic trends in Iraq against data produced by post-war surveys, the disparity providing an indication of the death toll caused by the wider effects of the war. According to her findings, the total number of Iraqis who died as a consequence of the war was approximately 205,500. Of these, 56,000 military personnel and 3,500 civilians were killed as a direct result of coalition military action. A further 5,000 military and 30,000 civilian deaths were attributable to the popular uprisings that began in the wake of the war. But the greatest single cause of death was found to be adverse health effects stemming from the destruction of Iraqi infrastructure. Approximately 111,000 civilians died as a consequence, of which 70,000 were children and 8,500 elderly. Thus, despite genuine efforts to the contrary, coalition military action appears to have indirectly resulted in great loss of civilian life.

2003: Bombing leviathan

The extent to which military actors are culpable for the indirect consequences of their activities is, perhaps, a question best answered by moral philosophers. Nevertheless, it is heartening to note that the US military's approach to the application of force has not stood still since Desert Storm, and an important reason for this is a desire to ameliorate the problem of civilian casualties as it manifested itself after 1991. In part at least, the current concept of 'Effects Based Operations' (EBO) reflects this concern.[13] One of the basic ideas behind EBO is to bring the process of target selection into a more intimate relationship with the wider effects that the application of force is intended to achieve. Thus, rather than generating 'bombing lists' which include all the infrastructure targets that might conceivably be expected to have military use for an enemy, the EBO approach seeks to identify a more limited selection of targets that are critical to achieving a desired effect. In 2003, for example, the range of Iraqi targets chosen was more narrowly geared to the goal of making the state defenceless than had been the case in 1991. Efforts were also made to introduce greater flexibility and responsiveness into the process, so that the bombing effort remained tied to the unfolding situation and, by extension, did not produce damaging effects that were irrelevant to changing circumstances.

Imaginative as such the operational concepts might be, however, their ability to reduce civilian casualties is likely to be undermined by a strategic objective that extends to rendering the enemy state defenceless. This is because no matter how elegantly and efficiently this objective is achieved, the act of making a state defenceless risks plunging its populace into anarchy and a Hobbesian 'Warre of every one against every one'. Quite how likely this is to occur would obviously depend on a variety of contextual factors. The degree of access enjoyed by the populace to vital goods and services would be important in this regard. An ethnically and religiously homogeneous population might be less likely to fracture and fall into civil war than a heterogeneous one that had hitherto been held together only by the power of the erstwhile state. But even the most benign post-war environment has the potential to turn nasty and brutal if not treated very carefully. The requirement to provide an alternative state to the one that has been removed means a physical presence on the ground which, if not handled sensitively, might readily lead to resentment and armed hostility from a recently 'liberated' populace. In this regard, making new states is always likely to be more difficult than breaking established ones.

The current situation in Iraq illustrates many of these problems. The United States and its allies toppled Saddam's regime with ease – this being a relatively straightforward military challenge amenable to advanced technology. In the United States, at least, there seems to have been an expectation that this process would permit the Iraqi people to create a new, more harmonious society at peace with itself and with the international community at large. Unfortunately, events have not proceeded as smoothly as anticipated, and from a jaundiced old-European perspective this was never likely to happen. The Iraqi people could not realistically be expected to build a new future for them without substantial help. Nor, moreover, could this process be expected to go smoothly given the deeply felt ethnic and religious divisions within Iraqi society. And yet seemingly to its surprise, the United States found itself cast in the role of reluctant Hobbesian: having bombed leviathan to pieces, it was rapidly faced with the problem of building an alternative.

This role might have proved more palatable were it not for the fact that US forces, along with anybody who co-operates with them, have been attacked on a sustained basis and frequently with deadly results. More than three years after 'major combat operations' were declared over at the beginning of May 2003, a dangerous opposition is still operating in Iraq and as yet has shown no signs of giving in. One reason for this is that the emergence of a relatively stable and prosperous new democracy would certainly be perceived as a threat by radical Islamists who have thus far represented the only credible alternative to the secular non-democratic regimes of the region. The notion of a new US-sponsored Iraq emerging phoenix-like from the rubble may be fanciful, but it is not a prospect that groups such as *al-Qaeda* can be expected to tolerate. On the other hand, a failed state – perhaps fracturing along

Kurdish, Shia, and Sunni lines – would provide a relatively benign recruiting and operating ground for extremist groups. Indeed, it is probably for this reason that the insurgents themselves are now bombing leviathan (or at least those parts of it that are embodied by Iraqi volunteers) and are producing shocking civilian casualties in the process. According to the *Iraq Body Count* website, the number of civilians killed consequent on the invasion is presently in excess of 39,000 and may be approaching 44,000.[14] These figures include deaths caused by coalition forces and by insurgent groups, along with those resulting from the elevated levels of crime associated with the collapse of state-imposed order. The upshot is that Washington and its allies have found themselves in something of a quagmire. Getting out of Iraq will be far more difficult than going in proved to be if the West wishes to leave something behind that is not significantly more dangerous to international peace and security than was Saddam's regime. US technology notwithstanding, the war in Iraq is both nasty and brutal, and is it not going to be short either.

All this suggests that the challenge of keeping civilian casualties to a minimum cannot be resolved by a process of military-technical innovation whose ultimate aim is to render enemy states defenceless in an evermore efficient manner. High levels of accuracy will not circumvent the problem that many of the targets one might wish to attack in order to cripple a state's military capability are also vitally important to the welfare of the people who live in that state. Moreover, the condition of defencelessness is in itself a potentially problematic one in as much as it will threaten the political stability that states routinely provide for the majority of their citizens. Accordingly, in the next section of this chapter I want to suggest that, rather than focusing narrowly on technical solutions to the problem, we need to impose substantially greater political control over the military uses of that technology via a revision to strategy.

Political control over military technology

Initiatives to restrain the employment of weapons are by no means entirely new. Perhaps the best-known of these are efforts to impose restrictions on their tactical employment, as instantiated by International Humanitarian Law (IHL).[15] Protocol I of the Geneva Conventions, for example, prohibits attacks 'which may be expected to cause incidental loss of civilian life, injury to civilians, damage to civilian objects, or a combination thereof, which would be excessive in relation to the concrete and direct military advantage anticipated'.[16] These kinds of restrictions are widely held to be right and proper – and also expedient given the influence that excessive collateral damage can exert on domestic and international opinion. Nevertheless, although IHL imposes certain limitations on the use of force (see, Farrell's Chapter 5) it cannot, in and of itself, secure civilians against high levels of casualties. As we have already seen, the experience of the last two wars with Iraq have clearly demonstrated that military force can be employed in such a manner as to be compatible with restrictions such as those stipulated in Protocol 1 of the Geneva Conventions and yet still, in the aggregate, produce effects that many would consider to be profoundly disproportionate. In 1991 coalition bombing was conducted in accordance with the Geneva Conventions and yet, according to Daponte's figures, was ultimately responsible for the deaths of more Iraqi children than military personnel. In 2003 the highly discriminate application of coalition force succeeded in plunging Iraq into bloody turmoil. For these reasons, I propose to focus on what I regard as a more fundamental form of political control over the employment of weapons – namely efforts to delimit the *strategic* goals that they are used to achieve.

In theory at least, strategy's location at the interface between military means and political ends makes it a potentially valuable site for the subjection of military technology to political control. The function of strategy is, after all, to translate political desires into military objectives. But for as long as the aim of strategy is understood to be the destruction of the enemies' means of resistance, this potential cannot be fully realised. With its ultimate aim fixed, strategy cannot faithfully translate the nuanced demands of politics into appropriate military goals. It is instead reduced to the status of a purely military activity, geared only to producing efficient processes of destruction. We have already seen that, under such conditions, the only possible response to the goal of avoiding civilian casualties is a technical fix, which in the current context means an improvement in accuracy or related capabilities. And yet, we have also seen that greater accuracy can never completely overcome the challenges associated with this goal. They can only be more fully addressed if we make the content of strategic behaviour contingent on the ultimate political purpose that it is intended to serve. What I am suggesting, in other words, is that the United States needs to reconsider its aversion to the concept of limited war.

Against this view are arrayed numerous military analysts and practitioners who would certainly argue that – far from politicising the content of strategy – we must seek to keep it an essentially military activity. Vietnam, they would claim, demonstrated the essential fallacy of the limited-war approach. The only viable course of action in war is to make one's enemy defenceless (and thus harmless) as rapidly as possible, and within this situation one does what one can to minimise civilian casualties with the aid of technology.

I have already suggested why I consider this line of argument fallacious. Limited war failed in Vietnam not because it was an inherently faulty approach, but because it was employed in the wrong context. Hanoi's commitment to the unification of Vietnam was such that nothing short of the North's destruction would have brought the war to a victorious conclusion for the United States. Self-imposed restraint only created opportunities for the North to gather itself and strike back. But, it should also be obvious that not all adversaries are as committed to their war aims as was Hanoi. Wars begun for lesser political aims than Vietnamese reunification may simply not command the level of commitment necessary to permit their continuance in the face of major adversity, or even a reasonable prospect of such adversity. Many opponents, in other words, may be prone to strategic coercion where Hanoi was not. Under these circumstances a strategy designed to render one's opponent defenceless would be unduly ambitious, resulting in military action of a kind that places unnecessary strain on technology's ability to maintain proportionality between political benefits and costs in terms of civilian deaths and destruction. Thus until the United States thinks more seriously about the issue of limited war, it will suffer from a potential response gap in its strategic repertoire.

Some of the problems that this kind of response gap can cause are illustrated by the tensions and uncertainties that accompanied North Atlantic Treaty Organisation's (NATO) bombing of Serbia in 1999. The political aim of the air campaign was not to oust Milosevic, but merely to halt his policy of ethnic cleansing and to reach a negotiated settlement on the political future of Kosovo. As such, it was a limited war in all but name; and as such it presented significant challenges to war planners who had internalised the idea that the essence of a good plan is to make one's enemy defenceless as rapidly as possible.

True to strategic orthodoxy, Lieutenant-General Michael Short, who served as NATO's Air South Commander, had originally advocated mounting a shattering psychological blow against the Serbian state apparatus.

> I'd have gone for the head of the snake on the first night [claimed Short]. I'd have turned the lights out on the first night. I'd have dropped the bridges across the Danube. I'd have hit five or six

> political-military headquarters in downtown Belgrade. Milosevic and his cronies would have waked [sic] up the first morning asking what the hell was going on.[17]

But such an approach was simply not acceptable in the face of Alliance sensitivities about collateral damage, and nor did many believe that it was actually a necessary precursor to NATO achieving its political goals. The French, for example, proved resistant to going for the 'head of the snake'. They favoured attacking Serbian forces operating in Kosovo, rather than striking at strategic assets located in Serbia proper. Milosevic, they reasoned, would be more inclined to make peace if he yet retained something to lose rather than if key strategic assets were destroyed during the opening stages of hostilities.[18] Although Paris ultimately acquiesced to various US targeting initiatives as the war continued, all NATO members remained deeply sensitive to the problem of collateral damage. The result was an air offensive that was severely restricted in terms of the range of targets that could be attacked, and the tempo at which such attacks could take place. As General Wesley Clark (NATO's Supreme Allied Commander in Europe) was to discover:

> Once we moved past the obvious air defense target set, every target … was in one way or another, likely to become controversial. In the U.S. channel, we would need a complete analysis of each individual target – location, military impact, possible personnel casualties, possible collateral damages, risks if the weapons missed the target and so forth … . And this had to be done to my satisfaction, then sent to Washington where it underwent additional levels of legal and military review and finally ended up on President Clinton's desk for his approval.[19]

The result was a bombing campaign that enjoyed certain clear similarities with earlier efforts in Vietnam, with military power being used in a highly politicised effort to coerce rather than to destroy outright.

That NATO did ultimately conduct a coercive bombing campaign suggests, at first sight, that the US penchant for decisively destroying its enemies' means of resistance is less problematic in practice than in theory. Orthodox strategic theory may provide no space for political sensitivities to influence the goal of military operations, but when war actually occurs politics nevertheless gets an important say in how it is fought. To an extent this is true, but it is also the case that a theoretical focus on the goal of rendering enemies defenceless, left war planners ill-prepared to conduct an efficient coercive campaign. Over the course of the Kosovo war, NATO bombing shifted between different classes of targets in trial-and-error fashion. It became clear that nobody knew enough about Milosevic and his motivations to understand which targets to hit and which to threaten. His capitulation came as something of a surprise, and even after the event it remained quite unclear as to why he had given in. In a post-war report to the US Congress, Defense Secretary William Cohen and Chief of Staff Hugh Shelton admitted that 'Because many pressures were brought to bear, we can never be certain about what caused Milosevic to accept NATO's conditions to stop the bombing … .'[20]

As a result, the conduct of the bombing campaign was rather more problematic than it might otherwise have been. With few exceptions, NATO's superior technology denied Serbia's armed forces the ability to strike back at their attackers, whilst the accuracy of the bombing helped keep collateral damage within politically manageable limits. On the other hand, the trial-and-error nature of the targeting meant that more attacks had to be made, and more death and destruction caused, than would have been necessary had NATO possessed a clearer understanding of how to coerce Milosevic. The US Air Force, in other words, demonstrated that it could bomb targets with a high degree of accuracy, only to discover that the associated benefits in terms of reduced civilian casualties were eroded by a failure to work out exactly what had to be bombed.[21] For his part, Milosevic proved adept at using images of collateral damage to undermine public support for the bombing amongst NATO states. At times, this badly undermined the Alliance's ability to continue with the war.

Of course, on the one hand, an understanding of one's adversary is never likely to be so complete as to entirely preclude a degree of muddling towards a targeting strategy that is effective for coercive purposes. On the other hand, it is unfortunate that Cohen and Shelton's report to Congress largely focused on the technical performance of NATO's armed forces rather than the problems associated with turning this technical performance into political results. The US Air Force already knows how to bomb targets rather well. It is therefore tempting to suggest that the effectiveness of its coercive bombing might be improved by less technical means. Rather than simply acquiring yet another generation of smart bombs, it might consider augmenting its targeting staff with a handful of sociologists, anthropologists, and historians – people who may possess important insights into how an adversary will respond to the experience of being coerced with military force.

Some final comments

When they must, therefore, the US armed forces clearly can conduct something that looks very much like limited war. Nevertheless, the price of focusing their intellectual effort on unpoliticised strategies, aimed at making their enemies comprehensively defenceless, which means that their coercive efforts are less efficient than they might otherwise be. Of course, for the moment at least there exists a high degree of agreement between US political and military leaderships about the desirability of strategic aims that extend to making adversaries defenceless. The 2001 attacks on the United States led to a hardening of attitudes towards rogue states and the adoption of regime change as a deliberate policy. Under these conditions, politics has come to exert correspondingly little influence over the formulation of strategic goals. Simply put, regime change demands that the target state be rendered defenceless. Any lesser strategic outcome will merely leave the adversary regime able (and presumably highly motivated) to continue what amounts to an existential struggle. For its part, the US military found the politicised nature of the Kosovo war to be a frustrating experience at the time, and has also retained its historical dislike for pulling its punches once committed to war, for fear that the enemy may thereby be granted an opportunity to strike back. As a result there is little institutional enthusiasm for limited-war strategies.

However, one can readily envisage future scenarios in which the need for strategy to accommodate itself to different political imperatives becomes important. Willing as Washington has recently been to overthrow rogue regimes, its appetite for picking up the pieces must now have been tempered by the experience of state-building in Iraq. It is also difficult to see where the necessary troop numbers could be found, were another Iraq-style contingency to arise in the near future. Moreover, regimes can change in Washington as well as in Baghdad, and whoever succeeds Bush may entertain different views about the ability of war to resolve political problems cleanly and decisively. Such misgivings will certainly be reinforced if future crises involve rogue states equipped with nuclear weapons. The possible consequences associated with their use will induce great caution. Thus, if force is nevertheless mandated under such conditions, its use will be subject to extreme political restraint because any effort to render a nuclear-armed regime defenceless would carry too much risk to be politically acceptable.

In short, the majority of future crisis scenarios will probably not recommend themselves to resolution via strategic action which aims at making the enemy defenceless, and which relies on superior technical means to keep civilian casualties to a minimum. Accurately applied force alone is not up to the job, which means that politics must enter into the process of formulating strategic aims with a view to restraining the destructive consequences of modern weapons, whilst ensuring that the security concerns of the West are addressed. Indeed, it is in the political, rather than the technical, sphere that the challenges posed by future war for the United States and its allies are most likely to lie. We can bomb things accurately but we are far less clear about how to wrest useful political results from the restrained application of accurate bombing. Such operations therefore risk causing unnecessary death and destruction, which is bad in itself and which may also undermine political support for the war. Under such conditions, the old adage 'know your foe' is particularly relevant, in the sense that we must know how to influence our adversaries via the coercive application of force rather than simply how to destroy them.

Notes

1. This line of reasoning has historically drawn force from a particular interpretation of Carl von Clausewitz, *On War*, J. J. Graham (New York: Barnes and Noble, 2004) [orig. 1832].
2. For a more detailed account of the developments in US strategy discussed here see, J. Stone, 'Politics, Technology, and the Revolution in Military Affairs' *Journal of Strategic Studies*, 27 (2004): 408–427.
3. See, for example, R. Osgood, *Limited War* (Chicago, IL: University of Chicago Press, 1957); T. C. Schelling, *Arms and Influence* (London: Yale University Press, 1966).
4. As explained by Johnson's Defense Secretary, Robert MacNamara, in *The Fog of War*, dir. E. Morris (2003).
5. For an overview of the debate as it emerged see, L. Freedman, The Revolution in Strategic Affairs, *Adelphi Paper 318* (Oxford: Oxford University Press, 1998 for the International Institute of Strategic Studies).
6. Col. Gary L. crowder, 'Effects Based Operations Briefing', 19 March 2003, http://www.defenselink.mil/cgi-bin/dlprint.cgi?http://www.defenselink.mil/transcripts/2003/t03202003_t0319effects.html
7. Strictly speaking, CEP provides a measure of precision rather than accuracy, but because this distinction is rarely made in non-technical literature I have opted to stay with the term accuracy.
8. CEP is, however, less relevant to guided than unguided weapons. Guided weapons tend to miss their target as a result of mechanical failure or similar faults, and thus their miss distances are less statistically reliable than those of unguided weapons.
9. Glosson cited in, *Gulf War Air Power Survey*, Volume II: *Operations, and Effects and Effectiveness* (Washington, DC: 1993): 38.

10. Crowder, 'Effects Based Operations Briefing', op. cit.
11. S/22366, 'Report to the Secretary General on Humanitarian Needs in Kuwait and Iraq' (20 March 1991): 5.
12. B. Daponte, 'A Case Study in Estimating Casualties from War and its Aftermath: The 1991 Persian Gulf War' *Physicians for Social Responsibility Quarterly*, 3 (1993): 57–66, http://www.ippnw.org/MGS/PSRQV3N2Daponte.html
13. For a collection of essays on Effects Based Operations, see, C. Finn, (ed.) *Effects Based Warfare* (London: Stationery Office, n.d.).
14. When accessed on 25 July 2006 the minimum and maximum death figures given on the website were 39, 284 and 43,744 respectively. Given the arguments made earlier in this chapter, it is interesting to note that the approach to counting casualties is now changing to reflect a 'growing awareness that we were too narrowly-focused on bombs and other conventional weapons, neglecting the deadly effects of disrupted food, water, electricity, and medical supplies'. See, www.iraqbodycount.org/background.php
15. B. Rappert, *Controlling the Weapons of War: Politics, Persuasion, and the Prohibition of Inhumanity* (Abingdon: Routledge, 2006).
16. Protocol I, Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts, 8 June 1977, Article 51, Section 5b. The application of force in pursuit of 'concrete and direct military advantage' is a reasonable definition of tactics.
17. Cited in, T. Judah, *Kosovo: War and Revenge* (London: Yale University Press, 2000): 257.
18. General W. K. Clark, *Waging Modern War: Bosnia, Kosovo, and the Future of Combat* (Oxford: PublicAffairs, 2001): 238–239.
19. Ibid.: 203.
20. William S. Cohen, *Senate Armed Services Committee Hearing on Kosovo After-Action Review* (14 October 1999): 6, http://www.senate.gov/~armed_services/hearings/1999/c991014.htm
21. In point of fact, accuracy was far higher against infrastructure targets than against military assets, which tended to be hidden away and thus harder to locate and destroy.

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Part III

In Focus

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7
Preventing the Future Military Misuse of Neuroscience

Malcolm Dando

In early 1998 the UK Defence Secretary announced to the House of Commons that it was believed that at the time of the first Gulf war Iraq could have possessed large quantities of a chemical weapons agent known as 'Agent 15'.[1] A US Congressional Research Service Issue Brief of April 1998 suggested that:[2] 'exposure to about 100 milligrams in aerosolized form would be sufficient to incapacitate. Symptoms, which begin within 30 minutes of exposure and may last several days, include dizziness, vomiting, confusion, stupor, hallucinations, and irrational behavior …'

Now that the 1993 Chemical Weapons Convention (CWC)[3] is nearing universal adherence and states in its Article I that

1. Each State party to this convention undertakes never under any circumstances:
   (a) To develop, produce, otherwise acquire, stockpile or retain chemical weapons, or transfer, directly or indirectly, chemical weapons to anyone;
   (b) To use chemical weapons;
   (c) To engage in any military preparations to use chemical weapons;
   (d) To assist, encourage or induce in any way, anyone to engage in any activity prohibited to a State Party under this convention …

and Article II states that:

For the purposes of this Convention:

1. 'Chemical Weapons' means the following, together or separately:
   (a) Toxic chemical and their precursors, except where intended for purposes not prohibited under this Convention, as long as the types and quantities are consistent with such purposes;

(b) Munitions and devices, specifically designed to cause death or other harm through the toxic properties of the toxic chemicals specified in subparagraph (a), which would be released as a result of the employment of such munitions and devices ...

2. 'Toxic Chemical' means: Any chemical which through its action on life processes can cause death, temporary incapacitation or permanent harm to humans or animals. This includes all such chemicals, regardless of their origin or method of production, and regardless of whether they are produced in facilities, in munitions or elsewhere ...

It might appear that we should regard the possibility of warfare involving the use of chemicals such as Agent 15 as a minor issue concerning a few 'rogue' states. As these states would clearly place themselves outside of international standards of appropriate conduct through the development of such technological capabilities, the security and moral argument for responding to them would seem relatively uncomplicated (even if, as Stone examines in Chapter 6, the proper means for doing that is not clear-cut).

Unfortunately, this is far from the situation in which we will find ourselves in the future if we do not attend carefully to preventing the development and use of such chemicals as knowledge of neuroscience continues to rapidly advance. This chapter examines how developments in the life and chemicals science have and might be employed by major state powers. In relation to the themes of the Introduction, it addresses how developments in civilian and military research can combine with indeterminate provisions of arms control treaties and an unfettered desire to pursue military options so as to threaten to undermine an international arms prohibition regime. The implications for international security and arms racing might well be profound.

The international prohibition regime of concern in this chapter is embodied by the CWC (and to a lesser extent the Biological and Toxin Weapons Convention (BTWC). The indeterminate provisions in question centres on the exemption put in place for 'law enforcement. Article II of the Convention states that

7. 'Riot Control Agent' means: Any chemical not listed in a [Verification] Schedule, which can produce rapidly in humans sensory irritation or disabling physical effects which disappear within a short time following termination of exposure ...

and

9. 'Purposes Not Prohibited under this Convention' means ...

(d) Law enforcement including domestic riot control purposes. Clearly, therefore, domestic riot control using well-known agents is allowed as a 'peaceful purposes' exemption from the prohibition. But it has to be noted that in Article II.9 (d) domestic riot control is an included sub-category within a larger category of 'law enforcement'. This raises questions such as: What is law enforcement? Is such law enforcement strictly domestic or could it be in other countries, for example in peacekeeping operations? More generally, does a law enforcement exemption exist that would allow the development of new chemical incapacitating agents without restriction by the Chemical Weapons Convention CWC?

Such concerns have existed since the CWC was negotiated over fifteen years ago, but have become more acute as the revolution in biology has accelerated over the past decade. As an editorial in the influential *CBW Conventions Bulletin* stressed:[4] 'It is hard to think of any issue having as much potential for jeopardising the long-term future of the Chemical and Biological Weapons Conventions as does the interest in creating special exemptions for so-called "non-lethal" [incapacitating] chemical weapons ...'

The reason given for this viewpoint was explicit:

> The one emerging area of technology that today is most in need of strong and lasting arms control – biotechnology – is exactly where new disabling chemicals are coming from, furnishing potential weapons that are tempting some government agencies to depart from or to seek revision of the prohibition of the CWC ...

In the later sections of this chapter some of those temptations will be delineated, but first it must be understood that this is not just an 'academic' issue.

Late in October 2002 a group of Chechens took some seven hundred people hostage in a Moscow theatre. After three days Russian forces pumped large quantities of an incapacitating chemical agent (or agent mixture) into the building prior to assaulting it.[5] All of the hostage-takers were killed in the operation as were 120 of the hostages. Many other hostages were hospitalised because of the effects of the chemical agent. It might well have been considered, nevertheless, that the operation was a success as many hostages had been saved from a murderous group of hostage-takers who might well have succeeded in killing most of them in bomb blasts.

While the operation was plainly domestic there remain some critical issues that require careful attention. This was clearly a military operation using large amounts of chemical agent[s] and, in particular, the main agent was most likely fentanyl or a derivative of fentanyl which is certainly not a standard riot control agent like CS gas (colloquially known as 'tear gas'). Fentanyl is, in fact, an opiate related to morphine which has pronounced effects on the human *central nervous system*, causing unconsciousness and stopping respiration. Unfortunately, as with any chemical agent, it was difficult to control the concentration in different parts of the building and to know the precise effects of any particular concentration of the agent on different people. So it was not always possible to separate the desired effect of rendering people unconscious from the dangerous effect of stopping their breathing.

Yet the Russian forces could not just have decided on the spur of the moment to use fentanyl. There must have been a background history of military interest in the use of such incapacitating chemical agents for it to have been on hand in large quantities and for Russian forces to have known what to do with it. We turn first therefore to some of that history in the Cold War era.

Some history

During World War I (WWI) both sides had made use of incapacitating and lethal chemical agents and such agents were held by both sides during the World War II (WWII) (the 1925 Geneva Protocol in reality banning only first use). What shocked the Allies after that war was the discovery that Germany had quantities of much more lethal 'nerve agents' such as Sarin that had a direct and specific effect on the human nervous system.

The nervous system is made up of individual units – cells called neurons. Information is transmitted *within* neurons by electrical means (the nerve impulse that can be seen and recorded on an oscilloscope). However, most information transmission *between* neurons is carried out by chemical means, by the release of a chemical neurotransmitter from the ending of the neuron when a nerve impulse arrives at that ending. This chemical neurotransmitter then attaches to special receptors on the next neuron in the chain, either causing it to be more (excitatory) or less (inhibitory) likely to initiate a nerve impulse in its turn. To prevent the unwanted continuation of this effect, various mechanisms clear the neurotransmitter from the junction between the neurons, the so-called synapse.

Acetylcholine (ACh) is a particularly important neurotransmitter which also transmits the final signal from the nervous system (via motor neurons) to muscles in order that they contract. Acetylcholine is cleared from junctions when no longer required by an enzyme called acetylcholinesterase. Nerve agents like Soman and Sarin block this activity of the enzyme and the system is consequently flooded with acetylcholine. Death can follow rapidly after contact with alarmingly small amounts of such nerve agents.[6] The potential effectiveness of such lethal agents in military operations led to the build-up by both sides of huge stocks of the agents during the Cold War. Destruction of the agents, as required by the CWC, is proving difficult and very expensive.

Of course this was the time, at the end of WWII and the start of the east–west Cold War, when the first serendipitous discoveries were made of chemical agents – pharmaceuticals – that could be used to help people suffering from various forms of mental illness. It should come as no surprise, therefore, that the military on both sides began intensive investigations of various kinds of new incapacitating chemicals. As the 1997 US *Textbook of Military Medicine* notes,[7] 'Virtually every imaginable chemical technique for producing military incapacitation has been tried at some time. Between 1953 and 1973, at the predecessor laboratories of what is now the US Army Medical Research Institute of Chemical Defense, many of these were discussed, and, when deemed feasible, systematically tested', and it went on to point out that: 'Chemicals whose predominant effects were in the central nervous system were of primary interest and received the most intensive study …'

Four groups of chemicals – stimulants, depressants, psychedelics, and deliriants – are reviewed in the text and it is argued that one sub-set of the deliriants were regarded as the most likely to be used as military incapacitating agents. This sub-set was the anticholinergics which, like the nerve agents, attacked acetylcholine neurotransmission, but by a different mechanism from the nerve agents. At particular types of acetylcholine synapses (junctions between neurons) these chemical agents block the action of acetylcholine and thereby produce the incapacitation. Depending on the dose and the particular person, this effect can range from blurred vision, or slurred or nonsensical speech, to hallucinatory behaviour, stupor, and coma.

One such agent, BZ, was in fact weaponised by the United States during the Cold War. BZ belongs to a chemical family called glycollates, and it is hardly surprising that the Iraqi 'Agent 15' was thought to be from the same glycollate family of chemicals. However, it is clear in retrospect that not enough was known about the functions of the nervous system during the Cold War period for precise, reliable, incapacitating effects to be obtained through the use of these agents. When BZ was weaponised in the middle of the Cold War era, it was known that there were two different classes of acetylcholine synapse. What was not known though was that neither were there many different sub-types of each class depending on different structures of the post-synaptic receptors for acetylcholine nor that these different sub-types of receptors were located in different brain circuits of neurons. It was thus impossible to know exactly what the BZ or any other glycollate was actually affecting in the brain and this was why the effects of the chemical agents were unpredictable.

As is clear from the use of fentanyl or a fentanyl derivative by Russian troops in the Moscow siege, and from what we know of studies by the military in the United States after the Cold War had ended, this unreliability did not prevent work on chemical incapacitants as it is still continuing.[8] Indeed, as will become clear, the military may well have concluded that advances in neuroscience were opening up the possibility of the development of much more specific and effective chemical agents.

What happened?

In the middle of the nineteenth century Charles Darwin convincingly argued that evolution of living organisms took place through a mechanism of natural selection. It took another century before James Watson and Francis Crick demonstrated, in the early 1950s, that the genetic material of living organisms – DNA – had a double helix structure. Since then the growth of our understanding of biology has accelerated at what appears to be an ever-increasing rate. The change in biology was perhaps symbolised by the announcement, early in the new millennium, that the whole of the genetic material – the DNA – of human beings had been sequenced in a multi-billion dollar international co-operative effort.

How did these momentous scientific and technological changes impact on neuroscience? First, it became clear that there were many, many more neurotransmitter chemicals than had previously been realised. Acetylcholine and other chemical transmitters known in the early post-war period were small molecules. It became apparent that in addition to these small molecule transmitters there was an expanding group of peptides that could also function as transmitters (peptides are molecules made up of strings of amino-acids). By using the new techniques related to the sequencing of DNA it also became clear that there were numerous sub-types of the different classes of receptors for such neurotransmitters. There were thus many more potential targets to attack. Alongside this, developments in combinatorial chemistry allowed many more and different chemicals to be produced for testing against such receptor sub-types. And, of course, the pharmaceutical industry was allocating vast resources to do just that in the hope of finding new beneficial drugs.

That was not all. Accompanying these developments in biomedical research great strides were being made in information technology (IT) – bioinformatics – which allowed the vast amounts of new data to be stored and analysed. Finally, new and ever more precise and real-time techniques of neuroimaging were developed which meant that the circuits functioning in the brain could be visualised when certain behaviours occurred.

These developments clearly opened up new opportunities for helping people suffering from debilitating mental conditions such as anxiety, depression, and Parkinson's disease, but equally they could potentially open up more avenues for the military use of novel chemical incapacitants.

New military possibilities

Before reviewing some of the circuits and neurotransmitter systems that might potentially be the targets of misuse it is essential to note that, in good part because of the need for more efficient and effective delivery of beneficial drugs, there have also been significant advances in drug delivery in recent years. Indeed, the 2006 US National Academies report, *Globalization, Biosecurity, and the Future of the Life Sciences*, suggested that four groups of technologies should be very carefully watched in the future. These four groups were[9]

1. The acquisition of novel biological or molecular diversity;
2. directed design;
3. understanding and manipulation of biological systems; and
4. production, delivery, and 'packaging'.

The fourth group of technologies, according to the report, included:

– Plants as production platforms – 'biopharming';
– Microfluids and microfabrication;
– Nanotechnology;

– Aerosol technology;
– Microencapsulation technology; and
– Gene therapy technologies.

The report notably also discussed the ongoing work and future possibilities for ‘targeting biologically-active materials to specific locations in the body’. So we must accept that in the future those with malign intentions could also use such technologies and be able to produce large quantities of agent, protect it during effective delivery and arrange for it to attack specific areas of the body.

It is possible to gain an insight into thinking about these new possibilities for military use of incapacitating chemicals from a report, titled *The Advantages and Limitations of Calmatives for Use as a Non-Lethal Technique*, produced in 2000 by a group known to be associated with the US military. Interestingly, in view of later events, an early draft of the report had a large depiction of the chemical formula for fentanyl on its front cover. It also had a list of ‘selective calmatives’ which it investigated. The list was extensive:[10]

– Benzodiazepines (GABA receptors);
– $Alpha_2$ adrenergic receptor (alpha 2 adrenoreceptor) agonists;
– Dopamine D3 receptor agonists;
– Selective serotonin reuptake (5-HT transporter);
– Serotonin $5\text{-}HT_{1A}$ receptor agonists;
– Opioid receptor Mμ agonists;
– Neurolept anesthetics (GABA receptors);
– Corticotropin-releasing factor (CRF receptor) receptor antagonists;
– Cholecystokinin B receptor (CCKB receptor) antagonists.

Moreover, for some of these possibilities the report displayed a marked enthusiasm, stating: ‘The Researchers identified several drug classes (e.g., benzodiazepines, alpha 2-adrenoreceptor agonists and individual drugs (diazepam, dexmedetomidine)) found appropriate for immediate consideration as a non-lethal technique …’

Such interest in the alpha 2-adrenoreceptor and its antagonists, for example, is not surprising given the long interest in such compounds in the US military. However, the report also went on to state that: ‘Equally important, the Researchers identified many promising developments that deserve further consideration with high potential as prototypical calmatives with availability in the near future’.[11]

'Calmatives' in this report are understood to be 'compounds known to depress or inhibit the function of the central nervous system'. The view that such compounds have potential as future non-lethal incapacitating agents was endorsed by a 2003 report from the Division on Engineering and Physical Sciences of the US Naval Studies Board. The report suggested that there should be:

> *Increased research in the field of human response to calmatives*. Calmatives have potential as NLW [non-lethal weapons] in many types of missions where calming of individuals or crowds is needed … . The human effects of these compounds and their safety must have thorough evaluation under conditions simulating their mission uses.[12]

However, as already noted, military interest in chemical incapacitating agents has ranged far beyond simply depressing or inhibiting the central nervous system.

The original 1970s study of chemical and biological weapons by the Stockholm International Peace Research Institute (SIPRI) noted, for example, that[13]

> In the early days of the US incapacitating-agent programme, there seemed to be many mechanisms of incapacitation which new CW agents might be developed to exploit. The US Army Chemical Corps drew attention to at least a dozen of them during its … soliciting during the late 1950s of Congressional support …

The study went to list some of these mechanisms: 'Hypotension was one such mechanism, for at that time the drug firms were starting to have impressive success in finding new therapeutics for hypertension. In healthy people, fainting is an early effect of suddenly lowered blood pressure, particularly if the subject is standing up …'

Then: 'Emesis was a second example, for a retching and vomiting soldier would clearly not be an effective one. Besides the harassing vomiting agents such as adamsite, a great many emetics are known, notable apomorphine and the staphylococcal enterotoxins …'

and: 'The disturbance of body temperature was a third example of something that an incapacitating agent might cause. A raised temperature can lead to incapacitating heat stroke and heat exhaustion … . Several bacterial endotoxins are amazingly potent fever-inducers in man, effective at submicrogram dosages …'

The text went on to point out that: 'Further examples included inhibition of the labyrinthine reflexes resulting in loss of the sense of balance; muscular hypotonia, leading to paralysis; temporary blindness, uncontrollable muscular tremors … and many different psychotropic effects …'

Whilst the SIPRI authors pointed out that at that time much more would have needed to be known about the nervous system for a successful agent to have been found,[14] it would clearly be foolish to imagine that all possibilities would not be re-explored in present-day circumstances. Investigations of possible new agents, therefore, and the mechanisms that might be affected in the central nervous system, must necessarily consider a broad range of possibilities.[15, 16]

The kinds of agents being discussed by those favouring the development of new agents are necessarily also of concern to those involved in defence against new agents. One analysis by a well-known defence scientist, titled 'The Threat of Mid-spectrum Chemical Warfare Agents', noted that these agents were either toxins or natural regulatory chemicals of the body (bioregulators) such as the neurotransmitter acetylcholine discussed here. The analysis listed some of the bioregulators of concern, including:[17]

- Substance P;
- Neurokinin A;
- Opioids (endorphins and enkephalins);
- Neuropeptide Y;
- Vasopressin;
- Cholecystokinin;
- Somatostatin;
- Neurotensin;
- Bombesin.

The list clearly suggests that a very wide range of possible means and types of incapacitation were viewed as potentially worrying.

Two examples

Two examples may illustrate the kind of opportunities that might be recognised by some military elements for developing new forms of incapacitating chemical agents.[18]

In addition to being the neurotransmitter produced by motor neurons to activate human voluntary muscles, *acetylcholine* is also produced by some neurons in the brain. During the Cold War period it was known that there were two major types of receptor that were activated by acetylcholine. One type was called nicotinic because it could be activated in the same way by nicotine and the other was called muscarinic as it could be activated by muscarine (an extract from a mushroom). The predominant types of acetylcholine receptors in the brain are muscarinic and there are now known to be five different sub-types, termed M_1–M_5.

It is known that a dysfunction in the brain's acetylcholine neurons is involved in the degenerative Alzheimer's disease. A particular set of acetylcholine neurons die progressively and there is therefore a concomitant loss of the neurotransmitter in the brain. Intensive efforts have been made to restore brain levels of acetylcholine to delay this degenerative process. One way to do this might be to block the M_2 receptors which are known to be inhibitory autoreceptors on ACh neurons (serving to limit ACh production). Pharmaceutical companies have had some success in doing this with novel chemicals in animal models. Such companies test many, many chemicals – with a range of effects and they store the results on their computer databases. Obviously, if means can be found to block the M_2 receptor it is also possible that means can be found to activate it – and thus reduce crucial ACh function in healthy people and there is a general concern about the danger of information also being available to those with malign intent.[19]

A second example concerns *endothelin*. This is a 21-amino-acid chain, a peptide, which is produced by the endothelium lining our blood vessels. It has a curious structure closely related to that of snake venom (sarafotoxin) and is a very powerful and long-lasting vasoconstrictor that could obviously cause great disruption of the blood supply if present in unusual quantities.

The presence of this peptide and its related receptor system in our bodies has only become known since the mid-1980s. In mammals there are three endothelins, ET-1, ET-2 and ET-3 (with slightly different structures.) ET-1 is the main vasoconstrictor in humans. There are two related receptors for these endothelins, ET_A and ET_B, and ET_A has the highest affinity for ET-1. Intensive efforts are in hand to find means of blocking the receptors, in order to help people with high blood pressure, but the dangers of discovering new agents that, to varying degrees, do the opposite are all too obvious. One State Party paper produced during efforts to strengthen the BTWC certainly included endothelin/sarafotoxin in its list of toxins of concern.[20]

What should be done?

The danger is that new military demand factors (peacekeeping operations, lower level military operations other than war, etc.) which raise a perceived need for incapacitants will combine with supply factors (new scientific and technological possibilities) to lead to the assimilation[21] of a new arsenal of chemical weapons into military forces around the world. This could then lead on to the full erosion of the prohibition against chemical weapons and thus to the demise of the CWC. The security implications of this would be tremendous.

As Fidler put it in his detailed analysis of the implications of the use of a fentanyl derivative to break the Moscow siege, the stakes in regard to the correct interpretation of the law enforcement exemption in Article II.9.(d) were high for both advocates of and those sceptical of new non-lethal chemical agents:[22] 'For skeptics, the provision represented a potential loophole that proponents of incapacitating chemical weapons could exploit to undermine the CWC's prohibition on the military anti-personnel use of incapacitating chemicals …'

but: 'For advocates, the law enforcement provision offered room to develop the potential of incapacitating chemicals and demonstrate their utility for both law enforcement purposes and missions the military would face in twenty-first-century armed conflict …'

Since the 2003 First Five-Year Review Conference of the CWC did not deal with the issue, the debate about how to prevent the CWC being eroded has been fierce.

Fidler examined the legal status of the 'law enforcement' exemption in some detail. He rejected the view that any chemical which is used for law enforcement purposes must have the same properties as standard riot control agents. He pointed out, for example, that toxic chemicals can be used to carry out a death sentence, he suggested that a proper reading of Article II is that it is 'toxic chemicals', not 'riot control agents' that are exempt when intended for law enforcement, that whilst Schedule 1 chemicals (the most dangerous) cannot be used for law enforcement no such exemption applies to Schedule 2 and 3 chemicals and, finally, State practice as shown in Moscow strongly suggests that non-standard agents can be used for law enforcement. Fidler argued that rather than a blanket ban on non-standard riot control agents, it is the 'types and quantities' restriction which limits a States Party's use of such chemicals.

Fidler also argued that 'law enforcement' has a broad meaning in Article II.9. (d). In relation to traditional military operations he argued that an occupying power has to maintain orderly government, to protect its members and property, to enforce laws it promulgates pursuant to its responsibilities and to regulate the behaviour of prisoners of war. In his opinion, this analysis applies also to non-traditional military activities, such as peacekeeping operations. In short he argued that: 'military forces conducting extraterritorial law enforcement activities permitted by international law during traditional and non-traditional military operations might not be limited to the use of riot control agents ...'

And he argued that some of the exemptions in the reservations made by the US Senate in ratifying the Convention[23] are in fact correct.

Yet Fidler's overall conclusion is relatively sanguine. He thinks that the 'types and quantities' restriction, when taken in conjunction with the provisions of International Humanitarian Law, is very restrictive and that 'The legal "loophole" in Article II.9. (d) is not, in fact, as dangerous as some NLW skeptics feared'. He also believes that recent US reports on new chemical agents and the CWC show an increasing reluctance to tamper with the Convention and his concerns appear to be more in relation to other forms of NLW which are not controlled by international agreements.

Ambassador von Wagner, who chaired the Ad Hoc Committee on Chemical Weapons which negotiated the CWC in the Conference on Disarmament has strongly disagreed with such an interpretation of the Convention.[24] In his opinion, given at a meeting arranged to coincide with the First Five-Year Review Conference of the CWC, toxic chemicals are not to be considered as chemical weapons if they are intended for law enforcement to be sure but, '[t]his is a very specific and limited exception to the general rule that toxic chemicals and their precursors are chemical weapons.' Furthermore, he argued that this exception has to be read in the interconnected set of specifications and limitations set out in the Convention and that, read in this way:

> it becomes clear that the specific term 'domestic riot control' is contained in the general one, namely 'law enforcement'. This relationship between the two terms, the specific one and the general one, is clearly expressed by the word 'including'. This means that 'law enforcement' and 'domestic riot control' are by no means alternatives, but part of a coherent statement.

His conclusion therefore was that: 'any interpretation considering "law enforcement" to be a purpose of its own, not defined in the Convention and, therefore, allowing to differentiate between toxic chemicals not prohibited for law enforcement and toxic chemicals not prohibited for domestic riot control is simply false.'

And on this reading, the definition of riot control agents in Article II.7 as '[a]ny chemical not listed in a Schedule, which can produce rapidly in humans sensory irritation or disabling physical effects which disappear within a short time following termination of exposure' applies equally to chemicals used for law enforcement.

Crucially, the Ambassador pointed out that if this were *not* the case, 'any State Party, without any restriction, could develop, produce, acquire, stockpile, retain or use listed toxic chemicals, claiming they were intended for law enforcement purposes. Such an interpretation would doom the CWC to meaninglessness'. Indeed, he argued that a new third generation of chemical weapons development, production and use would not, therefore, be prohibited by the Convention.

Closing remarks

It would seem on the basis of this analysis that there will remain for some time to come military demand factors and scientific and technological supply factors operating to favour the assimilation of new forms of chemical agents for so-called 'non-lethal' purposes. It also seems clear that there is, at the very least, a lack of agreement about whether the prohibitions embodied in the CWC actually prohibits the development, production and use of such chemicals. Moreover, once new chemicals of this kind begin to be used for law enforcement it is difficult to see where the process will end except in the erosion of the CWC.

Thus a clear conclusion is that the States Parties should reach an agreement that maximally limits the possible development of new 'non-lethal' agents for law enforcement purposes. To that end the view taken by Ambassador Wagner, as the chair of the negotiations, seems the safest. Fidler's interpretation appears to leave still too large a space for such developments to take place. However, given that a number of States Parties appear to be interested in going down this road,[25] it seems unlikely that such an agreement will be possible in the Second CWC Review Conference of 2008.

Therefore, it may well be that *civil society* will have to play a much greater role if the erosion of the Convention is to be prevented. In the short term, further informed discussions on the scope of the CWC and the development of more limited proposals – such as a new schedule on peptides and toxins[26] – may help to restrict the assimilation process. In the longer term it is to be hoped that the CWC and its prohibitions will become much better understood amongst relevant scientists and that they will bring pressure to bear to ensure that the benefits of their work are widely shared while the potential for misuse is minimised. Perhaps in that way the malign misuse of neuroscience will remain a spectre and not a reality.[27]

In short the topics under discussion in this chapter seems to be a particularly important example of where advances in an area of modern life sciences could certainly lead to the destruction of restrictions on a specific class of weaponry. Moreover it is an example where a clarification of the relevant international convention would greatly restrict that erosion, especially since the CWC is becoming increasingly universal and well implemented in the national legislation. But the question is whether civil society, which has rarely taken a decisive part in decisions on these issues, can act fast enough? There are some grounds for optimism as the creation of 'global issue networks' does seem to be possible with current communication capabilities,[28] and in some cases, such as the landmines agreement, they have been effective in producing state-level international agreements.[29] Sensible governance in regard to preventing the future military misuse of neuroscience is therefore possible even if today it appears somewhat improbable.

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8
Space Weapons: Technological Folly?

Mark Hilborne

As the world becomes increasingly reliant on space-based assets for many aspects of terrestrial life, the move to protect those assets seems reasonable, particularly by those with strong interests in space. However, introducing weapons into space for protective purposes creates distinctly contrasting opinions. Antagonists claim that any effort to protect space assets with weapons in space is unlikely to be effective due to a number of technical problems and physical realities, and likely to generate retaliatory moves from competitors. Furthermore, they note that securing vulnerable space assets is only one role envisaged for space weapons. Space force enhancement and force projection are also seen as potentially useful applications for space weapons, with the latter in particular generating predictions – again strongly contested – of an entirely new class of strategic weapons and destructive capability.

These possibilities make the migration of weapons into space potentially one of the most serious security issues of the emerging twenty-first century. At stake is not just the creation of new and devastating weapons systems, but also the undermining of the notion that space is a place of common heritage to humanity – an environment to be used for the good of mankind. In addition, at stake are the many international treaties which uphold this notion. Thus it calls into question how security is best achieved – by building new weapons systems or by establishing international consensus to prevent this.

Unlike efforts to stem the proliferation of nuclear weapons, there is the opportunity to prevent a new arms race before it begins – an arms race that could be enormously expensive.[1] Nonetheless, it appears that any agreement, much less a treaty banning weapons in space is a remote possibility. While the United States would appear to have the most to lose from the weaponisation of space due to its heavy reliance on space, so too does it stand to lose most from a total weapons ban. The latter is the case because the dual-use nature of the relevant technology and the potential for asymmetric responses leave it vulnerable. Despite the debate on this subject being a nascent one, it has already become polarised and emotive, and as a result much meaningful discourse is not heard or recognised. Those seeking to secure space with weapons argue that the weaponisation of space is inevitable, and that any system that offers the military the high ground is invaluable. In contrast, others maintain the international community has the opportunity to seek a more rational choice, and through collective action preserve space as a peaceful domain.

To understand this disagreement, this chapter will examine the issue from a number of perspectives. It will first examine the number of multilateral treaties that contain the notion that space is a global commons under international treaty and international law, and the implications if these were undermined. It will then examine types of weapons envisaged, the arguments that question their effectiveness, and what capability they offer beyond existing weapons systems. Finally, it will consider what obstacles exist for any collective or multilateral action to preserve space as a weapons-free zone and the practical problems that any system of governance will face. It will conclude that, at least in the near future, the greatest security challenge does not derive from forthcoming technological capabilities. Rather the most serious security challenge is the potential to undermine the relevant international treaties and related multinational processes.

Treaties, agreements, and the peaceful use of outer space

The launch of *Sputnik* in October 1957 truly ushered in the modern space age and with it the firm realisation that space could become an arena of military competition and confrontation. However, prior to the launch, statements had already been made about the peaceful use of outer space. In early 1957, President Eisenhower expressed his inclination to accept an international agreement to control the development of missiles and satellites, even though he believed that the United States would be the first into space. Such acceptance was to be linked to other disarmament agreements.[2] These sentiments were repeated by Henry Cabot Lodge, Washington's United Nations (UN) Ambassador, along with the hope that 'future developments in outer space would be devoted exclusively to peaceful and scientific purposes'.[3] Months later

Canada, France, Britain, and the United States requested an examination of the feasibility of an inspection system that would verify whether objects launched into space were for peaceful or scientific purposes. This proposal was subsequently incorporated into UN General Assembly resolution 1148 (XII), and marked the first time that the phrase 'exclusively for peaceful purposes' had been used in a UN resolution.[4] Clearly then the notion of peaceful uses of outer space was established from the outset of the space era – prior even to the placing into orbit of the first satellite.

With *Sputnik's* launch, however, the largely academic discussion of the legal issues pertaining to space, in particular the question of overflying a sovereign airspace, suddenly became urgent. No country, including the United States, objected to the overflight of their territory, and the Soviets reversed their earlier position of claiming sovereignty over outer space above their territory, and removed the distinction between civilian and military flights.[5] Thus no international convention followed immediately after the launch. The era of the 'spy in the sky' had begun, and with it hopes of preserving outer space for peaceful purposes appeared less likely.

Following this, the 'Question of the Peaceful Uses of Outer Space' was discussed by the General Assembly in 1958. The outcome was the adoption of resolution 1348 (XIII), which recognised 'the common interest of mankind in outer space' and 'that it is the common aim that outer space should be used for peaceful purposes only'. It went on to state that it wished 'to avoid the extension of present national rivalries into this new field', and desired 'to promote … exploration and exploitation of outer space for the benefit of mankind'.[6]

While these resolutions firmly established the idea of peaceful uses of outer space, it took a number of years before an international treaty was signed. Entering into force on 10 October 1967, the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies – more commonly known as the Outer Space Treaty – banned placing into orbit any objects carrying nuclear weapons or any other weapons of mass destruction (WMD), installing such weapons on celestial bodies, or stationing such weapons in outer space in any other manner. It also prohibited the 'establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military manoeuvres on celestial bodies'.[7] The treaty begins by recognising 'the common interest of all mankind in the progress of the exploration and use of outer space for peaceful purposes' and stating the belief 'that the exploration and use of outer space should be carried on for the benefit of all peoples'.

While the treaty makes five references to the peaceful use of space, placing weapons systems other than nuclear, chemical or biological into space orbit was and is not banned, nor is the testing of any weapons in space. The establishment of orbiting military bases is not prohibited, nor is the use of anti-satellite and anti-missile systems, whether they are air-, ground-, or sea-based, or indeed space-based as long as they are not nuclear. Clearly, nuclear weapons on International ballistic missiles (ICBMs) can also transit through outer space.

There are however a number of other treaties that pertain to space in different ways, and these provide some further restrictions on placing or testing weapons in space, or enhance the norm of peaceful co-operative uses of space.

While aimed at nuclear proliferation and reducing the effect of nuclear weapons testing, the 1963 Partial Test Ban Treaty bans the testing of any nuclear explosives in the atmosphere and in space. The 1968 Astronauts Rescue Agreement calls for 'the rendering of all possible assistance to astronauts in the event of accident, distress of emergency landing …' The 1972 Liability Convention created rules and procedures of liability for damage caused by space objects. The 1975 Registration Convention made provision for the national registration of objects launched into space, and created a central register for this at the UN. The 1979 Moon Agreement sought to establish a system for the exploration and exploitation of the moon. All these treaties make specific reference to the common interest of all mankind in utilising space for peaceful purposes.

There are also bilateral treaties that have an impact on the use of space. The arms limitation and disarmament accords signed between the United States and the USSR contained an agreement not to interfere with each other's national technical means (NTMs) of verification.[8] Established initially in the 1972 Strategic Arms Limitation Talks (SALT I), it was included also in the Intermediate-range Nuclear Forces Treaty (INF), which is a permanent treaty, and the Strategic Arms Reduction Treaty (START I), which is set to expire in 2009. These measures were intended to protect the NTMs, including space-based elements, from attack or interference in order that the parties to the treaties could maintain confidence that the treaty was upheld.[9]

Under these provisions, it is prohibited to interfere in any way with satellites used for early warning, imaging, intelligence, ocean surveillance, signals intelligence, or communications of either the United States or

Russia. This obligation was widened to include NATO and ex-Warsaw Pact members with the negotiation of the Treaty of Conventional Armed Forces in Europe (CFE) in 1990, which is another permanent treaty. As Dean points out, to be covered by these conditions, the satellites must be utilised for the verification of the treaties. However, in practice, it is very difficult to distinguish which satellites are or could be used for these purposes. Thus, in reality, all satellites are protected.[10]

The 1972 Anti-Ballistic Missile (ABM) Treaty, another bilateral agreement between Washington and Moscow, was the only treaty banning the deployment or testing of weapons in outer space other than (WMDs). However, since its withdrawal from the treaty in 2002, the United States has maintained its practice of non-interference with foreign-owned satellites.

Clearly then, within the legal regime governing the use of outer space, there are a number of international resolutions declaring the intended peaceful uses of outer space, and these have established quite strong expectation for behaviour. As such a move to weaponise space constitutes a normative and legal challenge to international security. A state considering such a move faces a serious decision as to whether its security interests are served better by placing weapons into space, and undermining these principles and the authority of the UN, or by adhering to the norms established by the wide body of opinion represented in the multilateral and bilateral agreements.

As indicated though there are important areas that are not covered by the legal regime and many aspects of military activity in space remain largely unregulated. Interestingly, also, the word 'peaceful' itself has not been clarified. Initially, while both space powers demanded that space be used exclusively for peaceful purposes, both were developing military satellite systems concurrently. By 1958 however, the United States had reinterpreted the term to mean *non-aggressive*, as opposed to non-military. In this interpretation, any military activity that was not aggressive was permitted in space. This contrasts with the interpretation of the term in other agreements, such as the Statute of the International Atomic Energy Agency (IAEA) and the Antarctic Treaty, which maintain that any military activity is non-peaceful.[11] Given the large number of military satellites in orbit, the US definition is perhaps a pragmatic one. However, it is clear that the potential weaponisation of space would go far beyond either of these competing interpretations of the peaceful uses of outer space.

While there is nothing specifically banning weapons other than WMDs from space, these resolutions and agreements do provide a number of normative and legal impediments to any potential weaponisation of space. However, as impediments, these rest untested. It has been the practice for the past decades that space has remained unweaponised, but the treaties underlying this practice have gone largely undebated since their inception. The idea of the peaceful use of space has been accepted more than developed. Thus the principle that space should remain peaceful is a fragile one, and yet, despite this fact, there has been no weaponisation. It is this that makes any attempts to place weapons into space most problematic, as it would push the margins of these structures, and risk their unravelling. These are a set of practices that have been adhered to, and have thus had meaning, and a sense of permanence. Once broken, these are not easily reconstituted.

Important also is the fact that these treaties represent initial presumptions of how space ought to be utilised, before technological capabilities had been developed to utilise it differently (though these were no doubt foreseen to a certain extent). It may be that technological opportunism tempts policy-makers to overlook these earlier notions, or consider them naive. Any such motivations need to be carefully balanced against the consequences stated above – that once weapons are in space, and treaties abandoned, it would be a difficult process to return space to its previous non-weaponised status.

Space weapons: their technology, role, and effectiveness

For proponents of the weaponisation of space, this would entail the development and deployment of a wide variety of systems that represent the very cutting edge of technology. These potentially include directed energy weapons, such as ground-, air, and SBLs, kinetic-energy weapons, conventional warheads, various forms of anti-satellite weapons (ASATs), space 'bombers', and hypervelocity rod bundles. These weapons are employed to fulfil a variety of roles with the ultimate intention of enhancing space security. While many of these ideas featured in the Reagan Administration's Strategic Defense Initiative (SDI), under the direction of Defense Secretary Rumsfeld many of these systems appear to have been given a great deal of impetus in the United States. Combined with a defence policy that asserts a priority for pre-emptive strike, this has raised the worrying prospect of bombardment from space, with targets able to be attacked almost instantaneously with immense force.

Such visions exaggerate the ability of the technological aspects of space weapons. In contrast, some compelling research indicates that the kinds of weapons envisaged in documents such the United States Air Force (USAF) *Transformation Flight Plan* will be ineffective or hugely expensive in the role for which they are designed and that existing weapons systems are often able to perform the same mission at far less cost.[12]

Before examining the contradictions that these systems create, the tasks for which they might be used will first be discussed. Different reports have identified a number of roles that space weapons could or should fulfil. The US Department of Defense identified the following in its *Joint Doctrine for Space Operations* document:

> **Space control operations** provide freedom of action in space for friendly forces while, when directed, denying it to an adversary, and include the broad aspect of protection of US and US allied space systems and negation of enemy adversary space systems.
>
> **Space force application operations** consist of attacks against terrestrial-based targets carried out by military weapons systems operating in or through space.[13]

These would be enhanced by 'Space force enhancement operations' and 'Space support operations' which would cover roles such as maintaining and replenishing space-based assets, and enhancing battlespace awareness.

A recent report by the Canadian government in conjunction with the Eisenhower Institute, identified a number of 'capability indicators', some of which are relevant to the weaponisation of space, that are quite consistent with the Department of Defense(US) (DoD) report. These are space protection, space negation, and space-based strike weapons.[14]

It is within the roles of space control and force application, or space protection, space negation, and space-based strike, that space weapons could conceivably be used.

Space control

Space control or protection is a prime motivation for placing weapons into space. Space assets are so vital to so many facets of terrestrial life that leaving them unprotected creates what is arguably a serious and perhaps irresponsible vulnerability. The military in particular has a large stake in these assets. The conflicts fought in the post-Cold War era bear witness to this fact. Each successive campaign has been characterised by increasing reliance on space assets for a variety of purposes. In the Gulf War approximately 3 three per cent of the munitions dropped were precision-guided munitions (PGMs), using global positioning system (GPS) satellites for guidance. In Kosovo, this number had risen to 33 per cent, and in Afghanistan, 60 per cent.[15] This trend continued with Operation Iraqi Freedom, where some six thousand were dropped. Paralleling this was an increase in satellite use for communications purposes. In the Gulf War, coalition forces used 16 military satellites and 5 commercial satellites, providing a maximum transmission rate of 200 million bits/second. By Operation Iraqi Freedom, the ratio of commercial to military satellites used was almost reversed and the information flow increased to 2.4 gigabits/second. The campaign in Afghanistan used four times the satellite bandwidth of the campaign in Kosovo, which itself used ten times that of the first Gulf War though only one tenth of the troops.[16]

A desire to protect such important intelligence of communications assets is then a logical progression. However, in terms of space control, this mission is the most difficult, and space weapons have little utility here. Space protection would need to counter a number of anti-satellite measures, such as electronic countermeasures or jamming, lasers used to blind or destroy satellites, air- or ground-launched anti-satellite missiles, space mines, or the delivery of clouds of 'space shrapnel' – particles whose kinetic energy will bring severe damage or complete destruction to orbiting satellites. Protection could be gained also by hardening satellites against jamming or lasers, but the introduction of space weapons for protection of a nation's own assets will not have much impact on their vulnerability.

Two types of weapons make this mission particularly difficult: micro-satellites, which can act as space mines, and space shrapnel payloads. These are extremely hard to detect and distinguish from non-aggressive space objects, and they are relatively low-tech weapons for which there may prove no defence and so easily deployed by a wide number of space powers.

Significant work is being done on micro-satellites, though not necessarily with a military emphasis, in a number of countries.[17] Micro-satellites are not in themselves space weapons, and they can have numerous applications, such as observation and communications for peaceful, as well as non-aggressive military purposes. However, the technology lends itself extremely well to a satellite attack platform. Intrinsically hard to detect, given a manoeuvring capability and an explosive payload, micro-satellites can perform the role of a space mine. Due to their small size, they could be launched easily, quickly. and cheaply in large numbers. As a threat to space assets, these would be very hard to counter.

The United States has itself tested two variants of micro-satellites under the Experimental Spacecraft System (XSS) Microsatellite Demonstration Project – the XSS-10 in 2003, and the XSS-11 in 2005. These designs have been used to demonstrate the technologies to locate and manoeuvre near an orbiting satellite without human guidance, using only data provided to the XSS at launch. These demonstrations are to lay the foundation for future manned and unmanned launch vehicle operations, whose functions may include cargo delivery, space station support, and satellite maintenance or retrieval. To date, the tests have been successful, with the satellites completing a number of close proximity functions. As mentioned, these have the potential to be a useful offensive weapons platform, but would not serve to protect satellites very effectively. To provide effective protection, they would have to be virtually omnipresent – impractical due to the immense expanses of space. Given their ability to manoeuvre, they would probably only be effective against kinetic-energy ASATs, or ramming weapons, which would have a clear and obvious approach trajectory.

Given the enormous disparity in cost between micro-satellites and major communications or observation satellites, micro-satellites represent a grave asymmetric threat to inherently vulnerable space assets. Far less capable space faring nations will be able to deploy these sorts of vehicles in the future, although not necessarily with the autonomous ability of the XSS-class demonstrators. In fact Surrey Satellites in the United Kingdom has built micro-satellites for Nigeria, and established a controversial co-operative venture with China.[18] Given their cost, micro-satellites will be an attractive weapons system for nations wishing to reduce the dominance of large space powers.

The use of space shrapnel is another cost-effective anti-satellite measure. Simply placing a cloud of pellets or debris into the path of an orbiting satellite would cause severe damage or total destruction of the target. This is a technologically simple technique available to states with any sort of space launch ability, and it is virtually impossible to defend against.

In common with any anti-satellite weapon, but of particular note with these cheaper weapons as it increases their cost-effectiveness disproportionately, is the secondary effect of the strike. Each successful satellite destruction causes more debris in low earth orbit (LEO), further increasing the likelihood of other enemy assets being damaged or destroyed. This serves to further enhance the significance of micro-satellites and space shrapnel as highly effective, cheap asymmetric anti-satellite measures. Their use is most applicable against those with a number of valuable space assets, and not of great use against those states who have little or no space presence. As one space analyst notes: 'There's nothing for the U.S. to shoot at in space', while in turn, the 'bad guys' have plenty of things to shoot at, underlining the potential asymmetric nature of space conflict.[19]

Thus the role that intuitively most justifies placing weapons in space is the least effective, and the protection of space assets does not appear a good basis on which to base a policy of weaponising space.

Force application

Equally counterintuitive, the category that has perhaps most galvanised perceptions and fear of space weapons – that of force application, or space-based strike – may in fact provide little advance in terms of destructive capability. Space-based strike weapons would initially seem to offer a practical solution for countries like the United States, who have large military bases overseas, facing increasing hostility and terrorist attack. Such weapons could eliminate the need for some of these bases, while providing fast response to time-sensitive targets. However, as Garwin indicates in a recent paper, many of the proposed systems face problems that have more to do with the laws of physics than with technology. Furthermore, the ability of these proposed systems do not offer any new capability, whether measured by response time, accuracy, or destructive capacity, when compared to payloads delivered by either existing ballistic or cruise missiles.

Of the many weapons systems outlined in the *USAF Transformation Flight Plan 2003*, a number fit into the force application role. They include laser systems, various spacecraft, and long rod penetrating weapons.

Common Aero Vehicle[20]

- An unpowered, manoeuverable, hypersonic glide vehicle deployed from a possible range of delivery vehicles such as an expendable or reusable small launch vehicle to a fully reusable Space Operations Vehicle.
- Will guide and dispense conventional weapons, sensors, or other payloads worldwide from and through space within one hour of tasking.
- Able to strike a spectrum of targets, including mobile targets, mobile time-sensitive targets, strategic relocatable targets, or fixed hard and deeply buried targets.

- The Vehicle's speed and manoeuvrability would combine to make defenses against it extremely difficult. (Mid-term)

Evolutionary Air and Space Global Laser Engagement (EAGLE) Airship Relay Mirrors[21]

- Will significantly extend the range of both the Airborne Laser and Ground-Based Laser by using airborne, terrestrial, or SBL in conjunction with space-based relay mirrors to project different laser powers and frequencies to achieve a broad range of effects from illumination to destruction.

Ground Based Laser[22]

- Would propagate laser beams through the atmosphere to LEO satellites to provide robust defensive and offensive space control capability.

Hypervelocity Rod Bundles[23]

- Would provide the capability to strike ground targets anywhere in the world from space.

Space Maneuvre Vehicle[24]

- Would be a rapidly reusable orbital vehicle deployed from the Space Operations Vehicle or Evolved Expendable Launch Vehicle that is capable of executing a wide range of space control missions.

Space Operations Vehicle[25]

- Would enable an on-demand spacelift capability with rapid turn-around, multiple standardised payloads, space vehicle maintenance, ISR, offensive and defensive counterspace, and space surveillance capabilities.
- The Space Operations Vehicle would also be one of the vehicles that would deploy the Common Aero Vehicle.

While these weapons have been discussed in *Transformation Flight Plan 2003*, it is important to note that this does not mean they will survive the technological or political obstacles and see fruition. Also of note, *Transformation Flight Plan 2004* makes little specific mention of potential space weapon systems. Analysis is rendered more problematic also by the fact that much of the budget relating to advanced research and space activity is classified, increasing the difficulty in identifying what funding, if any, has been allocated to these systems. Overall however, these documents do represent thinking, though perhaps on occasion wishful thinking, at a high level, and can be taken to imply at least a declaration of intent, and therefore cannot be overlooked.

Of the force projection weapons listed in the 2003 document, directed energy weapons, or lasers, will be examined first. These have long been seen as technology perfectly suited for use in space. In theory, lasers can engage targets at great range, literally at the speed of light. However, there are a number of difficulties that reduce their effectiveness, and the cost of lasers is much higher than other weapon systems.

A number of configurations and missions have been hypothesised for the use of lasers, from anti-missile defence interceptors to striking terrestrial targets, aimed from the ground, air, or space. This chapter will focus on those configurations of weapons that have a specifically space-based element to their design.[26]

The SBL are theoretically useful for interceptor and strike roles, depending on their configuration. For use against ground targets, a main problem faced by SBLs is the atmosphere, and in particular cloud cover, which on average is 30–40 per cent, though can be as high as 70 per cent in Europe and Asia.[27] It is unlikely that SBLs will be powerful enough to attack ground targets, certainly in the near term, unless perhaps deployed as a constellation.[28] Even then, they would be unable to attack hardened targets, heavily armoured targets or those that were buried or protected by smoke or cloud cover.

The cost of using SBLs would be very high. Garwin has calculated that a laser strike would cost in the region of $100 million per target (a figure that includes all aspects of the weapon's cost, such as its launch costs).[29] This compares unfavourably with a cruise missile strike, which costs in the range of $600,000 and is not adversely affected by cloud and can destroy a much wider array of targets. Accessibility too is notenhanced by space lasers – the latest generation of cruise missiles are able to engage a target virtually anywhere on the globe. While their response time may be significantly slower than laser weapons, their all-weather capability compensates for this. If a target is particularly time sensitive, then a conventionally armed Intercontinental ballistic missile (ICBM) or Medium range ballistic missile (MRBM) could be used; more costly than cruise missiles, but still significantly less than an SBL strike.[30]

The SBLs would be equally costly if used against satellites. The longer the range at which a target is engaged, the longer the target has to be illuminated, using more of the laser's chemical fuel. Keeping the beam focused on the target for the required time is in itself difficult. The fewer SBL platforms in orbit, the higher the probability that the range and thus illumination time will be greater. The costs per target are calculated between $16 to $150 million. Again there are much cheaper alternatives; as discussed, micro-satellites are highly cost-effective in this role. It is conceivable however that given sufficient time and development, lasers could become more competitive.

Ground-based lasers (GBL) would face many similar constraints attacking terrestrial targets as SBLs: limited target types and cloud cover. The latter would constitute an even greater limitation in this application, as it could affect both weapon site and target. In contrast, GBLs do not suffer chemical propellant limitations, or the cost of complex maintenance or refuelling. It would, however, necessitate the use of the EAGLE airship mirrors and space-based relay mirrors to attack terrestrial targets. These constitute added cost and would be a vulnerable target in themselves.

Turning to the Space Operations Vehicle, the Space Maneuvre Vehicle, and the Common Aero Vehicle, these again would represent a huge investment, and purely in terms of their utility as a weapon, would not provide a capability beyond an ICBM used with different payloads.[31] Clearly the Space Operations Vehicle and the Space Maneuver Vehicle could have a variety of non-weapons functions, such as maintenance and satellite retrieval, and this alone may justify their development and deployment. But as a weapons system, the response time would be no less than an ICBM's, the system's vulnerability no better, and the accuracy of the final munition would presumably be exactly the same, as these could be guided by Global positioning system (GPS) to their target regardless of delivery vehicle.

Of all the weapons outlined in the *Transformation Flight Plan 2003*, the most arcane sounding is the Hypervelocity Rod Bundle. This concept – also termed Long Rod Penetrators – first appeared in the 1980s, and had apparently been shelved due to numerous difficulties. The idea behind this weapons system seems a simple one – using long rods of heavy metals such as tungsten or uranium hurled earthwards at speeds over 7200 mph to create an impact equivalent to a small nuclear weapon.[32] Buried targets are considered to be one of the main target objectives for these weapons.

Some simple laws of physics mitigate against these rod penetrators, however. Essentially, greater destructive force is created by greater speed. However, if the delivery speed becomes too high, the rods will burn up in the atmosphere, or, if this problem is overcome, Garwin calculates they will liquefy and reduce penetration depth.[33] Citing tests carried out at Sandia Laboratory, Garwin maintains that the maximum penetration of even the hardest materials is 1 km/second. Beyond this, they liquefy, and are unable to penetrate as deeply. The energy of high explosive, however, is 3 km/s. Thus, the rods would be unable to match the destructive energy of conventional bombs.[34]

Furthermore, the costs of these weapons would be extremely high. Dominated by the cost of launch, and by the need for a number to be placed on station to ensure their ability to act when required, the use of rod penetrators would be in the range of $30 million per rod. Once again, the same effect could be derived from a similar payload on a ballistic missile.[35]

These calculations, even allowing a very wide margin of error and reductions in cost of some of these technologies as they mature, illustrate that the proposed weapons discussed here are uncompetitive compared to existing technology, and are often unable to accomplish the mission for which they are envisaged. If they create the risk that other space powers, as well as potential space powers, will react by activating their own space weapons programmes – which is quite probable – the policy of weaponising space appears questionable.

A more effective middle ground may have been identified in Transformation Flight Plan 2004, which refers to 'reversible effects', including jamming, dazzling, or data corruption that permit space systems to be disrupted or denied during a conflict, but remain able to function after the conflict has been resolved. Such a policy would be less threatening to states with vulnerable space assets, and less likely to generate a costly arms race. The use of these techniques also reduces the probability of space debris being generated either from testing or from use in conflict. While none guarantee against other states developing weapons, they would certainly reduce the likelihood by reducing the concern which other nations and commercial operators would have regarding the safety of their own space assets.

If the argument put forward here is in fact true – that these weapons may prove ineffective this is not cause for relief, however. Space weaponisation by a global power is bound to generate reactions by competing powers, and an arms race will likely result. The testing or use of these weapons will also produce space debris that will multiply by many times the debris which is already orbiting the earth – any conflict in space would likely produce sufficient debris that further launches into space are no longer possible.[36] Furthermore, many proponents of space weapons do not give credence to the possibility of countermeasures. Other nations can and will respond, often in asymmetrical ways, and countermeasures to new technology are often cheaper and simpler to build than the weapon they are designed against. Thus placing weapons in space on the basis of a false belief in their technological capability could prove to be an expensive folly.

Approaches for pursuing space security

The preceding sections have shown that there is much to lose by permitting weapons in space, and apparently little to gain, at least not at the current level of the relevant technologies' development. The strategic benefit of space weapons appears negligible, and existing weapons systems appear as effective and less expensive. Nonetheless, prospects for a treaty that could ban weapons in space appear remote. This is due to a number of reasons: first is the technical issue of the dual-use nature of much of the technology involved, making verification of a treaty of this kind extremely difficult. Second is the reluctance of the current US administration to enter into any kind of negotiations. Added to this is the creation of a US anti-missile (ABM) system which blurs the distinction between space weapons and other weapons. There are steps however that could be taken that would initially reduce vulnerabilities and consequently the fear of an arms race or of increased space debris from testing. Following an incremental path to regulating the use of space is perhaps the most pragmatic solution, and one that could lead ultimately to a wider ranging agreement.[37]

The first point – the dual-use nature of much of the relevant technology – creates difficult challenges, making agreement on any potential system of governance more complicated, though this is not unique to the issue of space weapons. An example of the complexity can already be seen in the use of commercial satellite communications assets by the US military in the recent Iraqi campaign in order to meet their bandwidth requirements. Here, satellites designed, built, and operated for commercial purposes were used for military tasks. It is conceivable that aspects of an ABM system can also be used as space weapons assets, whether these are observation and tracking systems or interception systems. Similarly, the technology used to dazzle or jam space assets as outlined in the *Transformation Flight Plan 2004* could have a rheostatic capacity, and the weapon could produce both reversible and non-reversible effects. This overlap of technology and/or capability makes any move towards placing weapons in space hard to detect, and certain elements may be made operational unnoticed, resulting in weaponisation by stealth.

It is often argued that the biggest obstacle to an agreement banning weapons in outer space is the reluctance of the current US administration, and certainly Washington is constantly criticised for its current posture. However, while the United States would appear to have the most to lose from the weaponisation of space, so too does it stand to lose most from a total weapons ban. As discussed dual-use aspects of technology mean many of the weapon systems that could be potentially deployed against America's space assets are intrinsically difficult to identify or distinguish as weapons. Given the sensitivity of military satellite payloads, any inspection regime seems highly unlikely.[38] Thus, while abiding by a ban, the wide array of US space assets would still be vulnerable because of the threat emanating from these dual-use technologies. Thus the probability of the United States entering into an agreement banning it from placing weapons in space seems unlikely, and given its interests in space, this position is unlikely to change. However, this dilemma ought not be quickly dismissed with cynicism. Any potential agreement will have to recognise this situation.

Furthermore, the diplomatic exchanges on this issue may also be misleading. There is the distinct probability that many of those states that criticise the United States within international fora are exercising a high degree of hypocrisy, and that this issue is used to gain leverage or raise anti-American sentiment in the UN and the Conference on Disarmament. Certainly the USSR/Russia has been involved in ASAT design and testing in the past, and there are many speculations surrounding China's nascent interest in space.[39] Certainly China's ASAT test on 11 January has produced a quandary. It may have been evidence of this hypocrisy, or it may have been an attempt to get the United States back at the negotiating table. Sifting through the rhetoric is of course fraught with difficulties, but it is almost certain that the United States is not alone in its exploration of space weapons.

To its cost, however, the United States has issued various documents that seem to indicate intent on unilateral weaponisation at a time when there appears no direct threat. The impetus behind this renewed initiative is unclear. While there are some overlaps with SDI, technological latency would not offer a convincing explanation. Regardless, a unilateral policy of weaponisation will most probably cause other nations to react to counterbalance the United States in space, and, particularly in the short term, undermine the support and goodwill of which the United States finds itself increasingly in need. This trend of unilateral action was underlined in 2006 with the publication of the new US National Space Policy document, which opposes 'the development of new legal regimes or other restrictions that seek to prohibit or limit US access to or use of space'.[40] While this does not indicate a reversal of policy, or a beginning of a weapons programme, it will inevitably fuel international suspicions that the United States will develop space weapons.

Nevertheless, none of this means that future progress on the issues is impossible. The United States can take a number of steps, as can the rest of the international community, to enhance confidence and reduce vulnerability in space. These may lead to deeper and more formal agreements being made. These steps would include confidence building measures, agreed codes of conduct, and unilateral declarations against testing or deployment. It is the latter option that receives the widest support, and is perhaps the most simple and least risky.[41] As Dean points out, unilateral moves such as No-First Testing or Deployment declarations are highly practical in that they 'avoid the burden of consensus.'[42] Not only would these statements provide assurance that states did not intend to place weapons in space, they would also lapse if one nation abandons its position, leaving nations less to fear from becoming tightly entangled in a formal treaty, and then left vulnerable by 'cheaters'.

In this situation the United States could also benefit from developing a certain technological capability, and then declaring it will not deploy, as other potential space weapons powers would be aware that any foray into space could be quickly countered. As a result this policy would appear relatively risk-free as a first step.

More specific measures would involve establishing codes of conduct for space operations. These could encompass greater transparency and notification procedures, minimum distances between satellites, and speed restrictions on satellites as they approach others in order to enhance warning time. Added to this could be an international monitoring system that could ensure compliance. This might also serve as the basis for a verification system if a formal treaty was subsequently agreed.

If testing could not be totally eliminated by unilateral policies, it could at the least be restricted to a certain altitude. This would serve a double purpose: if low enough, the debris created would fall back down to earth quite quickly, and such a restriction would establish most of outer space as a weapons-free zone.

Other options for minimising the vulnerability of space assets could use the very technology that constitutes part of the threat – the use of micro-satellites. By spreading its capabilities over a wider number of smaller satellites, a space power could reduce the ability of an opponent to inflict critical damage. Air breathing platforms, such as ultra-long endurance winged UAVs, or large, long endurance airships, could also be used to take over certain tasks, further reducing the importance and thus vulnerability of space assets. Finally, a robust ability to reconstitute space capability after an attack would provide an additional measure of assurance.

These points are all useful steps along an incremental path towards a regulatory regime or a ban, however distant that might currently seem. Recent negotiations in the field of arms control and disarmament provide a useful precedent from which future negotiations could draw. The consultation for the Ottawa Treaty banning landmines – known as the Ottawa Process – were marked by the close involvement of Non-Governmental Organisations (NGOs) with the result that the treaty is often considered the first instance where humanitarian values prevailed over military expediency. The negotiations were also notable for their speed. This process might act as a useful model for any negotiations on space weapons, although it is likely that space faring nations would feel that more is at stake in terms of national security, and therefore may be less inclined to involve non-government actors.

During the Cold War, the main belligerents signed agreements that codified their operations in different spheres. The agreement not to interfere with NTMs of verification has already been mentioned, as have the Astronauts Rescue Agreement and the 1972 Liability Convention. In addition the United States and Russia established the Incidents at Sea agreement, which was inspired by a number of incidents between the forces of the United States and Soviet navies.[43] This encompassed 'steps to avoid collision', 'not interfering in the formations of the other party', and 'avoiding manoeuvres in heavy sea traffic.' These agreements all contain elements that constitute useful precedents that could underpin any agreement on space weapons.

Conclusions

There is clearly a lot at stake related to the weaponisation of space. On balance it seems that there is more to lose than to gain from placing weapons in space. The main threats to security appear to come from the potential undermining of the treaties such as the Outer Space Treaty. This is compounded by the current challenges that the Non-proliferation Treaty (NPT) faces, both by errant members and the lack of accord demonstrated by the NPT's 2005 Review Conference. It is here that the potential space faring nations, and in particular, the United States can make a valuable contribution by providing leadership in the multilateral process as well as backing international treaties and arms agreements. More than most nations, the United States benefits from the current status quo, and the rules-based system that is its basis. Considering the apparent small contribution that space weapons could make to its security, and the damage that they might do to international security more generally, the United States and others should begin steps to limit, if not ban the development of these weapons. However, this is complicated by the point illustrated before that the United States will be left relatively more vulnerable than many other nations in the event of a space weapons ban due to, on the one hand its heavy investment in and dependence on space assets, and on the other the difficulty in protecting against low-tech space weapons or asymmetric responses. Certainly Washington's reluctance to enter into any formal treaty or agreement is reflected by the 2006 US National Space Policy announcement.

Given the unequal distribution of space assets, and the difficulty inherent in any treaty banning weapons from space, then the incremental steps outlined in the previous section are probably the best that can be hoped for, though an eye should always be kept on the ultimate goal of a comprehensive treaty. When and if the technical means for such a treaty becomes available is impossible to say. The challenges that any system of governance will face centre on the dual-use aspects of many of these weapons systems. The ability of developing a robust verification regime would in itself be a technological challenge given the vast area involved. Nonetheless the military, economic, and political ramifications of not controlling these weapons, and of an arms race in space is surely sufficiently compelling for the world's major nations to begin examining in earnest the possibilities of a space weapons regime.

Furthermore, the possibility of proscribing these weapons presents a unique opportunity. Unlike nuclear disarmament efforts, which were a reaction to the existence and use of these weapons, there is the possibility to ban weapons from space before their occurrence and thus maintain the non-weaponised and peaceful status of space. But with this opportunity comes urgency, for once weaponised it will be far more difficult to return space to its prior state.

Notes

1. Conservative estimates put the cost of those systems outlined in the USAF Transformation Flight Plan 2003 at $1 trillion. T. Weiner, 'Air Force Seeks Bush's Approval for Space Weapons Programs' *New York Times* May 18, 2005; B. DeBlois, 'Militarization, Weaponization and Space Sanctuary', in *Outer Space and Global Security*, Conference Report (Geneva, UNIDIR: 2003).
2. 'Text of President Eisenhower's Annual Message to Congress on the State of the Union' *New York Times* 11 January 1957. See, Colonel D. R. Terrill Jr.,

The Air Force Role in Developing International Outer Space Law (Maxwell Air Force Base, AL: Air University Press, 1999) http://www.au.af.mil/au/awc/awcgate/ space/terrill.pdf accessed 20/08/05.

3. H. Heintze, *Peaceful Uses of Outer Space and International Law*, International Network of Engineers and Scientists Against Proliferation, paper delivered at the conference 'Space Use and Ethics', Darmstadt, 3–5, March 1999, www.inesap.org/bulletin17/bul17art22.htm accessed on 20/08/05.
4. UN General Assembly resolution 1148 (XII) (Section 1, paragraph F), 14 November 1957.
5. Terrill, *The Air Force Role in Developing International*, op cit. 30.
6. UN General Assembly resolution 1348 (XIII), 13 December 1958. Full text at www.oosa.unvienna.org/SpaceLaw/gares_13_1348.html
7. Outer Space Treaty, Article IV, 27 January 1967. See, www.oosa.unvienna.org/SpaceLaw/outerspt.html
8. Dean, J. 'The Current Legal Regime Governing the Use of Outer Space', in *Safeguarding Space for All: Security and Peaceful Uses*, UNIDIR Conference Report, 25–26 March 2004, op cit. 38.
9. SALT II also noted the importance of NTMs, but never entered into force.
10. Dean, *Safeguarding Space for All*, op cit. 38.
11. Heintze, *Peaceful Uses of Outer Space and International Law*, op cit.
12. In particular, see, R. L. Garwin, *Space Weapons: Not Yet*, discussion paper presented at the Pugwash Workshop on Preserving the Non-Weaponization of Space, Castellón de la Plana, Spain, 22–24 May 2003 available at www.pugwash.org and Lt Col W. Spacey, 'Assessing the Military Utility of Space-Based Weapons' *Astropolitics* 1(3): 1–43.
13. US Joint Chiefs of Staff, *Joint Doctrine for Space Operations*. Joint Publication 3–14, 9 August 2002: ix–x. These have been listed here in different order to emphasise the similarity to the preceding definitions.
14. Canada, International Security Bureau of the Department of Foreign Affairs and International Trade, *Space Security 2003* (Ottawa, ISB, 2004): 4. Full text at http:// www.eisenhowerinstitute.org/ programs/ globalpartnerships/fos/newfrontier/SpaceSecuritySurvey%202003.pdf
15. G. Gilmore, 'Wolfowitz: Military "Has Come a Long Way" Since Gulf War' *Global Security.org*, 04 April 2002, available at www.globalsecurity.org/military/library/news/2002/04/mil-020403-dod03b.htm, accessed 02/08/06.
16. MacArthur Foundation, *Working Toward Security in Space*, available at http://www.macfound.org/site/c.lkLXJ8MQKrH/b.1075125/apps/nl/content2.asp?content_id={38A6DD7D-7A60-4066-921E-CA1BACADD35C}&notoc=1 accessed on 11/08/06.
17. While micro-satellites currently represent advanced research in satellite technology, nano- and pico-satellites are being studied for future constellations. There have been tests of satellites, the size of a drinks can.
18. Times, 'China's War Talk on Taiwan Heightens British Arms Feud', *Times Online* 6 March 2005, at, www.timesonline.co.uk/article/0,2089-1512653,00. html
19. John Pike of globalsecurity.org quoted in E. Book, *Will the 'Bad Guys' Shoot Down U.S. Satellites?*, National Defense, 1 October 2001. At http://www.globalsecurity.org/org/news/2001/011001-asat.htm, he also makes the valuable point that ground stations monitoring satellites are more vulnerable than the satellites themselves.

20. USAF, *USAF Transformation Flight Plan*, November HQ USAF/XPXC (Future Concepts and Transformation Division, 2003): Appendix D, 4.
21. Ibid.: 5.
22. Ibid.: 6.
23. Ibid.: 7.
24. Ibid.: 11.
25. Ibid.
26. For instance, the airborne laser (ABL) in the role of a boost-phase interceptor (BPI) of ballistic missiles would be fired from large aircraft at a missile during launch. This then is not a space application, and not considered here, although similar problems exist for DEW in the ABM role. For an analysis of space weapons in these roles, see, Spacey (2003). He identifies two main failings with SBLs: lack of power, certainly for the foreseeable future, and the prohibitive size of mirror required for these weapons.
27. Garwin, *Space Weapons: Not Yet*, op cit. 5.
28. Ibid.
29. Ibid.
30. While conventionally tipped ICBMs might be an effective weapon, a potential drawback relates to the response by other nuclear weapons states to what they might perceive as a nuclear strike. Notification would need to be given to assure these states that they were not targeted, thus reducing the element of surprise.
31. There have been persistent rumours that a similar vehicle, known as Blackstar existed in the early 1990s, utilising a launch craft and a small manned space vehicle with a weapons capability. W. Scott, 'Spaceplane Shelved?' *Aviation Week & Space Technology* 6 March 2006: 48–53.
32. T. Weiner, 'Air Force Seeks Bush's Approval for Space Weapons Programs', *New York Times* 18 May 2005.
33. Garwin, *Space Weapons: Not Yet*, op cit. 3.
34. It is conceivable that certain alloys or ceramics may be able to overcome this problem.
35. Garwin, *Space Weapons: Not Yet*, op cit. 3.
36. It is already feared that space debris has surpassed critical spatial density – the point at which a chain reaction of collisions becomes likely. The recent Chinese ASAT test on 11 January 2007, which produced over 800 space particles, has pushed this even further, increasing the likelihood of a chain reaction, to the point that it may severely limit access to space. J. B. William, 'Orbiting Junk, Once a Nuisance, Is Now a Threat', *New York Times*, February 6, 2007. See also, P. Rincon, Space blast's huge debris field, BBC News, available at http://news.bbc.co.uk/1/hi/sci/tech/6398513.stm
37. Such an approach had been suggested at the conferences held at the UN Offices in Geneva by UNIDIR, the Canadian Department of External Affairs and International Trade and the Simons Foundation of the University of British Columbia. See, UNIDIR Conference Reports 2003, 2004, and 2005.
38. Indeed the 1975 Registration Convention has been routinely ignored.
39. See, for instance, Department of Defense, 'Annual Report on the Military Power of the People's Republic of China' 2005, available at http://www.defenselink.mil/news/Jul2005/d20050719china.pdf, this report indicates that the Defense Intelligence Agency believes China is actively engaged in ASAT research, including laser-based designs.

40. US National Space Policy, released 18 October 2006. Full text at http://www.ostp.gov/html/US%20National%20Space%20Policy.pdf
41. See, B. DeBlois, *US Space Posture and the Role of Space Weapons*, paper delivered to Outer Space and International Security: Options for the Future Conference, Elliot School of International Affairs, 29 October 2003, available at http://www.gwu.edu/~spi/DeBlois.pdf; Prof U. R. Rao, *Space Benefit Security*, discussion paper presented at the Pugwash Workshop on Preserving the Non-Weaponisation of Space, Castellón de la Plana, Spain: 22–24, May 2003, available at www.pugwash.org; and Dean, 2004, 43.
42. UNIDIR Conference Reports 2004, op cit. 6.
43. Agreement Between the Government of The United States of America and the Government of The Union of Soviet Socialist Republics on the Prevention of Incidents On and Over the High Seas, signed 25 May 1972. Available at http://www.state.gov/t/ac/trt/4791.htm

9
Understanding the Broader Context

Bill Durodié

This final chapter examines the contemporary social and political context within which perceptions of security threats – and the prioritisation of technology in dealing with these – have arisen. Its starting premise is that our sense of security is never simply derived from an assessment of the actual, or objective, hazards that confront us. Rather it reflects subjective factors too, such as our degree of confidence, clarity of purpose, and levels of trust in those charged with leading us. Stepping back from current definitions of threats by acknowledging this enables the examination of alternative possibilities for promoting a sense of security.

The argument advanced in this chapter is that whatever new threats are held to confront us, the combination of an absence of direction and a process of social dislocation frames much of the current debate on security matters, as well as the emphasis on technological responses. Indeed, focusing on threats, rather than on what is being threatened at the level of society, encourages a distorted perception of risk, and a demand for narrow technological solutions in dealing with these. This approach is likely to be counter-productive and further delay the necessary political debate as to the aims and values which will be required to re-engage the public in pursuing broader social goals.

In seeking to understand the broader context in which security and technology are defined, this chapter begins by situating current relations between science and society within a set of historical transformations. That is followed by a historical analysis of the eroding bonds in Western societies, which have a direct bearing on how risks and insecurities are identified and prioritised. These remarks about science and society then provide a basis for reframing current discussions regarding the roles science and technology could play in securing security and fostering social resilience.

Science and society

The emphasis often given to the importance of science and technology (S&T) for effecting social change or enhancing our security is one-sided.[1] Science can transform society, but it is also a product of society. Its advances and remit, as well as being shaped by material reality and real needs, are circumscribed by the values and beliefs of the societies within which it develops. The ambition and imagination of those societies – or the lack of these – are essential influences.

Newton had an appreciation of this social element when he wrote in his famous letter to Hooke of 1676 that 'If I have seen further it is by standing on the shoulders of giants'.[2] Science comes with a history and the scientific revolution itself was a product of a broader aspiration for social liberation and change that both preceded it and derived from it.

The world of antiquity yielded many intellectual insights but, constrained by its social structures, these proved to be of limited practical consequence.[3] Then, from 400 AD to 1000 AD, Europe was in scientific terms a backwater. Some of the high points of Greek science were kept alive and developed in the Arab world, but the feudal order was largely static, positing a relationship between humanity and nature that was conceived as being fixed for eternity.[4]

It was the Italian Renaissance that first began to change and then challenge the old order. Built largely upon the development of trade, it raised new demands on individuals and society, encouraging invention through the merger of intellectual activity with practical needs. With the discovery of America in 1492 trade routes began to shift to the Atlantic seaboard. England, Holland, and France then began to accelerate as important centres of innovation driven by their own commercial interests.

Within a few centuries in addition to the development of the use of perspective in art and the construction of Brunelleschi's dome in Florence, the world had been circumnavigated, its largest continents discovered, the compass, telescope, and printing press invented.[5]

By 1660, when what was to become known as the Royal Society was founded in London, the ecclesiastical domination of the Holy See in Rome had been broken, whilst the trial and execution in 1649 of the monarch Charles I was fresh in people's minds. Accordingly, despite the Restoration, its founders adopted the Latin phrase; 'Nullius in Verba' ('On the Word of No One'), from the Roman poet Horace – the son of a freed slave – as their motto.

This was a bold statement of intent, as well as reflecting the political mood of the time. The champions of the new philosophy wished to emphasise the 'Experimental Learning' that was central to their outlook – but also their reluctance to take any pronouncement upon trust. The dogma of Pope and King having been challenged, acquired insight could henceforth aspire to replacing received authority.[6] As well as delivering remarkable achievements it was to be a practical battering-ram with which to challenge perception, prejudice, and power.

But this was a reflection and pronouncement of faith in humanity itself rather than merely in science. Social development had raised human expectations as to what was possible. It had given humanity confidence in the power of its own reason – a factor that then proved of significant importance to the development of science.

The scientific revolution represented the triumph of rationality and experimentation over the superstition, speculation, diktat, and domination that had gone before. It was more than simply an advance in scientific knowledge – it was part of a wider shift in attitudes and beliefs. The scientific revolution was the product of dynamic social progress, as well as becoming an essential contributor to it.

But just as the initial dynamic behind science was social change, so social change – or more particularly the lack of it – could circumscribe it too.

The vision of nature and humanity now developing was driven by aspirations for freedom and equality. These concepts represented the needs of a new elite – the commercial, and later industrial, capitalist class. But, as such, society would now encounter new constraints, not only from the on-going and vociferous rejection of the old religious and monarchical orders it had supplanted, but also from the inherent limitations of this new social system and the particular world view of its proponents.

From 1789, at the time of the revolution in France, and later, due to a growing threat from the dispossessed, promises of freedom, equality, and progress came to be seen as highly problematic, as they highlighted the failure of society to live up to those promises. The new establishment, in addition to social and political reformation, now needed to curtail the claims and effects of scientific enquiry, reason, and progress on society.

A model of science developed known as positivism, which consciously sought to facilitate the restoration of order.[7] Reflecting the simple mechanical processes emerging in industry, it posited that science operates on objective, absolute, and ascertainable facts connected by rigid links of cause and effect.[8] But this view of a clockwork universe with its uniform rules and truths being revealed by pristine individuals disinterestedly recording the underlying workings of invariable natural laws does not stand up to simple scrutiny.

It was a model of science still worthy of esteem – but robbed of any association with historical change and development. The link between the advance of science and that of society was lost. Many of today's confusions about science stem from the misapprehension that this approach, rather than being a limiting constraint, somehow continued the Enlightenment tradition.

Through the Victorian age a compromise was effectively reached whereby science could still develop – quite rapidly at times – but it no longer systematically challenged the old authorities. Darwin's secular universe cohabited that of the bishops but did not seek to tread on their patch. Scientists were held in high regard, but science was now decoupled from the political aspiration to transform society – although its consequences continued to do so.

Over the course of the twentieth century, philosophers of science gradually placed greater emphasis on the uniqueness of individual experience. This corresponded intellectually to the tremendous changes, impasses, and uncertainties that they found themselves caught up in. Two World Wars, a Depression, and continuing poverty and conflict in the developing world generated doubts as to the possibility of universal human progress and a 'fear of the future'.[9]

Accordingly, those seeking to defend science – including many in what we might now consider to be the scientific establishment – sought to separate it further from social and political transformation by increasingly placing it into a narrowly technological or reductionist straitjacket. Harnessed to the pursuit of American security through the Manhattan project and the Apollo missions, science also created opponents for itself amongst its old allies. The political left, that had traditionally supported the liberatory potential of scientific advance, now came to view it with increased suspicion. They argued that aspiration itself, rather than its failure – as evidenced in the collapse of confidence in social progress – had turned nature into 'mere objectivity' for humanity.[10] This attitude could then be found reflected in the subordination of people and countries and was increasingly facilitated through the use of instrumentalist technologies. Science was seen as the amoral steamroller of a dispassionate new modernity crushing communities and tradition.

What is so poignant about the modern disenchantment with science is that it has emerged at a time when its achievements are without precedent. But without social progress the direction and purpose of science has become uncertain, and once science had slowed down in relation to what it could do, society can begin to lose faith in it. Behind the current crisis of science, lies a collapse of confidence in humanity and hence in the desirability and possibility of social transformation.

Ironically, at the same time as S&T are increasingly viewed with concern and their potential curtailed accordingly, so their import and impact upon society are inflated out of all proportion. This is due to a loss of understanding of the extent to which we are shaped by social, rather than purely scientific forces.

The erosion of society

When Margaret Thatcher famously suggested in an interview that '*there is no such thing as society*', she was widely derided.[11] Today, it would appear that her statement was almost prescient. The erosion of core social bonds and forms of engagement over the last couple of decades has been striking. Among other outcomes this process has diminished the awareness of the extent to which many phenomena are shaped and determined by social forces.

The combination of a breaking down of social affiliations, at both the formal and the informal levels of participation, and the resultant isolation of individuals in society, together with the absence of a sense of collective purpose in the aftermath of the Cold War, has left people prone to an exaggerated sense of risk and insecurity in relation to numerous issues.

At the formal level, people in advanced Western societies are increasingly unlikely to participate in the political process. This effect is most striking among younger age groups.[12] Electoral turnouts in many countries are at an all-time low and in the few instances where these are high, emotional attachment appears to rule over reasoned argument.

Few today are active, or even passive, members of political parties or trade unions as their forebears were,[13] and there is little attempt to engage in – or raise the standard of – debate. When people do vote, it is often out of a sense of duty or on a negative basis – against a candidate, rather than for the alternative. The figures for those aged under 30 are even worse.

This means that there is little loyalty, and accordingly predictability in the outcome of contemporary elections. Marginal events, largely disconnected from the actual process – such as a terrorist attack, environmental disaster or claims as to the personal character traits of particular contestants – can have a disproportionate impact.

Turnouts range between 10 per cent in local elections to 60 per cent in national ones. As this is often split between several main parties, the actual mandate of those put into office is significantly lower.[14] In addition, what it means to actually belong to one of these bodies has irrevocably been altered too.

For the political elite, the disengagement of the masses from the electoral process is highly problematic. It exacerbates their own sense of isolation and insecurity, as their democratic mandate and political legitimacy becomes questionable. This has been made worse by a loss of vision and direction, which became particularly pronounced through the gradual demise of the political divide between the old socialist left and the free-market right.

Today, the categories of left and right have been expunged of their traditional associations and meanings.[15] Voters are mostly unable to distinguish between the pronouncements of the various major parties. Now, candidates fight for what they believe to be the centre ground and are desperately seeking issues that may reconnect with, and re-engage, ordinary people. Foremost amongst these have been issues relating to health and security as these resonate with people's individuated sense of vulnerability.

At the informal level of social participation, the changes in society are just as striking. Many have commented on the growing pressures faced by families, communities, and neighbourhoods. In his book on this theme, '*Bowling Alone*', the American academic Robert Putnam also pointed to the demise of informal clubs, teams, and associations.[16] Meeting up with friends too occurs less frequently than previously.

In other words, people are not just politically disengaged but also, increasingly, socially disconnected. These changes have developed within a generation and their consequences have yet to be fully appreciated. In particular, they have helped to transform active citizens into privatised individuals. The diminished sense of self that has resulted has further altered people's confidence to deal with problems and willingness to engage in social processes.

Not long ago, for instance, across most urban centres, children would go to school on their own. Parents assumed that if there were any problems, other adults would act '*in loco parentis*' – chastising their offspring appropriately if they were misbehaving and helping them if they were in trouble.

Today, despite the absence of any evidence of increased abductions, abuses, or accidents, this straightforward social arrangement no longer holds. The erosion of this unstated and self-evident social good suggests a breakdown of trust, or solidarity, between adults. In turn this demands the application of numerous personal solutions to what was once a public issue and actually makes the job of parenting harder.[17]

In a myriad of different ways the various social glues that used to give individuals a sense of identity and meaning through the provision of agreed or assumed social structures has gradually come unstuck. This comes at a cost.

The rise of risk perception

The erosion of collective forms of social association, both in the formal sphere of political conviction and participation, as well as in the informal sphere of everyday life, has had a dramatic impact upon how people view themselves and the world around them.

In the past, social networks and norms may have imposed seemingly arbitrary or authoritarian structures and rules upon people, but they also provided meaning, conferred identity, and facilitated social processes.

Being less connected leaves people less corrected. It allows their subjective impression of reality to go unmediated or unmoderated through membership of a wider group or trusted community. Without a sense of the possibility of social solutions, and divorced from trusted networks or webs of association by which to provide meaning and a sense of belonging for themselves, people have increasingly become inclined to view events as being inevitable, random, or out of control.

Views which, in the past, would have been filtered and scrutinised through various layers of public knowledge and private insight, often come today to form unchallenged personal frameworks for understanding the world. In such a climate, individual obsessions can grow into all-consuming world views that are rarely open to reasoned interrogation or debate. In part, it is this that explains the recent proclivity to emphasise or exaggerate all of the supposed risks that are held to confront us.[18]

From BSE (bovine spongiform encephalopathy, more commonly known as '*mad-cow disease*') to GMOs (genetically modified organisms), from the assumed risks presented by mobile phones or their telecommunications masts to the purported link between the MMR (measles, mumps, rubella) triple-vaccine, and childhood autism – all developments are now viewed through the prism of a heightened and individuated consciousness of risk.

Our fears are not restricted to the realms of novel scientific or technological products and processes. Many age-old activities and agents have also been reinterpreted through our growing sense of social isolation and fear. Abduction, bullying, crime, doctors, the environment, and food form just the first few letters of an ever-expanding lexicon of new concerns. Even relationships and sex are viewed as risky, and assessed and managed using an instrumentalist form of risk calculus – to the detriment of both.

But, rather than the world changing any faster today than in the past, or becoming a more dangerous, unpredictable, or complex place, it is a diminished, more fragile and isolated sense of self that has altered our confidence to deal with change and the problems it gives rise to.[19] Far from it being the inevitable reflexive consequences of manufactured risks in a '*risk society*' impacting upon us,[20] it is our sense of isolation, absence of direction, and associated distorted perceptions that lend themselves to identifying everything as a risk.

The erosion of a social perspective also leads to a diminished sense of the possibility that if there truly is a problem needing to be addressed then it is together – with others – that this can best be altered or challenged. In turn, these developments reduce the likelihood of our acting for some greater common good and end up making us less resilient, both as individuals and as a society.

All of these developments have a quite devastating and stultifying impact upon society. The breakdown of collectivities has, in the absence of any coherent replacements, enhanced the sense which isolated individuals have of themselves, as being frail and vulnerable. And an exaggerated perception of risk lends itself to increasing demands for greater regulation and social control.

Accordingly, people increasingly look to those in authority to enhance their sense of security by mitigating the worst effects of the natural world and human society, as well as the actions of those who seek to change these.

In an age characterised by an absence of political vision and direction, the politics of fear, or risk-regulation, have provided a hesitant and isolated elite with an agenda and a new, if limited, sense of moral purpose. The authorities have willingly embraced this role. Latching onto the generalised climate of isolation and insecurity, politicians have learnt to repackage themselves as societal risk managers.

But whilst there is a growing understanding that governments have, over recent years, increasingly made use of such a politics of fear, there is little appreciation of quite how widespread this has become.[21] Usually, the phrase is related to certain actions and proposals – such as extending periods of detention without charge, deporting detainees to their countries of origin, introducing identity cards or increasing airport security – for dealing with the ongoing '*war on terror*'.

These measures have all been discussed, at various times, in terms suggesting a degree of suspicion towards those seeking to introduce them. Politicians and officials are presented as having an interest in inflating the perceived risks posed by terrorist attacks in order to push through what, at any other time, would have been seen as being unpopular legislation.

But that is only the half of it. What the critics miss is the extent to which the same arguments have been deployed right across all policy agendas today. The '*act first, find the evidence later*' logic of precautionary thinking has been mainstream in environmental and public health circles for quite some time,[22] where it is widely supported by the same individuals decrying its use in relation to terrorism.

When Donald Rumsfeld famously talked of the difficulties he faced in dealing with '*unknown unknowns*', he was in fact using language widely used by those at the opposite end of the political spectrum.[23] The demand that science should emphasise uncertainties and unknowns is now widespread despite the fact that we can only ever learn about what we do not know starting from what we do know.

Radicals now view the state as an enabling mechanism of social protection. People who might once have sought to organise their own affairs and build their own institutions – in the absence of any sense of social solidarity or an ability to deal with problems collectively – now turn to the state to resolve matters. Even those environmental and consumer lobby groups with the most vehement anti-state rhetoric, look to the state to act as the ultimate regulator and enforcer.

Accordingly, politicians pose as the people who will protect us from our fears and regulate the world accordingly. But the demise of any positive sense of the possibility and desirability for social transformation has also led to a reduction in what it is that politicians actually offer the public today. The petty lifestyle concerns that they focus on, reflected in incessant debates about smoking, smacking, eating, and drinking are likely to inspire and engage a new generation of voters.[24] Nor – at the other end of the spectrum – do doom-laden predictions relating to global warming and terrorism.

Indeed, the more such concerns are highlighted, the more it becomes impossible for the authorities to satiate the insecurities they help create. Hence, alongside disengagement and alienation, has come a concomitant disillusionment and mistrust in all forms of authority, whether political, corporate, or scientific, as these invariably fail to live up to new expectations.[25] This corrosion of trust has replaced healthy scepticism with unthinking cynicism.

As expertise has come to be perceived as elitist and knowledge as biased or unattainable, in many situations today, the public are encouraged, and have become accustomed to, assuming the worst and presuming a cover-up. In the absence of the old structures this has generated new demands for the attribution of blame and compensation. Image and rumour now dominate over insight and reason. Myths and conspiracy theories abound, often encouraged by the same people who demand the inclusion of public perceptions in decision-making.

Focusing on people's perceptions has become the new mainstay of governments, activists, the media, and even risk consultants. These suggest that our perceptions of risks are as important – if not more so – than the actuality of the risks we face, as perceptions often determine behaviour. Thus, it is held, that irrespective of the basis for such fears in scientific fact, their effects are real in social consequence, leaving governments with little choice but to take such concerns on board and to regulate accordingly.

Such an approach benefits from appearing to take ordinary people's views very seriously. In an age when few participate actively in political life, it seems commendably inclusive and democratic. It is also a godsend to governments bereft of any broader dynamic or direction. But, assuming or adapting to popular perceptions is as contemptuous, and as patronising, of the public, as dismissing them outright. It may also be more damaging.[26]

Social responses

Fear is often understood in narrow psychological terms. It is usually taken to be a self-evident emotional response to an extreme or novel situation. But fear is also a social phenomenon, as how people behave in specific circumstances depends upon wider cultural norms, expectations, and beliefs.[27] That we become fearful as individuals or as a society is not simply dependent upon the threats that confront us, but also on our ability to make sense of those threats and the significance attributed to them.

In fact, how we as individuals, and as a society, define and respond to crises, is only partly dependent upon their causal agents and scale. Historically evolving cultural attitudes and outlooks, as well as other social factors, play a far greater role. Our degree of trust in authority, in other human beings and in ourselves shapes our perceptions and determines whether we consider a particular problem to be a disaster in the first place.[28]

There is, for instance, a contemporary cultural proclivity to speculate wildly as to the likelihood of adverse events and to demand high-profile responses and capabilities based on worst-case scenarios. In the end, this only serves to distract attention and divert social resources in a way that may not be warranted by a more pragmatic assessment and prioritisation of all of the risks that we face.

Technique and technology certainly help in the face of disaster, although the fact that particular societies both choose and have the capacity to prioritise such elements, is also ultimately, socially determined. More broadly, it is possible to say that resilience – loosely defined as the ability of individuals and society to keep going after a shock – is most definitely a function of cultural attitude or outlook.

Cultural values point to why it is that, at certain times and in certain societies, a widespread loss of life fails to be a point of discussion, whilst at other times or in a different society, even a very limited loss can become a key cultural reference point.[29] This evolving context and framework of cultural meanings explains such variations as our widespread indifference to the daily loss of life upon our roads, as opposed to, for instance, the shock that ensued across the globe from the loss of just seven lives aboard the Challenger spacecraft in 1986.

The loss of Challenger represented a lowpoint in the cultural assessment of human technological capabilities. It was a blow to our assumption of steady scientific and technological progress that no number of every day car accidents could replicate. It fed into and drove a debate that continues to this day regarding our relationship with nature and a presumed human arrogance in seeking to pursue goals beyond ourselves.

Hence, emergencies and disasters, including terrorist attacks, take on a different role dependent upon what they represent to particular societies at particular times, rather than solely on the basis of objective indicators, such as real costs and lives lost. In this sense, our response to terrorist incidents, such as those which occurred in the United States on 9/11 or in London on 7/7, teaches us far more about ourselves than about the terrorists.[30]

On the whole, the history of human responses to disaster, including terrorist attacks, is quite heartening. People tend to be at their most co-operative and focused at such times. There are few instances of panic.[31] The recent earthquake and tsunami in the Indian Ocean serve as a salutary reminder of this. Amidst the tales of devastation and woe, numerous individual and collective acts of bravery and sacrifice stand out, reminding us of the ordinary courage, co-operation and conviction that are part of the human condition.

People often come together in an emergency in new – and largely unexpected – ways, re-affirming core social bonds and their common humanity. Research reveals communities that were considered to be better off through having had to cope with adversity or a crisis.[32] Rather than being psychologically scarred, it appears equally possible to emerge enhanced. In other words, whilst a disaster, including a terrorist attack, destroys physical and economic capital, it has the potential to serve as a rare, if unfortunate, opportunity in contemporary society to build-up social capital.

Of course, terrorists hope that their acts will lead to a breakdown in social cohesion. Whether this is so, is up to us. Civilians are the true first responders and first line of defence at such times. Their support prior to, and their reactions subsequent to any incident, are crucial. Disasters act as one of the best indicators of the strength of pre-existing social bonds across a community. Societies that are together, pull together – those that are apart, are more likely to fall apart.

Whilst there is much empirical evidence pointing to the positive elements of ordinary human responses to disaster, it is usually after the immediate danger has subsided that the real values of society as a whole come to the fore. It is then that the cultural outlook and impact of social leaders and their responses begins to hold sway. These determine whether the focus is on reconstruction and the future, or on retribution and the past.

Sadly, despite the variety of ways in which it is possible to interpret and respond to different emergencies, the onus today seems to veer away from a celebration of the human spirit and societal resilience, towards a focus on compensation and individual vulnerability. The recent trend to encourage mass outpourings of public grief, minutes of silence or some other symbols of '*conspicuous compassion*' is undoubtedly negative in that regards.

In the long run, cultural confusion as to who we are, what we stand for, and where we are going undermines all our attempts at building social resilience. Society today is less coherent than it was a generation or so ago, it is also less complaint, but above all it is less confident as to its aims and purposes. This can not be resolved by training ourselves to respond technically to disasters, but by a much broader level of debate and engagement in society, not just in relation to terrorism and other crises, but to broader social issues.

Presumably, people are prepared to risk their lives fighting fires or fighting wars, not so that their children can, in their turn, grow up to fight fires and fight wars, but because they believe that there is something more important to life worth fighting for. It is the catastrophic absence of any discussion as to what that something more important is, that leaves us fundamentally unarmed in the face of adversity today.

Social resilience

In September 1940, at the height of the Blitz, 5,730 people lost their lives in London alone. This is one hundred times larger than the number killed by the London bombers on 7/7. By the end of World War II (WWII) the final fatality count in London had reached 30,000. How could the British population be so resilient in the face of such adversity?

In his landmark study, representing the official interpretation of these events, Richard Titmuss suggested the key factors to have been clear leadership, equitable treatment, and the provision of full employment to keep people occupied.[33] Others, such as Angus Calder have questioned this interpretation, pointing to the existence of looting, a significant black market and juvenile delinquency as evidence that the famed '*Blitz spirit*' was not all that it was cracked up to be.[34]

Nevertheless, it is clear that the overall response was a remarkable display of fortitude. And whilst government motives may have been brought into question, at the time and subsequently, at least it was clear that it had some. During WWII, there was a clear sense of the need to carry on with normal life and maintain everyday roles and responsibilities. Most of the population was actively engaged in the war effort and there was a particular focus on ensuring that people would not develop a '*shelter-mentality*'.[35]

Such responses reveal a number of important lessons for today. Now, it is assumed that the world has been irrevocably changed by the events of 9/11 and 7/7. In other words, normalcy can never be restored. What's more, as the public cannot be engaged in counter-terrorist activities they are simply encouraged to prepare themselves for the worst.

However, the most striking change over the past 50 years has been in how we assume that ordinary human beings will react in a crisis.[36] Beyond the grossly distorted belief in the likelihood of panic lies a more subtle, yet unspoken shift in cultural assumptions, that in itself undermines our capacity to be strong. That is, that in the past the assumption on the whole as born out by actual human behaviour was that people were resilient and would seek to cope in adverse circumstances.

Today, there is a widespread presumption of human vulnerability that influences both our discussion of disasters well before they have occurred, and that seeks to influence our responses to them long after.

A new army of therapeutic counsellors and other assorted professionals are there to '*help*' people recover.[37] This presupposes our inability to do so unaided. Indeed, the belief that we can cope, and are robust, is often presented as outdated and misguided, or as an instance of being '*in denial*'.

In some ways, this latter element, more than any other, best exemplifies and clarifies some of the existing confusions and struggles that lie ahead. If self-reliance is old fashioned and help-seeking actively promoted, for whatever well-intended reason, then we are unlikely to see a truly resilient society emerge.

This cultural shift is reflected in the figures that reveal that whereas in the United Kingdom, in the period of trade union militancy and unrest known as the '*winter of discontent*' of 1979, there were 29.5 million days lost through strikes, in 2002 there were 33 million days lost through stress.[38]

We have shifted from being active agents of history to becoming passive subjects of it. This may benefit social leaders lacking a clear agenda or direction. It may indeed be easier to manage the sick than those who struggle. But it also precludes the possibility of encouraging and establishing real resilience, resolve, and purpose across society.

The standard way of dealing with disaster today, is one that prioritises pushing the public out beyond the yellow-tape perimeter put up by the authorities. At best the public are merely exhorted to display their support and to trust the professionals.[39] Effectively, we deny people any role, responsibility, or even insight into their own situation at such times. Yet, despite this, ordinary human beings are at their most social and rational in a crisis. It is this that should be supported, rather than subsumed or even subverted.

Handling social concerns as to the possibility of various security threats is no easy feat. In part, this is because social fears today have little to do with the actuality, or even possibility, of the presumed threats that confront us. Rather, they are an expression of social isolation and mistrust, combined with an absence of direction and an elite crisis of confidence.

The starting point to establishing real resilience and truly effective solutions will be to put the actual threat posed into an appropriate context. This means being honest as to the objective evidence, as well as being able to clarify the social basis of subjective fears.

The incessant debate as to the possibility and consequences of an attack using chemical, biological, radiological, and nuclear weapons, is a case in point.[40] Whilst Western societies have debated such nightmare scenarios as if they were real, terrorists have continued to display their proficiency in, and proclivity to use, conventional weapons, such as high explosives, car bombs and, surface-to-air missiles.

Above all, if as a society, we are to ascribe an appropriate cultural meaning to the events of 9/11 or the 7/7 – one that does not enhance domestic concerns and encourage us to become ever-more dependent on a limited number of professionals who will tell the public how to lead their lives at such times – then we need to promote a far more significant political debate as to our aims and purposes as a society.

Changing our cultural outlook is certainly a daunting task. It requires people to clarify and agree on a common direction and then to win others to it. The reluctance to engage in this fundamentally political process and the clear preference to concentrate instead upon more limited, technical goals, leaves us profoundly ill-equipped for the future. It speaks volumes as to our existing state of resilience and may serve to make matters worse.

Bizarrely, few of the authorities concerned consider it to be their responsibility to lead in this matter. Nor do they believe such cultural change to be a realistic possibility. Yet, in the eventuality of a major civil emergency, they hope that the public will pay attention to the risk warnings they provide and alter their behaviour accordingly. By then it will be too late.

Conclusion

Many perceived problems in the world today – including security threats – are driven more by their social context than by their actual content. Scientists and politicians need to be alert to this, not least because technology and security occupy peculiar positions in contemporary life. A diminished sense of the significance of, as well as the desire and ability to shape, social forces has led to an increased focus on the importance and impact of science and risk upon our lives. In response to this people have become increasingly preoccupied with technology as a potential solution to problems, as well as a possible future threat.

This has led to the highlighting and fetishisation of purported technological solutions to what remain essentially social problems, as well as a concomitant and distorted perception of threat. We can see this overinflation of technology in many spheres. Above all it is most evident in the debate about security since 9/11. All kinds of technical means are posited to counteract terrorism including greater surveillance and screening, identity cards, physical barriers, protective clothing, vaccines, and equipment for detecting chemical, biological, and radiological agents.

The list, it would seem, is almost endless, limited only by our own imagination as to what the worst-case scenario might be. In many ways, it is we who are projecting our worst fantasies upon reality and then having to live as if these were true. A recent publication from the Royal Society is quite apposite in this regards.[41] The report, *Making the UK Safer: Detecting and Decontaminating Chemical and Biological Agents*, is undoubtedly rigorous in scope and methodology. However, it is the uncritical acceptance of the social context that needs examining.

In it, some of the UK's leading scientists take at face value the notion that; 'Recent global events have given greater prominence to the threat of chemical and biological agents being used malevolently against civil targets', and further that 'Science, engineering and technology are central to reducing the threat'. Both these assumptions would benefit from interrogation. Indeed, questioning the axioms of a debate ought to be the first step in being truly objective. Otherwise, we may be left with a technically competent but ultimately unscientific report.

It is not just the job of social scientists, but scientists too, to question whether this purported 'greater prominence' is real. Assuming that it is, scientists true to their tradition would then start by asking what this fact represents. Whether this is a media construct or a more deeply held social concern, across different layers of society. If it is the latter, it ought to be considered that such a concern may have little relation to the actual probability of the threat they fear. The fact that something is possible may cause alarm, but is the best way of assuaging this to assume those fears to be real and then seek to mitigate their outcomes, or alternatively, to interrogate those fears?

Ultimately, the Royal Society report may be of use to a highly limited number of technical specialists who, in the extremely unlikely eventuality of such a situation arising, would be charged with dealing with it. However, it is not obvious what its use is beyond that, in the public domain. Surely, publication of the report itself could now serve to confirm people's exaggerated perceptions of threat? It has certainly contributed to the 'greater prominence' that it originally sought to address. People might assume that if the UK's leading scientists are investigating such matters then their presumptions are more likely to be true.

Of course, new technologies do contain the potential for adverse outcomes, but history suggests that our ability to contain these develops hand-in-hand with the development of the technology itself. Holding back on technological advance, as some now advocate (see Chapter 2 for an elaboration), is just as likely to generate unknowns or uncertainties as seeking to deploy them. Indeed, the evidence points to the fact that societies which lack the ability, means, or will, to develop technically and scientifically, remain at greater risk than others.

At the same time, looking to technical means alone for establishing security fails to clarify any broader sense of purpose for society. Real security derives from a clear social orientation and ambition. The knee-jerk response to regulate or control risks undermines this and encourages people to be self-serving, as well as viewing others as potential threats.

Science and technology rely at their heart on the human spirit and will to explore and experiment. We should neither become defensive about this nor imbue our technologies with the potential to resolve social problems, let alone clarify for us a broader sense of direction and purpose. The latter is a political task which, with our contemporary obsession with security, we are increasingly in peril of losing all sight of.

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