The relationships between science, technology and the military have been an important topic of public and political debate throughout the twentieth, and into the twenty-first, centuries (Edgerton, 1990; Mendelsohn, 1997). Since at least World War II, a substantial percentage of the world’s scientific and technological personnel and resources have been committed to defense-related endeavors. Nevertheless, despite the continuous importance attached to such efforts by governments, questions have always been asked about the effectiveness of, and the ends served by, military R&D. Developments in international affairs have also produced misgivings about whether the basic assumptions underpinning such expenditure remained sound. Most recently, the attacks of 9/11 have led to widespread suggestions that “everything has changed” – not least with regard to perceptions of security threats and the legitimacy accorded to the use of military force. This, in turn, has produced counterclaims to the effect that very little has in fact altered.

This chapter reviews “STS” analyses of the relationships between science, technology and the military since the publication of the first Handbook in 1977. It does so with particular reference to the question of how notions of change and continuity have been marshaled in attempts to understand the place and purpose of science and technology in military matters. It highlights how perceptions of what is unique and common in international affairs have pervaded analyses of the relationships between science, technology and the military. In considering these matters, this chapter also engages with the manner in which the priorities and perspectives of STS have transformed over time.
Science, Technology, War and the Formation of STS

A reading of Harvey Sapolsky’s (1977) chapter “Science, Technology and Military Policy” tells us much about the international context of the late 1970s, in addition to the state of the study of science and technology at the time. The chapter was written during the Cold War, when the dynamics of the competition between the United States and the Soviet Union dominated strategic thinking. It is against this backdrop that Sapolsky identified the great importance attached to managing a basically open-ended process of military-technological innovation and the consequences that might flow from it.

Sapolsky surveyed many of the major policy issues associated with harnessing science and technology for military purposes, and the impact of military R&D on science. Much of the chapter focuses on topics such as the challenges associated with managing technological change, the organization of military R&D, and the return to civilian and military sectors from this expenditure. Advanced weaponry was understood to be increasingly integrated into systems designed for multiple purposes, and for use in novel military environments. The result was a steady drive towards complexity in weapons development that brought both technological and political forms of uncertainty, thereby confounding attempts to improve the weapons acquisition process (Perry, 1970; Leitenberg, 1973). Sapolsky also dedicated significant attention to debates about the institutional arrangements associated with military R&D efforts, to the existence or otherwise of a “Military Industrial Complex” (e.g., Lieberson, 1971), and to those arrangements that might generate more production competition (Kurth, 1971). The importance of basic research to weapons programs was becoming increasingly questioned at the time – a development that was undercutting the status of scientists and engineers as advisors on defense-related issues (e.g., Smith, 1966; Boeffey, 1975). However, one area in which scientists, individually and collectively, remained central was in international efforts to establish and police arms control agreements. As part of this contribution, the potential for setting international limits to applied military research was identified as an area of emerging discussion (Ruina, 1971).

As such, Sapolsky’s contribution to the 1977 Handbook focused principally on the policy issues associated with military R&D, and did so in the main from a political science perspective. Only passing indication is provided of the notion that military science and technology might itself be problematized – as exemplified in Sapolsky’s (1977: 453) comment that “new weapons, it would seem, are less the product of technological forces than they are of institutional and socio-political factors”.

In the 1995 edition of the STS Handbook, Wim Smit identified both differences and commonalities between the international contexts of the late 1970s and early 1990s, along with the corresponding priorities in the analyses of science and technology (Smit, 1995). The subtitle of his chapter – “Relations in Transition” – signaled an assessment that the associations between science, technology and the military were located somewhere between a recent past dominated by the Cold War and a future as yet uncertain.
Five far-reaching changes from the time of Sapolsky’s chapter were identified as relevant to the harnessing of science and technology for military purposes, and to understanding the effects of military R&D on the character of scientific and technological developments. One was the shifting place of universities within military R&D, a process that was particularly pronounced in the United States. Between the mid-1970s and mid-1980s military funding for universities increased almost three-fold, with the increase being spread unevenly across the disciplines. This development was accompanied by policy allocation questions about who received what resources and to what end, whilst the increasing importance placed on such research also sparked wide-ranging contention about its desirability. Moral and political debates centered on the compatibility of military pursuits with the goals of the university (Dickson, 1984; Kevles, 1978) – disputes which often relied on the attributions of science as objective, neutral and value-free that have subsequently been questioned in STS. More conventional concerns over the efficacy of military-related research encouraged discussions about whether the strings attached to military funding (e.g., publication restrictions) jeopardized the conditions (e.g., openness, skepticism) that made science productive – another topic where STS questioned many widely voiced presumptions. At the time controversy also attended the matter of whether the priorities of academic researchers were being shaped by military funding, yet another debate that was steeped in problematic assumptions regarding the “natural” course of science and the distinctions between “basic” or “applied” research. In relation to the place of universities, Smit suggests STS was just beginning to pose interesting new questions about whether scientists or the military determined funding agendas; whether developments in the US were exerting a global influence on research directions; and whether military funding could influence theories in science (Forman, 1987; Gerjuoy & Baranger, 1989).

The other four important changes identified by Smit centered on the exploitation of science and technology for military ends. First, the integration of civilian and military technology became a high profile topic with the end of the Cold War. Reflecting (on) the times, Smit (1995: 618) commented that “one thing is already clear: military budgets and forces will be substantially reduced both in the United States and in all European countries”. Not surprisingly, therefore, those countries with large military expenditures were beginning to ask demanding questions about the future composition of military-industrial capabilities. The search for so-called dual use technology became a major preoccupation for many Western governments. This was especially so in the US where this policy came to abate calls for the large-scale conversion of defense manufacturing capabilities (Alic et al., 1992) and where it intersected with calls for ‘agile’ and ‘postfordist’ production practices. Organizations such as the Advanced Research Project Agency were assigned a critical role in leveraging military funding and expertise for civilian innovation. Against this background, STS studies were seen as informing the manner in which distinctions were drawn between “civilian”, “military”, and “dual-use” technology as well as the compatibility of “civilian” and “military” ends (Elzinga, 1990; Gummett, 1990; 1991; Gummett & Reppy, 1988; Irvine & Martin, 1984). As part of this contribution, historical cases studies indicated the important role played by military imperatives in shaping the character of civilian technology (e.g., in lasers [Seidel, 1987], transistors [Misa, 1985], and fission reactor design [Hewlett & Holl, 1989]) as well as
facilitating civilian manufacturing and production technologies (e.g., Smith, 1985; Noble, 1985).

A second area of important change identified by Smit in which STS was seen to be relevant to policy discussions was an emerging interest in steering the direction of military R&D (Greenwood, 1990; Woodhouse, 1990; Smit, 1991). A related area where traditional policy concerns were being re-thought was that of arms-racing behavior. Here numerous studies had already suggested the multiple dynamics at work in the development and procurement of weapons that might provide lessons for post-Cold War attempts to rein in technologies and R&D (Buzan, 1987; Ellis, 1987). Indeed there had been a marked shift since the 1970s away from “action-reaction” models of the arms race, which treated states as simply responding to technological developments amongst their competitors, to “domestic structure” models, which included internal political, economic and social factors as explanations of arms-racing behavior (Buzan & Herring, 1998).

These new understanding were themselves underpinned by the fifth major development discussed by Smit: an emergent appreciation in STS of the processes underpinning the development of technology. Key studies examining the process of weapon innovations (e.g., MacKenzie, 1990; Gummett & Reppy, 1990; Kaldor, 1982) were complementing wider efforts to comprehend the social construction, or shaping, of technology. This development was accompanied by a critique of existing linear models of innovation wherein technologies flowed unproblematically from scientific discoveries – a critique that, in turn, undermined prevailing definitions of “science” and “technology”. In their place emerged an analytical approach within STS that stressed the need to treat science, technology, and society as constituting “seamless webs”, or sociotechnical networks, rather than as distinct entities. Such an approach questioned the distinctions employed in past analyses, such as Sapolsky’s distinction between “technological” and “political” forms of uncertainty in the weapons-acquisition process.

This brief account of the previous two Handbook chapters indicates the scope of issues they covered along with the priorities they attached to them. As already suggested, notions of change and continuity pervaded efforts to examine the relations between science, technology and the military. Thus, whilst the policy issues associated with the harnessing of science and technology to military purposes, along with the impact of military R&D on the organization of science, were major themes in both chapters, they were addressed in relation to different circumstances. Change itself could be regarded as part of the usual run of developments in the sense that military R&D was understood to be conducted in an ever-changing security environment, which, in turn, justified continuing attention to these major themes.

The two previous chapters can also be characterized according to how they portrayed the study of science and technology. Sapolsky’s review concerned itself squarely with what analysts were saying about the issues associated with science, technology and the military, rather than problematizing science and technology themselves, and their boundaries with society, economy, politics and the military. The studies cited by
Sapolosky were drawn from a variety of fields, but principally that of political science. Smit adopted similar substantive preoccupations, although he explicitly identified an emerging multi-disciplinary field of “STS” which was bringing some distinctive perspectives to bear on traditional concerns, especially in “opening the black box” of technology.

STS has continued to develop since the early 1990s, and the rest of this chapter brings that story up to date. In doing so, it dispenses with a review of general policy issues associated with science, technology and the military. With the continuing development of the field, it focuses instead on the question of what specifically STS has had to say on such matters. This approach demands an engagement with the question of what counts as “STS” work, as well as what distinctive contribution “it” has made to the understanding of science, technology, and the military. Designations of the field and determinations about what counts as a rightful contribution to the literature are mutually defined. This issue is particularly salient in the case of STS because it cannot be demarcated by reference to a single or limited set of theories, methods or topics of investigation. If science and technology are understood as distributed and heterogeneous practices, specifying neat boundaries to STS itself becomes problematic. So overall, the remainder of this chapter seeks to review the prominence, priorities, and purposes of recent STS themes associated with science, technology and the military while posing questions about the manner in which this is done.

STS & the Military: Further Continuity, More Transitions

In the years since the publication of Smit’s chapter, events have continued to challenge previous assumptions and agendas regarding security and military matters. The decline of Cold War ideological divisions led many commentators to forecast the arrival of a new era characterized by the triumph of liberal democracy and market economics (e.g. Fukuyama, 1992). Nevertheless, the 1990s witnessed a growing preoccupation amongst Western governments with “rogue” states that were judged to transgress the standards of the international community, and “failed” states that proved unable to endure the realignments of political and economic power consequent on the end of the Cold War. Efforts to resolve these new problems led to a variety of military responses, ranging from peacekeeping operations, via the coercive use of force, to fully fledged invasions aimed at regime change.

Against this backdrop, contributors to the field of STS have continued to explore traditional concerns associated with the harnessing of science and technology to military ends, and the impact of military R&D on scientific development. Not surprisingly, however, they have also turned their attention to topics hitherto unexamined and the “they” that makes up this corner of STS has come to incorporate new scholars from such areas as anthropology and cultural studies.

As far as the shifting role of universities within military R&D is concerned, Smit (1995) identified three traditional concerns: moral and political issues; divergence between military aims and university missions; and the influence of military research on the
direction of science and technology (e.g., Wright, 1991; Edgerton, 1996; Kaiser, 2004). Subsequent analysis of these concerns has taken place in the light of two important developments. First, newly opened archival sources and a small measure of post-Cold War transparency have enabled the investigation of military research establishments as social settings for the production of knowledge (e.g., Bud & Gummert, 1999; Forman & Sanchez-Ron, 1996). Second, construing the relations between science and the military as a “seamless web” has enabled STS scholars to revisit topics that had previously been defined as “non-epistemological” and which had been confined to institutional sociology of science or science policy. Thus the well-worn topic of ethics in military research has recently been reinvigorated by constructivist studies of scientists’ moral frameworks in relation to military projects. Thorpe (2004b), for example, argues that as Oppenheimer wrestled with the morality of authoring the atomic bomb, he was equally troubled by a more general shift in the scientific profession towards narrow and blinkered specialization, thus precluding moral deliberation and reflection, and moving scientists away from their former role as “universal intellectuals”. Other studies of the justifications provided by universities and scientists for engaging in military research and development activities have contended that it is too simplistic to view these justifications as involving the suppression or abandonment of a Mertonian normative framework, and that they should be regarded as part of the professional ideology and culture of the weapons laboratory (Balmer, 2002; Reppy, 1999; Gusterson, 1998).

Previous concerns about the compatibility of university and military research have been carried through into a wider examination of the cultures of different R&D efforts. What might be termed “weapons cultures” have been identified as constituted by relations of secrecy – relations that allow for forms of moral regulation, that facilitate the development of peculiar moral economies, and that legitimize particular avenues of research or research practices. Compartmentalization, and the strict organization of time within the Manhattan Project, for example, arguably closed off opportunities to reflect on ethical concerns (Thorpe, 2004a). Secrecy, whilst not confined to military institutions, is a defining element of the space in which death becomes a routine goal of the research process. As a result, it has been argued that secrecy is not simply about restricted flows of, or access to, information. Instead, scholars have suggested that we should attend to the ways in which secrecy is talked about by scientists (Dennis, 1999), how it changes scientific authorship (Gusterson, 2003), and how it becomes constitutive of social identities (Wright & Wallace, 2002). For instance, secrecy affects how military researchers see themselves as scientists. They “become weapons scientists rather than, simply, scientists” claims Gusterson (1998: 89), which in turn affects how they relate to their families and the rest of society. Closer to the heart of traditional SSK concerns, secrecy in recent analyses has been treated as co-produced with knowledge as particular practices of establishing and maintaining secrecy are constituted alongside particular types of experimental and field practices. For example in the wake of public exposure of a fishing trawler to biological warfare agents in 1952, the practices of secrecy and the transformation of the accident into a monitoring experiment were thoroughly intertwined (Balmer, 2004). This productive dimension of secrecy also becomes apparent when breached secrecy produces differing interpretations of what exactly has become known and by whom (Masco, 2002; Kaiser, 2005; Balmer, forthcoming).
Turning to the influence of the military on the direction of scientific and technological change, a number of historical studies have emerged in recent years that demonstrate how the imperatives of war affected science. These include Mirowski’s charting of the shift of physicists and economists into military-funded Operations Research during World War II, and the consequences of this migration for the disciplinary landscape of postwar economics (Mirowski, 1999; 2001). War also provided impetus and direction to biological research. Prior to World War II, plant auxins were conceptualized as growth stimulators, but the advent of war encouraged them to be seen as potential “killers” within the context of anti-crop warfare efforts (Rasumussen, 2001). At a more biographical level, Galison (1998) has argued that the types of visualizable solutions and theorizing valued in war-time Los Alamos had a lasting effect on Richard Feynman’s personal ways of working and theorizing, encouraging the development of Feynman diagrams.

Cold war concerns also meant that military patronage acted as an important influence on the development of science and technology. As mentioned, recent studies on this topic within STS have largely shifted away from concerns over whether the military distorted the “natural” trajectory of science. Instead they have framed their analysis in terms of charting the effects of military patronage without reference to any counterfactual, pure trajectory (Cloud, 2003; Dennis, 2003; Barth, 2003). The military have been shown, in the US at least, to have profoundly influenced the character of entire universities such as MIT and Stanford (Leslie, 1993; Lowen, 1997). Military funding and goals have been shown to have affected academic disciplines besides the well-recognized areas of physics and engineering, with recent studies in this vein covering the earth sciences (Doel, 2003; Harper, 2003; Oreskes, 2003; Barth, 2003), the social sciences (Mirowski, 2001; Lowen, 1997; Solovey, 2001) and even ornithology (MacCleod, 2001). A number of these commentators have described the co-existence of secret military research alongside civil research (see also van Keuren, 2001), and have noted how secrecy has created the impression of a civil-military separation which belies the intimate connections and interface zones built up between the two sectors in the course of the Cold War (Cloud, 2001; Dennis, 1994).

The organization of military institutions in war and peace has also been shown to affect the direction of research. In addition to the studies of the military influence on technology cited earlier, Eden (2004) has focused on the organizational “framing” of scientific knowledge. Eden drew on social studies of science and organizational theory to argue that the phenomenon of nuclear bomb damage was framed by military planners and scientists in a manner that focused attention on blast rather than fire damage. Incendiary damage was regarded as far less predictable and those (such as fire-protection officers) working in the “fire damage frame”, were largely marginalized. Eden’s work has complemented institutional studies of the roles played by scientific advisers to the military. These studies have built on the seminal work by Gilpin (1962), by drawing on recent insights from STS on the nature of scientific advice in order to show how both expert advice and advisors are constituted in particular social and political contexts (Balmer, 2001; Thorpe, 2002).
In recent years, little attention has been given to the integration of, or conversion between, civilian and military technology in STS. The frequent use of force as a tool of foreign policy since the early 1990s means that many of the initial hopes for a large-scale conversion of military industries to civilian ones have been dashed. Nevertheless, Martin (1993; 1997; 2001) has made proposals for the replacement of military force and equipment with non-violent forms of self-defense. Attention has also been paid to the challenges associated with disposing of some of the more dangerous products of cold-war military competition, and the manner in which disposal decisions have been shaped by political as well as technical considerations. Macfarlane (2003) shows that the ostensibly scientific process of selecting a site for the long-term storage of US nuclear waste has also been a political one, but that the political dimension has itself been influenced by the character of the scientific knowledge brought to bear on the problem. For Macfarlane, therefore, the selection process has been attended by the “co-production” of politics and science. In his study of the US chemical weapons disposal programme, Futrell (2003) demonstrates the ability of the public to exert a positive influence over the formulation of policy on highly technical matters. According to Futrell, public involvement can produce decisions that not only enjoy greater political legitimacy, but that are also technically superior to decisions made by technical experts alone.

Writing his contribution to the 1995 edition of the Handbook, Smit identified the emerging literature on the social construction of technology as leading to wide-ranging changes in our understanding of the development of technological systems. The processes associated with the development and acquisition of weapons have long been understood in terms that might loosely be described as “constructivist.” Simplistic notions of new weapons following unproblematically from developments in technology have never been a conspicuous feature of the weapons-acquisition literature. On the contrary, many Cold War studies drew attention to the salient roles played by service rivalries, and by competing bureaucratic and domestic political interests, in the weapons-acquisition process (e.g., Armacost, 1969; Halperin, 1972). As such, they have been retrospectively claimed as important instances of the “social shaping” of military technology (Mackenzie & Wajcman, 1999: 347). Clearly, however, seminal constructivist works, such as Mackenzie’s (1990) analysis of missile-guidance systems – which demonstrated that the development of the technology and its subsequent technological trajectory were by no means inevitable – have informed more recent studies of the origins of new weapons (e.g., Farrell, 1997; Spinardi, 1994).

In his study of the development of British nuclear weapons at Aldermaston, Spinardi (1997) claims that weapon designers exerted considerable, but not unilateral, influence over military requirements because they were in a strong position to make technical judgments about what it was possible to create. Looking further back in time, Moy (2001) has shown how the US Army Air Corps and the Marine Corps of the interwar period developed distinctive technologies (for precision bombing and amphibious operations respectively) that reflected their political interests and cultural values. In this regard, the Army Air and Marine Corps did not so much predict the effects that emerging technology would autonomously exert on the future of military operations, as develop
technologies which permitted them to conduct specific operations that accorded with their bureaucratic interests.

Other studies in the constructivist tradition have concentrated on military-related technologies in order to understand the intertwining of the technical, the political and the social (Edwards, 1996), to question the distinctions drawn between modernism and postmodernism (Law, 2002), and to map the peculiarities of innovation in military settings (Abbate, 1999). Weber (1999) has undermined the notion that military technologies are inherently masculine by highlighting the manner in which contingent processes in the design of US military aircraft cockpits subsequently worked to exclude women from becoming pilots. Constructivist analyses have continued to extend research into the topic of conventional and unconventional arms races identified by Smit. Grin (1998) emphasized that military-technological innovation occurs within “networks of organizations”, and explored the possibilities that this suggested for guiding the development of military technology in politically desirable directions.

Constructivists have also challenged widespread presumptions about the permanence of scientific and technological knowledge. So, while in examining arms-control efforts in the first STS Handbook, Sapolsky (1977: 461) offered the disheartening remark that “knowledge once created is indestructible”, MacKenzie & Spinardi (1996) subsequently contended that the tacit (as opposed to formalized) knowledge required in the production of nuclear weapons means that they must be reinvented in new programs in non-trivial ways. The need for reinvention through the acquisition of tacit skills not only limits the proliferation of nuclear weapons but suggests that without practicing their skills, those once competent to create them might lose their ability.

Turning from the acquisition of weapons to the effects they create, it is worthwhile noting that military technology has often been considered to provide “hard cases” for substantiating constructivist approaches. If constructivism can be relevant to the study of such topics, then surely (the argument goes) it can be relevant elsewhere. Collins and Pinch’s (1998) analysis of the debates surrounding the performance of the US Patriot missile system during the 1991 Gulf War revealed wide scope for negotiation in appraising the effectiveness of weapons technology. The presence of disagreements over whether, and by what criteria, Patriot was successful (disagreements that continued into the 2003 Iraq War [Postol, 2004]) clearly illustrates how efforts to measure the effectiveness of technology operate as a social activity. And yet despite such challenges to conventional thinking, Grint and Woolgar (1997) using weapons as their exemplar, have argued that many constructivists still cling to the notion that certain core capabilities of technology exist which can be known independently from acts of interpretation. By shifting the terms of this debate away from what is true, and towards how we know what is true, others have furthered the work of Grint and Woolgar by using it to question analytical dichotomies between relativist and realist approaches in STS as well as the “disposal strategies” employed in attempts to establish rules for the acceptability of force (Rappert, 2001; 2005).
Many recent contributions to the STS literature do not fit neatly into the categories created in the previous editions of the Handbook. These contributions embrace such disparate concerns as the construction of history in accounting for actions during the Iran-Contra hearings (Lynch & Bogen, 1996); the “disenrollment” of humans and technologies from a dominant actor-network in the nuclear submarine industry (Mort & Michael, 1998); and the social construction of Gulf War-related illness (Brown et al., 2001; Zavestoski et al., 2002). Mindell (2000) has explored the effects associated with the introduction of new technologies on military personnel’s experience of war. The oft-stated requirement to minimize bloodshed in contemporary warfare has led Rappert (2003a) to examine the proliferation of so-called non-lethal weapons, with a view to subjecting the notion that capabilities inhere in weapons themselves to a constructivist unpicking. The non-western militarization of science has also begun to attract scholarly attention within STS and related fields (Abraham, 1998; Gerovitch, 2001, 2002; Holloway, 1996).

Following a more general trend towards a focus on the body in the social sciences and humanities, the field of STS has also belatedly taken some interest in the relationship between the military and the body.\(^1\) In her study of how the body parts of atomic-bomb victims were eventually repatriated from the United States to Japan, Lindee demonstrates how science played a crucial role in constituting a particular power/knowledge nexus through “filing systems, autopsy protocols and diplomatic negotiations surrounding a collection of sectioned and dispersed human bodies” (Lindee, 1999: 377). The body parts, she argues, became “frozen in a special state of victimization.” As part of the “spoils of war,” they were removed from Japan for scientific research, providing a material instantiation of US victory. Their repatriation occurred only in the context of the return of political power to Japan. Nevertheless, both countries’ interest in the body parts remained primarily scientific, the motivation being to “study, slice and display”, rather than (say) to allow the Japanese public an opportunity to mourn. In a similar vein, Gusterson has argued that the scientific practices involved in calculating the extent and effects of the bombings at Hiroshima and Nagasaki, such as using photographs of injured victims taken from behind or in very close focus, conceal the whole, suffering bodies. Carrying his argument forward to the 1991 Gulf War, he contends that the technocratic military discourse of weapons and machines fighting other weapons and machines provided a powerful way of making the bodies of war victims disappear. This discourse contributed to the image that the war was being fought without killing, and lent it “a surreal air of simulation” (Gusterson, 2004: 73).

On the theme of simulation, Lenoir and der Derian have charted the generally sporadic, but increasingly planned, links between academics, the entertainment industry and the military (Lenoir, 2000, der Derian, 2001). They respectively adopt the terms “military-entertainment complex” and “military-industrial-media-entertainment network” to capture the military’s increasing use of simulated environments and scenarios for training purposes, at a time when “military technology, which once trickled down for civilian use,

\(^1\) History of medicine has also developed this theme in new studies of military medicine, for a review see Bourke (2000).
now often lags behind what is available in games, rides and movie special effects” (Lenoir, 2000: 328). With the same technologies used to prepare for military missions and for gaming, the boundary between fantasy and reality, they suggest, is becoming increasingly blurred. This blurring through simulation does, however, have historical precedents. Ghamari-Tabrizi (2000, 2005) has charted the role of RAND social scientists in creating role-playing scenarios and human-machine simulations (where whole command centers would be built to create an elaborate exercise such as a nuclear attack) for the military during the Cold War. Although the scenarios were meant to be objective and realistic, Ghamari-Tabrizi reveals the dynamics of the debates which occurred over what counted as objective and realistic, or, more precisely, which elements of a simulation were relevant to its realism and objectivity, and which were superfluous or trivial. Ultimately, she argues, with no actual emergencies to compare against, settling these debates became a matter of intuition and judgment over what would happen outside a simulated situation.

Participants in simulation tests could be regarded as cyborg experimental subjects. And, with the ending of the Cold War, there has been increased documentation of a wide variety of military research on humans (Moreno, 2001). From a science studies perspective, Mitchell (2003) has documented how soldiers’ bodies became contested objects for military science. After experiments involving soldiers crawling across the sites of atomic explosions became public, the British Ministry of Defence claimed that no compensation would be forthcoming because the research had not been conducted on bodies. Rather, it had been conducted on the soldiers’ clothing. Civilian bodies can equally be reconfigured as experimental material for military purposes (Balmer, 2003, 2004; Crease, 2003), as was evident with large-scale spraying of non-pathogenic bacteria across the county of Dorset in the UK during the 1960s (Balmer, 2003). Although the military regarded the civilians as being outside the experiment, considerations of safety and secrecy with respect to the public still influenced its conduct.

These diverse contributions to the literature of STS attest to its expansion well beyond the policy concerns that dominated the previous editions of the Handbook. Yet defining the distinct contribution that STS has made to “the” understanding of the relationships between science, technology and the military is difficult. Developments in other fields concerned with military matters have proceeded in parallel, but with few direct linkages to STS (though see Herrera, 2003). Since the early 1990s, ideational-based approaches to International Relations have been challenging the traditional power- or interest-based approaches to explaining political affairs. An important component of this challenge has been the identification of the roles played by social norms in constituting identities and regulating behavior. Likewise, in the study of the conduct of warfare and the operation of military forces, norm-based approaches have questioned naturalistic, rationalistic and deterministic assumptions about the development of weaponry and also sought to

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2 This post-Cold War shift from military-led solutions to commercial-led solutions for military problems, as investment in military R&D and wider defence budgets were cut, has also been charted in the field of computer security (MacKenzie & Pottinger, 1997). For a fuller discussion of the relation between civil and military R&D see Alic et al (1992) and on the shift from ‘spin-off’ to ‘dual-use’ terminology see Mollas-Gallart (1997), Cowan and Foray (1995).
consider how notions of self-identity and appraisals of technology are co-constituted. Thus it has been argued that many developing nations procure high-tech weaponry not because of capability needs defined by strategic calculation, but because of identity considerations about what it means to be a modern state (Eyre & Schuman, 1996). Studies of the taboos against the use of nuclear weapons (Tannenwald, 1999) and the development of chemical weapons (Price, 1997) have elaborated on the processes by which particular weapons became stigmatized to such an extent that their use is rarely seriously contemplated. Both Tannenwald and Price argue that acquiescence in these taboos – which were chiefly promulgated by Western industrialized states – constituted a means of defining what it meant to be “civilized”. Yet with the exception of Price (1997), this body of norms work in international relations makes little explicit reference to the other analyses of technology mentioned in this chapter.

Security in the Post-9/11 World

The events of 9/11 and its aftermath have posed important questions for policy makers, scholars, and members of the public regarding the degree of change and continuity in international security and what must be done as a result. Global terrorism and the proliferation of “Weapons of Mass Destruction” (WMD) now dominate many policy and popular discussions, whilst the use of military force has become a recurring – albeit not uncontested – aspect of Western policy. As a result, Smit’s (1994) prediction that “military budgets and forces will be substantially reduced both in the United States and in all European countries” has not come to pass. On the contrary, at $419.3 billion the Bush administration’s defense spending request for Fiscal Year 2006 is 41 percent larger than it was in 2001. Of this, approximately $69.4 billion (16.6%) is allocated to the research, development, testing and evaluation activities associated with the creation of new capabilities (Whitehouse, 2005).

Bijker (2003) has posed the question of whether technological societies are changing because of 9/11 and if so how? As of yet, however, only a few writers have addressed the post-9/11 situation through the lenses of STS. Each, in different ways, suggests that the purportedly radical newness of the current security situation is contestable. Thus: the complexity of many Western technological systems has not suddenly become a risk factor; the (ir)rationality underpinning terrorist acts is not wholly alien to the West; while the US responses to the threat of international terrorism and the anthrax attacks following 9/11 are by no means without historical precedents. Winner (2004) argues that by focusing on the enemy “out there,” policy-makers and social scientists may ignore the fact that the vulnerability of many large technological systems is not inevitable, but is instead a consequence of previous choices. A nuclear power plant, for example, is a result of prior political and technological choices – choices that make it a more likely and “unforgiving” terrorist target than a windmill farm. Turning to the terrorists themselves, Gusterson (2001) draws attention to the dominant discourse of “othering” that represents the terrorist threat as an irrational, pre-modern threat to the rational West. Gusterson claims that this discourse is incorrect; that terrorists – in assessing the number of deaths and the degree of spectacle required to achieve their goals – have embraced the same
calculative, managerial rationality as weapons designers and war planners. Taking a more historical perspective, Jenkins (2002) argues that the US response to the 9/11 attacks is not without precedent. During the interwar period, he argues, a combination of politicians, scientists and engineers, along with business and the military, joined forces to create the idea of a threat to the US public posed by “outlaw” states armed with aircraft and chemical weapons. Their purpose in creating this fear was to bolster their own position as guardians of US security – an approach that for Jenkins anticipates certain aspects of the current “War on Terror”. With respect to the anthrax attacks which followed in the wake of 9/11, King analyses the continuities and discontinuities in the responses of the authorities. Concerns expressed during the attacks about borders, civil liberties and surveillance, were symptomatic, he suggests, of “American concerns about global social change [being] refracted through the lens of infectious disease” (King, 2003: 435).

Whatever assessment one makes of the “newness” of the post-9/11 situation, in the future much scope will exist for revisiting issues raised in the previous section regarding the harnessing of science and technology, and the effects of military R&D on science and technology. At the time of writing (especially, albeit not solely, in the US), security and military issues are particularly salient. In the West’s search for security against terrorists and WMD, the military has become increasingly integrated and coordinated with other political and social institutions. Science has not been immune from this. With the growing attention given to bioterrorism, for instance, billions of dollars are being dedicated to R&D against possible bioagents (Wright, 2004). Yet, alongside such funding, it has also been contended that developments in the life sciences might facilitate the construction of biological weapons. This has led to a situation where scientists are increasingly expected to find ways of regulating their behaviour and controlling the future application of their work (Rappert, 2003b). Also, in relation to fears about terrorism many Western countries are witnessing the merger of security and public health concerns (Guillemin, 2005), and an increasing turn to surveillance technologies along with attendant concerns over the infringement of civil liberties (Caplan & Torpey, 2001, Lyon 2003).

Science and technology, therefore, remain central features of the changing security and military landscape, even if this landscape remains a rather peripheral concern of the STS community. Another important point is that the relatively few new studies of the relationships between science, technology and military concerns discussed in this chapter have benefited from the post-Cold War situation with regard to secrecy. As mentioned earlier, since the 1995 edition of the STS handbook, scholars have enjoyed access to new archival sources along with greater openness on the part of policy-makers and other actors in relation to sensitive issues. To the extent that information is becoming accessible, it is possible to revisit previous presumptions in the field, such as the degree of unanimity between government, armed forces, and contractors in the military industrial complex (Scranton, 2004). Yet, military-related topics remain an area where access continues to be a critical methodological and political issue and where, at the time
of writing, it is still not clear to what extent current modest, but improved, levels of transparency in some countries are but a transient phenomenon. 3

The limited interrelationships between STS and other fields concerned with the military and security remains unfortunate. Additional inroads continue to be made, such as Edgerton’s (2006) study of the history of military technology and Rappert’s (2006) attempt to reframe efforts to prohibit weapons under international humanitarian law through an examination of the latter’s classification schemas. Yet overall, the integration of “STS” within many traditional fields of study remains limited. For instance, “Strategic Studies” and its cognate fields potentially have much to learn from recent developments noted in this chapter. Awareness of the social content of science and technology has not been a conspicuous feature of Strategic Studies analyses, which have been prone to grant them autonomous or deterministic qualities. Exceptions exist, a notable example being Freedman’s (1998) analysis of the changing nature of warfare associated with the exploitation of information technologies by modern armed forces – a phenomenon commonly termed the “Revolution in Military Affairs.” According to Freedman, the influence of information technologies on the character of warfare has itself been contingent on the broader political and strategic contexts in which it has occurred, the implication being that there is nothing inevitable about such developments. In relation to more traditional weapons, Stone (2000; 2002) contends that national variation in the design of tanks have historically been a function of differences in the military doctrines that govern their employment in war. These differences in doctrine have also been important for shaping attitudes towards the threat posed by new antitank systems. The interpretation placed on such threats has in large part rested on the precise roles and missions that tanks have been expected to conduct. According to Stone, therefore, debates about the future of the tank should accommodate doctrinal, as well as technical, considerations. Many of the STS analyses identified in this chapter could provide excellent means with which strategists might seek to build on positions such as these, but this will be possible only if transparency and access are adequate. In the meantime, the United States in particular is moving along a path of extensive military-technical innovation, the consequences of which are quite uncertain.

References


3 The US National Archives and Records Administration (NARA), for example, announced that “in light of the terrorist events of September 11, we are re-evaluating access to some previously open archival materials and reinforcing established practices on screening materials not yet open for research” (http://archives.gov/research_room/whats_new/notices/access_and_terrorism.html accessed 21/02/05).


