

Preface

New and unpredicted technologies are emerging at an unprecedented pace around the world. Communication of those new discoveries is occurring faster than ever, meaning that the unique ownership of a piece of new technology is no longer a sufficient position, if not impossible. In today's world, recognition of the potential applications of a technology and a sense of purpose in exploiting it are far more important than simply having access to it.

Technological surprise has and will continue to take many forms. A plethora of new technologies are under development for peaceful means but may have unintended security consequences and will certainly require innovative countermeasures. A relevant example is the tremendous development in biotechnology that has occurred since the advent of recombinant DNA and tissue culture-based processes in the 1970s. If US government agencies and the defense and academic communities had more clearly recognized the potential for biotechnology to affect fundamental security and warfighting doctrines 20 years ago, the situation today could be very different. Defense against chemical and biological weapons – from both states and nonstate actors – currently presents a threat that is difficult to predict and for which traditional solutions are increasingly less effective.

Nanotechnology has emerged as a well-funded discipline that, like biotechnology, carries the potential for groundbreaking applications and the potential for unpredictable harm. The world is likely 20 years away from the full impact of the nanotechnology on defensive capabilities. Now is therefore the time to explore the potential for new science and new breakthroughs, and now is the time to begin the strategic thinking needed to achieve, exploit, and defend against these discoveries.

The ability to preempt technological surprise by forward thinking is a tempting goal. Making accurate predictions, however, is never easy and can many times be dangerous. For these reasons, any attempt to look forward more than 20 years must be driven by strategic concerns as well as deep knowledge, flexible thinking, and sound tactics.

Scope and Purpose

The research underpinning this book, and the workshop that was undertaken as part of it, was intended to better enable an informed national debate and to affect international debate on the potential role and impact of nanotechnology and emerging science on national defense and homeland and international security. The text highlights the findings and conclusions from the study and accompanying workshop as well as identifies research directions in basic and applied science that may foster transformational breakthroughs in nanotechnology-based chemical and biological countermeasures. This ambitious effort serves manifold objectives, including the following:

- To give policymakers a strategic roadmap to provide a basis for research direction decisions for chemical and biological nanotechnology countermeasures
- To provide an overview of the current and future challenges associated with chemical and biological defense, both for military operations and for homeland security applications
- To provide a survey of potential future proliferation and malevolent cooption of emerging technologies, such as nanotechnology, incorporating a robust technical perspective
- To consider the impact of the changing threat environment in which the military operates and the implications for fostering innovative research support for chemical and biological countermeasures
- To highlight current successes and challenges in the organizational structure and management of chemical and biological defense-related research as well as nanotechnology-related research at the federal level

This study and workshop emphasized revolutionary rather than evolutionary science and technology. Evolutionary developments refer to foreseeable and incremental improvements in a technological capability based on the current state of the art. Revolutionary or breakthrough science is that which changes the current way of thinking about solving a problem, specifically chemical and biological defense in this application. Some historical examples of revolutionary technologies are the understanding the role and structure of DNA, the use of genetic engineering, and the capability of electron microscopy to “see” with electrons rather than light.

Further, the study and workshop intentionally spanned both technical disciplines and the social sciences. Ideas or work from across the experimental and theoretical physical and life sciences are included and contributions of social scientists were actively sought. To paraphrase Secretary of Defense Robert Gates,¹ the challenges facing the world require a much broader conception than during the Cold War, and the solutions will require application and engagement of additional intellectual disciplines that transverse previous conceptions of interdisciplinary.

Chapters 1 and 2 provide an overview of the current situation and provide detailed background on the “four worlds” construct – the scenarios – used to frame the study. Chapter 3 describes the potential applications for nanotechnology in specific areas of CB defense – physical protection, detection and diagnostics, decontamination, and medical countermeasures. Chapter 4 examines the potential for intentional misuse of nanotechnology in the chem-bio regime. Chapter 5 outlines near-term research directions, and Chapter 6 provides a summary and concluding remarks.

Chapters 3–5 delve into a level of detail directed toward the scientific community. Technical references to specific documents and leading scholarly journals are included for the reader who is interested in more closely examining the ideas upon which the text, scenarios, conclusions, and recommendations are based.

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Note

1. Speech as delivered by Secretary of Defense Robert M. Gates to the Association of American Universities (Washington, DC), April 14, 2008, <http://www.defenselink.mil/speeches/speech.aspx?speechid=1228>. Accessed 30 June 2008.



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