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Rogue Science

Maxwell Gregg Bloche
Georgetown University Law Center, bloche@law.georgetown.edu

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REVIEW ESSAY

Rogue Science

SCIENCE IN THE SERVICE OF HUMAN RIGHTS. By Richard Pierre Claude, University of Pennsylvania Press, 2002. Pp. 280. $42.50.

SCIENCE AND TECHNOLOGY IN A VULNERABLE WORLD. Edited by Albert H. Teich, Stephen D. Nelson and Stephen J. Lita. American Association for the Advancement of Science, 2002. Pp. 83. $12.95.

M. GREGG BLOCHE*

INTRODUCTION: WAR, SCIENCE AND SOCIAL CONSEQUENCES

More than 600 years ago, invading Tatars intent on controlling Silk Road trade attacked the Black Sea port of Kaffa in unconventional fashion. Tatar catapults lofted dead human bodies, victims of bubonic plague, over the town's walls. Residents of Kaffa came down with the disease. Some townspeople fled to Italy by sea. But their ships contained flea-infested rats, and the fleas, in turn, carried the bacterium that causes plague. Italian cities that accepted these ships endured devastating plague outbreaks. Some theorize that the Black Death, which killed nearly a third of Europe's population over the next several years, was the product of these outbreaks—and, perhaps, a product of the Tatars' biological attack.[1]

At least since Roman times, invading armies have launched dead animals over city walls and dumped them into water supplies to spread disease.[2] There is little recorded history of reluctance on the part of those with the knowledge needed to do such things. To the contrary, the history of warfare is a story of unrestrained translation of technical advances into destructive capability.[3] No long-standing canon of ethics, akin to the Hippocratic tradition in medicine,

* Professor of Law, Georgetown University and Adjunct Professor, Bloomberg School of Public Health, Johns Hopkins University. I thank Viet Dinh, Mark Frankel, Steven Goldberg, David Koplow, and David Luban for their comments and suggestions and Maria Granovsky and Matthew Pierce for their research assistance.

1. George W. Christopher et al., *Biological Warfare: A Historical Perspective*, 278 JAMA 412, 412 (1997).

2. *Id. See also* John Ellis van Courtland Moon, *Controlling Chemical and Biological Weapons Through World War II*, *in* ENCYCLOPEDIA OF ARMS CONTROL AND DISARMAMENT 658 (Richard D. Burns ed., 1993).

3. *See generally* MARTIN VAN CREVELD, TECHNOLOGY AND WAR: FROM 2000 B.C. TO THE PRESENT (1991).

which limits the purposes to which clinical skills may be put,[4] has constrained those with the ability to turn state-of-the-art science toward destructive ends.

Scientific inquiry as a *professional* endeavor with self-imposed norms of conduct dates back only a few hundred years,[5] by contrast with the 2500-year-old Hippocratic tradition. These norms of conduct, moreover, have focused on the process of scientific inquiry, not the permissible uses of scientific knowledge. Requirements that theories be experimentally falsifiable, that data be reported accurately and with minimal bias, and that lines of argument and experimental methods be set forth clearly to facilitate scrutiny and replication[6] aim at ensuring that scientific progress remains rigorously tied to empirical observation. Habits of skepticism toward novel claims, an aesthetic preference for simple explanations of experimental data, and a preference for theories that lead to robust agendas for new research[7] reinforce the tight connection between scientific understanding and observed evidence. This process-oriented conception of scientific obligation pointedly ignores social consequences; indeed, it treats concern about the social and political uses of scientific knowledge as a potential distraction from the pursuit of evidence-driven understanding. In the words of Robert Oppenheimer, director of the Manhattan Project:

> If you are a scientist you believe that it is good to find out how the world works; that it is good to find out what the realities are, that it is good to turn over to mankind at large the greatest possible power to control the world and to deal with it according to its lights and its values.[8]

This Essay will consider the tension between this vision of science's mission and the fears of malicious use and terrible consequences that have come to the fore since the terrorist attacks of September 11, 2001. These fears have led some to call for government restrictions on the substance of scientific research and communication. In general, this approach is likely to do far more harm than good. But scientists need to take the problem of social consequences more seriously than they have so far. I argue in this Essay that in some circumstances, when rogue use of science can do large-scale harm and when there are strong grounds for believing that a foe has the will and ability to do such harm, self-restraint within the scientific community is called for.

4. *See* M. Gregg Bloche, *Clinical Loyalties and the Social Purposes of Medicine*, 281 JAMA 268, 268 (1999).

5. *See* EUGENE B. SKOLNIKOFF, THE ELUSIVE TRANSFORMATION: SCIENCE, TECHNOLOGY, AND THE EVOLUTION OF INTERNATIONAL POLITICS 16 (1993).

6. *See, e.g.*, KARL R. POPPER, THE LOGIC OF SCIENTIFIC DISCOVERY 27–48 (1968).

7. *See* THOMAS S. KUHN, THE ESSENTIAL TENSION 266–92 (1977).

8. ROBERT OPPENHEIMER: LETTERS AND RECOLLECTIONS 317 (Alice K. Smith & Charles Weiner eds., 1980).

I. SCIENTIFIC FREEDOM AND SOCIAL RESPONSIBILITY

The development of nuclear weapons changed many scientists' thinking about the question of social consequences. Anticipating the destructive power of an atomic bomb, some World War II-era physicists rejected Oppenheimer's entreaties to participate in the Manhattan Project. By some accounts, the physicist Werner Heisenberg, asked by the Nazis to lead Germany's efforts to build an atomic bomb, intentionally sabotaged the German program to keep nuclear weapons out of Hitler's hands. After the nuclear strikes against Hiroshima and Nagasaki, more scientists declined to take part in atomic weapons research. Oppenheimer himself was accused by U.S. authorities in the 1950s of trying to undermine American efforts to build a hydrogen bomb.[9] Albert Einstein and others urged both abolition of nuclear weapons and renunciation of war,[10] but they stopped short of recommending an end to research with potentially destructive military applications.

Many more American scientists eagerly participated in Cold War-era research on nuclear weapons, missile guidance systems, and other state-of-the-art military technologies. The nation's leading universities affirmed their commitment to conducting science in service of the nation's security, though they insisted on maintaining Chinese walls between classified military research and academic programs.[11] In the Soviet Union and other nations, scientists similarly devoted themselves to advancing their countries' weapons capabilities. To be sure, some internationally agreed upon limits emerged: Human rights instruments, most notably the International Covenant on Civil and Political Rights,[12] bar experimentation on human beings for any purpose without their informed consent,[13] and international codes of medical ethics impose this proscription directly upon

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9. PHILIP M. STERN, THE OPPENHEIMER CASE: SECURITY ON TRIAL 215–17 (1969).

10. *Russell-Einstein Manifesto*, July 9, 1955 (signed by Max Born, Perry W. Bridgman, Albert Einstein, Leopold Infeld, Frederic Joliot-Curie, Herman J. Muller, Linus Pauling, Cecil F. Powell, Joseph Rotblat, Bertrand Russell, and Hideki Yukawa), *available at* http://www.pugwash.org/about/manifesto.htm (last visited Nov. 3, 2003).

11. Universities typically required that classified research be conducted in separate laboratories, overseen by university officials but off-limits to students and apart from educational programs. Classes and student research could be conducted only in unclassified settings, on unclassified topics, without security-related restrictions on discussion or publication. Classified research could not count toward thesis requirements or otherwise receive academic credit. This approach was thought to preserve the intellectual freedom necessary for scientific progress while putting the fruits of this progress to use for America's security. *See generally In the Public Interest: Report of the Ad Hoc Faculty Committee on Access to and Disclosure of Scientific Information*, 2002 MASS. INST. TECH. 1 [hereinafter *In the Public Interest*].

12. International Covenant on Civil and Political Rights, Dec. 19, 1966, art. 7, 999 U.N.T.S. 171, 175.

13. American and foreign researchers have often fallen short of this standard. The U.S. Advisory Committee on Human Radiation Experiments found that from 1944 to 1974, most physicians conducting clinical research in the United States "did not obtain consent from patient-subjects for whom the research was intended to offer a prospect of medical benefit." ADVISORY COMMITTEE ON HUMAN RADIATION EXPERIMENTS, FINAL REPORT OF THE ADVISORY COMMITTEE ON HUMAN RADIATION EXPERIMENTS (ACHRE) 502 (Oxford 1996).

physicians.[14] But these limits constrain the research process, not science's political or social (or military) applications. Arms control treaties and multilateral agreements banning biological and other weapons[15] bind governments under international law but do not hold scientists personally responsible for research that aids development of proscribed weapons.[16] There is, in short, no ethical or legal consensus limiting scientific research based on its potentially destructive applications.

To the contrary, as Richard P. Claude observes, international law affirms scientists' freedom to choose research topics, communicate findings and ideas, and participate in transnational intellectual exchange.[17] In *Science in the Service of Human Rights*, Claude points out that the framers of the 1948 Universal Declaration of Human Rights rejected efforts to condition scientific freedom on scientists' commitment to peace, social justice, or other political ends.[18] When the Soviet delegate to the drafting body, the U.N. Human Rights Commission, urged recognition of "people's rights" to "science mobilized" for "progress and democracy" and for "peace and international cooperation," Eleanor Roosevelt, the U.S. representative, cautioned that these abstract aims could become concrete "pretext for the enslavement of science."[19] After others warned that assigning a "political mission" to science risked interfering with "the quest for truth,"[20] the drafters declined to make scientific freedom contingent upon political purposes or social consequences. They were influenced, as Claude notes, by sensitivity to totalitarian regimes' misuse of science: from Nazi racial

14. *See, e.g.*, DECLARATION OF HELSINKI: ETHICAL PRINCIPLES FOR MEDICAL RESEARCH INVOLVING HUMAN SUBJECTS §B-20, (World Med. Ass'n, last modified 2002), *available at* http://www.wma.net/e/policy/b3.html (last visited Sept. 2, 2003).

15. *See generally* Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on their Destruction, Sept. 18, 1997, 36 I.L.M. 1507; Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction, Jan. 13, 1993, 32 I.L.M. 804; Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction, Apr. 10, 1972, 26 U.S.T. 583, 1015 U.N.T.S. 163.

16. Scientists who participate in the *use* of banned weapons can be held accountable for war crimes based on their own conduct or their role in military chains-of-command. The Rome Statute establishing the International Criminal Court includes in its definition of war crimes the use of chemical and other internationally prohibited weapons. Rome Statute of the International Criminal Court, *opened for signature* July 17, 1998, art. 8, § 2(b)(xvii)–(xx), *reprinted in* 37 I.L.M. 999, 1007 (entered into force July 1, 2002). However, the range of activities that constitute involvement in such use is not specified in the Rome Statute and is ill-defined elsewhere in international criminal law. In a case involving Zyklon B, the poison gas used by the Nazis for mass killing of concentration camp inmates (including some allied nationals), a British Military Tribunal convicted two German corporate executives, Bruno Tesch and Karl Weinbacher, of war crimes for supplying gas to the German government with knowledge that the government would use the gas to kill detainees. The Zyklon B Case (Trial of Bruno Tesch and Two Others), 1 Law Reports of Trials of War Criminals 93, 101–02 (Brit. Mil. Ct. 1946). However, no one has been convicted of participation in war crimes for his or her involvement in research leading to production of prohibited weapons or to supply of lethal materials for prohibited use.

17. RICHARD P. CLAUDE, SCIENCE IN THE SERVICE OF HUMAN RIGHTS 27–56 (2002).

18. *Id.* at 31–38.

19. *Id.* at 33.

20. *Id.*

theory's rendering of "progress" as realization of Aryan superiority,[21] to the contortion of evolutionary and psychological theory by Stalinist ideologues to support Marxist beliefs about the plasticity of human nature.[22]

Subsequent international legal instruments, most notably the International Covenant on Economic, Social, and Cultural Rights (ICESCR), took a similar approach, emphasizing freedom of scientific expression and exchange, as well as intellectual property protection for scientific findings and ideas.[23] Like the Universal Declaration, ICESCR proclaims a human right to enjoy the benefits of scientific progress[24] but does not burden scientists with a duty to produce research results beneficial to humanity. And, like the Universal Declaration, the Covenant contains no language calling upon scientists (or states) to eschew research with troublesome applications. This approach protects freedom of inquiry against the overbearing state at a price—silence, even permissiveness, on the question of scientists' responsibility for the social impact of their work.

Claude resists acknowledging this trade-off. His book is in large measure a paean to progressive scientists' efforts to employ their skills and cultural standing on behalf of human rights. The accomplishments of these scientists are extraordinary. Consider the efforts of Patrick Ball, a sociologist on the staff of the American Association for the Advancement of Science (AAAS). When thousands of Muslim refugees fled the Yugoslav province of Kosovo during the 1999 Kosovo war, Yugoslav strongman Slobodan Milosevic denied allegations of "ethnic cleansing" by the Serb-dominated Yugoslav military. Milosevic claimed that NATO bombing, not marauding Serb troops, had forced the refugees to flee. Journalists and human rights monitors at Kosovo's border crossings had only the individual, subjective accounts of traumatized refugees to rebut this claim. But Ball and his collaborators organized a large-scale effort to translate these accounts into objective data about the origins and timing of refugee flows. They reasoned that information about places of residence and dates of flight was less subject to traumatic distortion than refugees' narrative accounts of their experiences.

Ball's team assembled accounts from thousands of displaced Kosovars and collected information on refugee flows from relief groups and the Albanian border authorities. They then correlated this data with publicly available information about the times and places of NATO air strikes, hostilities between Serb and Kosovar fighters, and killings by Serb forces. The results were a devastating

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21. *See id.* at 16.

22. Soviet authorities adhered officially to Trofim Lysenko's theory of genetic transmission of acquired characteristics long after it had been conclusively disproved, *see generally* ZHORES A. MEDVEDEV, THE RISE AND FALL OF T.D. LYSENKO (I. Michael Lerner trans., 1969), and they embraced Ivan Pavlov's model of all thinking and behavior as the product of neurophysiologically mediated environmental conditioning. M. Gregg Bloche, *Law, Theory, and Politics: The Dilemma of Soviet Psychiatry*, 11 YALE J. INT'L L. 297, 308–11 (1986).

23. International Covenant on Economic, Social and Cultural Rights, Dec. 16, 1966, art. 15, 993 U.N.T.S. 3, 9.

24. *Id.*

rebuttal to Milosevic's bid to blame NATO. Refugee flows correlated closely with the killings and only weakly with the air strikes.[25] Confronted with Ball's April 2002 testimony to this effect at his own war crimes trial in The Hague, Milosevic (who personally cross-examined Ball) offered bluster but no evidence-based challenge.[26]

Other examples of the use of science to protect and promote human rights include sequencing of mitochondrial DNA to reunite children with their grandparents after their parents were murdered during military rule; anthropologic excavation of mass graves to document clandestine killing; medical assessment of torture victims to support political asylum claims; and statistical evaluation of pregnancy and abortion rates to document mass rape as a crime of war.[27] Examples of scientists' use of their cultural stature to campaign for progressive conceptions of human rights include opposition to war and to particular weapons systems; support for the right to health and other social and economic rights; and resistance to private sector efforts to broaden intellectual property rights. Richard Claude celebrates these examples, sometimes without clearly distinguishing between the goals of liberal politics and the requisites of established human rights law. But these examples represent scientific voluntarism. They do not reflect researchers' ethical or legal obligations, as these now stand.

II. THE REACTION TO SEPTEMBER 11

The high-stakes premise immanent in this noncommittal stance toward social responsibility is that science will contribute more toward human well-being over the long term if left unconstrained by concerns about social consequences.[28] The repeated failure of authoritarian regimes in economic competition with the West has seemed consistent with this premise. Nevertheless, September 11 and its aftermath have driven many to revisit it. Though the September 11 hijackers made use of everyday, even banal technology, the catastrophe they brought about made previously-ignored nightmare scenarios suddenly seem plausible. The mysterious anthrax mailings a month later killed

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25. *See* Transcript of the Trial of Slobodan Milosevic before the International Criminal Tribunal for the Former Yugoslavia, Mar. 13, 2002, at 2140, 2204–08 (testimony of Dr. Patrick Ball), *available at* http://www.un.org/icty/ind-e.htm (last visited Nov. 3, 2003). *See generally* ABA CENT. & E. EUROPEAN LAW INITIATIVE & AM. ASS'N FOR ADVANCEMENT OF SCI., POLITICAL KILLINGS IN KOSOVA/KOSOVO, MARCH – JUNE 1999 (2000), *available at* http://shr.aaas.org/kosovo/pk/politicalkillings.pdf (last visited Nov. 3, 2003).

26. Transcript of the Trial of Slobodan Milosevic before the International Criminal Tribunal for the Former Yugoslavia, Mar. 13, 2002, at 2140, 2208–16 (testimony of Dr. Patrick Ball), *available at* http://www.un.org/icty/ind-e.htm (last visited Nov. 3, 2003).

27. *See* CLAUDE, *supra* note 17, at 127–45.

28. There is a loose analogy here to Anglo-American tort law's rejection of a "duty to rescue." Proponents of the traditional "no duty" position argue that requiring rescue—as well as aid to others more generally—encumbers citizens with obligations that crowd out inventiveness and initiative, making society worse off in the long run.

five Americans,[29] fewer than one-twentieth of the daily average of traffic deaths,[30] yet pushed fear of bioterror to the top of the list of American worries. Formerly fantastic-seeming scenarios involving weaponized microbes, nuclear and radiological bombs, and chemical attacks now preoccupy national security and law enforcement authorities.

Against this backdrop, scientific advances that might have made news as steps toward the cure or eradication of disease now inspire fear—and bring calls for constraints on research agendas and on publication of research results. A dramatic example is the engineering of the mousepox virus for pest control purposes. Australian researchers altered the virus by inserting the gene for a protein that they theorized would prompt rodents' immune systems to destroy their own egg cells, rendering the creatures sterile. But the investigators faced an obstacle to their contraception strategy: The immune systems of some strains of mice disabled the virus before the protein could achieve the desired sterilizing effect. The researchers tried to solve this problem by adding the gene for interleukin-4, a protein that suppresses the anti-viral immune response in rodents (and humans), to their mousepox virus. They succeeded beyond their expectations. All of the infected mice from resistant strains died. Press coverage seized upon the most terrifying implication. Could the interleukin-4 gene, inserted into smallpox, a close relative of mousepox, produce a virus of previously undreamt of lethality, rendering smallpox vaccine ineffective?[31]

Another example is the synthesis of live polio virus from commercially available chemicals by scientists who used polio's publicly available genome sequence as their roadmap.[32] This development inspired fear that such deadly viruses as Ebola and the 1918 "swine" flu strain could be similarly synthesized.[33] In both the mousepox and polio cases, some observers questioned the decision to conduct the research, while others criticized its publication.

Chilling reports concerning the size and scope of biological weapons programs in the former Soviet Union and elsewhere[34] complete the circle of fear. Whereas smallpox was once thought to be confined to well-guarded stores in Moscow and the Centers for Disease Control in Atlanta,[35] American military and civil defense planners now assume the existence of rogue supplies of

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29. *See* Eric Lipton & Kirk Johnson, *A Nation Challenged: The Anthrax Trail*, N.Y. TIMES, Dec. 26, 2001, at A1.

30. 42,116 Americans died in traffic accidents in 2002—approximately 115 per day. NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., NAT'L CTR. FOR STATISTICS & ANALYSIS, FATAL ANALYSIS REPORTING SYSTEM WEB-BASED ENCYCLOPEDIA, *available at* http://www-fars.nhtsa.dot.gov/main.cfm (last visited Nov. 3, 2003).

31. *See* Jon Cohen, *Designer Bugs*, ATLANTIC MONTHLY, July–Aug. 2002, at 113.

32. *See* Andrew Pollack, *Scientists Create a Live Polio Virus*, N. Y. TIMES, July 12, 2002, at A1.

33. *See, e.g.*, Sylvia Pagan Westphal, *Ebola Virus Could be Synthesized*, NEW SCIENTIST, July 17, 2002, at 6.

34. *See generally* KEN ALIBEK, BIOHAZARD: THE CHILLING TRUE STORY OF THE LARGEST COVERT BIOLOGICAL WEAPONS PROGRAM IN THE WORLD, TOLD FROM THE INSIDE BY THE MAN WHO RAN IT (1999).

35. Lawrence K. Altman, *Smallpox Virus, Frozen in 2 Labs, Escapes a Scalding End for Now*, N.Y. TIMES, Dec. 25, 1993, at 1.

smallpox and anxiously debate vaccination strategies.[36] Worries over black markets for bioweapons, Russian scientists available to rogue states for a price, and efforts by transnational terror networks to acquire unconventional weapons preoccupy military and law enforcement authorities. The emergence of Pakistan and North Korea as nuclear powers has amplified international fears.

III. THE RESEARCH COMMUNITY'S RESPONSE

For American science, the challenge is twofold. First, how should scientists put their skills and knowledge to use to address these new risks and fears while sustaining the nation's commitment to democratic liberties and other values? Second, to what extent, if at all, should these new security concerns constrain scientific inquiry and exchange?

A. CIVIC DUTY AND SKEPTICAL DISTANCE

So far, the first question has proven easier to address. As M. R. C. Greenwood observes in her contribution to the anthology *Science and Technology in a Vulnerable World*, after September 11 the American research community energetically embraced the paradigm of "civic scientists engaged in civic duty."[37] Following their World War II-era forbearers, whose participation in the nation's mobilization yielded myriad advances in medical technique and military hardware, many scientists today are refocusing their research agendas on such tasks as detection of clandestine biological and radiological weapons, treatment of illness and injury inflicted by such weapons,[38] and more precise, even nonlethal means of waging war.[39] As Greenwood notes, this redesigned agenda reflects both scientists' civic commitment and the nation's rechanneling of resources to counter threats from terrorists and rogue states. In another essay in *Science and Technology in a Vulnerable World*, Lewis M. Branscomb recalls nostalgically: "Before and during World War II, and even for some time after, everyone understood that you dropped what you were doing when your country needed you. The science and technology community was totally dedicated to

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36. *See, e.g.*, Barton Gellman, *4 Nations Thought to Possess Smallpox; Iraq, N. Korea Named, Two Officials Say*, WASH. POST, Nov. 5, 2002, at A1; Gina Kolata, *With Vaccine Available, Smallpox Debate Shifts*, N.Y. TIMES, Mar. 30, 2002, at A8.

37. M. R. C. Greenwood, *Risky Business: Research Universities in the Post-September 11 Era*, *in* SCIENCE AND TECHNOLOGY IN A VULNERABLE WORLD 1, 4 (Albert H. Teich et al. eds., 2002).

38. The Department of Homeland Security has stated its intention to promote and sponsor research aimed at developing sensors to detect chemical, biological, nuclear, and radiological weapons, http://www.dhs.gov/dhspublic/display?theme=25 (last visited Nov. 3, 2003), as well as new vaccines, antidotes, diagnostic tools, and therapies for biological and chemical warfare agents, http://www.dhs.gov/dhspublic/display?theme=53&content=208 (last visited Nov. 3, 2003).

39. *See* COMM. ON THE NAVY & MARINE CORPS IN REG'L CONFLICT IN THE 21ST CENTURY, THE NAVY AND MARINE CORPS IN REGIONAL CONFLICT IN THE 21ST CENTURY 10–12 (1996) (recommending greater use of guided weapons technology in order to reduce both collateral damage and U.S. military losses); *see also* COMM. FOR AN ASSESSMENT OF NON-LETHAL WEAPONS SCI. & TECH., AN ASSESSMENT OF NON-LETHAL WEAPONS SCIENCE AND TECHNOLOGY 23–24, 98 (2003) (reviewing the technology for non-lethal weapons and concluding that "the case for [such weapons] appears to be strong and getting stronger").

defeating the enemy. . . ."[40]

This conception of scientists' duty, which renders researchers as warriors, has the virtue of simplicity, achieved by sacrificing professional distance from wartime passions. Wartime passion, conjoined to wartime marshaling of public resources, is a powerful driver of technical innovation. But, left unrestrained by scientific norms of skeptical detachment, it risks compromising the scientific community's judgment about potential research avenues and the policy implications of scientific knowledge. Greenwood cautions that the post-September 11 research and development emphasis on "missiles and medicine," aimed at defeating our enemies in battle and hardening our defenses against biological attack, risks crowding out research with the potential to further our prosperity, health and environmental security.[41] It also risks crowding out social science inquiry into the origins of terrorism, the reasons for state failure, and the things we might do to diminish potential enemies' interest in doing us harm. Sustaining a scientific ethic of skeptical distance in the face of wartime emotion would empower the research community to speak to these issues—and to render wiser, more dispassionate judgments about the efficacy of "missiles and medicine."

An ethic of skeptical distance represents neither a departure from patriotism nor an endorsement of moral equivalence between terrorists and ourselves. To the contrary, it constitutes a long-term wager in favor of professional self-discipline—a wager rooted in the proposition that scientists can do more for the nation's security by maintaining their analytic detachment than by acting as uncritical boosters of national policy. This detachment is also more likely to engender resistance to uses of technology that endanger civil liberties and human rights.[42] The post-World War II science and human rights movement chronicled by Richard Claude has succeeded in institutionalizing a commitment to human rights within major professional and scientific organizations.[43] The ethic of skeptical distance holds out the potential to strengthen this commitment into a generalized refusal to collaborate in human rights abuse. On the other hand, this ethic allows for loyalty to country. Members of the science and technology community can retain their critical detachment while siding unabashedly with their country in its struggle against foreign enemies. The ethic of

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40. Lewis M. Branscomb, *The Changing Relationship between Science and Government Post-September 11*, *in* SCIENCE AND TECHNOLOGY IN A VULNERABLE WORLD, *supra* note 37, at 21, 22.

41. Greenwood, *supra* note 37, at 11.

42. An example is the Pentagon's post-September 11 "Total Information Awareness" program, designed to monitor e-mail, internet transactions and website viewing patterns of potentially large numbers of people to ferret out potential terrorists. John Markoff & John Schwartz, *Many Tools of Big Brother Are Now Up and Running*, N.Y. TIMES, Dec. 23, 2002, at C1. Whether and to what extent this program might infringe upon people's privacy rights (and protections against government searches and self-incrimination) is a subject beyond the scope of this discussion. But the ethic of skeptical distance I urge above should encourage members of the science and technology community to raise this sort of question when asked to participate in national security programs with nettlesome human rights implications.

43. *See generally* CLAUDE, *supra* note 17, at 127–95.

skeptical distance is thus a weaker constraint on nationalist partisanship than are the ethics governing military physicians, who must treat wounded friendly and enemy troops alike[44] and who cannot take up arms against the foe.[45]

Like many other professional norms, the ethic of skeptical distance to some degree serves the interests of its adherents. It reinforces the research community's professional autonomy and social and political cachet, to the extent that scientists are believed to exercise their judgment in public-spirited fashion.[46] But this self-interest is not a basis for rejecting the ethic of skeptical distance, any more than the profit motive is a basis for rejecting the freedoms of a market economy. So long as the social benefits of scientific skepticism and detachment outweigh the costs of a looser, more voluntaristic connection between scientists' conduct and public purposes, the self-interest involved is a useful motivator, not a problem.

B. REGULATORY CONSTRAINTS ON SCIENTIFIC INQUIRY AND EXCHANGE

Post-September 11 fears have prompted some in government to push to regulate the conduct of scientific inquiry and exchange. Limits on foreign nationals' participation in research and conferences, constraints on access to research equipment and supplies, non-publication of experimental methods, and non-publication of findings deemed "sensitive" are among the types of restrictions urged.[47] As Eugene Skolnikoff notes in his contribution to *Science and Technology in a Vulnerable World*, academic researchers strongly oppose these efforts.[48] Their resistance is well-founded. In brief, they argue that American science's culture of openness is key to its unparalleled productivity, and that this productivity is critical to our country's security.[49] Our economic prosperity and

44. WORLD MED. ASS'N, REGULATIONS IN TIME OF ARMED CONFLICT (1957, as amended), *available at* http://www.wma.net/e/policy/a20.htm (last visited Nov. 3, 2003).

45. Geneva Convention for the Amelioration of the Conditions of the Wounded and Sick in Armed Forces in the Field, Aug. 12, 1949, art. 4, 75 U.N.T.S. 31, 34. *See id.* at annex 1, art. 2.

46. In general, public confidence in science and scientists is high, as evidenced by continually rising federal support for research and public reliance on professional peer review to select research proposals for grant funding. *See* STEVEN GOLDBERG, CULTURE CLASH: LAW & SCIENCE IN AMERICA 37–38, 56–57 (1994). But the popular culture stereotype of the "mad scientist" as villain, consumed by the joys of specialized technique and unconcerned about public purposes, points to the dependence of public confidence upon the perception that scientists are committed to the public interest. *See* Tom Lehrer, *Wernher von Braun, on* THAT WAS THE YEAR THAT WAS (Reprise Records 1965) ("'Once the rockets are up, who cares where they come down? That's not my department,' says Wernher von Braun."); *see also* DR. NO (United Artists Films 1963) (James Bond saves the world from a fanatical scientist); DR. STRANGELOVE (Hawk Films, Columbia Pictures Corp. 1964) (mad atomic scientist thrills to impending nuclear war); THE 6TH DAY (Columbia Pictures 2000) (rogue scientist clones man lost in an air crash).

47. *See generally* Eugene B. Skolnikoff, *Protecting University Research Amid National-Security Fears*, CHRON. OF HIGHER EDUC., May 10, 2002, at B10.

48. Eugene P. Skolnikoff, *Research Universities and National Security: Can Traditional Values Survive?, in* SCIENCE AND TECHNOLOGY IN A VULNERABLE WORLD, *supra* note 37, at 65.

49. *See, e.g., Conducting Research During the War on Terrorism: Balancing Openness and Security: Hearing Before the House Comm. on Science*, 107th Cong. (2002), *available at* http://www.house.gov/science/hearings/full02/index.htm [hereinafter *Balancing Openness and Security*] (testimony by leaders

military advantage rest on this science base,[50] as does our ability to devise countermeasures to domestic biological, chemical, and radiological attack.[51]

Proponents of barring foreign students from participating in research with potentially destructive applications[52] disregard the uncomfortable truth that upwards of one-third of all American Ph.D.s in the hard sciences, and upwards of one-half of Ph.D.s in some physical science and engineering fields, are conferred upon students from abroad.[53] Not only do these students conduct a great deal of cutting-edge research on the way to their Ph.D.s; many make their careers in the U.S. in both the industrial and academic sectors, contributing to American scientific leadership at their own countries' expense. Closing off many of the research opportunities that attract and keep them would cut off this infusion of talent and energy into the U.S. economy. It would, moreover, constrict an important pathway by which understanding of American culture spreads abroad to potential enemies who might otherwise learn about Americans only through media caricature.

Proposals to restrict publication of experimental methods that might imaginably be put toward destructive ends[54] strike at the core of the scientific process—the opportunity peers have to review the validity of these methods and to replicate experimental results.[55] Shielding experimental methods from colleagues' scrutiny neutralizes the skepticism that disciplines scientific progress. Peer review and replication identify errors (and worse)[56] committed by investigators. Of greater practical importance—in view of the high cost of research, low professional rewards for duplicating others' work, and the resulting low inci-

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in academic science, opposing current and proposed government restrictions on the conduct and dissemination of research); *In the Public Interest*, *supra* note 11 (reviewing the Massachusetts Institute of Technology's (MIT's) reasons for opposing many of these restrictions).

50. *See generally* ERNEST VOLKMAN, SCIENCE GOES TO WAR: THE SEARCH FOR THE ULTIMATE WEAPON, FROM GREEK FIRE TO STAR WARS (2002).

51. *See* Abigail Salyers, Editorial, *Science, Censorship, and Public Health*, 296 SCI. 605, 617 (2002) (urging unfettered scientific communication and international exchange as the best protection against bioterror).

52. *E.g.*, Press Release, White House, Homeland Security Presidential Directive-2, Combating Terrorism Through Immigration Policies (Oct. 29, 2001), *available at* http://www.whitehouse.gov/news/releases/2001/10/20011030-2.html.

53. NAT'L CTR. FOR EDUC. STATISTICS, U.S. DEP'T OF EDUC., DEGREES EARNED BY FOREIGN GRADUATE STUDENTS: FIELDS OF STUDY AND PLANS AFTER GRADUATION (1997), *available at* http://nces.edu.gov/pubs98/98042.htm (citing NAT'L CTR. FOR EDUC. STATISTICS, U.S. DEP'T OF EDUC., DIGEST OF EDUCATIONAL STATISTICS (1996)).

54. *See* Memorandum from Andrew H. Card, Assistant to the President and Chief of Staff, to the Heads of Executive Departments and Agencies (Mar. 19, 2002) (discussing measures to protect a wide variety of information deemed "sensitive," including findings from scientific research); *see also Balancing Openness and Security*, *supra* note 49, at 47 (statement of John H. Marburger, Director, Office of Science and Technology Policy).

55. *See* Salyers, *supra* note 51, at 617.

56. *See* Comm'n on Research Integrity, Integrity and Misconduct in Research (1995) (discussing role and limits of peer investigators' replication of experiments as a means of detecting and deterring scientific misconduct), *available at* http://ori.dhhs.gov/multimedia/acrobat/commissionreport.pdf (last visited Nov. 3, 2003).

dence of efforts to precisely replicate published research—is the caution that comes with awareness that others *might* try to replicate one's methods. Judiciousness in describing methods and reporting results renders published scientific findings more dependable. This, in turn, enables investigators to build more efficiently upon each others' work, by treating published findings as given and applying established methods to new questions. Absent solid intelligence establishing a rogue actor's capacity and intent to employ a new experimental method for destructive purposes, prior restraints on publication of experimental methods should be avoided.

Proponents of restrictions on publication of experimental findings deemed "sensitive" challenge the traditional separation of scientific inquiry into so-called "fundamental" research, conducted in academic settings and published without national security-related constraints, and classified research, performed off-campus by investigators who accept restraints on publication. Twenty years ago, at a time of rising Cold War tension, the Reagan Administration advanced a similar idea, urging the extension of prior restraint on publication of research findings beyond classified research to other findings thought to be problematic from a national security perspective.[57] University-based researchers mounted strong opposition,[58] and President Reagan relented. National Security Decision Directive 189 (NSDD 189),[59] issued by the White House in 1985, proclaimed a clear line between "classified" information, kept secret on national security grounds, and "fundamental" research. NSDD 189 permits publication of the latter without restraint; only "classified" research can be suppressed on national security grounds. After September 11, some in the Bush Administration argued that this bright-line approach gives insufficient weight to the risk that unclassified research, in the wrong hands, might yield results dangerous to national security.[60] They urged recognition of a new category—"sensitive but unclassified" research—subject to publication restriction on national security grounds, based on government determinations of sensitivity.

As it did in the early 1980s, the academic research community strongly opposes this approach. As several of the essays in *Science and Technology in a Vulnerable World* observe, a vast range of technologies can be used for malign

57. For a discussion of the Reagan Administration's position, see Jon Zonderman, *Policing High-Tech Exports*, N.Y. TIMES, Nov. 27, 1983, at 100.

58. Opponents produced a National Academy of Sciences report concluding that the academic research community played only a small role in technology transfer to the Soviet Union. University officials lobbied Reagan Administration officials, and the presidents of MIT, California Institute of Technology, and Stanford University even threatened to refuse federal contracts that would have allowed Defense Department reviewers to restrict publication of findings from unclassified research. *In the Public Interest*, *supra* note 11, at 5–6.

59. Nat'l Sec. Decision Directive 189, National Policy on the Transfer of Scientific, Technical and Engineering Information (Sept. 21, 1985), *available at* http://www.fas.org/irp/offdocs/nsdd/nsdd-189.htm.

60. *See* Memorandum from Andrew H. Card, *supra* note 54 (explaining "sensitive but unclassified" status and recommending how to treat such information).

purposes. Thus, the concept of "sensitive" information is dangerously elastic when seen from a perspective partial to scientific freedom. The research community is alarmed by this elasticity and its implications for government's power to disrupt the exchange of scientific information.[61] In its alarm, the research community has not paid enough heed to the possibility that unclassified science could produce findings immediately convertible into capability to do this country (or others) great harm.

Proponents of the "sensitive but unclassified" designation, on the other hand, have not offered a clear definition of "sensitive." Nor have they made the case for the existence of terrorists or rogue states with scientific capability sophisticated enough to monitor a vast array of research publications, spot new findings with destructive applications, and convert these findings into devastating weapons. To the contrary, it seems implausible that Al Qaeda, Hezbollah, or current rogue states could marshal anything resembling the technological capacity of the former Soviet Union in the 1980s—a capacity the Reagan Administration ultimately deemed insufficient to justify the censorship of unclassified research. The current administration's calls for restrictions on dissemination of "sensitive but unclassified" research have been curiously devoid of evidence bearing on the science and technology capability of the terror networks and impoverished dictatorships that are now our principal security concern.[62]

Absent such evidence, we are reduced to playing the odds, and these favor scientific freedom. The information needed to assemble a wide range of deadly chemical and radiological weapons is already in the public domain. Access to the necessary materials and ability to deliver an assembled weapon are the main obstacles to these forms of attack. Biotechnology is another matter. The knowledge needed to disseminate anthrax (in crude form, at least) and some other infectious agents is widely available. Furthermore, although genetic engineering techniques at science's cutting edge inspire myriad nightmare scenarios,[63] the ability of terror networks and rogue states to keep up with cutting edge biotechnology, let alone to quickly translate advances in this field into mass destructive possibilities, is speculative. Playing the odds, absent evidence of present capability and immediate threat, means betting that publication of any given biotechnology development is much more likely to lead to new therapies and prevention methods than to new terror weapons.[64] To put it simply, our

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61. *See Balancing Openness and Security*, *supra* note 49.

62. In conversations (on condition of anonymity) with this author, individuals recently privy to classified White House national security briefings report that they contain little information about the scientific research and development capabilities of terror networks and rogue states. U.S. failure, so far, to find proof of nuclear, biological, or chemical weapons in Iraq, after years of high suspicion, underscores the weakness of American intelligence concerning these capabilities.

63. The hypothetical, vaccine-resistant smallpox that terrified the Australian creators of immune-resistant mousepox is illustrative. *See supra* text accompanying note 31.

64. There are no data drawn from past experience that bear on the comparative likelihood of new terror weapons versus new therapies and prevention methods. But there are odds to play, based on indirect inference from the comparative research and development capabilities of the major industrial

terrorist foes cannot keep scientific pace with us. To figure otherwise, and to suppress knowledge of, say, a new genetic engineering accomplishment because we fear that some terrorist will learn about it, would be akin to driving a long distance because of fear of flying, despite air travel's superior safety.[65]

The case against aggressive federal regulation of scientific inquiry and exchange on national security grounds is further strengthened by a variety of cognitive and motivational factors likely to bias regulators against scientific freedom. Novel risks inspire disproportionate fear,[66] a point eagerly noted by national security-conscious conservatives in debates over hazards to health and the environment from nuclear power and industrial pollutants.[67] Perhaps the most potent example of this lack of proportion is the disconnect between the federal government's robust response to the threat of transnational bioterror and its tepid approach to the global spread of AIDS.[68] This more familiar scourge is expected to kill tens of millions of people by 2020,[69] more than would die in a

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democracies and rogue actors. The vast resources of the former—in university, government, and corporate laboratories—surely overwhelm the latter. According to Anthony S. Fauci, Director of the National Institute of Allergy and Infectious Diseases and a principal designer of the U.S. government's response to the bioterror threat, some intelligence officials believe that publication of new therapeutic responses to bioterror threats will push foes to develop bioweapons of greater lethality. Fauci rejects this argument, insisting that the more likely result of publication will be to spur rival laboratories to come up with even more effective therapies. For each rogue researcher who might try to answer with a more powerful bioterror agent, Fauci argues, "there are twenty scientists who are out making even better antivirals. That's the way the field is, it's a competitive field." *An Expanded Biodefense Role for the National Institutes of Health* (Interview with Anthony Fauci), *available at* http://www.homelandsecurity.org/journal/Articles/fauci.htm (last visited Nov. 3, 2003).

65. *See* U.S. DEP'T OF TRANSP., A COMPARISON OF RISKS: ACCIDENTAL DEATHS—UNITED STATES—1994–1998, *available at* http://hazmat.dot.gov/riskcompare.htm (last visited Nov. 3, 2003).

66. *See* Paul Slovic et al., *Facts Versus Fears: Understanding Perceived Risk*, *in* JUDGMENT UNDER UNCERTAINTY: HEURISTICS AND BIASES 463, 465 (Daniel Kahneman et al. eds., 1982).

67. *See generally* Peter Huber, *Safety and the Second Best: The Hazards of Public Risk Management in the Courts*, 85 COLUM. L. REV. 277 (1985) (arguing that society is overly concerned with public risk, as exemplified by fears of new technology).

68. In fiscal year 2003, the Federal Government spent $3.5 billion on bioterrorism preparedness, *see* News Release, U.S. Department of Health & Human Services (Sept. 2, 2003), *available at* http://www.hhs.gov/news/press/2003pres/20030902.html, but only $1.115 billion directly on fighting AIDS abroad (in addition to this $1.115 billion, the Federal Government contributed $348 million to the Global Fund to Fight AIDS, Tuberculosis, and Malaria, approximately 60% of which goes to AIDS-related programs), *see* Raymond W. Copson, HIV/AIDS International Programs: Appropriations, FY 2002 - FY 2004, CRS REPORT FOR CONGRESS (Congressional Research Service, updated Oct. 3, 2003). To his credit, Secretary of State Colin Powell has argued that AIDS represents a "catastrophe worse than terrorism." *Foreign Operations, Export Financing, and Related Programs Appropriations for Fiscal Year 2003: Hearings on H.R. 5410/S. 2779 Before a Subcomm. Of the Senate Comm. on Appropriations*, 107th Cong. 161 (2002) (statement of Colin Powell, Secretary of State).

69. AIDS is expected to kill almost 70 million people by 2020. *See* JOINT UNITED PROGRAMME ON HIV/AIDS (UNAIDS), REPORT ON THE GLOBAL HIV/AIDS EPIDEMIC 45 (2002), *available at* http://www.unaids.org/barcelona/presskit/barcelona%20report/chapter3.html (projecting that in the forty-five countries most severely affected by AIDS, 68 million people will die earlier than they would have in the absence of AIDS between 2000 and 2020). This estimate assumes that prevention techniques will have only a "modest effect on the growth and impact of the epidemic in most countries over the next two decades." *Id.* at 46. The assumptions behind the estimate do not include the impact of a vaccine, which

nuclear exchange between India and Pakistan.[70] Other familiar (and treatable) conditions—nutritional deficiencies, maternal and perinatal health problems, and tuberculosis, malaria, and other infectious diseases—are expected to kill tens of millions more.[71] Regulators inspired by such dramatic scenarios as genetically-engineered, vaccine-resistant smallpox and laboratory-synthesized Ebola virus are at risk of overreacting—and of thereby slowing scientific progress that might empower us to better manage larger, more likely threats.

Even sober warnings about bioterror risks and public health preparedness, like Donald A. Henderson's contribution to *Science and Technology in a Vulnerable World*,[72] could have the unintended effect of amplifying such overreaction. Henderson, who led the World Health Organization's campaign to eradicate smallpox and served as Director of the U.S. Office of Public Health Preparedness for six months after the October 2001 anthrax attacks, calls for "balance" between the "needs of security" and the "needs of research,"[73] but he says almost nothing about the latter. Public officials with national security and civil defense backgrounds are not likely to be well-informed about the causal connections between scientific inquiry and exchange, technological progress, economic development, and military strength. The military and homeland security bureaucracies these officials oversee are likely to focus on scientific communication as a near-term threat, rather than a long-term opportunity. Moreover, politically accountable officials are likely to be more wary of making "Type I" errors, by failing to prevent highly visible adverse events like terror attacks, than "Type II" errors, involving low visibility costs like the slowing of scientific progress.

C. TOWARD A SCIENTIFIC ETHIC OF REASONED SELF-RESTRAINT

Beyond these arguments against aggressive, security-oriented government regulation, there is the question of such a regulatory program's influence upon the science community's self-restraint. A considerable body of empirical evidence documents the so-called "crowding out" effect, by which both regulatory interventions and market incentives can suppress intrinsic, non-calculative motives.[74] To the extent that the research community experiences government

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could reduce the current infection rate, or medications that could increase longevity among the already infected. *Id.*

70. *See* Richard G.A. Feachem, *AIDS Hasn't Peaked Yet: And That's Not the Worst of It*, WASH. POST, Jan. 12, 2003, at B3.

71. WORLD HEALTH ORGANIZATION COMM'N ON MACROECONOMICS AND HEALTH, *Macroeconomics and Health: Investing in Health for Economic Development* 40–42 (2001) (estimating that 16 million deaths occur each year in low- and middle-income countries from these treatable conditions).

72. Donald A. Henderson, *Public Health Preparedness*, *in* SCIENCE AND TECHNOLOGY IN A VULNERABLE WORLD, *supra* note 37, at 33.

73. *Id.* at 39.

74. *See generally* Bruno S. Frey, *Institutions and Morale: The Crowding-Out Effect*, *in* ECONOMICS, VALUES, AND ORGANIZATION 437–60 (Avner Ben-Ner & Louis Putterman eds., 1998) (reviewing evidence on "crowding out" of intrinsic motives by market pressures and regulatory coercion).

restraints as hostile to its values and corrosive of its morale, regulatory intrusion undermines the moral psychology of self-restraint.[75] And there is good reason to look to professional self-restraint by researchers as our principal safeguard against the channeling of scientific knowledge toward terrorist ends. Researchers have front-line familiarity with emerging methods, findings, and potential applications. Military, civilian intelligence, and other national security authorities cannot match this understanding,[76] though they may have unique knowledge about terrorists' and rogue states' scientific capacities. The research community also has a front-line sense of how constraints on inquiry and exchange might hold back scientific progress. There is a hazard here: Researchers are inclined to focus on the costs of these constraints, just as national security bureaucracies and officials are inclined to emphasize the risks of rogue science. But reliance upon a research ethic of self-restraint as our principal safeguard against rogue science ameliorates this hazard by reinforcing professional values and attitudes of public-spiritedness.[77]

How might the scientific community promote the emergence of an ethic of self-restraint, and what should this ethic ask from researchers? For starters, we should recognize that there are psychological and institutional limits on the capacity of professions to sustain self-regulation through ethical norms. In general, social groups sustain self-governance through their own behavioral norms to the extent that they form close communities, held together by webs of mutual dependence that mediate rewards and sanctions for behavior.[78] The ethical and other norms thus formed and maintained tend to enhance group welfare.[79] Medicine is the paradigmatic example among the professions,[80]

75. *See id.* at 443–46 (contending that "outside interventions"—for example, government regulation—undermine intrinsic motivation to act ethically when they are perceived as "controlling" and as not "acknowledging" of intrinsic motivation).

76. In cognitive psychology language, this in-depth understanding is subject to "information impactedness": It abides within small communities of investigators working on particular scientific problems, and it is difficult and costly to communicate to outside monitors such as national security-focused officials. *See* OLIVER E. WILLIAMSON, MARKETS AND HIERARCHIES: ANALYSIS AND ANTITRUST IMPLICATIONS 31–37 (1975).

77. *See* Frey, *supra* note 74, at 439–43 (discussing public spirit, civic virtue, and other "non-calculative" inclinations as motives more likely to flourish absent external rewards and punishments, such as regulation and market incentives). My claim is not that scientists will surrender their partiality toward free exchange; it is rather that public-spirited self-restraint is more likely to produce countervailing self-discipline in a less intrusive regulatory environment.

78. ROBERT ELLICKSON, ORDER WITHOUT LAW: HOW NEIGHBORS SETTLE DISPUTES 124–26 (1991).

79. For a lively debate that centers on the question of whether a closely knit group's behavioral norms maximize its welfare or serve other functions (at the expense of aggregate welfare), such as signaling (through norm compliance), cooperativeness, subgroup membership, or something else, compare Eric A. Posner, *Symbols, Signs, and Social Norms in Politics and the Law*, 27 J. LEGAL STUD. 765 (1998) with ELLICKSON, *supra* note 78, at 167–69.

80. Among the features of medical socialization and practice that have held the profession together are a high degree of isolation from the rest of society throughout a prolonged training period, dependence on fellow physicians for career opportunities (for example house staff positions, employment, and referrals), and almost soldierly camaraderie and mutual support in the face of high stress and

though the growth of specialization, systems of administrative supervision,[81] and financial rewards and penalties mediated by actors outside the profession[82] is weakening the mutual reliance that binds physicians to each other. The scientific research community is less tightly knit than the medical community. The loneliness of research training contrasts with the camaraderie of clinical education, and many researchers work in hierarchical institutional settings without the fraternity characteristic of the professional paradigm. Research is a balkanized endeavor, carried out in corporate and government settings, university laboratories, and independent institutes, characterized by different cultures, organizational pressures, and institutional goals. Bureaucratic hierarchy and institutional differences pull centrifugally against efforts to sustain standardized norms of conduct.[83] And scientific inquiry as a profession is a recent social phenomenon, without medicine's many centuries of ethical tradition.

Yet within these constraints, an ethic of reasoned self-restraint is viable. Such an ethic should start with recognition that vast areas of biological and physical science research have potential rogue applications. The NSDD 189 approach, which draws a bright line between classified science and research that can be freely disseminated,[84] does not dispose of the possibility that published methods or findings could empower those who wish us ill to act on their intentions. Opposition to a retreat from the NSDD 189 bright line, toward federal restrictions on communication about "sensitive but unclassified" research, need not imply rejection of professional self-restraint. A measure of self-restraint is in the interest of the entire research community, if for no other reason than its potential to forestall federal censorship. But if this self-restraint is to reflect a pragmatic balance between the risks of rogue science and the costs of slowing scientific progress, it should take account of our propensity toward cognitive distortions when assessing risk. We know that novel risks inspire disproportionate fear and that low visibility costs, like the slowing of scientific progress, are easier to disregard than is the threat of a highly visible adverse event like a terror attack. Though there are gaps in our knowledge about the scientific capabilities of terror groups and rogue states, we have good reason to believe that our capabilities are so far ahead of their's that dissemination of methods and findings with potential rogue applications is much more likely to widen our advantage than to increase our risk. The prospect of fierce competition among research teams to develop better detection devices, vaccines and therapies, and

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life-and-death decisions. *See generally* ELIOT FREIDSON, PROFESSION OF MEDICINE: A STUDY OF THE SOCIOLOGY OF APPLIED KNOWLEDGE (1970).

81. These include managed care systems, administrative structures within large group practices, and hospital bureaucracies.

82. Financial incentives designed by managed health plans to influence physicians' clinical decisions are the main example.

83. *See* MAGALI S. LARSON, THE RISE OF PROFESSIONALISM: A SOCIOLOGICAL ANALYSIS, 178–207 (1977) (analyzing tensions between professional self-governance and bureaucratic organization).

84. *See supra* note 59.

other countermeasures is much more realistic than are the sci-fi scenarios so often set forth in discussions of anti-terror preparedness.

This knowledge, against a backdrop of awareness of the long-term importance of scientific progress for national prosperity and security, favors a strong presumption against professional self-censorship. But when previously unpublished methods or findings have a rogue application that can inflict large-scale harm—*and* when there is a solid basis for believing that a foe has both the will and the capacity to use these methods or findings to do harm—self-restraint is appropriate. On these rare occasions, researchers, journal editors, and others in the science community should pursue least restrictive alternatives—for example, selective omissions from publications rather than non-publication or avoidance of entire lines of research. In scientific fields where rogue application is a particular concern, professional societies could consider designating a small number of senior researchers to obtain security clearances in order to access classified information about rogue actors' scientific capabilities. These senior figures could then counsel other investigators when concerns arise about matches between rogue capabilities and potentially destructive uses of new research. This collaborative approach would ground reasoned self-restraint in rigorous security risk assessment, while shielding the research community from direct government constraints.

To preserve intellectual openness and a sense of fairness in the academic science community, universities should not deny foreign students or visiting researchers access to classes and seminars, on-campus labs, or other academic programs. The principle of "high walls around narrow areas"[85] ought to prevail. Classified research should remain off-campus, apart from academic life, and national origin (or security clearance) should be irrelevant to university community members' access to academic programs.[86] On the other hand, entry into this community can reasonably be conditioned on threshold assessment of whether a foreign visitor has the will and capacity to do us harm. This assessment, though, should be the province of U.S. immigration authorities, not academic institutions, both because the latter lack the capabilities to conduct security-oriented background reviews and because giving the academy this responsibility risks chilling its intellectual life.[87] Finally, access to research materials with poten-

85. John C. Crowley, Science and Secrecy: NSDD 189 – Prologue to a New Dialogue?, Presentation at the American Association for the Advancement of Science's Science & Technology Policy Colloquium (Apr. 20, 2003), *available at* http://www.aaas.org/spp/rd/JCC.ppt (last visited Dec. 16, 2003).

86. Skolnikoff, *supra* note 48, at 72.

87. Along these lines, it is reasonable for U.S. law to empower immigration officials to obtain foreign students' addresses and information about their enrollment status from universities, but it would be overreaching to require universities to provide information about students' academic performance, interests, or viewpoints for the sole purpose of reviewing visa applications. The USA Patriot Act allows the Attorney General to obtain access to students' educational records (including information about course selection and academic performance) only upon a judicial determination that these records are relevant to investigation or prosecution of terrorism. *See* Uniting and Strengthening America by Providing Appropriate Tools Required to Intercept and Obstruct Terrorism Act of 2001 (USA Patriot

tially destructive applications—for example, radioactive elements, microbes, and recombinant DNA reagents—can be tightened through such mechanisms as registration and simple background checks[88] (like those urged by gun control advocates) with only minimal impingement on scientific inquiry.

The research ethic of reasoned self-restraint acknowledges that the risks of rogue science are real and posits that the research community has a professional responsibility to manage them. But, conscious of cognitive distortions, it eschews overreaction that could unduly slow scientific progress, undermining our prosperity and security over the long haul. Maintenance of a self-regulating scientific culture is a hallmark of this management strategy. But some reliance upon government's capability in security matters is permissible—indeed, desirable.

CONCLUSION

In the face of nightmarish possibilities for rogue use of science, it is tempting to see pre-September 11 protections for academic science's atmosphere of openness as irrelevant, even quaint. But we've been similarly tempted before, by the Cold War-era threat of an opposing superpower with thermonuclear weapons. Openness prevailed then, and so did we, over a threat now receding into historical memory. We were lucky in a crucial way then, and we are lucky today. It is closed, anti-pluralistic societies that tend to see us as a mortal enemy, and they cannot compete with us in the economic and military spheres. Science can best contribute to this competitive advantage, and to our prosperity and security more generally, by sustaining its culture of skepticism and openness. But a measure of public-spiritedness is essential if the research community is to both manage genuine threats to public safety and sustain popular confidence in the face of novel fears.

An ethic of skeptical distance from patriotic ardor can strengthen scientists' capacity to advise the nation's leaders wisely concerning national security-related research options, as well as prospective national security uses of current technology. Skeptical distance is also likely to stiffen professional resistance to uses of technology that breach internationally recognized human rights. An ethic of reasoned self-restraint can empower the science community to manage the risk of rogue uses of research methods and findings while preserving the scientific spirit of openness. Tensions between immediate national security concerns and scientific freedom are unavoidable. But, as a society, we have placed our long-term bet on the intellectual open market, and so far we have surpassed all who have bet on the other side.

Act), 107 Pub. L. No. 56, 115 Stat. 272, 367–68 (2001) (allowing the Attorney General to collect (1) students' education records from educational agencies and institutions, and (2) "reports, records, and information (including individually identifiable information)" from the National Center for Education Statistics when the information collected is relevant to an authorized investigation or prosecution of terrorism).

88. Such background checks should entail no more than confirmation that a researcher's immigration record is in order and that he or she faces no outstanding criminal charges.