Online Ethics Center
FOR ENGINEERING AND SCIENCE

Chapter 7: Physics and Military Research

Author(s)

Marshall Thomsen

Description

Chapter 7 of "An Instructor's Guide for Ethical Issues in Physics."

Body

Chapter 7: Physics and Military Research

Section 7.1: Introduction

Whether or not a country should pursue a particular line of military research is largely a public policy issue, but because a large component of military research involves the physical sciences, it is reasonable for physicists, as members of the public, to become engaged in the debate over that research. In an ethics class, it may be difficult to maintain a focus on ethical issues for physicists rather than letting the discussion become purely one of public policy. The areas in which ethics for *physicists* become an issue are the extent to which physicists choose to involve themselves in a particular line of military research and the extent to which physicists involved in the public policy debate are providing technical information based on their own expertise.

Section IV of the APS Guidelines on Ethics states, “It is an investigator’s obligation to weigh the societal benefits of a research program against the costs and risks to human welfare.”[1] The APS also has a Statement on Civil Engagement that begins, “The American Physical Society applauds its members who have helped ensure that public policy decisions are informed by sound scientific analysis. APS encourages its members to take advantage of opportunities for civic engagement drawing on their experience, whether through public or government service, by providing advice and information to government officials, or by contributing to public debate.”[2] Although it is not possible to address issues like military research without at least some discussion of public policy, keeping students focused on these two APS statements will help keep the conversation focused on ethics in physics rather than on public policy.

Caution needs to be exercised in looking at the historical cases outlined here. All of the materials in this chapter that provide details of the cases addressed were published prior to the release of the APS Guidelines on Ethics and the Statement on Civil Engagement. While it is likely that much of what is said in these APS statements was understood and accepted by physicists in earlier years, students should be encouraged not to evaluate physicists in earlier years based on standards that were not part of the community consensus until very recently. The discussions can focus on how actions by previous physicists may have informed the standards we have today and how we can apply today’s standards to similar situations that we may face now or in the coming years.

Note that this chapter concludes with some discussion prompts that would be relevant to any of the readings.

Section 7.2: The Manhattan Project

The Manhattan Project is the code name given to the effort by the United States (later joined by Great Britain) to develop the first nuclear weapons. The best-known part of the project was the bomb design and development portion located in Los Alamos. There were also other locations around the U. S. where important research and production took place.

The project involved large numbers of engineers and scientists, especially physicists. Since many of the brightest minds of the time were recruited for the project, many of that generation's best known physicists were a part of the project. Many of those physicists wrote autobiographies, making for a large collection of material containing personal reflections of participants in the Manhattan Project. This section highlights a few of those autobiographies. There has been no attempt to screen these sources for objectivity. The point of using them in an ethics class is to give students a chance to understand what it was like to be involved in the Manhattan Project through first-hand accounts of how physicists grappled with ethical challenges. These case studies provide more depth and complexity than brief, hypothetical case studies and hence may not be appropriate for discussion in a class that does not have much prior experience with ethics case studies.

It is not uncommon for students in the present generation, who are far removed from World War II, to assume that physicists involved in the Manhattan Project were focused exclusively on developing the bomb, with no thought given to the ethical issues development of nuclear weapons raised. At minimum, an important goal of addressing the Manhattan Project in an ethics course is to disabuse students of this perspective.

Edward Teller

Edward Teller was a theoretical physicist who became involved with bomb design at Los Alamos as part of the Manhattan Project. His Memoirs contains several chapters relevant to the Manhattan Project.[3] Of those, Chapter 18: An End and a Beginning is a particularly good one for exploring the question of to what extent a scientist is responsible for the way in which their research is used. The chapter opens with a description of Nazi, and later, Communist, brutality in Hungary. This helps provide context to debates related to the development of the original atomic bomb and later the hydrogen bomb. Next, there is an exchange involving Teller, Robert Oppenheimer, and Leo Szilard regarding a petition being circulated by Szilard on the topic of how the first atomic bombs should be used. Szilard argued that as developers of the weapon they had a special responsibility to provide input into its use. Oppenheimer's position was that, as scientists, they had no special expertise in geopolitical issues, so they should defer to those with more experience. Teller originally agreed with Szilard but was then swayed by Oppenheimer's perspective. The chapter concludes by recounting how the decision to use the weapons was actually reached, including the observation that Oppenheimer did, in fact, play a role in the decision-making process.

Two other chapters are also somewhat relevant. Chapter 15: Academicians Go to Work (1941-1943) provides background about World War II that could be helpful to students several generations removed from the event. On page 162, Teller recalls Eugene Wigner explaining that physicists developing a nuclear weapon will raise the profile of the physics community. Teller thought that was a bad reason to develop the weapon. On page 163 he recounts a discussion with Oppenheimer in which they disagreed over the relationship between scientists and the military. To give students a feel for the atmosphere at Los Alamos, have them read Chapter 16: Settling in at Los Alamos (March 1943 – November 1942).

Discussion Prompts:

1. Teller describes an indirect debate between Oppenheimer and Szilard on the role scientists in the Manhattan Project should have played in policy decisions regarding use of atomic bombs. Who do you think makes the stronger case? Is there any guidance in present day ethical codes that would help in the event you were confronted by a similar situation?
2. Try to imagine yourself as a physicist in the early 1940s deciding how to respond to a request to help in the Manhattan Project. Would the immediate concerns of Nazi atrocities and the possibility that either Germany or Japan would develop an atomic bomb affect your decision? What other factors should be considered?

Leo Szilard

Leo Szilard is not a household name, but his understanding of the impact of emerging understanding of nuclear science was frequently well ahead of even most other experts in the field. The book Leo Szilard: His Version of the Facts provides insight into his actions and motivations.[4] Each chapter begins with a transcript of his tape-recorded recollections and then is followed by reproductions of relevant documents, most of which are letters. Each chapter can be read independently of the others. There will likely be some events and names in the later chapters that students who have not read the earlier chapters will be unfamiliar with, but for the most part that will not interfere with an examination of the ethical issues involved.

The first chapter of this book contains a few passages that show Szilard's early concerns about the implications of the evolving understanding of nuclear reactions. On page 16, he recalls that in 1932 he read the 1913 H. G. Wells book The World Set Free. That book imagines a future, the early to mid 1900s, in which the discovery of artificial radioactivity leads to a devastating world war involving atomic bombs. On page 18, Szilard comes back to this book, as he describes his investigation into whether or not beryllium could sustain a chain reaction. This possibility led him to apply for a patent at the British patent office. By assigning the patent to the British Admiralty, he hoped to keep the technology secret. Document 12 is a letter discussing the fact that others in the science community misunderstood Szilard's motivations for requesting the patent.

In the second chapter, Szilard recounts a discussion with Enrico Fermi on whether or not physicists should be devoting resources to determine if a chain reaction could be achieved. Szilard then recalls the beginnings of his (ultimately unsuccessful) efforts to get agreement among physicists in the U.S., England, and France to avoid publishing papers related to nuclear chain reactions. After a discussion of experiments that he was involved with, Szilard's recollections conclude with chronicling the breakdown of his efforts to embargo papers. Document 22 is a 1939 letter to Lewis Strauss, who in later years would chair the Atomic Energy Commission, in which Szilard discusses the possibility that atomic bombs might be feasible. Documents 30-39 all related to Szilard's efforts to delay publications related to nuclear chain reactions.

Chapter III focuses on the origins of Albert Einstein's letter to President Roosevelt about the military implications of a nuclear chain reaction being possible. This letter was drafted by Szilard and grew out of efforts involving Szilard, Edward Teller, and Eugene Wigner. The story is told in six pages of recollections, but the numerous letters in the document section are also worth reading, time permitting. Document 55 is the letter to President Roosevelt that Einstein signed.

Chapter IV presents an interesting story of how slowly the bureaucratic wheels of government can turn, recounting that a full year went by with no research progress. Aside from a brief reference to the issue of whether or not secrecy should be maintained, the chapter does not directly address any ethical issues. Likewise, Chapter V, with its focus being the experiment that generated the first chain reaction, is interesting from an historical perspective but does not address many ethical issues.

In Chapter VI, Szilard tells of his efforts in the final months of World War II to have an impact on the decision of how to use the atomic bomb. This chapter thus addresses the question of to what extent scientists are responsible for the use of technology that they help develop. Szilard circulated two different petitions among scientists in the Chicago component of the Manhattan Project. Szilard was particularly adamant that the United States should not reveal the existence of the bomb (and hence not use it) until there was a clear plan for the future of this technology in the post-war era. Document 101 lays out his vision of the way the technology might be controlled through international agreements. The primary issue of *scientific* ethics involved here is that Szilard felt the need to write the memo, and hence even if students only have time to skim this lengthy document, a good classroom discussion of the ethical issue is possible. Document 102 includes a letter intended to be delivered to President Roosevelt, asking him to consider these long term issues before arriving at a decision to use the weapon. This did not make it to Roosevelt before he died. Documents 105-111 relate to the petitions that Szilard circulated regarding use of the atomic bomb. This cluster of documents can probably be understood in the absence of reading the recollections in this chapter, but an understanding of their significance would be greatly enhanced by reading the opening recollections first.

The final chapter of the book illustrates the efforts of Szilard to lobby Congress on the issue of a bill to establish a formal program for regulating use of atomic energy. While this chapter does illustrate a scientist taking responsibility for how society chooses to use the results of his research, it does not do so as effectively as Chapter VI.

Discussion Prompts

1. [Chapter I] What motivated Szilard to apply for patents on nuclear technology? How might his actions have been misinterpreted?
2. [Chapter II] Discuss the details of Szilard’s plan to keep papers related to

fission and possible chain reactions from appearing in print. What caused the plan fail? If a similar situation arose now, do you think it would be possible to get agreement among scientists in a particular field to refrain from publishing on a topic with potentially dangerous military implications?

3. [Chapter II] Suppose you had just drafted a paper and a colleague came to you and asked you to delay publication due to national security concerns. Discuss what other information you would need before deciding on your colleague's request. What parts of the APS Guidelines on Ethics are relevant to your decision? Are other ethical codes (explicit or implicit) relevant?
4. [Chapter III] If you were in Einstein's position, what ethical considerations would have been relevant in deciding whether or not to sign the latter drafted by Szilard?
5. [Chapter III] Imagine that you were one of the few physicists in 1939 able to foresee the possibility that a nuclear chain reaction could be used to build a powerful bomb. If given the opportunity, would you have joined Szilard's efforts to encourage more research to determine if such a bomb were feasible?
6. [Chapter VI] What role, if any, do you think physicists involved in the Manhattan Project should have had in determining how the atomic bombs would be used?
7. [Chapter VI] What are the factors identified by Szilard as entering into the United States' final decision to drop two atomic bombs on Japan?

Herbert York

Herbert York's involvement in the Manhattan Project began at the Radiation Laboratory in Berkeley, where he helped develop equipment for uranium isotope separation. He then moved to Oak Ridge to help run the Y-12 production facility. He details his experiences in the first chapter of Making Weapons, Talking Peace.[5] In particular, a reading assignment beginning at the section "At the Rad Lab" and going through the end of Chapter 1 will cover his involvement in the Manhattan Project. The first part of the reading is focused more on the science and logistics of the isotope separation project while the last part reflects on the consequences of the project. While this reading is not as comprehensive as others, it is a good choice for a short introduction to a part of the Manhattan Project often overlooked by students as well as for a discussion of some ethical considerations of those involved in the project. It also provides background on a physicist who later in his career was active in arms control in an official capacity.

Discussion Prompts

1. Some people at the Oak Ridge facility knew only that their work was related to a top secret war project but did not know that it was related to an atomic bomb. Would you work on a project where information was so compartmentalized that you did not know what the project goal was? In considering your answer, keep in mind that compartmentalization of information is a common strategy to employ when secrecy of a project is deemed as essential. That is, insisting that you be informed of the project goal may well lead to your being told you cannot work on the project.
2. Herbert York and others had specialized knowledge that was important to the overall success of the project. Given that during World War II a significant portion of young adult males in the United States were drafted, do you think that physicists with specialized knowledge of relevance to the war effort should have felt an *obligation* to participate in military projects?

Luis Alvarez

Luis Alvarez wrote an autobiography that includes two chapters devoted to the Manhattan Project.[6] Chapter 7 does not directly address ethical issues but does an excellent job of telling the story of Alvarez's work at Los Alamos. This chapter can be useful for giving students a feel for the intensity of the work and of the collaboration at Los Alamos. While the book is written for a general audience, physics students will find enough scientific information to gain some important insights into how nuclear weapons work. In Chapter 8, Alvarez describes his role in measuring the yield of the Hiroshima bomb, once more with some interesting scientific details. Alvarez uses the last half of the chapter to discuss the ethical issues associated with the Manhattan Project. He addresses several questions that have commonly been raised, such as why a demonstration explosion was not used and why the second bomb was dropped. In each case, he argues that there was no better course of action available than the one the United States ultimately took. While not all readers will agree with Alvarez's conclusions, they will be more likely to come away from this reading with an improved appreciation for just how difficult these questions are to address in hindsight, and how they were even more difficult to address then with less information available.

Discussion Prompts

1. Assuming that Alvarez's factual information was correct, do you think his position regarding the use of the atomic bombs in Japan is defensible? (In this case, defensible means that you can accept a reasonable person coming to this conclusion, not necessarily that you agree with the conclusion.)
2. What critical facts or assumptions would you want to check before deciding whether or not you agree with Alvarez's conclusions?

Section 7.3: The Strategic Defense Initiative

In 1983, President Ronald Reagan gave a speech announcing the Strategic Defense Initiative (SDI), a program whose goal was to build a defensive shield around the United States to protect it from nuclear weapons, making such weapons obsolete. His speech caught most of the scientific community off guard and quickly led to intensive debates on the merits of the program. Students can study the SDI debate to gain insight into how the APS statements highlighted in Section 7.1 apply in real situations.

Much was written in the 1980s about SDI. Only a narrow portion of the available sources are reviewed here, with the focus being on coverage of the issue in Physics Today.

Physics Today published a somewhat lengthy article by Gerold Yonas, who at the time was the Chief Scientist of the Strategic Defense Initiative Organization.[7] The article does a good job of discussing the origins of the program and providing details about how the multiple missile defense systems would work. Not surprisingly, Yonas asserted that research was justified because sufficient preliminary work indicated that the proposed missile defense systems would be feasible. The next article in that same issue, by Wolfgang Panofsky, is a public policy analysis grounded in technological understanding.[8] While Panofsky's article is much more about policy than science, it illustrates the fact that in some cases these two arenas are inextricably linked. Panofsky's perspective was that the goals of SDI were ill-defined and that strategic defense research was best handled through existing, more modest programs. These two articles together are effective at illustrating the SDI debate in the 1980s. A collection of letters to the editor in a subsequent issue addressed these two articles. Of particular note is the question raised about whether it was appropriate for Panofsky, as a physicist, to engage in public policy debate.[9] Panofsky's reply argues that at times physicists must place science in the context of public policy. In a class setting where time for reading papers is limited, students may be able to understand and benefit from reading just the letters if the instructor first gives a brief overview of the SDI program and the nature of the Yonas and Panofsky articles.

A very short article, which also raises the issue of the extent to which scientists should be involved in public policy debates, discusses efforts by the Union of Concerned Scientists to oppose the SDI program.[10]

One of the initiatives that arose within the community of physicists was the circulation of a petition in which signatories promised not to solicit or accept funding through the SDI program. This is described in a Physics Today article[11] and in a more detailed report by one of the petition's authors.[12] There was also a less publicized petition in favor of SDI research.[13] This set of readings illustrates how the collective actions of physicists can impact public policy.

President Reagan's announcement of the Strategic Defense Initiative and the ensuing public debate led the American Physical Society to form a study group for investigating the status of and future prospects for technology associated with directed-energy weapons. This became known as the DEW study. One of the components of the defense systems envisioned by SDI was the use of directed-energy weapons to shoot down missiles and warheads. The Department of Defense gave the study group access to classified information and in exchange the APS allowed the department to screen the final report for classified information before the public version was released. A short article on the release of the report, which also includes a history of the study group, appeared in Physics Today.[14] The full report is quite lengthy and appeared in Reviews of Modern Physics.[15] Another article chronicles the response of the SDI research community to the DEW study and provides further details about the report release.[16] This article also includes the text of an APS statement highlighting the tremendous uncertainty about technological developments needed for SDI. Finally, members of the DEW study group responded to some criticisms of the report in a Physics Today article.[17]

Roy Woodruff, while employed at Lawrence Livermore National Laboratory, became concerned that the level of achievement in x-ray laser development was being oversold and that this was creating undue optimism about the prospects of a successful defensive shield as envisioned by President Reagan. Woodruff’s role as a whistleblower is detailed in a Bulletin of the Atomic Scientists article.[18] This article can be used to address the importance of objectivity when scientists are providing technical advice to policymakers.

An article in Physics Today by Kurt Gottfried provides an overview of the role played by physicists in public policy debate.[19] The section on pages 46-47 provides a concise summary of the SDI debate and can be understood on its own. At the same time, students who have the time to read the entire article will be able to appreciate more generally the role physicists have played in public policy debates.

Discussion Prompts

1. Is the information in the articles by Yonas and Panofsky sufficient for you to decide if you would have supported or opposed the SDI program? If not, what additional information would you have required? Do you think that information would have been readily accessible at the time?
2. If a scientist is opposed to a particular military program, is it unethical for that scientist to receive research funding from that program? What if the scientist

believed that the particular piece of the project being funded could also lead to technology that would have applications beneficial to society? Does your answer to these two questions depend at all on whether or not the scientist thought the aims of the military research program were achievable?

3. Imagine you were presented with a petition that was being circulated among scientists that supports (or opposes) the development of a specific type of military technology. Under what circumstances would you sign that petition? How much technical expertise do you think you would need to have in order for your signing the statement to be an ethical act?
4. Does your answer to the previous question change if instead the petition is politically based, circulating among the general public? If so, how?
5. The APS DEW study group was given access to classified information in part due to the level of respect the Department of Defense had for the APS. If you were a member of that study group, what actions and standards would be important in order for you to help the APS maintain that level of respect?
6. If you were part of a classified research project and believed the project to be fundamentally flawed, what actions would you explore taking to deal with the situation? [Note to instructors: what actions actually could be taken within the law, and what the consequences of breaking a law might be, are relevant considerations but at the same time are areas about which the students are likely to have insufficient information. By phrasing the questions in terms of exploring actions, the students can be encouraged to consider a wide range of options, with the understanding that if they found themselves in this situation, they would want to explore the legal ramifications of each of those options.]

Section 7.4: Arms control in the age of nuclear weapons

Since World War II, physicists in the United States have had significant influence on policy related to military weapons. Some physicists have been employed as technical advisors, providing broad ranging scientific advice to the executive and legislative branches, while others have worked through external, nonprofit organizations whose goal is to influence public policy. Some physicists not involved in either of these areas of influence still have an impact on policy by carrying on debate in publications such as Physics Today. This section will focus on the role played by physicists in the area of arms control.

The Pugwash Conferences grew out of the 1955 Russell-Einstein Manifesto, which said in part, “In the tragic situation which confronts humanity, we feel that scientists should assemble in conference to appraise the perils that have arisen as a result of the development of weapons of mass destructionS for nuclear weapons and material to fall into the hands of fringe groups. Sig Heckler recounts the yeaned up additional avenue...”[20] During the three decades that followed, the United States was engaged in the Cold War with the Soviet Union. One of the important features of these conferences was that they involved scientists from both the US and the Soviet spheres of influence. Joseph Rotblat, who won a share of the 1995 Nobel Peace Prize for his efforts in co-founding the Pugwash Conferences, wrote a history of the early years of Pugwash.[21] This article begins with a discussion of how physicists confronted ethical issues related to the development of the first nuclear weapons and then explores the evolution of the Russell-Einstein Manifesto. Rotblat describes the first conference in some detail before concluding with how the Pugwash organization overcame early suspicions that it was a Soviet propaganda tool and gained acceptance as a serious contributor to the arms control movement.

Some physicists have become directly involved in nonproliferation efforts, especially since the fall of the Soviet Union opened up additional avenues for nuclear weapons and material to fall into the hands of fringe groups. Sig Hecker recounts his work in the nonproliferation field in a 2010 Physics Today article.[22] His description of numerous international visits and collaborations ends with a statement of motivation: “… as former director of Los Alamos National Laboratory, the birthplace of the bomb, I feel a special professional obligation to help manage the evolving global nuclear dangers.” Letters to the editor by DeVolpi et al. provide some different perspectives on Hecker’s article[23] and would be a worthwhile addition to this reading assignment.

For a more international perspective, see Frank von Hippel’s article detailing the influence of a group of three Soviet physicists and one Soviet historian on the evolution of nuclear policy and arms control treaties in the 1980s and 1990s.[24] The article places visits between US and Soviet scientists in the context of key developments in the Cold War, such as the evolution in antiballistic missile policy and the nuclear testing moratorium. Some readers took exception with von Hippel’s portrayal of a few of the events.[25] This set of readings shows once again how ethical considerations in physics can become deeply intertwined with public policy issues.

An article by Pierce Corden and David Hafemeister describes relevant technology associated with two nuclear weapons treaties, in particular focusing on detection of nuclear test explosions by other countries and techniques for producing weapons-grade material.[26] An article by Matthias Auer and Mark Prior goes into more depth on mechanisms for monitoring a nuclear test ban.[27] These discussions make more explicit why input from physicists is needed in treaty negotiations.

For a detailed look at how an arms control treaty develops, see Chapter 14 of Herbert York's Making Weapons, Talking Peace.[28] This chapter can be understood without having read the prior chapters. It opens with a discussion of the history of arms control relevant to the Comprehensive Test Ban Treaty. York became the chief US negotiator for the Comprehensive Test Ban talks during the Carter administration. While much of the chapter describes logistical details of the negotiations, it is important for students to see that some physicists can make significant contributions to society in an environment that seems very far removed from the laboratory. At the same time, the end of the chapter analyzes why the talks did not result in a Comprehensive Test Ban Treaty during the Carter administration, when political forces overwhelmed the negotiations. This material also appears in another book by York, Arms and the Physicist.[29]

Discussion Prompts

1. What is it about nuclear arms control negotiations that makes participation by physicists helpful?
2. What ethical standards are relevant for physicists who are involved as government employees in nuclear arms control efforts? Are the standards any different for physicists who are not government employees, such as those working through organizations like Pugwash?
3. If you were to write a code of ethics covering physicists active in the area of arms control, what elements would you include?
4. In the realm of arms control, discuss the extent to which it is possible to separate technical considerations from foreign policy considerations. That is, is it possible and desirable for physicists to restrict their advice to purely *technical* advice?

Section 7.5: Dual-use technology

Dual-use technology refers to technology with both military and nonmilitary applications. Such technologies provide ethical challenges to a physicist who might be comfortable with the nonmilitary use but not the military use of the technology. A good example of dual-use technology is the National Ignition Facility (NIF). The home page of NIF has links that describe its role in nuclear stockpile stewardship, fusion energy research, and basic science research.[30] Having students read through the descriptions of each of these roles can then set the stage for a discussion of what to do in a situation where emerging technology has multiple uses, some that one finds desirable and some that one finds undesirable. For the most part, it is unlikely that the answer to these ethical dilemmas will be found in professional ethical standards. They involve broader moral theories on how to weigh competing interests. A ten-minute introduction to moral theory can be found on this video by Michael Loui, who has a series on engineering ethics.[31] That video also contains suggestions for resources that address moral theories in more detail.

In the life sciences, the focus is, not surprisingly, somewhat different: “Dual Use Research of Concern (DURC) is life sciences research that, based on current understanding, can be reasonably anticipated to provide knowledge, information, products, or technologies that could be directly misapplied to pose a significant threat with broad potential consequences to public health and safety, agricultural crops and other plants, animals, the environment, materiel, or national security.” [32] The set of government policies remind us of the complexities that arise when standards of academic research (academic freedom and openness) come into conflict with principles related to public safety and national security.

Section 7.6: General discussion prompts for the entire chapter

1. Compare and contrast the role of scientists doing military research to the role of soldiers in the armed forces, both during times of war and during times of peace. Consider issues such as ethical obligation to volunteer one’s service,

appropriateness of one being drafted into service, and when the expectation to follow orders is superseded by moral concerns.

2. To what extent is an individual scientist responsible for the consequences of their research? Does it make a difference whether the consequences were foreseeable or not?
3. A scientist looking at a public policy issue requiring a decision might break down the decision-making process in the following way: acquire relevant data, analyze data to determine their impact on the issue, explore possible courses of action and their likely impact on relevant sectors of society, recommend a specific course of action, and develop an implementation plan. Are all of these phases likely to be ones that would benefit from scientific input, or just some of the phases?
4. Physicists have training not only in the laws of physics, how to interpret them and how to perform experiments related to them, but also in how to approach data-driven problems logically and analytically. With that in mind, what can physicists do as individuals to support policy-makers in their decision-making processes?
5. What can physicists do collectively, through organizations such as the American Physical society, to support policy-makers in their decision-making processes?

Continue to Chapter 8:

Acknowledgment

The author is grateful for the time and effort of the anonymous reviewers of this work, and for their numerous helpful suggestions.

Continue to Chapter 8: Climate Change

[1] American Physical Society Guidelines on Ethics (19.1) (2019). https://www.aps.org/policy/statements/guidlinesethics.cfm

[2] American Physical Society, "Statement on Civil Engagement," (Statement 15.1), adopted November 14, 2015, https://www.aps.org/policy/statements/15_1.cfm (accessed October 21, 2019).

[3] Edward Teller, *Memoirs: A Twentieth-Century Journey in Science and Politics,* (Perseus Publishing, Cambridge MA, 2001).

[4] Leo Szilard, *Leo Szilard: His Version of the Facts*, (Spencer Weart and Gertrud Weiss Szilard, editors, MIT Press, Cambridge, MA 1978).

[5] Herbert F. York, *Making Weapons, Talking Peace: A Physicist's Odyssey from Hiroshima to Geneva*, (Basic Books, Inc., New York, NY, 1967).

[6] Luis W. Alvarez, *Alvarez: Adventures of a Physicist*, (Basic Books, Inc., New York, NY, 1967).

[7] Gerold Yonas, "Strategic Defense Initiative: The Politics and Science of Weapons in Space,", Physics Today **38** (6) 24-32 (1985). https://doi.org/10.1063/1.880976

[8] Wolfgang K. H. Panofsky, "The Strategic Defense Initiative: Perception vs Reality," Physics Today **38** (6) 34-45 (1985). https://doi.org/10.1063/1.880977

[9] Marilyn Lloyd et al., "SDI: Political Realities," Physics Today **38** (10) 9-15 and 142-144 (1985). https://doi.org/10.1063/1.2814721

[10] Irwin Goodwin, "Star Wars and the Debate Among Physicists," Physics Today **38** (7) 58 (1985). https://doi.org/10.1063/1.2814631

[11] William Sweet, "'Star Wars' Petitions Attract Strong Support at Some Schools," Physics Today **38** (11) 95 (1985). https://doi.org/10.1063/1.2814769

[12] Lisabeth Gronlund, *A Status report on the boycott of Star Wars research by academic scientists and engineers*, Released May 13, 1986, digitized by the University of California November 23, 2010.

[13] William Sweet, "Some Physicists Speak Out in Favor of Star Wars Research," Physics Today **39** (1) 79 (1986). https://doi.org/10.1063/1.2814850

[14] Gloria B. Lubkin, “APS Releases Report on Directed-Energy Weapons,” Physics Today **40** (5) S1-S2 (1987). https://doi.org/10.1063/1.2820010

[15] N. Bloembergen et al., “Report to The American Physical Society of the study group on science and technology of directed energy weapons,” Reviews of Modern Physics **59** S1 (July 1987). https://doi.org/10.1103/RevModPhys.59.S1

[16] Irwin Goodwin, “SDI Attempts to Zap APS Directed-Energy Weapons Report,” Physics Today **40** (6) 43-46 (1987). https://doi.org/10.1063/1.2820071

[17] Gregory H. Canavan, Nicolaas Bloembergen, and C. Kumar Patel, “Debate on APS Directed-Energy Weapons Study,” Physics Today **40** (11) 48-53 (1987). https://doi.org/10.1063/1.881090

[18] Deborah Blum, “Weird Science: Livermore’s X-Ray Laser Flap,” Bulletin of the Atomic Scientists **44** (6) 7-13 (1988). https://doi.org/10.1080/00963402.1988.11456176

[19] Kurt Gottfried, “Physicists in Politics,” Physics Today **52** (3) 42-48 (1999). https://doi.org/10.1063/1.882612

[20] Bertrand Russell, et al., “The Russell-Einstein Manifesto,” https://pugwash.org/1955/07/09/statement-manifesto/ (accessed October 28, 2019).

[21] Joseph Rotblat, “The Early Days of Pugwash,” Physics Today **54** (6) 50-55 (2001). https://doi.org/10.1063/1.1387592

[22] Sig Hecker, “Adventures in scientific nuclear diplomacy,” Physics Today **64** (7) 31 (2011). https://doi.org/10.1063/PT.3.1165

[23] Alexander DeVolpi, et al., “Discussions in scientific nuclear diplomacy,” Physics Today **65** (2) 8 (2012). https://doi.org/10.1063/PT.3.1411 https://doi.org/10.1063/PT.3.1412 https://doi.org/10.1063/PT.3.1413 https://doi.org/10.1063/PT.3.1415

[24] Frank von Hippel, “Gorbachev’s unofficial arms-control advisers,” Physics Today **66** (9) 41 (2013). https://doi.org/10.1063/PT.3.2116

[25] Alexander DeVolpi et al., “Russia and the US in the Cold War arms race,” Physics Today **67** (4) 8 (2014). https://doi.org/10.1063/PT.3.2324 https://doi.org/10.1063/PT.3.2325

https://doi.org/10.1063/PT.3.2326 https://doi.org/10.1063/PT.3.2327 https://doi.org/10.1063/PT.3.2328 https://doi.org/10.1063/PT.3.2329

[26] Pierce Corden and David Hafemeister, “Nuclear proliferation and testing: A tale of two treaties,” Physics Today **67** (4) 41 (2014). https://doi.org/10.1063/PT.3.2348

[27] Matthias Auer and Mark Prior, “A new era of nuclear test verification,” Physics Today **67** (9) 39 (2014). https://doi.org/10.1063/PT.3.2516

[28] Herbert York, *Making Weapons, Talking Peace: A Physicist’s Odyssey from Hiroshima to Geneva,* (Basic Books, Inc. New York, NY 1987).

[29] Herbert York, *Arms and the Physicist* (AIP Press, Woodbury, NY 1995).

[30] National Ignition Facility home page, https://lasers.llnl.gov/ (accessed October 28, 2019).

[31] Michael Loui, Professional Ethics in Engineering, Part 9: Overview of Moral Theories.
https://www.youtube.com/watch?v=ZJa6xGUrN6Y&list=PL746AE3CCB29B64B8&index=10&t=
(accessed October 28, 2019).

[32] National Institutes of Health, Office of Science Policy, “Dual Use Research of Concern,” https://osp.od.nih.gov/biotechnology/dual-use-research-of-concern/ (accessed January 17, 2020).

Rights

Resource Type

Instructor Materials

Topics

Dual Use Research
Controversies
Military and Defense Research
Social Responsibility

Discipline(s)

Physics
Computer, Math, and Physical Sciences
Teaching Ethics in STEM
Research Ethics