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Teaching Social Responsibility: The Manhattan Project

Commentary on "Six Domains of Research Ethics" (K.D. Pimple)

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ABSTRACT: *This paper discusses the critical necessity of teaching students about the social and ethical responsibilities of scientists. Both a university scientist and a middle school science teacher reflect on the value of teaching the ethical issues that confront scientists. In the development of the atomic bomb in the US-led Manhattan Project, scientists faced the growing threat of atomic bombs by the Germans and Japanese and the ethical issues involved in successfully completing such a destructive weapon. The Manhattan Project is a prime example of the types of ethical dilemmas and social responsibilities that scientists may confront.*

In his heuristic framework for organizing issues in ethics research, Kenneth Pimple[1] makes the point that the Public Health Service (PHS) Core Instructional Areas include the first five of his six heuristic domains of research ethics, but omit the sixth domain on social responsibility.

Pimple's Six Domains of Research Ethics

- Scientific Integrity
- Collegiality
- Protection of human subjects
- Animal welfare
- Institutional integrity
- Social responsibility

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In our minds, science and responsibility are coupled, not only in the first five domains, but also, especially, in the sixth domain of social responsibility. As a university professor, one of us, Penny J. Gilmer, finds that in teaching research ethics, social responsibility is an issue that many students have not considered beforehand. However, it becomes meaningful as students learn and interweave history with the human issues, coming to realize that ethical issues are implicit in advances in science and technology.

The importance of scientists considering their social responsibilities became apparent during my time as a graduate student at the University of California, Berkeley, while taking a course through the "free university" entitled *Social Responsibility of the Scientist*, taught by Joseph Neilands.[2] Owen Chamberlin spoke to the class about his experience working on a secret project as a graduate student (and for which he later shared a Nobel prize) as part of the Manhattan Project during World War II. I was so moved by his experience and presentation that I promised myself that, once tenured as a university chemistry faculty member, I would offer a similar course. This promise became *Science, Technology & Society* (STS) offered at least once a year since 1984.[3, 4]

The course has evolved with time, but has always included the history of the Manhattan Project coupled to the ethical issues it raises for the scientists involved in the project and the effect of the development of the first nuclear bomb on the public. There were four major goals in the section, "The Scientific Enterprise" in the STS course:

Goals in STS Course on the Manhattan Project

1. To explain why science is the way it is now—as a result of history
2. To teach some science and its applications in technology
3. To see how scientists' participation thereafter has affected science and scientists
4. To demonstrate the power of science and technology in our society

In her edited collection of papers from the journal *Science*, from the period 1949 to 1988, Rosemary Chalk has a section entitled, "Science and Responsibility".[5] Included in this collection is an article originally published in 1960 by Bertrand Russell, a fellow of Trinity College, Cambridge.[6] Based on a presentation given in London a year earlier at a meeting organized by the Campaign for Nuclear Disarmament for British scientists, Russell emphasizes that scientists must consider how their discoveries/findings can be utilized by society. He was particularly interested in the idea that science "from the first had an intimate and sinister connection with war."[6(p.391)] C.P. Snow's famous paper, "The Moral Un-Neutrality of Science" originally published in Science on 27 January 1961[7] and also included in the Chalk[5] anthology, was initially given as an address at the annual AAAS meeting and examined the concerns of scientists during World War II:

> Most scientists thought then that Nazism was as near absolute evil as a human society can manage. I myself thought so. I still think so, without qualification. That being so, Nazism had to be fought, and since the Nazis might make fission bombs—which we thought possible until 1944, and which was a continual nightmare if one was remotely in the know—well, then we had to make them too.[7(p.258)]

However, Snow felt that scientists must take responsibility beyond that of the average citizen and share what they know. He stated, "It is not enough to say that scientists have a responsibility as citizens. They have a much greater one than that and one different in kind. For scientists have a moral imperative to say what they know."[7(p.259)]

These are heady issues for any person, yet for students, it is a wake-up call to the power of science and technology in society and the importance of ethics in the practice of science. Many current students have never studied the history of World War II and barely know what the term, Manhattan Project, means. I include in the study of the Manhattan Project a favorite quote from William L. Laurence of the *New York Times*, the only newspaper reporter allowed to witness the first atomic bomb explosion at the Trinity site in New Mexico on 16 July 1945. It gives students the feeling of the power of science and technology:

> It was like the grand finale of a mighty symphony of the elements; fascinating and terrifying, uplifting and crushing, ominous, devastating, full of great promise and great foreboding… On that moment hung eternity. Time stood still. Space contracted to a pinpoint. It was as though the earth had opened and the skies split. One felt as though he had been privileged to witness the birth of the world—to be present at the moment of Creation when the Lord said: "Let there be light." [8]

The light was so strong that even a blind man was said to be able to see.[8] The sound wave took one and a half minutes to reach the closest observers and the roar of the explosion was deafening, even 20 miles away.

Brigadier General Leslie R. Groves was the person in charge of the development and implementation of the bomb in the Manhattan Project for the U.S. Army.[8, 9] After the first successful detonation of a plutonium-type atomic bomb, Groves sent the following coded message to U.S. President Harry Truman who was attending the Potsdam Conference in July 1945, with Stalin and Churchill:

> Doctor has just returned most enthusiastic and confident that the little boy is as husky as his big brother. The light in his eyes was discernible from here to Highhold [Secretary of State Stimson's house on Long Island] and I could hear his screams from here to my farm. [8 (p.358), **a**]

Groueff said, "In a brief moment, the light within twenty miles was equal to several suns at midday...As Brigadier General Farrell wrote later in the report for the Secretary of War, it was 'unprecedented, magnificent, beautiful, stupendous and terrifying'." [8 (p.255)]

The scientists were very curious about learning the secrets of the atom and wanted to know if it were possible to develop an atomic bomb. They learned that they could. However, once the bomb was successfully deployed in Alamogordo, New Mexico, the scientists had no further political say as to whether atomic bombs would be utilized in the war. When Truman received the coded message, he knew that the U.S. government

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a. This was quoted within 8. The coded reference to "big brother" was to the plutonium atomic bomb, while the "little boy" referred to the uranium atomic bomb, and the "screams" were in reference to the deafening roar of the explosion. The "light in his eyes" was enough to light momentarily the entire 5:29 AM sky and all the surrounding mountains at the Trinity site.

had successfully exploded the first atomic bomb and that it would be up to him as President to make the decision whether to use this weapon against Japan. The power of science and technology was never more apparent and the deployment of atomic bombs brought on the resulting arms race with fifty years of cold war.

As part of a Science for Early Adolescence Teachers (FEAT) program funded by the National Science Foundation,[10] 72 practicing middle school teachers learned about the Manhattan Project.

One of us (Michael DuBois) teaches physical science in a rural middle school in Florida and participated in this Science FEAT program. The teachers participated in a survey before and after a 100-minute lesson on the Manhattan Project in order to assess the teachers' knowledge of the subject. As evidenced both by comparing responses in the pre-survey and post-survey [b] (both in 1993), and by examining actions taken in the classroom over the past nine years, the lesson on the Manhattan Project had a significant impact. In the written survey responses there are more details in the post-survey than the pre-survey, though this may reflect the fact that the questions in the two surveys are somewhat different. Nevertheless, the lesson revealed how much the scientists' curiosity about the secrets of the atom took them towards the final steps to producing the bomb.

Nine years later the Manhattan Project is still part of my class. The students have many questions regarding atomic structure, but some of the most frequently asked questions are: "How do scientists split atoms?" or "How does an atomic bomb work?" This creates an opportunity for me to talk about The Manhattan Project and scientific ethical dilemmas. We discuss why it was so critical that the US develop an atomic bomb before Germany or Japan, and that, as horrendous as it seems to us now, the use of the bomb as a weapon marked the end of a devastating war. The discussion then

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b. Pre-survey question: Briefly describe what the Manhattan Project was. What ethical dilemma was raised by some of the people who worked on this project?

Michael DuBois' pre-survey response: The Manhattan Project was a concentrated effort by the U.S. government under Roosevelt to develop the atomic bomb. The urgency was caused by Hitler's increasing atrocities in Germany and the idea that they were also working on an atomic bomb. The ethical dilemma was the conflict between pursing a terrific scientific breakthrough and the ramifications in terms of human life.

Post-survey questions: What ethical dilemmas did the scientists who participated in the Manhattan Project have to face? What do you think you would do if you were a scientist and faced with a similar ethical dilemma now? What long ranging impact might your decision have on science and our society in the future?

Michael DuBois' post-survey response: The ethical dilemma was whether or not to develop an atomic bomb. On the one hand, if they didn't develop it, the Germans or the Japanese might have and that could have changed the outcome of World War II. Plus, I think the scientists really wanted to see their project through for the sake of science. But on the other hand, they created an instrument of mass destruction that would change the world's idea of what the potential costs of war might be. If I were faced with a similar dilemma, I would still pursue the goals of science. Scientists can't ignore potential discoveries because of how people might use them. Just as with the Manhattan Project, if one scientist doesn't pursue a discovery, the next one probably will. Society really has the dilemma as to how to use scientific discoveries.

progresses to the Cold War and the build up of nuclear weapons in the Soviet Union and the US. We consider Carl Sagan's description of a "no winner" scenario of global nuclear war, and some students become very interested in nuclear arms reductions and elimination when considering the prospect of a nuclear winter.

Teaching students about the Manhattan Project provides an excellent opportunity to discuss the many ethical implications of scientific discoveries. Students seem to agree that it is human nature to keep learning and that scientific discoveries will keep occurring. How we use our knowledge is what is most important.

Not all teachers in the 1993 class reacted the same way. However, the point of this comment piece is that introducing students (and practicing teachers) to a case such as the Manhattan Project opens up an avenue of discourse for students with teachers and among themselves. It encourages everyone to reflect on the ethical issues within the scientific enterprise.

In light of the September 11, 2001 terrorist attacks in the United States and the renewed Middle Eastern conflicts, more students are aware of the implications of war. More people now worry about other types of bombs, such as suicide bombs and germ warfare. There are social responsibility issues here for scientists as well. It is critical to include the social responsibilities of scientists in the teaching and learning of future scientists and science teachers.

Teaching other teachers is a way of amplifying the influence of college faculty on the learning of the next generation. If one teaches 70 middle school teachers, each of them in turn teaching 150 students per year, one reaches ~10,000 students per year. In the nine years since the teachers had this powerful lesson, a total of ~90,000 middle school students could have had the opportunity to learn about the Manhattan Project and its ethical implications.

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