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Abstract

The successes of the United States military in the Gulf War (1990-1991), Operation Enduring Freedom (2001-) and Operation Iraqi Freedom (2002-) have generated enormous discussion on the value of technology in projecting national will through armed force. As technologies continue to challenge and change our understanding and assumptions of warfare, it becomes increasingly critical to raise questions concerning their development and use.

The discipline of history and the field of the history of technology can provide useful conceptual tools for investigating the complicated historical relationship of technology and war. Although history cannot offer predictive models, this limitation should not reduce the value of historical inquiry when considering current strategic issues. As Prussian officer and philosopher of war Carl von Clausewitz noted, "even if history does not here furnish any formula, we may be certain that here as well as everywhere else, it will give us exercise for the judgment."

This presentation will provide such an exercise by using the "externalist" and "contextualist" approaches o the history of technology to examine some historical case studies involving technology and war. The role of non-technical factors will be emphasized. They include the role of social context and values; the nature of institutions; the role of individuals; and the importance of the human being in the technological battlefield.

THINKING OUTSIDE THE BLACK BOX: SOME HISTORICAL INQUIRIES INTO THE RELATIONSHIP OF TECHNOLOGY AND WARFARE

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Introduction

There is great value in studying the context in which technology, military or otherwise, is created and used. This may seem obvious, but context is often relegated a secondary place in technological discussions.[1] Many works concerning the Revolution in Military Affairs discuss changes in doctrine, organization, and different national application, but technology is the catalyst for the revolution.[2]

The field of the history of technology was once dominated by a strict focus on a technology's origins and development. Historian John Staudenmaier named this the "internalist" approach. These works abound in technical insights, but the context of a technology's development tended to deliquesce.

Staudenmaier contends that many internalist disdain context because they have been persuasively influenced by empirical approaches that have dominated our view of science and technology since the days of Sir Frances Bacon[3]. Empiricism puts a premium on separating context from methods in order to gain a better and more objective view of the world. Many view technology in empirical terms. A sign from the 1933 Chicago World's Fair expressed this position nicely: "Science Finds, Industry Applies, Man Conforms."[4]

Empirical thinking is rooted in the Western worldview thanks to the many benefits it has brought through science and technology. But when it comes to understanding the varied nature of technology, especially in military affairs, the separation of method from context distorts as much as it clarifies. Many internalists have been accused of succumbing to the temptation of presenting a technology's history as a series of rational technical developments leading to an inevitable outcome, autonomous of contextual factors. It has led to works that historian Reinhardt Rüurp classified as "company histories," narrative success stories that any company would be glad to send its stockholders. [5] As a result, a myth of progress about technology began to develop from the internalist view. One I would wager most people share.

It is true that history, an art concerned with objective reality, prides itself on maintaining an empirical ethos. As critic Northrop Frye noted, it is this scientific principal in historical analysis that "distinguishes history from legend."7 But many historians of technology now pursue studies that integrate contextual data, producing, in my own opinion, a richer intellectual product, one in which outcomes are not inevitable. Without context, to paraphrase Frye, historians lose the zeitgeist in which their principals operate and while their work may not become myth, it certainly loses its verity. I will follow in this contextual approach today and examine three non-technical factors that influenced the development of the atomic bomb: The international climate; the importance of people and ideas; and the nature of regimes.

The Atomic Bomb

Nothing about the development of the atomic bomb was destiny. Its development was, of course, a result of numerous and incredible scientific and technical achievements. But contextual factors outside of the laboratory also contributed to the existence of a weapon that thirty years previous was an idea suitable only for one of H. G. Well's scientific romance.8

In 1938 at the Kaiser Wilhelm Institute in Berlin, German physicists Otto Hahn and Fritz Strassman made a shocking discovery. They were able to **split** the nucleus of uranium atoms by bombarding them with neutrons. They called this process fission: the nucleus split into two separate parts and in doing so released a tremendous amount of energy; roughly a million times more than a chemical reaction could produce.9

Over a hundred scientific papers were released in 1939 on the topic of nuclear fission.10 If the energy released from fission could be harnessed, and that was a big if in 1938, then it could be used for any number of purposes, including weaponry. Could one make a bomb that utilized nuclear energy? These questions were raised in part because of the concern over the international climate this discovery arrived in.

International Climate:

Fission was uncovered at a time of diplomatic challenge and crisis in Europe. Democratic nations struggled to deal with the belligerence of the Axis powers. The increasing daring of Adolf Hitler's foreign policies was the most troubling. In 1938, the same year as Hahn and Strassman's discovery, Austria and the Sudetenland were incorporated in the Reich. By March the following year, the German dictator reneged on the Munich settlement and annexed the rest of Czechoslovakia. After securing a non-aggression pact with the Soviet Union in August, Germany invaded Poland on September 1st.11 The Second World War was on.

This climate is crucial to understanding the subsequent development of the atomic bomb. Times of war and peace shape people's perceptions of technological applications. Author Robert Pool postulated that if fission had been discovered in the twenties when the exhaustive experience of the First World War was still close to hearts and minds of millions, it may have taken a different route than then towards a weapons application.[12]

But the discovery was made at a time of international crisis that turned to war, and so scientists reasonably wondered what the military potential of fission might bring to the nation that managed to harness it. The discovery itself was not **ordained** to occur at this time. Hahn and Strassman's report on their findings expressed their own shock at the results of their experiments, and about its possible repercussions. Fission was not part of a larger military weapons program, but part of the advanced scientific studies that Germany had been pursuing academically for decades. Still, once the idea was released into the environment the genie was out of the bottle, though there was still no telling where it would go. Military application was certainly one logical destination. The idea grew into reality from this climate of international hostilities and then open warfare.

But the discovery itself did not make an atomic weapon an inevitable success story and the political climate alone did not decide its fate. The actions of individuals also translated this "idea" of an atomic bomb into a technology.

People and Ideas

By, 1939, fission's potential alone began to worry some scientist. One was Leo Szilard, a Jewish-Hungarian physicist who had obtained his Ph.D. in Berlin but left Germany for Britain when Hitler came to power in 1933, and moved to the United States to work at Columbia university in 1936.[15] After learning of Hahn and Strassman's findings, Szilard feared that the potentials of an atomic bomb would garner the attention of Adolf Hitler. After all, fission had been discovered in the heart of Nazi Germany. Some of the leading physicists of the day, such as Nobel laureate Werner Heisenberg, were German. Germany had a thoroughly modern scientific and technical infrastructure and controlled Europe's uranium mines.[16] In the spring of 1939 Szilard witnessed experiments that convinced him of the feasibility of a creating a chain reaction with uranium and graphite. An atomic bomb, though it would be exorbitant, was possible. And if he had realized this, Szilard thought, so had his counterparts in Germany.[17]

In July and August, he discussed his worries with colleagues Edward Teller and Eugene Wigner. They discussed warning the Queen of Belgium, because Germany might target the uranium-rich Congo. Albert Einstein, who had met the Queen, was called in to write the letter explaining the potential dangers of atomic power should Germany choose to pursue it. Wigner pushed for contacting the US government, so the letter to the Queen was to be sent through the State Department. While the draft was written, these discussions came to the attention of Dr. Alexander Sachs, an economist who had contributed economic texts to Roosevelt's election campaign. Sachs convinced Szilard that the President should be contacted directly, and that he would do it himself, which he did on October 11, 1939[18]. The meeting with the President proved fruitful. Sachs read his own summation of Einstein's letter, the first authoritative report to a head of state of the possibility of using nuclear energy to make a weapon of war.[19] Within days Roosevelt authorized an advisory committee on uranium and the United States government took tentative but active national steps towards investigating the potential of nuclear power.

What this narrative presents, I hope, is that technological developments do not strictly occur in laboratories, but are ushered into existence by a network of people and ideas acting and reacting to international and scientific developments. The decision to bring Szilard's concerns to the attention to the President of the United States was not emperical or preordained; the letter might very well have gone to the Queen of Belgium. The decision of this group of men, based on their own ideas and convictions, helped initiate the US bomb program.

Germany and the Atomic Bomb

Despite these steps, in 1939, Germany, not the United States, seemed the most likely candidate to develop an atomic bomb first. As mentioned, they had the scientific and technical expertise, as well as some of the material goods. In December 1939, Werner Heisnberg presented a paper to the government that outlined how a nuclear reactor could work and the possibility of creating of an atomic bomb. The conquest of Norway in April 1940 added the heavy water facilities of the Norsk Hydro plant in Vermok to Germany's technical capabilities, increasing her potential to make fissile materials .[20] But at wars end Germany was years behind Britain and the U.S. in actually developing an atomic bomb.

German failure to develop an atomic bomb rested largely on how little Adolf Hitler valued the project. By the nature of the regime's dictatorial system, he alone decided the nations strategic policies and priorities, including weapons development, something he considered himself to be an expert on. But the weapons Hitler was both familiar and enthusiastic with were tanks, guns, planes, artillery, the ones that had already been winning the war for Germany. The potential of nuclear physics, on the other hand, was not an easy subject for leaders in science to recognize, let alone politicians. While its potentials were great, they had yet to be proven. The costs involved in researching them were high, with possibly little pay off. It is not surprising that Hitler was hostile to atomic science, not unlike most people when confronted with a revolution that has not yet materialized. But unlike the conservative skepticism which desperation had shed away in Britain and the U.S., Hitler distrust of nuclear physics was also grounded in the racial views that defined the Reich. When Albert Speer attempted to discuss the nation's atomic research, Hitler condemned it as a "spawn of Jewish pseudo-science."[22] No weapons program in Nazi Germany could succeed without the support of the political leadership. Hitler's technical enthusiasm would find outlets by supporting Germany's advanced rocketry programs and missile development. These were the wonder weapons the dictator approved of, since they seemed likely to produce decisive results in terms the Fuehrer understood and appreciated.

Hitler was not convinced of the weapons potential, and its priority in weapons development reflected this belief. And in one way Hitler was right. The war in Europe was not won by the power unleashed by split atoms. No one succeeded in developing the weapon before German defeat by conventional arms in 1945[23]. But Germany's failure at least can be understood by the nature of regime.

Conclusion:

Technology tends to dominate our visual landscape of war. Philosopher and Second World War veteran J. Glen Grey labeled this the "Lust of the Eye." Soldiers in combat often find themselves engrossed by the spectacle of large-scale technical destruction, loosing themselves in the terrible beauty of events they cannot control.[24] I believe technology can also have such an effect, though on a smaller scale. Modern military technology can be so impressive, even awe inspiring, that one can be overwhelmed by its capability, its complexity, its potential. The context of the technology, less engaging to look at, soon ends up in the shadow of the object itself.

A technology's internal story is imperative to understanding its potential and implications, and should be studied with rigor by those who know it best. But as imperative is that space in which a technology sits. Non-technical factors will encroach on the designs born in laboratories, and not always beneficially. Every technolgy influence our world, and responds to its many contextual factors, be it a hostile international climate, the actions of men and the influence of ideas, or the nature of political regimes. The results, as in the case of the atomic bomb, can be frightening and profound.

Endnotes

1 Alex Roland, "Technology and War: A Bibliographic Essay," in *Military Enterprise and Technological Change: Perspectives on the American Experience* ed. Merritt Roe Smith, (Cambridge and London: MIT Press, 1985), p. 347- 379, Barton Hacker, "Military Institutions, Weapons, and Social Change: Toward a New History of Military Technology," *Technology and Culture* 35 (1994), p. 768-834. Some excellent papers on diverse topics of war and technology from the view of military history can found in Geoffrey Jensen and Andrew Wiest, eds, *War in the Age of Technology: Myriad Faces of Modern Armed Conflict*, (New York and London: New York University Press), as well as Ronald Haycock and Keith Neilson, eds., *Men Machines and War* (Waterloo: Wilfrid Laurier University, 1988). While there are many works on the changing nature of military history, the history of technology can only trace its professional roots to this past century. For a review of its development through the Society for the History of Technology's (SHOT) journal, *Technology and Culture*, see Howard P. Segal,

"Technology, History and Culture: An Appreciation of Melvin Kranzberg," *The Virginia Quarterly Review* 74 (1998): 641-53, John Staudenmaier in, *Technology's Storytellers: Reweaving the Human Fabric* (Cambridge and London: Published jointly by the Society for the History of Technology and the MIT Press, 1985), as well as his paper, "Rationality, Agency, Contingency: Recent Trends in the History of Technology," *Reviews in American History* 30 (2002), p. 168-181.

2 The literature on the RMA is voluminous, but the following articles deal with the basics of the discussion that arose after the Gulf War, Eliot Cohen, "A Revolution in Warfare," *Foreign Affaitrs* 75 2 (March/April), p. 37-54, Eric Sterner, "You Say You want a Revolution (in Military Affairs)?" Comperative Strategy, 18 4 (October/December 1999), p. 297-308. For an competing looks at Canada's response to the RMA, see Elinor Sloan, "Canada and the Revolution in Military Affairs: Current Responses and Future Opportunities," *Canadian Military Journal* 1 3 (Autumn 2000), p. 7-14, Sean Maloney and Scot Robertson, "The Revolution in Military Affairs: Possible Implications for Canada," *International Journal* 54 3 (Summer 1999), p. 443-462.

3 Neil Postman, *Technopoly: The Surrender of Culture to Technology*, (New York: Vintage Books, 1993), p. 35-8, 40-43.

4 Cited in Staudenmaier in, *Technology's Storytellers*p.165.

5 Staudenmaier, *Technology's Storytellers*, p. 146, 165,175

7 Northrop Frye, *Anatomy of Criticism*, (New Jersey: Princeton University Press, 1997), p. 7.

8 H. G. Wells, *The Last War: A World Set Free* (London: Bison Bks Corps, 2002). The original edition of the book was published in 1914 before the start of the First World War and examines a world ravaged by atomic warfare.

9 Robert Pool, *Beyond Engineering: How Society Shapes Technology*, (New York and Oxford: Oxford University Press, 1997), p. 32

10 MacLachlan, *Children of Prometheus*, p. 261

11 A. J. P. Taylor, *The Origins of the Second World War,* (London: Penguin Books, 1991), 168-302.

12 Pool, *Beyond Engineering*, p. 33.

15 Rhodes, *The Making of the Atomic Bomb*, 26.

16 Thomas Powers, *Heisenberg's War: The Secret History of the German Bomb* (Boston: Little Brown & Company, 1993), p. vii, Pool, *Beyond Engineering*, p. 33.

17 Rhodes, *The Making of the Atomic Bomb*, p. 301

18 Rhodes, *The Making of the Atomic Bomb*, p. 303-314.

19 Rhodes, *The Making of the Atomic Bomb*, p. 314.

20 Overy, *Why the Allies Won*, p. 236.

22 Overy, *Why the Allies Won*, p. 237.

23 Overy, *Why the Allies Won*, p. 238-244.

24 J. Glen Gray, *The Warriors: Reflection of Men in Battle*, (University of Nebraska Press: Lincoln, 1998), p. 29-38.