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Abstract

Intellectual property and contract have been integral to the construction of an enframing paradigm of militarized science for the institution of science. The paper traces how the Manhattan project provided the U.S. with its first large-scale experience of using contracts and intellectual property to restrict the diffusion of sensitive military technology. In the following decades private law, namely contract and intellectual property, were used to bind the military, firms and universities into a system. Science, including university science finds itself in an iron military cage. The final section asks whether private law tools can help science break out of this cage.

Keywords

contract, defence procurement, intellectual property, military-industrial complex, patents, university ownership of intellectual property, weapons innovation.

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1. Introduction

In 1969 the artist and designer Jacques Carelman published Catalogue of Objets Introuvables (translated in 1971 as the Catalog of Fantastic Things). Carelman's eye-catching drawings of his fantastic objects included a weapon, the Kangaroo Rifle. This rifle, runs the sales pitch, has a barrel designed to send the bullet in an undulating trajectory to follow the evasive manoeuvres of a bounding kangaroo. For purchasers of weapons by mail order in the United States the Kangaroo Rifle was probably more quaint than fantastic. By 1971 the Sidewinder missile had been in military service for 14 or so years. The missile's name came from the Sidewinder snake which tracks the body heat of its prey. Much like its reptilian namesake, the Sidewinder missile could generate the wave-like movement needed for lethal accuracy. For an arms lover if one really wanted to make quick work of a hapless bounding Australian marsupial the Sidewinder missile had to be the preferred purchase.

The Sidewinder had been used with astonishing success in a dogfight in 1958 between Taiwanese-piloted Sabres (sourced from the U.S.) and Chinese-piloted MiG-15s (sourced from the Soviet Union).[1] Despite being outnumbered the Taiwanese pilots were able to release the heat-seeking Sidewinders before the Chinese MIGs came close enough to be able to use their cannons. As the number of kills by the Taiwanese pilots mounted the Chinese pilots retreated. Not for the first time an innovation weapons had changed the rules of engagement.

In what follows I outline why the link between intellectual property and weapons innovation deserves more attention. My purpose is not to trace the patenting of weapons. This use of the patent system has always been there. The Sidewinder missile is a case in point. After its invention in 1947 by William McLean, Director of a Naval Ordnance Test Station, it was kept a secret but then a series of patents were granted on the missile technology in the 1970s.[2] One can trace the links between patent privileges and weapons much further back; for example the grant of monopolies by the English Crown in the 16th century for the making of saltpeter and sulpher (important in the making of explosives).

In this paper I show how intellectual property and contract have been integral to the construction of an enframing paradigm of militarized science for the institution of science. I begin with a discussion of how the organization of academic knowledge in Germany played a crucial role in the rise of the military industrial complex (section 2). The Manhattan project provided the U.S. with its first large-scale experience of using contracts and intellectual property to restrict the diffusion of sensitive military technology (section 3). The ties of private law, namely contract and intellectual property, were then used to bind the military, firms and universities into a system (sections 4 and 5). The cost of this comes in the form of an enframing paradigm for science that diminishes the capacity of science (section 6). University science

[1] For a short history of the missile see Alex Hollings, 'The Almost-Unbelievable True Story of the Sidewinder Missile' 21 March 2021 Popular Mechanics https://www.popularmechanics.com/military/weapons/a35701747/sidewinder-missile-story/ accessed 4 May 2024.

[2] See Stacy V. Jones, 'Patents' *New York Times*, (New York, 8 March 1980) 29.

finds itself in an iron cage. In the final section I ask whether private law tools can help science break out of the iron cage (see section 7).

Finally, a quick word about the metaphor in the title. In 1947 the scientists of the Bulletin of the Atomic Scientists (founded in 1945 by Einstein, Oppenheimer and other scientists) created the Doomsday Clock with midnight being the moment of a man-made apocalypse. I return to another version of the metaphor in my conclusion.

2. Universities in the Military-Industrial Complex - Origins.

Whenever the political system of a state chooses war, the reaction from its citizens is manifold, ranging from passionate patriotism to conscientious objection. As the twentieth century showed, when it comes to killing on a large scale it is the reaction of inventors, especially scientifically-trained ones, that really matters. During World War I the US patent office was flooded with suggestions for improving weapons, most of which did not show much promise.[3] Individual artisanal invention did not meet the industrial-scale needs of large armies. Science and, just as importantly, the organization of science were needed to extract the gifts of Mars.

Fritz Haber was a German patriot, a chemist, a Nobel Prize winner and the first to have success with a large-scale gas attack in World War I.[4] Haber's leadership had been central to organizing the provision of scientific solutions to be scaled by German industrial firms such as BASF and Bayer to satisfy the materiel needs of the German army. The stalemate in mud produced by armies dug deeply into networks of trenches had led France, Germany and the UK to conduct small-scale experiments with the release of gas to drive the enemy out of their trenches. These experiments had suggested a gas attack was too difficult to control. Haber approached the problem by focussing on potentially deadly gases like chlorine rather than those designed for extreme discomfort, like tear gas. He also recruited as many scientists as he could find to refine poison gas into a usable weapon. By the time he finished his unit housed five future Nobel Laureates in chemistry and physics (including Haber who was awarded a Nobel in chemistry in 1918).[5] Haber brought his scientists together at the Kaiser Wilhelm Institute for Physical Chemistry and Electrochemistry to investigate the chemistry of poison gas, and to build a knowledge of meteorology. Staff rotated between the laboratory and frontlines, theory and practice entwining to deadly effect.

On the 22nd of April 1915 Haber's science troops released 150 tons of chlorine gas on the frontlines near Ypres. Thousands of Allied infantry enveloped by a green cloud of gas experienced what the poet Wilfred Owen would later memorialize as ''guttering, choking, drowning''.

For the rest of the war Haber's institute became the centre of gas research, growing to some 1500 personnel and becoming part of German military command. Out of its laboratories came

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[3] Karl Fenning, 'Patents and National Defense' (1941) 27 AB J 305.

[4] For a detailed account of Haber's life see Daniel Charles, *Mastermind: The Rise and Fall of Fritz Haber, the Nobel Laureate Who Launched the Age of Chemical Warfare* (HarperCollins e-books 2005).

[5] William Van der Kloot, 'April 1915: Five Future Nobel Prize-Winners Inaugurate Weapons of Mass Destruction and the Academic-Industrial-Military Complex' (2004) 58 Notes and Records of the Royal Society of London 149, 150.

other gases, phosgene and then mustard gas. Van der Kloot is probably right to describe Haber's re-organization of his Kaiser Wilhelm Institute as a forerunner of the ''Academic-Military-Industrial Complex'' although perhaps the order should be military-industrial-university complex to reflect the real chain of command.[6]

In the U.S., some scientists, anticipating US involvement in World War I, pushed for the creation of an organization that would bring system to science's service of the military-industrial needs of the U.S. Their wish was granted in the form of the US National Research Council in 1916.[7] Under an executive order signed by President Wilson in 1918 the functions of the Research Council included organizing research on military and industrial problems raised by the war.[8] The first steps in creating what would become the world's largest planned defence economy had been taken.

3. The (patented) destroyer of worlds

Some 36 years after the formation of the National Research Council, the Manhattan Project accelerated military-university cooperation. For scale and structure there had never been a military project to rival it. Over the life of the project some 500,000 people were employed across several hundred sites mostly scattered across the U.S., including more than two dozen universities.[9] The number of patents covering the atomic bomb, like everything else associated with the project, mushroomed. Within the Office of Scientific Research and Development (OSRD), which had been set up in 1941 to integrate processes of industrial innovation for military purposes, a patent group was established to manage the patent issues raised by the number of inventions coming out of the project. By the end of 1946, this group had approved some 2,100 patent applications for filing of which 1,250 were filed with the US Patent Office. As Wellerstein's detailed study makes clear, these numbers should be put in the context of their time.[10] In 1946 1,250 applications represented 1.5% of all patent filing applications.

The decision to use the patent system for atomic weapons invention was largely driven by Vannevar Bush, the scientist who had been appointed by President Roosevelt to head the OSRD.[11] In Bush's view the use of patents and contract by the US government represented the best path to inhibiting the spread of atomic weapons knowledge. Since under the patent

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[6] William Van der Kloot, 'April 1915: Five Future Nobel Prize-Winners Inaugurate Weapons of Mass Destruction and the Academic-Industrial-Military Complex' Notes and Records of the Royal Society of London (2004) 58 149. For some historians the relational core of the US and British military-industrial complexes were forged at the end of the nineteenth century. See Katherine C. Epstein, *Torpedo: Inventing the Military-Industrial Complex in the United States and Great Britain* (Harvard University Press 2014).

[7] For a brief history of the Council see https://www.nasonline.org/about-nas/history/archives/milestones-in-NAS-history/organization-of-the-nrc.html accessed 14 May 2024.

[8] Albert L. Barrows, 'A History of the National Research Council, 1919-1933: X. The Divisions of General Relations' (1933) 2021 Science 254.

[9] See the facts reported in Alex Wellerstein, 'Manhattan Project,' October 2019 Encyclopedia of the History of Science https://doi.org/10.34758/9aaa-ne35 accessed 14 May 2024.

[10] For the numbers see Alex Wellerstein, 'Patenting the Bomb: Nuclear Weapons, Intellectual Property, and Technological Control' (2008) 1999 Isis 57, 78-79

[11] Alex Wellerstein, 'Patenting the Bomb: Nuclear Weapons, Intellectual Property, and Technological Control' (2008) 1999 Isis 57, 61.

social contract publishing the details of the invention is required, secrecy orders had to be applied to patents related to the bomb. The basic thinking was that a combination of exclusive government ownership and secrecy was the most effective way for the U.S. and the United Kingdom to control the future of nuclear power.

Ownership of the Manhattan Project's patent rights appears to have been a matter of intense negotiation. Vannevar Bush's plan for the government to own all the intellectual property had received Roosevelt's blessing.[12] However, industrial firms and universities saw that nuclear power would have important civil uses, most obviously in energy markets and so were reluctant to part with any intellectual property they either brought to the project or generated during its course. In the end four standardized contracts were used to settle the patent ownership and licence issues depending on whether it was a contract for research and development or whether, for example, it covered the construction of a plant.[13] In the case of research and development some contracts gave the government full ownership of the patent, but in others the contractor retained ownership, with the US government being provided with a licence to use the patented technology for defence purposes.

The diversity of contracting around patent ownership when the US government was involved in the funding and/or purchase of technology led President Roosevelt in 1943 to request the US Attorney General to report on the policies and practices followed by US government agencies when dealing with inventions made by employees or private contractors.[14] One bedrock principle animated the Attorney General's report in 1947 – the patent ownership of publicly funded inventions, whether produced by a public employee or a private contractor, should remain with the public. Among the dangers of allowing private contractors to acquire title to inventions financed by the public was ''undue concentration of economic power in the hands of a few large corporations''.[15]

However, the standardized patent clause for defence contracting that made it into federal regulations in the 1950s started from the position that the contractor could elect to own the patent with the government being granted an irrevocable and royalty free licence.[16] The principle of public ownership of publicly funded inventions became over time muted in other ways, one notable example being the passage of the University and Small Business Patent Procedure Act (commonly referred to as the Bayh-Dole Act) in 1980. This legislation created

[12] Alex Wellerstein, 'Patenting the Bomb: Nuclear Weapons, Intellectual Property, and Technological Control' (2008) 1999 Isis 57, 66.

[13] Richard G. Hewlett and Oscar E. Andersen, JR., *The New World, 1939-1946: A History of the United States Atomic Energy Commission* (Volume 1, Pennsylvania State University Press, 1962) 496-97.

[14] U.S. Department of Justice*, Investigation of Government Patent Practices and Policies: Report and Recommendations of the Attorney General To The President* (Volume I, U.S. Printing Office 1947).

[15] U.S. Department of Justice*, Investigation of Government Patent Practices and Policies: Report and Recommendations of the Attorney General To The President* (Volume I, U.S. Printing Office 1947) 4.

[16] Thomas F. Olson, 'Patent Rights in Department of Defense Research and Development Contracts' (1959) 47 California Law Review 721.

a starting position in which small businesses and non-profit organizations could be the first owners of inventions the research for which had been financed federally.[17]

4. Hub and Nodes

The early university involvement with the military was primarily a market in bilateral contracting in which individual universities or their faculty saw economic opportunities. So, for example, before World War I the US Navy and the Federal Telegraph Company entered into contracts for the development of radio technology for naval use, contracts which allowed the Federal Telegraph Company to build a patent portfolio. Stanford faculty were involved with and investing in this company.[18] World War II placed US defence on another plane altogether, one in which centralized planning and acquisition came to the fore. The U.S. transformed itself into the national security state.[19] The practical organizational expression of the national security state was the establishment of a defence bureaucracy administering defence acquisition contracts to support industrial innovation of new technologies by US firms in emerging areas of weapons technology such as atomic energy, computing and jet engines. As big as the spending on weapons innovation had been during the World War II, what came afterwards dwarfed it. In 1957 approximately 50,000 companies had been included in Defence Department contracts to work on missile development (obviously only one area of weapons innovation) and by the end of the 1960 fiscal year the Department projected a spend of US$3 billion on research and development, a sum that exceeded the spend by all the armed forces during World War II.[20] In approximately two decades a market in bilateral contracting had been replaced by a hub and spoke architecture in which the hub is a system and the spokes nodal actors such as individual universities or firms. The private law tools used to build this hub-and-spoke architecture have been, as we will see in the next section, contract and intellectual property.

5. Carrots of Nodal Integration

Tracing the web of relationships in US university militarized science is not especially easy. Lists of defence contractors are available, such as the list of the top 100 defence contractors to the Department of Defence, but the DoD is not the only government entity contracting for weapons innovation.[21] The large and small players in this paradigm are part of complex

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[17] For a discussion on the effects on universities see Rebecca S. Eisenberg & Robert Cook-Deegan, 'Universities: The Fallen Angels of Bayh-Dole' (2018) 147 Daedalus 76.

[18] Stephen B. Adams, 'Arc of Empire: The Federal Telegraph Company, the U.S. Navy and the Beginnings of Silicon Valley' (2017) 91 The Business History Review 329.

[19] Daniel Yergin, *Shattered Peace: The Origins of the Cold War and the National Security State* (Andre Deutsch 1978).

[20] Thomas F. Olson, 'Patent Rights in Department of Defense Research and Development Contracts' (1959) 47 California Law Review 721.

[21] Lists of top 100 vendors for many US government departments and agencies can be found at the following official US website https://sam.gov/reports/awards/static For fiscal year 2022 the Department of Defense and DARPA have separate listings with 13 universities appearing in the DARPA list. John Hopkins is the first university appearing on the DARPA list, being ranked 5th. DoD has also published a list of vendors with contracts over $25,000. A search of this document turns up some 305 cases of university vendors (this includes different campuses of the same university). See

network relationships that can be housed in a variety of legal forms including research partnership agreements, resource-use agreements (for example, allowing access to special testing facilities) and personnel exchange agreements.[22] A large prime contractor like Lockheed will typically have multiple relationships with the university sector. There are also fora in which universities participate that are cooperatively relational that may lead to contractual relations for specific projects.[23]

Universities can also enter the defence market using federal government programs aimed at helping high technology startups with research and commercialization. For example, the DoD is a huge player in issuing grants under programs such as the Small Business Innovation Research and Small Business Technology Transfer (SBTT) programs. In 2023 it made 3,140 awards to 1570 applicants totalling over US$2.2 billion.[24] The SBTT program requires small businesses to partner with non-profit research institutions based in the U.S. Through this program universities can work on military projects such as improving the accuracy of hypersonic missiles using machine intelligence.[25] Keeping in mind that the SBTT program was established in 1992, it is likely that over more than 30 years thousands of defence contracts have drawn in thousands of US universities to work on inventing for the military.

Contract and the use of intellectual property rights combine to build the paradigm of militarized science with different forms of contract being used to incentivize actors to enter the paradigm. An important form of contract is the other transaction authority (OTA). The OTA has its origins in the creation of NASA in 1958 when Congress decided that the new agency had to have maximum flexibility to bring in the research resources it needed to overtake the Soviet Union in the space race.[26] The purpose of these contracts is to draw into the defence-contracting world the many smaller technology companies that are deterred by the compliance costs normally attached to government contracts.[27] On the issue of intellectual property an agency using an OTA can allow a contractor to keep the intellectual property in the technology even

https://dodsoco.ogc.osd.mil/Portals/102/Documents/Conflicts/2023%2025K%20covering%20FY2022.pdf?ver=f7CHvUlbGeU%3D accessed 16 May 2024.

[22] For a detailed discussion see Nayanee Gupta, Brian J Sergi, Emma D Tran, Rashida Nek, Susannah V Howieson, Research Collaborations Between Universities and Department of Defense Laboratories, IDA Science and Technology Policy Institute, 2014 https://apps.dtic.mil/sti/citations/tr/AD1008624 accessed 14 May 2024. accessed 16 May 2024.

[23] For example, the Universities Space Research Association appears on the DARPA list at number 91. THe USRA was established in 1969 to facilitate collaboration between NASA and the university research community. According to USRA's website close to 500 universities were involved in its programs.

[24] The analytics dashboard for this calculation is available at https://www.sbir.gov/analytics-dashboard?agency_tid%5B%5D=105729&program_tid%5B%5D=105791&program_tid%5B%5D=105792&year%5B%5D=2023&year%5B%5D=2022&year%5B%5D=2021&year%5B%5D=2020&year%5B%5D=2019&year%5B%5D=2018&year%5B%5D=2017&year%5B%5D=2016&year%5B%5D=2015&year%5B%5D=2014 accessed 16 May 2024.

[25] See for example the contract involving Ata Engineering and the University of Arkansas to work on 'Data-Driven Hypersonic Turbulence Modeling Toolset' https://www.sbir.gov/node/2579295 accessed 16 May 2024.

[26] See Moshe Schwartz and Heidi M. Peters, Department of Defense Use of Other Transaction Authorization: Background, Analysis, and Issues for Congress, 2019 CRS Report, R45521.

[27] On the issue of lower compliance costs see https://www.darpa.mil/work-with-us/contract-management#OtherTransactions accessed 14 May 2024.

though the agency has paid for research and development.[28] Integrating ''non-traditional commercial defense contractors'' into the US defence system came to be seen as vital because from the 1980s onwards private research and development was driving so much of the innovation that mattered to the US national security state.[29]

For players like Lockheed another form of contractual enticement comes from the way in which independent research and development is treated in defence contracts. In that mythical place, the competitive market, the research and development costs underpinning a product are either recovered or not depending on the success of the product. Defence contracting is far less risky when it comes to such costs. Major contractors can recover their independent research and development costs in ''real time'' through progress payments from the government, making such contracts a source of liquidity and profit for defence contractors.[30] In addition the contractor gains the benefits of intellectual property rights it developed through the expenditure of its independent (but reimbursable) research and development costs.[31] Allowing defence contractors to keep publicly-funded intellectual property rights is a practice that has been going on for decades in the U.S.[32]

In a world where weapons innovation increasingly depends on innovation with dual or multi-use characteristics (compare the atom bomb with semiconductor chips) the US defence system's monopsony power suffers some decline. Intellectual property rights have been a key tool to incentivize nodal suppliers of private goods to enter the defence system. Contracts allowing nodes to keep the intellectual property arising out of publicly-funded research is part of the price of keeping the nodes integrated in the system. Contract in this particular case has a particular public ordering effect that moves beyond relational contracting and into an integrative function. The rents and the rights to rents delivered through contracts create incentives for the nodes to stay engaged with the system hub. Nodes have the best opportunity for earning the highest rents from being integrated into the US hub because it is willing to and does outspend the system hubs of all other nation states.

6. Enframed – the Costs of System

Two big risks flow from the existence of a militarized system of science. One risk revolves around the failure to gain sufficient levels of knowledge to manage crises. A militarized

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[28] The DARPA website makes this point expressly. See https://acquisitioninnovation.darpa.mil/years-of-innovation accessed 14 May 2024.

[29] Jacques S. Gansier, William C. Greenwalt and William Lucyshyn, *Non-Traditional Commercial Defense Contractors*, University of Maryland, School of Public Policy, Center for Public Policy and Private Enterprise, 2013 https://apps.dtic.mil/sti/tr/pdf/ADA613239.pdf accessed 15 May 2024

[30] See *Contract Finance Study Report*, Department of Defense, Office of the Under Secretary of Defence for Acquisition and Sustainment Defence Pricing and Contracting April 2023, 154. https://www.acq.osd.mil/asda/dpc/pcf/docs/finance-study/FINAL%20-%20Defense%20Contract%20Finance%20Study%20Report%204.6.23.pdf accessed 15 May 2024.

[31] *Contract Finance Study Report*, Department of Defense, Office of the Under Secretary of Defence for Acquisition and Sustainment Defence Pricing and Contracting April 2023, 158.

[32] Walter Adams, 'The Military-Industrial-Complex and the New Industrial State' (1968) 58 American Economic Review 652.

paradigm of science carries an opportunity cost. It diminishes the capacity for grasping opportunities to build the knowledge we need for coping with the problems of our world.[33] Eisenhower warned of this opportunity cost in his famous 1961 address when he referred to the danger of "domination of the nation's scholars by Federal employment, project allocations''.[34]

The other risk flows from continuous cycles of weapons innovation races aimed at improving the power to destroy. Innovation in nuclear weapons has never stopped. Both the Trump and Biden administrations have pushed on with modernizing the nuclear arsenal of the U.S.[35]

The problems here run deep. On Kuhn's account of change in scientific knowledge, one paradigm is replaced by another when the anomaly build-up in the paradigm is net of the puzzles it explains.[36] If we extend the paradigm concept to include the broader institutions within which the funding, practice and steering of science occurs, then the military-industrial-university system becomes part of the institutional reality within which successive paradigm changes in science have become and will continue to be nested. This institutional nesting is not just a point about the infrastructure of support for science. The system itself becomes epistemically directive. It operates as the enframing paradigm for successive paradigms of science. Each paradigm shift in science sets new puzzles for the young minds of science, but these new puzzles are nested within a large systems reality of a defence hub seeking to turn abstract puzzles into contextual problem-solving tasks. Quantum physics is an example of Kuhn's paradigm revolution in science if anything is. The enframing puzzles provided by militarized science for quantum physics appear to be many, one into which rival militarized systems will eventually pour trillions of dollars as they look to quantum scientists to use their knowledge to build war technologies, like better gyroscopes for nuclear submarines along with better devices for detecting them as they glide through our warming oceans.[37]

In a recent book John Braithwaite argues that independent universities are one important institutional idea for generating the knowledge we need to understand complex and interlinked crises such as war, pandemics and climate change.[38] The challenge, as he recognises, is to find ways to escape the integration of universities into the military-industrial complex. In the late 1960s students confronted MIT (sometimes referred to as Pentagon East because it was at the time the number one university defence contractor) and Stanford because of the

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[33] Stuart W. Leslie, *The Cold War and American Science: The Military-Industrial-Academic Complex at MIT and Stanford* (Columbia University Press, 1993) 9.

[34] The text of Eisenhower's speech is available at https://www.archives.gov/milestone-documents/president-dwight-d-eisenhowers-farewell-address accessed 15 May 2024.

[35] For a list of innovative bombs and war heads see Stephen Young, 'Why the Biden Administration's New Nuclear Gravity Bomb is a Tragedy' Bulletin of the Atomic Scientists February 13 2024 https://thebulletin.org/2024/02/why-the-biden-administrations-new-nuclear-gravity-bomb-is-tragic/#:~:text=In%20late%20October%202023%2C%20the,%2D13%2C%20a%20gravity%20bomb accessed 15 May 2024.

[36] Thomas S. Kuhn, *The Structure of Scientific Revolutions* (University of Chicago Press 1962).

[37] For a review of this and many other possibilities see M. Krelina, 'Quantum technology for military applications' (2021) 8:24 EPJ Quantum Technology 1 https://doi.org/10.1140/epjqt/s40507-021-00113-y accessed 15 May 2024.

[38] John Braithwaite, *Simple Solutions to Complex Catastrophes: Dialectics of Peace, Climate, Finance and Health* (Palgrave Macmillan, 2024).

research these universities were doing for the military.[39] At MIT the organizers were focussed on creating a public discussion around the social costs of using science to build war machines rather than to tackle what today we call wicked problems. Two laboratories at MIT were heavily involved in classified work, the Instrumentation Laboratory and the Lincoln Laboratory. They became the focal point of rallies and confrontations. At Stanford the admission that for eight years the CIA had funded work at the university on electronic surveillance lit a blaze of revelation about the university's involvement in military work.[40] The Stanford Research Institute, which the university had incorporated as a non-profit entity, turned out to be holding defence contracts worth millions of dollars. For students it became the symbol of what had gone wrong with Stanford's values as a university. Eventually MIT divested itself of the Instrumentation Laboratory. Stanford followed the same legal path with the Stanford Research Institute. By the 1980s it was clear that this reshuffling of legal identities had done little to stop the building of war machines or the involvement of university staff with these new entities.[41]

As the evidence in the previous section suggests, since those protests in the 1960s many US universities remain contractually integrated into the militarized system of innovation. The dangers that come from cycles of intensifying arms races is why John Braithwaite argues for the adoption by universities of "a simple rule that neither our brightest and best, nor our greediest and worst, should be permitted to deploy the knowledge-creation infrastructure of universities to invent weapons of war."[42] In the next and final section I outline some of the obstacles facing the implementation of this rule and the possible use of private law to help meet the goal of the rule.

7. Escaping the Iron Cage?

Freeing the knowledge-creation infrastructure of universities from the military-industrial system is the right goal for which to fight. There are recursive globalizing dangers in this US model of militarized knowledge development. As the model is seen to be more ''successful'' in delivering innovative weapons of war, so other states will copy the institutional model so they also can be more ''successful'', leading all states into the enframing paradigm of militarized science. An illustration of this modelling dynamic can be seen in the way the Bayh-Dole Act of 1980, which allowed US universities to file for patents on inventions supported by federal research funding, led some OECD countries to adopt similar rules.[43]

Reversing the integration of US universities into the military industrial complex is, as the student protests of the 1960s showed, difficult. These days the starting point of most US

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[39] See Stuart W. Leslie, *The Cold War and American Science: The Military-Industrial-Academic Complex at MIT and Stanford* (Columbia University Press, 1993) chapter 9.

[40] Stuart W. Leslie, *The Cold War and American Science: The Military-Industrial-Academic Complex at MIT and Stanford* (Columbia University Press, 1993) 241.

[41] Stuart W. Leslie, *The Cold War and American Science: The Military-Industrial-Academic Complex at MIT and Stanford* (Columbia University Press, 1993) 250-251.

[42] John Braithwaite, *Simple Solutions to Complex Catastrophes: Dialectics of Peace, Climate, Finance and Health* (Palgrave Macmillan, 2024) 62.

[43] David C. Mowery and Bhaven N. Sampat, 'The Bayh-Dole Act of 1980 and University-Industry Technology Transfer: A Model for Other OECD Governments?' (2005) 30 Journal of Technology Transfer 115.

universities is that they own the intellectual property produced by their employees.[44] Technology transfer offices now dot university campuses to manage transacting in intellectual property. Whatever knowledge-washing universities do for the benefit of their prospective students there is a reality that many of them are careful not to speak about – they chase money and intellectual property in weapons innovation. They do so in a more bureaucratically organized way and on a larger scale than in the past.[45] To borrow one of Max Weber's most famous metaphors, perhaps universities with their technology transfer offices have entered a military iron cage.

Acts of rebellion against the military industrial system, whether individual or through social movements, will always occur. Conscience will drive people to ask why their work is being utilized by military-industrial systems in ways that they see as breaching human rights standards. A recent example is Google and Amazon employees forming No Tech for Apartheid to protest the contracts that Google and Amazon have entered into for the provision of AI and cloud services to the government of Israel.[46] For these employees the contracts are ''part of a larger pattern of Big Tech fueling state violence across the globe''.[47] Developing AI systems to kill human beings is easy with today's technology, "a graduate student project''.[48] AI research leaders like Stuart Russell, who have been warning of the dangers for years, have been key to starting processes of UN scrutiny and possible multilateral regulation of lethal autonomous weapons.

Treaties are but one thread in a regulatory web for solutions to complex problems. To place the weight of hope on one thread is likely to see those hopes dashed. Acts of conscience have a role to play but conscience will direct individuals down very different paths of reasoning and action. Fritz Haber saw himself as being under a duty to invent a gas weapon of mass destruction. Over150 scientists in the Manhattan Project did not want the U.S. to drop the bomb on cities in Japan and signed a petition to that effect.[49] The mathematician and game theorist Von Neumann, also part of the Manhattan Project, was very much in favour of dropping the bomb. He made the calculations around the explosive force needed to maximize the number of civilian deaths and was key in the selection of the Japanese cities to erase (although he did not get his first preference, Kyoto).[50]

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[44] For a survey showing this see Patricia E. Campbell, 'University Inventions Reconsidered: Debunking the Myth of University Ownership' (2019) 11 Wm. & Mary Bus. L. Rev. 77.

[45] For the argument that the integration of the university into the military-industrial complex has deepened post 9/11 see Henry A. Giroux, *The University in Chains: Confronting the Military-Industrial-Academic Complex* (Routledge 2016).

[46] Billy Perrigo, Google Workers Revolt Over $1.2 Billion Contract With Israel, April 8 2024 https://time.com/6964364/exclusive-no-tech-for-apartheid-google-workers-protest-project-nimbus-1-2-billion-contract-with-israel/ accessed 15 May 2024

[47] https://www.notechforapartheid.com/ accessed 15 May 2024.

[48] AI researcher Stuart Russell quoted in David Adam, 'Lethal AI weapons are here: how can we control them?' Nature 23 April 2024, https://www.nature.com/articles/d41586-024-01029-0 accessed 15 May 2024.

[49] Fred Jerome, *The Einstein File: The FBI's Secret War Against The World's Most Famous Scientist* (Baraka Books 2018) 88.

[50] See Alan Bollard, *Economists at War: How a Handful of Economists Helped Win and Lose the World Wars* (Oxford 2019;online edn) chapter 7 https://doi.org/10.1093/oso/9780198846000.003.0007, accessed 15 May 2024.

If we want to draw universities out of servicing the weapons desires of military industrial systems, university employees should contest the claims of universities to own the intellectual property of their employees. My basic position here is that universities have demonstrated they are not to be trusted with that ownership. It is, I would argue, better to let those who generate intellectual property make choices about its future uses rather than letting university managers with the profit mentality of a Midas decide its licensing future. No doubt some researchers will happily take the military's money in exchange for delivering weapons. But if they wish to do so they will under John Braithwaite's simple rule of prohibition, have to leave the university. Other researchers, with a different view of what a university community should be doing, will choose differently. Everyone's decision should be made transparent, especially to students. Transparency is needed to expose dissembling by faculty about claims to be doing basic research. When Stanford students in 1969 managed to obtain around 100 contracts between faculty members and the US Defence Department, they saw large discrepancies between the claims of the faculty members to be doing basic research and the practical nature of what the military were expecting to be delivered under the contract.[51] The enframing paradigm of militarized science allows academics to engage in a doublethink in which making a bigger better weapon counts as foundational research.

Tools of private law might also be employed to complicate the weapons acquisitions strategies of military industrial systems. Scientists interested in restricting the use of patented multi-use inventions for peaceful purposes could adopt the defensive patent licence. This licence mimics the copyleft style of licence in which, under a principle of reciprocity, free access by a party to patented inventions is conditional upon that party making their inventions freely available.[52] This type of licence could be used to support a community of scientists interested in patents for peace. Over time it might be possible to build a network across universities and firms (perhaps facilitated by disillusioned Google employees) that wished to see technology being used for peaceful purposes alone.

There are, of course, transaction costs in assembling, monitoring and defending patent portfolios for peace. Perhaps some foundations could be persuaded to help meet the cost. An interesting idea for reducing the costs of traditional patents for open innovation comes from Geertrui Van Overwalle's proposal for a new form of patent, the inclusive patent, a lower cost patent aimed at allowing a community to develop enforceable conditions of open sharing.[53] The problem with any patent reform proposal is, as Overwalle recognizes, the potential for gaming behaviour to undermine it. The military-industrial system might respond by pulling on levers of state power such as compulsory licensing to acquire the technologies it wanted. Still, in a democratic society with a free press, a government would have to explain its actions to a wider public.

My own preferred position is for universities not to chase intellectual property rights at all. Rather they should stay focussed on generating propositional knowledge that, among other

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[51] Stuart W. Leslie, *The Cold War and American Science: The Military-Industrial-Academic Complex at MIT and Stanford* (Columbia University Press, 1993), 248.

[52] For details of the licence see https://www.defensivepatentlicense.org/license

[53] Geertrui Van Overwalle, 'Inventing Inclusive Patents: From Old to New Open Innovation' in Peter Drahos, Gustavo Ghidini and Hanns Ullrich (eds), *Kritika: Essays on Intellectual Property* (Vol. 1 Edward Elgar 2015) 206.

things, will increase the range of socially beneficial actions for dealing with crises such as pandemics and climate change.

8. Conclusion

US universities, through being enframed by a paradigm of militarized science, have become central to propagating two kinds of risks - the risk of things going wrong with ever larger arsenals of weapons and the risk of not producing the knowledge we need in times of crisis. Other countries in the name of innovation will likely follow the U.S. in building this enframing model. A simple rule for researchers not to work on the fruiting of knowledge in weapons of destruction should be a rallying point for those working in universities. Private law tools may be able to help researchers prevent the use of their knowledge for weapons innovation.

Decisions of conscience by scientists matter to our collective future. Scientists stand in the garden of midnight where there are a thousand different trees of knowledge, a thousand different futures to choose. Universities should be one of the places to help drive collective discussions of the effects of knowledge, not places where knowledge is used to facilitate a trade in military procurement contracts. Collectively we need to be open to the idea of not building some things from trees of knowledge. Fritz Haber's development of gas technology was refined and during World War II used in Germany's sealed gas chambers to murder millions of people, including Haber's close relatives. The Doomsday Clock does not have to chime in the garden of midnight. Midnight can arrive and pass peacefully. Everything depends on the wisdom we show in choosing trees of knowledge to develop.