Assembling America's Private Arsenal for Democracy, 1920-1961

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When I first read the Hagley call for this conference, I doubted that my current work on military-industry relations would be of much interest to the conference organizers. They asked for proposals to engender a dialogue between gender, race, and class studies scholars and business historians. My proposal hardly ventured outside the usual business-government vernacular of markets, competition, technology, strategy, bureaucratic politics, and war. Business historians have done rather well mixing and matching the concepts associated with these words. So, when I received an e-mail invitation to participate in this conference, I presumed some red guard hacker was spreading misinformation to sabotage Hagley's efforts at bridging the gap between the haves (historians who study the bosses) and the have nots (historians who study the masses). However, when a similar invitation arrived weeks later by snail mail, I relaxed, knowing that Hagley's e-mail was secure.

Now, I wondered what unfamiliar tools I brought to the study of business history and, more particularly, to business-government relations. I even found myself in an e-mail conversation with a conference organizer, who pointed to my work's synthetic quality – i.e., to my ability to string out markets, technology, strategy, etc. into a sentence. However, when I sat down to write the paper, I had difficulty using this trope. Synthesis succumbs to disciplinary difference. So, I turned to the introduction of my recent coauthored work on corporate management and the regulatory state [Kaufman, Zacharias, and Karson, 1995]. Although this book – which is part of the Oxford University Press series on business ethics – covers familiar themes in business history, we asked a question inspired by intellectual history: how did the modern corporation – which from its inception seemed so inimical to liberty – find a legitimate place in the post-World War II polity?

Let me put these rather terse sentences into a familiar historiographic form. Business historians who examined the interactions between corporations and the government have drawn heavily on Chandler's *The Visible Hand: The Managerial Revolution in American Business* [1977]. Following his lead, they

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customarily start with the firm or a group of firms and treat their interactions with government in purely instrumental terms. They ask first how government regulations restrain corporate strategies, and second how managers respond politically and economically to offset these constraints. In telling their stories, these historians account for the political environment much in the way a corporate social issues manager would ascertain the forces affecting a particular issue. Although these studies have contributed enormously to our understanding of the dynamics between business and government, in the main they have neglected the field of managerial collective action and resolutely have refused to discuss normative issues [Vietor, 1994].

Another group of historians, working in the corporate liberalism tradition, begins with the notion of collective action and norms. Although writers in this tradition disagree on many issues, most contentiously over whether the large firm has detracted from democracy, they share a strong commitment to understanding the interactions between interests and norms, markets and the rule of law [Hawley, 1966; Sklar, 1988].

In telling our tale, we let liberty's tenuous structure – namely, the tension between public and private authorities, between control and autonomy, between interest and procedure – provide our narrative themes. These themes raised additional questions: how did the regulatory state apparently reconcile the modern corporation's authoritarian order with liberty; in the struggle to fashion the regulatory state, how did managers overcome competitive discord to act collectively; and how did they fashion a professional creed that portrayed them as liberty's modern stewards?

These same concerns inform my current research on the military. After World War II, how did the polity that once viewed the officer corps and its industrial suppliers as illiberal threats to democratic rule comfortably delegate to these officers large discretionary powers, particularly over scientific and economic development? What structures did Congress put in place that checked the officer corps' newly gained power? In articulating a professional doctrine, how did procurement officers reconcile the military's command/control procedures with liberty's demand for autonomous behavior? And, how did the military gain the cooperation of so many civilians, particularly scientists, engineers and managers, in its postwar campaign to continuously revolutionize military weapon systems?

Historical answers to these questions have a convenient starting point – the nation's constitutional debates, where propertied white males negotiated terms of association.[2] These record the political values that, in large part, defined the initial rules regulating the military's relationship to Congress and industry. A skeletal officer corps, public arsenals, and contracts emerge as the basic concepts by which America's liberal polity constrained the military and its industrial contractors from promoting wasteful, bellicose policies.

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[2] My summary of the Constitution's liberal biases relies on Pangle [1988]. Pangle's interpretation needs the historical tempering found in Wood [1991].

By the early twentieth century, aviation – and its air power prophets – allowed Congress to consider the market as an alternative to public arsenals. Unlike other military weapons, aviation promised mass commercial markets. Air officers willingly divested their air arsenals to sustain Congressional and industry support for an independent air force. However, these markets did not materialize in sufficient scale, either during the interwar years or during the cold war's formative years, to sustain a war-making aircraft industry. Air officers found that, by virtue of their monopsony, they still exerted control over the industry. They acknowledged this regulatory power when, at World War II's conclusion, they secretly stamped the aircraft industry a private arsenal. But, this acknowledgment did not invalidate the traditional divide between public and private authority. The military gained industrial and scientific support by contracting for a "private arsenal." In so doing, the military avoided criticisms that it sought to replace a liberal order with a garrison state.

The Government Arsenal System

The call for a more perfect union had largely arisen from the Confederation's obstacles to unified military action and the commercial rivalries the Confederation fostered [Hamilton, Madison, and Jay, *The Federalist*, pp. 1-53; and Kohn, 1991, pp. 61-94]. Alexander Hamilton's writings offer insights into the early military establishment. He recommended that a peacetime army be kept under the Confederation's control. Like other Continental Army officers, Hamilton had found the state militia poorly trained and unreliable in battle. His report called for a regular army of approximately 3,000. To supplement it, the report would have the national government establish a larger elite reserve which would volunteer for eight years and be subject to training twenty-six days a year. This force, paid and supplied by the national government, would come into active service should war break out. State militia would be an additional force that could be mobilized in emergencies. In addition, the report called for an extensive arsenal system to supply arms and preserve ordnance skills, particularly in the manufacture and use of artillery [Hamilton in Lodge, vol. 6, 1886, pp. 71-79].

Justifications for public arsenals went beyond market scarcity. Hamilton found an additional fault in private arms suppliers' opportunist propensity: "as the calculations of [private ordnance] contractors have reference primarily to their own profit, they are apt to endeavor to impose on the troops articles of inferior quality[,]...not [to deliver] as early as the services required, or not in sufficient quantity..." Avarice might be a useful passion for spontaneously organizing the economy, but Hamilton, like his intellectual benefactor, Adam Smith, warned government against capitalist claims that policies beneficial to their interests naturally promoted the general welfare. Thus, Hamilton cautioned the government to establish armories "to provide for the deficiencies of the contractors..." [Lodge, vol. 6, 1886, pp. 108-109].

Hamilton's wariness, though, did not let him conclude that the government should rely solely on military armories; he advocated a

procurement system that combined private and public manufactures. When Congress asked him, as Secretary of the Treasury, to report on the best means "to render the United States independent on foreign nations for military and other essential supplies[,]" [Lodge, vol. 3, p. 294] he responded with his much cited "Report on Manufactures." To his mind, a national defense industry would naturally come about once the United States had a vibrant commercial manufacturing sector. However, United States nascent manufacturers could hardly compete against rival English or European firms. To overcome this comparative disadvantage, Hamilton made a controversial recommendation: let government promote infant manufacturers, most judiciously by bounties [Hamilton, "Manufactures, Communicated to the House of Representatives, December 5, 1791," in Lodge, vol. 3, pp. 294-416].

Hamilton's advocacy for subsidized manufacturing, arsenals, and a standing army comprised only three elements in his program for economic development; a funded debt, national bank, and excise taxes completed his plan. During the federalist period much of Hamilton's program became policy, although not without opposition nor as fully as he had recommended. During the antebellum period much of this program, particularly the national bank and subsidized manufacturing, generated intense political battles.

The War of 1812 regrettably revealed the arsenal system's deficiencies. In 1815 Congress passed "An Act of the better regulation of the Ordnance Department." This Act explicitly stated the Ordnance Department's responsibility and increased its authority. Previously, the Department merely inspected ordnance and supervised its manufacture at government arsenals. Now, the Department's Commissary General of Purchase had authority to make contracts for ordnance and command over the Springfield and Harpers Ferry Arsenals. Finally, the law instructed the Ordnance Department to establish uniform standards for all ordnance, their storage, and repair [M.R. Smith, 1985, pp. 39-86; Strum, 1986].

Small arms manufacturers, which so benefited from government contracts, complained bitterly about government competition during market upswings and downturns. By 1830 a new group of small arms manufacturers emerged that were less dependent on government for financing and technological assistance than earlier companies. These firms expanded the market for their products both domestically and abroad. While they competed fiercely with one another and undid much of the cooperation that had existed earlier, they came together to protest government competition. In fact, during the 1850s Congress seriously considered doing away with government armories. These companies followed a similar strategy after the Civil War, when demand contracted [Deyrup, 1948, pp. 117-132 and 202-214].

The Army Air Corps Takes Command: 1920-1926

At the turn of the century, the War Department still oversaw government arsenals that designed and manufactured diverse military products for which commercial markets did not exist. The oldest, the Springfield

Armory, manufactured small arms; Watervliet Arsenal, artillery; Watertown Arsenal, seacoast gun carriages, railway gun mounts, and antiaircraft mounts; Frankford Arsenal, small arms ammunition, artillery ammunition components, and fire control instruments; Rock Island Arsenal, gun carriages; and Picatinny Arsenal, artillery ammunition, bombs, and pyrotechnics. All of these arsenals dated back to the nineteenth century [Campbell, 1946, pp. 35-51; Thomson and Mayo, 1960, pp. 72-73]. However, by World War I, tinkers and inventors had spurred a new technology, aviation, that promised to satisfy military and commercial needs. In the war's aftermath, during the interwar aviation scandals, political opportunities arose for the Army to establish an aircraft manufacturing presence. However no powerful voice emerged. Instead, an inchoate private arsenal system became recognizable, one that neither Congress, the Army nor industry fully acknowledged until World War II's demobilization.

By the mid-1920s, military theorists acknowledged that aircraft could be used as an offensive weapon and as a deterrent. A nation that initiated air strikes on a foe's military, economic. and population centers might achieve a "first-strike" advantage. To take this action, a nation had to have technologically proven bombers and an industry ready to mass produce a force large enough to overwhelm the enemy. This threat of mass destruction, especially of vulnerable cities, made a mighty air force a deterrent. In this new technological era, military air advocates and aircraft manufacturers warned that no nation could afford to be without a viable mass production aviation infrastructure. However, no government could fiscally afford to build the necessary capital intensive factories nor train the requisite skilled labor force. Aviation manufacturing had to be self-sustaining; it had to be commercially viable.[3]

Within Congress, these arguments ascended. Doomsayers fueled prudential congressional behavior. Happier impulses also charged congressional action. Some representatives saw in commercial aviation a promise to develop a high technology industry free from trusts.

Jacob Vander Meulen in *The Politics of Aircraft: Building an American Military Industry* [1991] provides a rich story on how these forces worked against the development of a public aircraft sector. Besides the antipathy toward a strong military, Vander Meulen notes Congress's hostility toward big business or "trusts." Congress' progressive (à la Wilson) and populist representatives hoped that the aircraft industry would reconcile modern technology and small scale production. In this respect, Congress more or less agreed on private sector control over aircraft manufacturing. But disagreements arose over whether large or small firms made the most efficient manufacturers. Consolida-

[3] The following paragraphs draw on private sector testimony in President of the United States, *Aircraft in National Defense: Message from the President of the United States Transmitting the Report of the Board, Appointed by the President of the United States on September 12, 1925, to Make a Study of the Best Means of Developing and Applying Aircraft in National Defense,* (The Morrow Report), Senate Document No. 18, 69th Congress, 1st Session, (Washington, DC, 1925); and U.S. Congress, House of Representatives, *Inquiry into Operations of the United States Air Services: Report of the Select Committee of Inquiry into Operations of the United States Air Services,* (The Lampert Committee) Report No. 1653, 68th Cong., 2nd Session (Washington, DC, 1925).

tion occurred in the 1920s. Investors became active as technology improved and government made promises about stimulating future commercial growth. Financiers had to assure long-term returns, a process that could best be done through oligopolistic arrangements. Despite mergers and consolidation, financiers failed to contain competition as commercial demand faltered. While the government at first encouraged this consolidation by its mail subsidy program, it later reversed itself as antitrust advocates exposed corruption in the mail subsidies.

Congress's and industry's insistence on a private aircraft industry had the potential to alienate Army air partisans. Against long standing tradition, Army air officers joined the commercial chorus. Without direct access to the General Staff or the Secretary of War, Army aviators found it difficult to advance air doctrine independent from land force strategy. In promoting their organizational ambitions, these aeronauts found private sector allies a godly gift. Without an arsenal tradition to protect, the Army's winged warriors willingly conceded Congress's and industry's sacrificial price [U.S. House of Representatives, pp. 520-51].

In 1926 Congress passed the Air Corps Act. It instituted the Army Air Corp (AAC), giving Army aviators the organizational wherewithal to pursue independence [Brown, 1988, pp. 59-83]. The law also came close to designating the aircraft industry a private arsenal. The Act approved expanded AAC purchases, both to satisfy military needs and to provide the faltering industry with a steady demand. Still, the Act did not acknowledge the industry as "a national defense asset," for it instructed the AAC to determine demand based on its – not the industry's – requirements.

Organizing For Mass Production, 1927–1942

In the years following the Air Corps Act, through the early years of World War II, the AAC honed its in-house contractual skills. Wright-Patterson Air Base trained engineers and procurement officers in the basics of aeronautics, production, management and contracting. These staffs lacked the skills and resources to design and manufacture aircraft, but they could ably write specifications for new aircraft, contracts to procure them, and procedures for overseeing production chains and product quality [Walker and Wickham, 1987, pp. 118-145]. After mobilization, Congress initiated reforms that renamed the AAC the Army Air Force (AAF) and allowed its to conduct strategic operations separately from the Army's land forces [Sherry, 1987, pp. 147-77].

To ensure the AAF played a "decisive" role in winning the war, the air officer corps adopted known designs, standardized parts (for government furnished equipment) and fostered intra- and inter-industry cooperation. To manage these production lines effectively, the AAF organized its engineering division along product market (or to use the current term, weapon system) rather than functional lines and its production division into units that worked with specific prime contractors.

These actions provided a setting in which industry could develop processes for mass producing aircraft. Though the AAF set doctrine, prime aircraft manufacturers retained the design and engineering know-how to ramp up production, to assemble production teams and to educate non-aviation firms [Holley, 1964; Lilley, Hunt, Butters, Gilmore, and Lawler, 1947; Taylor and Wright, 1947; Putnam, 1947]. In short, America's air arsenal for democracy operated within liberty's divide between public and private authority. The AAF acted like a smart consumer – or more precisely, as a well financed monopsony – who contracted, rather than commanded, for a revolution in air production.

The Air Force Private Air Arsenal, 1943-1950

When air production peaked in 1943, the AAF began to plan for service autonomy and for the next war. Though the AAF had favored known technologies during the war, its officer corps keenly understood: 1) that air power's dominance depended on scientific and engineering advances; 2) that the aircraft industry and its supporting scientific communities constituted a private arsenal; and 3) that imaginary wars – i. e., a scientific quest to build weapon systems that bettered the best – constituted a technological imperative that Congress could hardly ignore.

In a practical sense, the tasks for sustaining air power's industrial foundations began in earnest in August, 1945, when the War and Navy Departments reconstituted the Army Navy Munitions Board (ANMB). These Departments charged the Board to formulate future mobilization plans.[4] Within a year, the Board recommended that the military had to yearly purchase a minimum of 3,000 replacement aircraft to sustain the industry's research, design and manufacturing capabilities. The Board added that the military had to maintain 26 million square feet of standby facilities to meet future mobilization needs.[5]

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[4] Memorandum for: Colonel W.D. Eckert, Chief, Readjustment & Procurement Division Office, Assistant Chief of Air Staff-4, Subject: Report on the State of Development of Industrial Mobilization Planning, 27 May 1946, National Archives Record Group 341 HQ U.S. Air Force, Entry 468 Deputy Chief of Staff, Materiel Director of Industrial Resources Industrial Plans Division Facilities Branch General File 1944-50, Box 60, Folder 3, p.4. This memorandum provides administrative information on the ANMB, the conflicts among the agencies and the AAF's surplus disposal plan. Also, for a history of ANMB's responsibilities, see Memorandum, Subject: Application of National Security Clause to Army Air Forces Sponsored Industrial Facilities, To: J C Vaughan, 20 June 1947, from Grandison Gardner, Major General, U.S.A., Acting Asst. Chief of Air Staff-4, National Archives Record Group 341 HQ U.S. Air Force, Entry 468 Deputy Chief of Staff, Materiel Director of Industrial Resources Industrial Plans Division Facilities Branch General File 1944-50, Box 60, Folder 3.

[5] Memorandum for the Under Secretary of War, the Assistant Secretary of the Navy, Subject: Report of Air Coordinating Committee, 18 July 1946, from Richard R. Deupree, Executive Chairman, National Archives Record Group 341 HQ U.S. Air Force, Entry 468 Deputy Chief of Staff, Materiel Director of Industrial Resources Industrial Plans Division Facilities Branch General File 1944-50, Box 61, Folder 6.

Wright Field's Industrial Plans Section, Logistics Planning Division had the responsibility for developing AAF mobilization plans. It promised to provide tools for managing the industry's development. These included: census methods for acquiring and updating aircraft industry data; forums for interacting with industry to review mobilization production schedules; plans for ensuring material supplies and standby facility reserves to meet mobilization needs; principles for sustaining the industry's competitive health; and public relations campaigns to build public support.

As the Plans Section pursued its work, Lt. General N.F. Twining, Commanding General Air Materiel, asked his superior, General Spaatz, Chief of Staff, to formally acknowledge the AAF/aircraft industry's special relationship.[6] Twining asserted that "the aircraft industry [is] in effect the AAF arsenal. Whereas, Ordnance, for example, relies primarily on its own government-owned and operated arsenal system for its research and development and current procurement, the Army Air Forces must rely on the privately owned and operated aircraft industry."

General Spaatz agreed with Twining's description. This special relationship between the AAF and the industry became the subject matter for an AAF internal document "Strategic Concepts of Industrial Preparedness." To capture the skies and to obliterate an enemy's industrial base, air power depended on the nation's scientific and industrial ingenuity to bear superior aerial weapon systems.

> Recognition and frank admission is needed by the Air Forces that, to an extent never true of land and sea arms, the air power of the United States is centered in industry's hands. The problems henceforth are largely technical and industrial. Industry now embraces the design, development, production, supply, and maintenance of air weapons. Industry is our arsenal of democracy. There must be an immediate integration into the Air Forces as a voluntary air industrial reserve of air weapons industries...[p]ossible only if the Air Forces are able to adapt their concepts, organizations and methods to conform to 1) the new realities of air war, and 2) to the established habits of American industry.
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> This means an Industry-Air Force team in the broadest sense of the word. It means a team that can function in peace as well as

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[6] Memorandum, Subject: Preferential Treatment for Aircraft Manufacturers with Respect to the Purchase or Lease of Government-Owned Facilities. To: Commanding General, Army Air Force, 13 March 1946, from N. F. Twining, Lieutenant General, U. S. A., Commanding, National Archives Record Group 341 HQ U.S. Air Force, Entry 468 Deputy Chief of Staff, Materiel Director of Industrial Resources Industrial Plans Division Facilities Branch General File 1944-50, Box 60, Folder 4. This explains, Twining went on, why the Army requested $2.2 billion of government-owned facilities, while the AAF only asked for $420 million.

> in war. It means a team in air research, development, production, supply, maintenance, and training of personnel.[7]

This desire to build an AF/industry team influenced procurement decisions. The AF Aircraft and Weapons Board considered objections to its proposed fiscal 1948 airplane purchasing plan. Critics found the plan lacking because the Board had developed it "solely on military considerations" without regard to its industrial consequences. Allegedly, these would be considerable. One report claimed that "86% of 1948 appropriations would be placed with three airframe manufacturers." Such a concentration would undermine "a sound aircraft industry capable of adequate expansion to meet mobilization requirements." Moreover, the aircraft industry's desperate financial situation made it imperative for the AF to spread around its business.[8] The Board acknowledged its mistakes and reworked its plan.[9]

The Cold War Air Force: Strategy and Structure, 1951-1961

With independence in 1947, AF officers devised a strategy to ensure its strategic dominance. Simply put, the AF differentiated itself by maintaining its grip over scientific and engineering aerospace developments. Even before World War II ended, AAF Chief of Staff H.H. Arnold had contracted for a scientific report to guide air weapon systems development over the next 20 years. The final report called for a permanent weapon systems revolution.[10] An imagined technological imperative gave the AF officer corps its justifications for large postwar budgets. Through them, these officers successfully connected science's limitless quest after knowledge with the aircraft industry's limitless quest after profits.

To implement this strategy, the AF officer corps had to decide whether to make or buy basic and applied research [Williamson, 1985]. Earlier, the AAC had gone through a similar exercise in whether to make or buy its aerial weapons; political factors had favored a buy decision. Similar considerations came to influence the AF's outsourcing of basic and applied research. AF

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[7] "Strategic Concepts of Air Industrial Preparedness," National Archives Record Group 341 HQ U.S. Air Force, Entry 468 Deputy Chief of Staff, Materiel Director of Industrial Resources Industrial Plans Division Facilities Branch General File 1944-50, Box 60, Folder 3.

[8] Headquarters United States Air Force, Secretariat of the USAF Aircraft and Weapons Board, Agenda for Second Meeting, USAF Aircraft and Weapons Board, January, 1948, Item 2 and Tab A, National Archives Record Group 341 HQ U.S. Air Force, Entry 190, Deputy Chief of Staff, Development Director of Requirements, Executive Office, Mail and Records Branch, First Aircraft and Weapons Board Subject File 1947-1948, Box 192, Folder Untitled.

[9] Memorandum for the Chief of Staff, Subject: Summary Minutes of Second Meeting, USAF Aircraft and Weapons Board, 27 January 1948, from F.H. Smith, Jr. Brigadier General, USAF, Secretary, USAF Aircraft and Weapons Board, National Archives Record Group 341 HQ U.S. Air Force, Entry 190 Deputy Chief of Staff, Development Director of Requirements, Executive Office, Mail and Records Branch, First Aircraft and Weapons Board Subject File 1947-1948, Box 183, Folder Untitled.

[10] Theodore von Karman, the noted California Institute of Technology aeronautical scientist, formed this research group, which eventually became the AF Scientific Advisory Board [Strum, 1967, pp. 1-79].

officers had devoted themselves to forming air warrior teams, not to building scientific research centers. An internal scientific corps would require two promotional tracks that could undermine the AF's martial culture. Moreover, by relying on university and industry teams, outsourcing allowed the newly formed AF to take the initiative against rival, well established services.

And, outsourcing had important precedents and strong private sector proponents. Before World War II, the armed services had relied on the National Advisory Committee on Aeronautics, which contracted for scientific research [Roland, 1985]. During World War II, the War Department kept to this course by establishing the Office of Scientific Research and Development [Owens, 1994; B. Smith, 1990; Sapolsky, 1990]. Scientists strongly preferred this contractual option. The AF's industrial partners echoed these sentiments. In their opinion, the AF simply had to have enough in-house capabilities to assimilate advances, to write specifications and to test new weapon systems.[11] All this led the AF to write contracts for scientific services, which implicitly tied these well regarded private sector interests to the AF's political fortunes.

Outsourcing began in earnest, when, in 1950, the AF separated the Air Materiel Command's (AMC's) engineering division and transformed it into the Air Research and Development Command (ARDC). Now, research and development operated under one command, ARDC, and procurement, production, and logistics under a second, AMC [Putnam, 1947, p. 4]. Like the other services, the AF, found it could focus scientific attention on particular problems by supporting university research centers, such as MIT's Lincoln Laboratories [Price, 1954, pp. 64-95]. In cases where the problems posed required no new knowledge but expert application of known techniques, the AF relied on private research corporations. Douglas Aircraft Co.'s nonprofit spinoff, RAND Corp., provides the classic example [B. Smith, 1968].

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[11] Arthur E. Raymond, Vice President in Charge of Engineering, Douglas Aircraft Company, Inc. summarized the position in an exchange with Senator Mitchell, Special Committee to Investigate the National Defense Program:

> Senator Mitchell: But how are they (procurement officers) going to set those requirements and specifications? You presuppose that they are going to await the development of industry on the basic research.
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> Mr. Raymond: In large measure, yes.
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> Senator Mitchell: They are going to depend upon industry.
>
> Mr. Raymond: In large measure, their settings of requirements come from evaluation that they make of the devices that are submitted plus their knowledge of military tactics and requirements.

U.S. Senate, *Investigation of the National Defense Program: Hearings before a Special Committee Investigating the National Defense Program*, 79th Congress, 1st Session, July 18, 23, 24, 27, and 31; August 16, 18, 21, 22, 23, and 24, 1945 (Washington, DC: GPO, 1946). p. 15406. Mr. Raymond did not advocate that industry alone carry the research burden. He recognized some government agencies as credible research providers, for example, NACA. However, he considered universities as the prime basic research contractors. Industry took on development responsibilities. The military would manage these various providers through contractual relationships and a system of coordinating committees.

By creating this voluntary network of research centers and corporations, the Air Force mobilized research scientists to preserve peace by perfecting destruction. Once science became incorporated into the Air Force's strategy, air superiority no longer depended on quantity but on quality, on information, yield, and accuracy. To secure air dominance, a nation had to produce a few highly complex defensive and offensive weapon systems. And, research soon crossed over into practical systems analysis for melding contractors' products into viable defensive and offensive weapons. Such work required research and systems engineering skills that went beyond the AF's in-house monitoring capabilities.

Take the case of Lincoln Laboratories. After the Soviet Union detonated a nuclear bomb in 1949, the AF began to work on a complex defense system. To develop this system's equipment and operating techniques, the AF first had to solve numerous scientific and engineering problems. University-based scholars eagerly labored on these. Once solved, the AF required competent engineers to meld the various components into a workable system. The AF asked Lincoln Laboratories to take on this effort as a commercial venture. MIT, however, found that this foray into business jeopardized the its academic credibility. So, the AF founded a government funded nonprofit research center, MITRE [MITRE, 1979, pp. 1-21]. The private designation allowed the AF to recruit scientists and engineers from Lincoln Labs and elsewhere at industry pay scales and to place these highly skilled employees in a university-style research environment.

Offensive aerial capabilities also increased in complexity as well as in destructive yield. This brought batch production back to aviation. Unlike its earlier incarnation, this new production form required system engineering skills even to monitor manufacturing progress [Hughes, 1994, pp. 51-82; Hounshell, 1995]. The AF unhappily learned about this new complexity when delays occurred in the manufacture of jet aircraft. Whereas during World War II mass produced B-17s depended on fitting standardized parts into a variety of aircraft, the new B-47 jet bomber demanded specially designed, interdependent components [Knaack, 1988, pp. 101-112]. Interdependency forced engineers and production managers to consider aerial weapons in system and product lifecycle terms. The AF now had to plan and oversee seamlessly a weapon system from its design through its manufacturing and operational phases.

Organizational solutions to these new design and production problems first came from the ARDC's Western Division, which was responsible for missile development. This task posed two novel problems. First, the AF could not contract with a prime to undertake this job, since no single firm had all the expertise to build this system. Second, this undertaking's experimental nature cut across functional and, more importantly, command lines. To solve the first problem, the Western Division took the unprecedented step of directly employing an advisor to coordinate the program. This contractor, Ramo-Woodbridge's Guided Missile Division, later Space Technology Laboratories (STL), assembled a scientific and managerial team to integrate and oversee the project, a job that Wright-Patterson had done formerly. To solve the second

problem, the AF gave the Western Division's project manager extraordinary powers, including budgetary authority, to control the project from its development to its operational phase. This arrangement gave the project manager the authority to cut across ARDC and AMC lines [Neufeld, 1990, pp. 65-118].

By the early 1960s, this reliance on outside contractors to evaluate proposals and oversee projects became normal practice. In 1960, the AF advanced the practice by having RW, now TRW after a Thomas Products merger, sell STL to the AF. It reincorporated STL as a federally funded nonprofit corporation and renamed it Aerospace Corporation.

Congress had recommended this action. During late 1957 and early 1958, Congress had learned how the Air Force's reliance on STL's system engineering skills created conflicts of interests. Since STL's parent company had commercial relations with the AF, this potentially gave TRW an unfair competitive advantage. To rectify this situation, the AF had explicitly prohibited TRW from doing business with the Air Force. TRW found this policy too restrictive. And, since STL was a TRW subsidiary, competitors resisted sharing information with STL out of fear that it leak proprietary information to TRW. To resolve these conflicts, the AF purchased STL.

The Air Force provided the initial capital and worked out transfer terms for equipment and personnel with TRW. Under its California incorporation charter, Aerospace "engaged in scientific activities and projects for, and...perform[ed] and engage[d] in research, development and advisory services to or for the United States Government" [as quoted in Aerospace Corporation, 1980, p. 18]. Aerospace had no capital stock, nor could its efforts benefit individuals. Instead, the firm served the public interest. As a nonprofit organization offering the AF systems management services, Aerospace did not compete directly with AF prime contractors. This lessened AF contractor concerns about sharing information with a potential rival. In all, the Air Force carefully manipulated the public/private distinction to create a hybrid organization by which to mobilize scientists, engineers, and technicians into a civilian-military corps.

As the AF reworked its relations with science and industry, the AF officer corps rethought its organizational structure to align its operating units with modern systems analysis procedures. In particular, the Air Force found the command division between research (ARDC) and production (AMC) a substantial hindrance to weapons program management. After a substantial review, the AF adopted the air missile program's structure that unified program management under a single authority. The AF created an Air Systems Command that integrated applied research, development, and procurement into one operational unit, and an Air Logistics Command that handled operational, supply and maintenance problems. The reform also separated the AF Office of Aerospace Research as an independent unit that reported directly to AF Headquarters.

The AF now had the strategy and structure to contractually assemble what we frequently refer to as the military industrial complex.[12] The AF cleverly manipulated, but never violated, the liberal divide between public and private authorities. In so doing, AF procurement officers could argue that they, along with corporate managers, were democracy's steward and protector.

Conclusion

One might ask why I chose to characterize this story as an exercise in intellectual history rather than as a synthetic effort in business government relations. The answer has to do with the initial question that took me on my excursion: how did an expanded cold war AF comfortably fit into a liberal order? Much of the analytics for answering this question and related ones concerning the government's regulatory authority over economic relationships draw heavily from political and economic discussions. Whether you prefer the right's or the left's dicta, their prescription for writing the regulatory state's history has generic ingredients – liberty, equality, the law, markets, competition, and technology. For those who adopt this strategy, intellectual history has shifted from a study of the few who practice theory to a study of the many who struggle to make liberty a secure practice.

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