Major General George Owen Squier:
Father of American Airpower
and Military Technocracy

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INTRODUCTION

Who is the father of American airpower? The public and even many military historians would likely nominate Lt. Colonel Billy Mitchell, or perhaps Henry "Hap" Arnold who was the only Air Force general to achieve 5-star rank. This would, however, overlook the Army officer who procured and tested the first American military aircraft and who was an influential advocate for military airpower in scientific and engineering journals well before World War I erupted. That officer, Major General George Owen Squier, was also the first American military professional to earn a doctoral degree and he held numerous patents in communications and materials science. Squier eventually led not only the Signal Corps and its Air Service, but the entire nascent American aircraft industry. In doing so, Squier created the template for a new kind of military officer, specifically the military technocrat who would rise to prominence in the twentieth century.

GEORGE OWEN SQUIER – EARLY LIFE AND EDUCATION

George Owen Squier was born in the small town of Dryden, Michigan, on March 21, 1865, just as the American Civil war was ending.[1] The son of a farmer and unsuccessful businessman, Squier was persuaded by his family to stop his formal education at the eighth grade to be apprenticed in the merchant trade—a not uncommon thing for a young middle-class man in those days. But the siren's call of curiosity and higher learning evident from his earliest days on the farm would not leave him. ("I was always tinkering around . . . I felt I had invented something and was happy."[2]) After two years in the dry goods business, Squier had an epiphany:

> But about September 1880 I began to get restless. I thought over my whole prospect if I remained with Mr. Lamb and drew the probable limit of the greatness and usefulness I would reach in the mercantile business. I thought this, -- If I remain here . . . I will become quite a wealthy merchant and then retire a gray headed man with nothing as a result of my having lived but a few houses, store and the like."[3]

After two years of attending high school and farming part-time to support himself, Squier saw a notice for the competitive examination for a congressional appointment to the United States Military Academy at West Point. He took it, finished first in the group, and received the appointment.[4]

Entering West Point in the summer of 1883, Squier received the standard, fixed academic curriculum prescribed by the academy for all cadets. Squier excelled, graduating in 1887 with a bachelor's degree and ranking 7th in his class in "general merit" which considered both academic and military achievements. After his graduation and commissioning in June 1887, while on leave in Europe where he took in the sights of northern Europe on bicycle with some West Point classmates, he learned that he had received his Army branch of choice–artillery. Instead of San Francisco, he was going to be posted at historic Fort McHenry in Baltimore with the Third Artillery Corps.[5]

This assignment says much about Squier's inclinations and the role of chance. That Squier picked artillery, and specifically coast artillery as opposed to field artillery, clearly indicates an interest in taking on the most technically challenging specialty available to an Army officer at that time. This branch of artillery required an expert's grasp of physics and mathematics to calculate the complex ballistics problem of hitting moving warships at great distance. The 1885 Endicott Report underscored the sorry state of America's coastal defenses, a highly important mission to the Army now that the frontier was all but closed. Congress had just appropriated a massive twenty-year $127,000,000 program to upgrade the fortifications and artillery along the Atlantic and Pacific coasts. Young Second Lieutenant Squier would be right in the middle of it.[6]

More importantly, he was now stationed a mere six miles from the Johns Hopkins University, the nation's new and most advanced graduate institution which in 1876 began offering a graduate program based on the German model of a modern research university.[7] For modern military officers, a graduate degree is *de rigueur*, but in Squier's time pursuing this level of education was completely unheard of. Squier was, in fact, the first American military officer to ever earn a PhD.[8] **[**

Earning that degree while an active-duty Army officer became a highly convoluted affair. In addition to his regular assignment as a battery officer at one of Fort McHenry's large guns, Squier had additional duties such as weapons instruction, court martial jury, etc. Nonetheless, within his first year at Fort McHenry, he enrolled part-time at Johns Hopkins, attending classes during the week and performing additional duties on the weekend or taking on other officers' duties then. After a year of part-time study, it became clear that serious study required full-time attention during the academic year. Squier applied through his chain of command to the War Department for permission to be detailed to Johns Hopkins. One of his professors wrote to the War Department as well, testifying to Squier's diligence and academic promise. This was denied due to regulations requiring three years of service before such detached duty, so two years later Squier applied again. Despite letters from Johns Hopkins testifying to Squier's academic potential and pointing out that the Navy had begun detailing officers for study there, as well as support up his military chain of command, the Secretary of War personally rejected the request. Squier, ever determined, requested an eight-month relief from duties to begin in October 1890, which was finally approved contingent upon the Post Commander at Fort

Figure 1 Lt Squier at Fort McHenry, courtesy Dryden Historical Society.

McHenry's assent. This was granted and Squier resumed his studies. In addition to pushing norms on off-duty education attendance, Squier also exercised the patience of his superiors by dodging military school assignments (such as the mandatory Artillery branch course at Fortress Monroe) and requests by West Point to have this academically gifted lieutenant transferred back to the Academy to serve as an instructor there. Finally, in June 1892, Squier completed all coursework and submitted his doctoral thesis, *Electro-Chemical Effects Due to Magnetization*. His thesis was approved and he was awarded his degree at the next commencement ceremony in 1893.[9]

CREATION OF THE MILTARY TECHNOCRAT

Squier's military superiors now expected, not unreasonably, that he would resume his regular duties at Fort McHenry. They would again be disappointed. The Columbian Exposition and World's Fair in Chicago, a celebration of the 400th anniversary of Columbus's landing in the Western Hemisphere, promised to be a showcase for two technologies that would revolutionize military affairs: heavy artillery from Germany's Krupp AG and electrification via a pavilion by Edison and Westinghouse. The Army planned on having observers at the Exposition anyway. Squier considered himself the perfect candidate to assess the maturity of and military application of these technologies. To overcome resistance of his superiors at Fort McHenry, Squier enlisted the help of Thomas Mendenhall, Superintendent of the United States Coast and Geodetic Survey, who procured permission from the Secretary of War himself as a personal favor. Just as important as the exhibitions was the network of prominent scientists Squier would meet. Squier himself presciently wrote:

> Never so many men distinguished in the domain of electrical science had been assembled at one time for mutual conference and benefit . . . and I think it can be safely said that in the importance of its deliberations and the immediate influence they will exert upon the industrial and commercial progress of the world in the next decade, no gathering of men . . . will compare...[10]

Squier's observations of the exposition were carefully recorded in a lengthy report published in the next issue of *The Journal of the United States Artillery*. Many artillery officers must have read this article – if they bothered reading it all – with a mixture of boredom and amusement; what was this doing in an artillery journal? To ensure his superiors saw the military relevance of his Chicago visit, Squier pointed out obvious applications to coastal artillery of electrification – powerful coastal searchlights for targeting, electrical motors to slew heavy artillery, and centralized control of entire batteries of defenses through electrical remote control. To oversee these developments, Squier advocated an "electro-technical" education for "specialist" officers within the artillery branch who could competently introduce these new technologies.[11]

Upon his return to Fort McHenry after the Chicago Exposition, Squier resumed research at Johns Hopkins as a sort of unofficial post-doctoral fellow, this time on a subject with a direct military application—the effects of magnetization on steel artillery castings. That summer he planned another European leave with one of his Hopkins professors. It was not received favorably:

> Letters received at the headquarters from Lieutenant Squier during the prolonged indulgence extended to him at Johns Hopkins University stated that after the completion of the course at that place he very much wished to take the course at the Artillery School, and for that reason he was, on several occasions, excused from other details . . . the Major General Commanding does not think that he should be longer excused from this and other details his brother officers are obliged to take.[12]

The Army leadership may have thought transferring Squier away from Johns Hopkins would mark an end to his inordinate interest in modern technology but, if so, they were very much mistaken. His assignment to Fort Monroe in Virginia was in fact ideal for continuing the path he started at Johns Hopkins.

After the long-delayed graduation from Artillery School, Squier was immediately assigned back to it as Chief Instructor in the Department of Electricity and Mines. Research into the exploitation of the new science of electricity for military purposes would now be central to his military duties, not a side activity requiring constant approval from his superiors. He also had the use of the Army Electrical Engineering Laboratory, established only a year before based upon his own recommendations. And he would have funding from the Army for his work, courtesy of the Board of Ordnance and Fortifications.[13]

Over the next several years Squier, in partnership with Albert Cushing Crehore, a physics professor at Dartmouth College who had studied with him at Johns Hopkins, collaborated on various research projects at the Army Electrical Laboratory. Most of these centered on the vexing problem of measuring the muzzle velocity of artillery rounds, both inside the cannon tube and in flight. The previous inability to accurately measure this information forced artillerymen to estimate these figures, resulting in less than accurate ballistics tables. Squier and Crehore's electromagnetic measuring system also allowed for nondestructive testing to occur, a significant cost savings for the Army. They eventually published their research in 1897 in book form as *The Polarizing Photo-chronograph: Being an Account of Experiments in the U.S. Army Artillery School, Fort Monroe, Va., in Creating This Instrument*.[14]

In their other investigations Squier and Crehore focused on coastal defense. Squier investigated the use of searchlights for coastal defenses; installed a 194 million candle power unit, one of the most powerful in the world; and warned the United States lagged far behind the major European military powers in their use. Squier also began investigating the use of radio ("the military and naval possibilities of this system should be thoroughly investigated"[15]) for military voice communications and remote control of weapon systems, but the Spanish-American War interrupted these investigations, presenting him with new challenges and a new military career direction.[16] The years spent studying at Johns Hopkins, far from being the intellectual pursuits of a mere dilettante, were yielding tangible results in the nation's high priority coastal defenses. Certainly not all senior army officers appreciated the need for a new kind of military technocrat, but some did.

SPANISH AMERICAN WAR, AND THE SIGNAL CORPS SCHOOL

The outbreak of the Spanish-American War in the spring of 1898 re-arranged Squier's priorities. The Army shifted funding away from coastal defense and its new research laboratories to support the fighting underway in both the Caribbean and Pacific theaters. At the personal request of the Chief Signal Officer of the Army, General Greely, Squier was transferred to the Signal Corps, a branch responsible for military communications, first with a reserve and later with a regular commission, still in the grade of First Lieutenant.[17] Recognizing Squier's singular talent, Greeley assigned him a multitude of tasks, any one of which could have easily become a full-time job: implementing some of the first tactical radios, testing underwater communication cables, installing range-finding equipment, humanitarian relief work, and even research into Samuel Langley's experimental heavier-than-air flying machine.[18] The Philippine Insurrection quickly pushed underwater communication cables to the top of Squier's priorities. When the rebellion against American occupation began, it took between two and four months simply to relay a message from one of the islands in the Philippines archipelago to another, an intolerably long time in a rapidly changing guerilla action.[19] Squier was dispatched to the Philippines to command the cable-laying team on the *USS Burnside* which, with another Signal Corps ship, managed to lay over 1,300 miles of underwater cable in a little over a year.[20] Squier, however, longed to return to his real interest of research and development.

Squier's unique technical expertise led him to become a pioneer in professional military education in military aeronautics. Concerned the United States was falling behind Germany, the world's leader in military affairs, the War Department undertook a series of reforms based on the German model. A General Staff was formally established, as well as a War College for senior officers; corresponding branch schools were likewise created for junior and field grade officers, including a Signal School at Fort Leavenworth, Kansas. Squier, then a major, was assigned to lead it.[21] His classes covered all aspects of "signaling" (communications), from semaphore flags to telegraphy, topography and other such skills. Squier also added aeronautics, a new, cutting-edge technological innovation which would soon revolutionize warfare. Aware of the Wright Brothers' success in heavier-than-air flight and despite Army Board of Fortifications and Ordnance twice ignoring in 1905 the Wrights' offer to provide the Army with an aircraft twice, Squier insisted the Signal School curriculum add an aeronautical component, teaching both lighter-than-air and heavier-than-air systems. "The subject of military aeronautics has passed the experimental stage and is a permanent part of the equipment and instruction of foreign armies"[22]

Squier's insistence yielded immediate results, sparking the imaginations of the next generation of army officers who would form the nucleus of an air corps and eventually an independent air force. Under Squier's tutelage and in the very first graduating class at the Signal School, First Lieutenant (later Major General) Benjamin Foulois was inspired to "think differently and imaginatively" and wrote his thesis on "The Tactical and Strategic Value of Dirigible Balloons and Aerodynamical Flying Machines," even though some of his classmates thought him "some kind of a nut."[23] Two years before the Army even had its first airplane, Foulois was prescient enough to write:

> In all future warfare, we can expect to see engagements in the air between two hostile aerial fleets . . . These will have an important effect on the strategical movements of the hostile ground forces before they have actually gained contact . . . the aerial victory should be an important factor in bringing campaigns to a short and decisive end.[24]

For Foulois' vision to become reality, the Army would actually have to procure and learn to use this new technology. The first step? Create an organization specifically tasked with the air mission. As the official Signal Corps history states:

> Under Chief Signal Officer Allen, aviation assumed a more prominent role in the Signal Corps' mission. His assistant, Maj. George O. Squier, was instrumental in bringing about this change. While at Leavenworth Squier had pursued the study of aeronautics in addition to his other scientific interests. He recognized the importance of the work being done by the Wright brothers and

> closely followed their progress. When he came to Washington in July 1907, Squier brought not only his expertise but his extensive list of contacts within the scientific community at large and the aeronautical community in particular. Shortly after Squier's arrival Allen issued a memorandum on 1 August 1907 creating an Aeronautical Division within the Office of the Chief Signal Officer, which was to have charge "of all matters pertaining to military ballooning, air machines, and all kindred subjects."[25]

GETTING THE ARMY AN AIRPLANE

Speculating on the possibilities of a new technology in warfare is one thing; acquiring an actual operational system is quite another. Reassigned to Washington in 1907 and an assistant to the Chief Signal of the Army, Squier was in position to influence key decision makers to allocate some of the meager army budget to obtain both heavier- and lighter-than-air aircraft to determine their military suitability— far from a foregone conclusion even after the Wright Brothers' success at Kitty Hawk. The Army had previously invested $50,000—and been greatly embarrassed—by the failure of Samuel Langley's "aerodrome," which crashed very publicly and unceremoniously on the banks of the Potomac during an attempted flight in 1903. However, interest from President Roosevelt in the Wright's invention and a personal plea from Wilbur Wright himself motivated the Army to reconsider; and, by 1907 Squier was tasked with developing the first specification for a military aircraft.[26]

The ensuing document, *Signal Corps Specification No. 486, Advertisement and Specification for a Heavier-Than-Air Flying Machine* was issued December 23, 1907, with a proposal due date of February 1, 1908. Considerable data was also required of each bidder, which, coupled with the short proposal preparation time of just over a month, was probably intended to discourage cranks and fakes from wasting the Army's time. This attempt was not altogether successful as the Army still received 41 bids ranging in price from $500 to $1,000,000, including one from a prisoner in a federal penitentiary who sought no payment save release from solitary confinement. The Army quickly eliminated all but three bidders, and on February 10, 1908, awarded a $25,000 contract to the Wright Brothers with a delivery period of 200 days.[27]

Squier's specification, like the rest of his work, was the result of careful study and considerable thought, including review and input from numerous leaders of the scientific community who recently formed the Aero Club of America.(now the National Aeronautic Association). While one might expect a technologist such as himself to dictate the details of a specific engineering solution, Squier did just the opposite, creating a "performance oriented" specification that focused on what the system would do, and not how it would do it.[28] He also pioneered the use of financial incentives and penalties in contracts, in this case, relating to the aircraft's speed:

> 40 miles per hour, 100 per cent.
> 39 miles per hour, 90 per cent.
> 38 miles per hour, 80 per cent. . .
> Less than 36 miles per hour rejected.
> 41 miles per hour, 110 per cent.
> 42 miles per hour. 120 percent.
> 43 miles per hour, 130 per cent.[29]

In September 1908, the Wright Brothers with their *Flyer* arrived at Fort Meyer, VA, and acceptance testing began. Since their maiden flight at Kitty Hawk in December 1903, the Wrights continued to make significant improvements to their design back in Dayton. Most important of these was the ability to turn the aircraft through "wing warping" (the original aircraft had only been able to fly in a straight line), a critical feature needed to pass the specification requirement. "During this trial flight of one hour it [the test aircraft] must be steered in all directions without difficulty and at all times under perfect control and equilibrium."[30] The improved *Flyer* was also longer, heavier, and equipped with a better engine. On September 3, 1908, with Orville Wright as pilot and Major Squier observing as the Army's test director, the *Flyer* made its first preliminary test flight of one minute, eleven seconds. Five more test flights were made over the next week, totalling just over twenty-five minutes, to the astonishment of ever-increasing crowds from nearby Washington, including President Taft.

Confident the *Flyer* was ready, on September 9 the formal acceptance testing began.[31]

The tests began as well as the Wrights could have hoped. The first day of testing saw a new world record for flight endurance, a record that would be broken almost daily over the course of the next week. Things went so well that Orville Wright allowed Lt. Frank Lahm to accompany him on a short test flight at the end of that day, making it the first "military" flight in history. Just a few days later Major Squier himself went airborne as a passenger. The experience was exhilarating, even for a man like Squier who was not one to be easily carried away:

Figure 2 Major Squier (right) at Ft Meyer Testing, courtesy Wright State University archives.

> That was bully. It is the most exciting sport in the world . . . It is remarkable. I'd have to exhaust the list of descriptive adjectives if I started out to describe the sensations of the trip.[32]

As is frequently the case with new technologies, disaster struck just as success was in hand. The final test flight was scheduled for September 17. Thousands of visitors were now crowding around the tiny parade ground at Fort Myer that served as the test range, and the tests were receiving front page treatment in the press. At 5:14 p.m. the *Flyer* took off for what Orville Wright, the pilot, undoubtedly thought would be nothing but a victory lap. Accompanying him was Lt. Thomas Selfridge, an artillery officer who was assigned test duty and who had previously been aloft during Army tests of lighter-than-aircraft earlier that year. Approximately four minutes into the flight, after circling the parade ground four times, the *Flyer* took a sudden dive "like a duck shot on the wing."[33] The aircraft was a total loss. Orville Wright was conscious and suffered a broken thigh and ribs. Lt. Selfridge quickly lost consciousness and died of a skull fracture at nearby Water Reed Army Hospital three hours later, becoming the first US military aviation fatality.[34]

Military observers, including Major Squier, quickly rushed to the crash site to rescue the pair. The press who witnessed the entire tragedy naturally wanted comment and Squier rather coolly stated:

> Of course we deplore the accident, but no one who saw the flights of the last four days at Fort Myer could doubt for an instant that the problem of aerial navigation was over . . . No one seems to realize at this close range what a revolution the flights portend. The problem is solved, and it remains to work out the details.[35]

The official accident report, written by Lt. Lahm, was based on the eyewitness accounts of the military personnel present and several civilian experts including Mr. Octave Chanute, an aviation pioneer whose work had heavily influenced the Wrights' own design. The cause of the accident was simple enough: a new and longer (by about four inches) propeller had been installed just that morning to improve aircraft performance for the final test since higher speed would result in receiving more financial incentive. It had struck a guy wire in the control system and snapped it, causing loss of flight control. Chanute, who saw the propeller come off in flight, examined it afterward and found a contributing cause to be that "the wood was brittle and overseasoned."[36] The Wrights' requested an extension of their contract period of performance to allow Orville to recover, build a new aircraft, and complete the acceptance testing. The Army approved.

In the meantime, Squier returned to his pure research roots and authored an important update for the scientific world on the Army's aircraft test program. Since the Army was actively involved in both lighter- and heavier-than-air aircraft, Squier published a paper in the February 9, 1909, edition of *Scientific American* entitled "Ships in Air and Water: Some General Relationships Between the Two." Reflecting the uncertain futures of these two types, Squier began his paper with this introduction:

> At the present moment, so many minds are engaged upon the general problem of aerial navigation that any method by which a broad forecast of the subject can be made is particularly desirable. Each branch of the subject

> has its advocates, each believing implicitly in the superiority of his method. On the one hand the adherents of the dirigible balloon have little confidence in the future of the aeroplane, while another class have no energy to devote to the dirigible balloon, and still others prefer to work on the pure helicopter principle. As a matter of fact, each of these types is probably of permanent importance, and each particularly adapted to certain needs.
>
> Fortunately for the development of each type, the experiments made with one class are of value to the other classes, and these in turn bear close analogy to the types of boats used in marine navigation."[37]

Squier then goes on to describe in great detail the fluid dynamics principles behind these similarities, showing an impressive grasp of a subject not his principal field of study at Johns Hopkins, and a great familiarity with the latest scientific literature on the subject. That old desire to know the forces of nature was as strong as ever. This article complements one written just a month earlier for the same publication that was clearly intended for the general public. In the January 2, 1909, publication of *Scientific American* entitled "Aerial Locomotion in Warfare," Squier warned:

> Whatever may be the influence of aerial navigation upon the art of war, the fact which must be considered at present is, that each of the principal military powers is displaying feverish activity in developing this auxiliary as an adjunct to the military establishment . . . The question as to whether or not the powers will ultimately permit the use of aerial ships in war is not at present the practical one, because in case such use is authorized it will be too late adequately to equip ourselves after war has been declared.[38]

This exact situation would be realized less than a decade later as America entered WWI. Less presciently, Squier closed this article on an optimistic note that twentieth-century warfare would later mock:

> The world is undoubtedly growing more humane year by year. We have arrived at a conception of the principle of an efficient army and navy, not to provoke war but to

> preserve peace, and it is believed that, following this principle, the perfection of ships of the air for military purposes will materially contribute, on the whole, to make war less likely in the future than in the past.[39]

On June 29, 1909, with Orville recovered from his injuries and a new *Flyer* ready, acceptance testing resumed at Fort Myer. Once again, the test program began conservatively, with several short flights to test out the new aircraft. It was indeed a new aircraft with several significant design changes including shorter wings and new landing skids. On July 2 another setback occurred when the engine stopped during flight, resulting in a serious but not catastrophic crash requiring one wing to be replaced. While that damage was repaired, the Wrights took the opportunity to upgrade the steering system with simpler two lever controls. The Wrights then successfully re-ran the endurance flight test (one-hour duration) with Lt. Lahm again as a passenger on July 27. Only the speed test remained.[40]

For the speed test Squier assigned Lt. Benjamin Foulois to fly with the Wrights and to also lay out a 10-mile round trip test course. Foulois was known to have excellent map reading and navigation skills, and so would be of help to pilot Orville Wright. Moreover, he was of small stature, adding less weight (and therefore less loss of velocity) to the test. Foulois selected a small hill as the turnaround point, Shooter's Hill now the site of the George Washington Masonic Memorial.[41] On July 30, despite the threat of rain and with approximately 7,000 citizens from Washington looking on, including President Taft, the test began at about 5:30 p.m. It was a bumpy ride and several times Foulois thought they might crash. Orville was able to maintain control and finish the flight with an average speed of 42.538 MPH, meeting the specification requirement of 40 MPH. The flight set world records for distance, altitude (400 feet) and speed, and so the Wrights declined the two additional tries the contract allowed, settling for a $5000 speed bonus and a total contract price of $30,000. Using the specification Squier had written, the officers Squier mentored, and the flight test program Squier led, the US Army finally had an airplane.

THE CREATION OF AN "AIR FORCE" – AND CONTROVERSY

American aviation had a head start yet quickly fell behind after the acceptance of that first Wright *Flyer*. Unlike France which spent $22 million on military aviation by the outbreak of WWI, the United States spent less than $1 million. The Army simply did not believe the unproven airplane merited significant investment, not surprising considering the tremendous competition between army branches for the tiny American military appropriation. that quickly changed with the declaration of war against Germany in April 1917.

By 1917, the combat utility of airpower was no longer in doubt. It was an indispensable tool for reconnaissance on the Western Front, and quickly became an important adjunct in ground combat as well. All combatant nations had fleets of tactical aircraft in the hundreds, but the US had not a single up-to-date aircraft capable of fighting in Europe. Squier, now Chief of the Signal Corps Aviation section and in February 1917 as Chief Signal Officer of the Army with the rank of Major General, undertook the monumental task of building an American air force virtually overnight.

The organization to oversee this goal was the Aircraft Production Board, perhaps the earliest manifestation of what would later be called the "military-industrial complex." Chaired by Squier but consisting mostly of business executives, some of whom, such as Edward Deeds, would soon be directly commissioned into the army, this organization oversaw the entire military procurement effort although the actual contractual work was still done by the services. The first task was determining the actual production requirement. Initial estimates by the Army and Navy of a $300 million, three-year program put together by officers who themselves had never planned for anything of this scale were deemed too conservative by our new French allies who were desperate for American resources. A massive $640 million aircraft procurement was proposed instead, the largest appropriation in American history for a single purpose. On July 24, 1917, President Wilson signed this into law.[42]

The American people, swept by enthusiasm for a war they had long avoided, now eagerly expected a tidal wave of American combat aircraft that would win the war, an enthusiasm encouraged by several members of the Aircraft Production Board. Deeds and other board members, almost all from the automotive industry that was then building over a million cars annually, confidently projected production targets that soon proved absurdly optimistic. Warnings from true aviation experts largely went ignored, such as one from Dr. Charles Wolcott, chairman of the National Advisory Council for Aeronautics (later, NASA), that "no amount of money will buy time" to recover the time lost by not having already developed the manufacturing processes to mass produce aircraft.

Squier made more sober plans. Aware that the infant American aviation industry lacked the knowledge to design a combat aircraft, he decided America would instead produce already designed European aircraft on a "build to print" basis, mostly Curtiss JN-4-H training planes and De Havilland DH-4 light bombers. To gather further technical information and refine the procurement strategy, Major Raynal Bolling was dispatched to Europe where he toured French aircraft factories and reported a list of recommendations for a two-phased plan. Prior to July 1, 1918, American aircraft factories would primarily build aircraft for the stateside training of the enormous number of new pilots needed. Afterwards, focus would shift to providing combat aircraft for the Western Front. To help bridge the gap, America would buy several thousand French tactical aircraft such as the SPAD XIII which turned out to be the only planes Americans actually flew in combat. The Aircraft Production Board, leveraging the extensive experience America had with internal combustion engines in automobiles, also oversaw the highly successful Liberty engine program, producing thousands of engines that continued to be used in a variety of vehicles for decades after the Great War ended.

Overseeing wartime aviation production, however, was now but a small part of Squier's overall responsibilities as Chief Signal Officer during a transatlantic war. Suddenly thrust into a modern technological fight, the Signal Corps not only had to create a wide variety of fixed station communications (telegraph and telephone) throughout elaborate technology complexes in France, but also field evolving new technologies such as radio. Even providing transatlantic military communications now fell into Squier's lap.[43] European militaries had already transitioned their air forces to autonomous or semi-autonomous status, but the US Army stubbornly clung to its prewar organizational structure. A visit to decidedly old school Army Chief of Staff, General Hugh Scott for additional staff to manage his gargantuan workload was utterly fruitless.[44] Finally, the realization that Squier's span of control was impossibly wide sunk in, but only after public outcry over the perceived failures of the Army airplane program.

Figure 3 *Baltimore American* cartoon 1918

With the signing of the $640 million congressional appropriation, the Army divided its Air Service into three branches, foremost being the Equipment Division charged with the actual procurement of aircraft. To run this operation, Squier selected the newly minted Colonel Deeds, a Dayton automobile executive with no previous aviation or military expertise, who helped form the Dayton Wright Airplane Company within 48 hours of the declaration of war. By August 1918, Deeds was directly commissioned into the army in the rank of colonel in the Regular Army instead of a reserve commission–a highly unusual arrangement. Over the next nine months he set about the task of contracting out for a vast air fleet. One of the first companies awarded work was his own Dayton Wright which received a contract for 4,000 light bombers and 400 training aircraft on September 7, 1917, on a "sole source", i.e., noncompetitive bid.[45]

In just a few months it started to become clear that the early predictions of nearly instant success by men such as Deeds were based on a single, faulty assumption that building airplanes was not significantly different from building cars. In fact, differences abounded both in materials and manufacturing skills. For example, wings required extremely long, single beams of spruce not easily obtained. The US in fact had to essentially commandeer the timber industry in the Northwest to meet its material quota. Unlike automobiles, readily assembled by semi-skilled labor, aircraft parts and assemblies required a high level of craftsmanship and close tolerances that were difficult to achieve. By early 1918, when the promised fleet of aircraft failed to appear, first the public and then Congress expressed outrage at what appeared to be a $640 million boondoggle. A congressional inquiry and a special investigation led by future Chief Justice of the Supreme Court Charles Evans Hughes led to recommendation of court martial for Deeds and discipline for two officers under him, but Secretary of War Newton Baker intervened and the whole affair was quickly ended.[46]

Squier was never investigated for any corruption or misconduct, although he was roundly criticized in the press for poor judgement and organizational skills. In retrospect, his primary shortcoming seems to have been placing excessive trust in a group of businessmen who possessed skills and business contacts he lacked and motives he somewhat naively misjudged. Given the enormous span of control he had as Chief Signal Officer, it is hard to see how he could have done otherwise than delegate the enormous details of procurement to someone else. As stated in a pamphlet, probably underwritten by Deeds and widely distributed in Dayton after the affair ended,

> General Squier himself summed up the general principles that governed him in the handling of his work. His part, as he saw it, was: "To foster individual talent, imagination, and initiative, to couple with this a high degree of cooperation, and to subject these to a not too minute direction; the whole vitalized by a supreme purpose which serves as the magic key to unlock the upper strata of the energies of men.[47]

An important side effect of the whole affair was that in April 1918 the War Department, after a careful study, finally decided to create a new combat arms branch, the long overdue Air Service. Perception inside the army, however, was that the Signal Corps "lost" aviation because of Deeds' mismanagement.

Despite the taint of scandal, the aircraft production program was hardly a complete failure. Squier's original vision of a fleet of American aircraft playing a pivotal role in winning the Great

War probably would have been realized had the war ended in the spring of 1919 with a final Allied offensive, as war planners assumed. More importantly, Squier gave the spark for the development of an American aviation industry which would play a pivotal role in winning the next World War twenty years later.

> Showing remarkable resilience and ingenuity, the new industry overcame a myriad of design and supply chain issues and–given a reasonable production curve–began producing combat aircraft in just over a year, just as the original Bolling Commission had expected when it recommended awarding the French the 5,875-airplane-contract the year before. In the war's last 3 months, DH-4 production deliveries to Europe were as follows: September - 757, October - 1097, November - 1072. Production was now at a highly respectable rate of 12,000 aircraft a year.[48]

Squier retired from the army in December 1923 but never lost his interest in technology or invention. After his army career, he discovered his 1910 patent for carrier multiplexing (the ability to transmit information signals over electrical power lines) could be adapted to transmit music; an innovation that resulted ultimately in the rise of "Muzak" and later of video streaming services such as Netflix.[49]

TRUE FATHER OF AIRPOWER AND MILITARY TECHNOCRACY

While many better-known names have been bandied about as the true father of American military airpower, it is hard to see how they approach, much less exceed, Squier's accomplishments. Within a few years of the Wright Brothers first flight, despite general skepticism of whether it had even occurred, Squier was investigating it, saw the military potential, and began instructing a whole generation of young officers in the evolving technology at the Signal Corps branch school. Many of these junior officers he educated and mentored—Benjamin Foulois, Billy Mitchell and "Hap" Arnold—later became the key leaders in twentieth-century American airpower. He convinced an Army uninterested in innovation to finally procure an airplane using the specification he developed and then supervised the acceptance testing of that airplane. Once America entered the war and real funding was finally available for a true air force, he seized the opportunity, and the American aerospace industry was born. Had he simply taken the final step and acquired a pilot rating, he undoubtedly would be a fixture in Air Force histories.

All this was possible because of Squier's initiative in seeking out and acquiring the finest technical education available to an American at the time. In this regard he was unique. The first army officer to earn a doctorate had to do it the hard way, going to school while simultaneously fulfilling the routine duties of a junior officer, or by risking the wrath of superiors for requesting leaves of absence. Throughout his career Squier showed a talent for seeing the military potential in a new technology, whether electric power, communications, or aviation, and for turning that potential into real working systems with the operational capabilities to fight and win wars. In this regard he was the prototypical military officer/technocrat, a new kind of military leader who understood both the complexities of technology and its military applications, setting the stage for our modern military-industrial complex.

Figure 4 Chief Signal Officer Major General Squier, courtesy Wikimedia

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[1] Arthur Kennelly, *National Academy of Sciences Biographical Memoirs, Biographical Memoir of George Owen Squier* Vol. XX (Washington, DC: National Academy of Sciences, 1938)
[2] Emmett Dougherty, "Army's Greatest Inventor" in *Popular Mechanics* (September 1927)
[3] George Squier, "A Few Facts of My Own History", User Home Page Book: Squier-Atwell Family Reunion Tree: I Change My Mind and Head for College" https://www.genealogy.com/ftm/b/a/r/Cathy-Diane-Barryorth/BOOK-0001/0111-0001.html
[4] Paul W Clark and Laurence A Lyons, *George Owen Squier – US Army Major General, Inventor, Aviation Pioneer, Founder of Muzak* (Jefferson, NC: McFarland and Company, 2014),16
[5] Clark and Lyons, 18-19
[6] William Endicott, *Board of Fortifications or Other Defenses* (Washington, DC: Government Printing Office, 1886)

[7] Charles J. Gross, "George Owen Squier and the Origins of American Military Aviation" in *The Journal of Military History*, 54, no. 3 (1990): 283
[8] Gross, 21-22
[9] Gross, 22-26
[10] George Owen Squier, "The International Electrical Congress of 1893, And Its Artillery Lessons", *The Journal of United States Artillery III* (1894): 1-13
[11] Squier, 13
[12] Clark, 32-33
[13] Clark, 33-35
[14] Albert Cushing and First Lieutenant George Squier, *The Polarizing Photo-chronograph: Being an Account of Experiments in the U.S Amy Artillery School, Fort Monroe, Va., in Creating This Instrument* (New York: John Wiley and Company, 1897)
[15] George Owen Squier, memorandum in Board of Ordnance and Fortification Files (February 12, 1898)
[16] Clark, 41-44
[17] Clark, 51-59
[18] Clark, 59-62
[19] Rebecca Robbins Raines*, Getting the Message Through: A Branch History of the Signal Corps* (Washington, DC: Center for Military History, 1996), 100
[20] Raines, 100
[21] Clark, 70-74
[22] Clark, 74
[23] Benjamin Foulois, *From the Wright Brothers to the Astronauts* (New York: Arno Press, 1980) 43-44
[24] Foulois, 43-44
[25] Raines, 127
[26] Gross, 284-86
[27] Foulois, 53-55
[28] As a student at the Defense Systems Management College in 1985 I was taught that Squier's specification remains a model for specifying military weapon system performance requirements.
[29] George Owen Squier, "Signal Corps Specification 486" in *Wright Brothers History*, (Washington, DC: Government Printing Office, December 23, 1908) http://www.wright-brothers.org/History_Wing/Wright_Story/Showing_the_World/Back_in_Air/Signal_Corps_Spec.htm
[30] See note 29 above
[31] Foulois, 52-57
[32] Clark, 88
[33] Foulois, 55-57
[34] Clark, 89
[35] Foulois, 57
[36] Foulois, 57
[37] George Owen Squier, "Ships in Air and Water", *Scientific American* 67, Issue 1727 (February 6, 1909)
[38] George Owen Squier, "Aerial Locomotion in Warfare", *Scientific American* 67, Supplement 1722, (January 2, 1909)
[39] See note 38
[40] David R. Chenowith, "Testing the Wright Flyer at Ft Meyer 1908-09", (January 28, 2001), https://corescholar.libraries.wright.edu
[41] Foulois, 61-64
[42] Foulois, 146-48

[43] Raines, 171-88
[44] Clark, 153
[45] Michael H Taint, "The Colonel, the Sculptor and the Supreme Court Justice", unpublished paper presented in 2017 to the Ohio Valley History Conference. All material on Deeds and Squier and the subsequent investigation are derived from this source. Email author at mhtaint@gmail.com for more information
[46] See note 45
[47] John K. Barnes, "The Vindication of Squire and Deeds", *Dayton History Books Online*, (July, 1921), https://www.daytonhistorybooks.com/index.html
[48] See Note 45
[49] Gross, 210-15

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