

53rd IAA HISTORY OF ASTRONAUTICS SYMPOSIUM (E4)
History of US Contribution to Astronautics Post WWII (2)

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**AEROJET ENGINEERING CORPORATION:
STIMULATION AND CREATION, 1935–1942**

Abstract

There are multiple published accounts of the stimulation and creation of the Aerojet Engineering Corporation that are inconsistent, incomplete, or erroneous in significant details, describing principals involved, timing, and funding of the creation process. This paper corrects the record and offers a well-documented and reliable history of the creation of the Aerojet Engineering Corporation.

A small group of academic researchers and technicians, joined by an attorney, working at the California Institute of Technology (Caltech), accomplished the formation and creation of the corporation. The group of six men incorporated and served as initial officers of the Aerojet Engineering Corporation—Dr. Theodore von Kármán; Dr. Frank Malina; Dr. Martin Summerfield; John Parsons; Edward Forman; and a Washington, DC, attorney, Andrew Haley.

A government-funded program definition study at Caltech generated a proposal to produce a means of providing superior aircraft performance capabilities using rocketry, often referred to as jet propulsion, due to engineering disrepute of “rocketry” prior to WWII. Caltech successfully conducted flight demonstrations at March Field (Riverside, California) in the summer of 1941, leading Drs. von Kármán and Malina to discuss and explore the best method to provide for production of jet-assisted takeoff (JATO) rockets with established industrial leaders, as well as industrial organizational alternatives. Von Kármán, Malina, Summerfield, Parsons, and Forman continued these discussions until von Kármán decided, in early 1942, to solicit the legal advice of Andrew Haley on how to proceed. After meetings at von Karman's home in Pasadena, on Haley's recommendation and using his volunteered initial corporate funding, it was agreed to incorporate the group. Articles of incorporation were drawn up by Haley and on 19 March 1942 were formally filed with the Delaware Secretary of State, establishing the Aerojet Engineering Corporation.

Many accounts previously published have distorted or misreported many of the details of the process followed by the group that created the company. It is intended that this paper will be regarded as a fully researched historical account of the creation of the Aerojet Engineering Corporation. Included are the historical environment, the industrial motivations, descriptions of key players, the role of government, and the ultimate confluence of these factors with the motivation of a champion and the availability of the required resources.

Pasadena, California, in the Late 1920s

Dr. Robert Millikan, the chairman of the Executive Council of the California Institute of Technology (Caltech), was interested in placing Caltech at the center of what Millikan perceived as an emerging aeronautical community in Southern California. Several significant aircraft manufacturing companies were selecting sites in the Los Angeles area for their production plants. Millikan learned that the Guggenheim Foundation was in the process of funding the establishment of aeronautical study centers at the University of Michigan, New York University, and at the Massachusetts Institute of Technology, among others. In a visit with Daniel Guggenheim in New York, Millikan obtained a conditional commitment from Guggenheim to also fund the creation of an aeronautical studies center at Caltech in Pasadena, California.¹

As a condition of funding, Guggenheim required Millikan to provide from Europe an intellectual leader and renowned aerodynamics educator to serve as head of the proposed new aeronautical laboratory at Caltech. After consulting with Dr. Paul Epstein on the Caltech faculty, in 1926, Millikan invited Hungarian aerodynamicist of renown Dr. Theodore von Kármán (Figure 1). Millikan previously had met von Kármán at a conference in Europe and invited him to the United States for a visit to discuss the establishment of a new wind tunnel and the establishment of an aeronautical laboratory at Caltech. Guggenheim, who was funding the invited travel, added significantly to the purposes of the proposed visit.



Figure 1. Dr. Theodore von Kármán [Credit: New Mexico Museum of Space]

Dr. von Kármán was at that time a professor at the Aachen Technische Hochschule in Germany.² Coincidentally, at about the same time (1926), Admiral Yoshida, at the Japanese embassy in Berlin, extended an invitation to von Kármán to visit Japan for six months, to help Japan's leading airplane manufacturer, Kawanishi Machinery Manufacturing Company in Kobe, to establish a major aeronautical laboratory and Japan's first wind tunnel for research work in aeronautics.³

Von Kármán decided to combine the trips. He requested a year-long leave of absence from Aachen, to visit the US from September to Christmas (1926), and then to spend the rest of the 1926–1927 academic year in Japan. Josephine, Theodore's sister (known in the family as Pipö), wanted to accompany him for the US segment of the trip. Josephine wanted to support her unwed brother, providing multiple exceptional language skills including fluent English.

¹ *The Guggenheim Aeronautical Laboratory of the California Institute of Technology: The First Twenty-Five Years*, v-vii, attributed to Clark Millikan, 25th Anniversary Booklet, published by the Guggenheim Institute, October 1954.

² T. von Kármán with L. Edson, *The Wind and Beyond: Pioneer in Aviation and Pathfinder in Space*, Little, Brown & Co., Boston, 1967. Materials in this biography of von Kármán provided substantive content of the following paragraphs. See also M. H. Gorn, *The Universal Man, Theodore von Kármán's Life in Aeronautics*, Smithsonian Institution Press, Washington, DC, 1992, 202 pp.

³ T. von Kármán with L. Edson, *op cit. supra*, note 2 at 121–122. The Kawanishi Company later produced Japanese Zero aircraft.

New York City and Long Island, Fall 1926

When Josephine and Theodore von Kármán disembarked at the pier in New York, they were met by a retired naval officer, Admiral Cone, the deputy director of the Daniel Guggenheim Fund for the Advancement of Aeronautics. The von Kármáns were escorted to the Guggenheim home in Port Washington, Long Island, for what von Kármán later described as a very pleasant weekend visit. In his biography, von Kármán described what Guggenheim asked him to do.

My mission for the Guggenheim Foundation in 1926 was twofold. I was to spend several weeks in Pasadena as advisor for the projected aeronautical laboratory at Cal Tech. The remainder of the time was to be devoted to lectures at various universities and institutions engaged in aeronautical research, including the National Advisory Committee for Aeronautics and the Air Force.⁴

In sequence, von Kármán first visited Pasadena for several weeks of discussion and planning activities with Millikan and his staff at Caltech. During that time, Millikan and associates, with von Kármán's assistance, discussed and developed plans for a new wind tunnel. The von Kármáns then visited the Grand Canyon, toured, and Theodore lectured at the University of Michigan, New York University, and Massachusetts Institute of Technology. To conclude his obligations to Guggenheim, von Kármán visited Washington, DC, where he gave lectures to the National Advisory Committee for Aeronautics (NACA) and members of the US Army Air Corps (USAAC). He also found time to visit Orville Wright in Dayton, Ohio. This broad exposure of von Kármán to the leading minds in aeronautics in the United States obviously allowed Guggenheim to informally collect assessments of the knowledge and capabilities of this proposed leader of the contemplated Caltech laboratory.

At Christmastime 1926, Theodore's sister, Pipő, returned to her mother at the family home in Vaals, Holland, close to Aachen, Germany. Theodore left the United States for Japan. When he arrived by ship in Yokohama harbor, his Japanese hosts met him and took him to a mountain retreat hotel to rest for 10 days before permitting him to do any work.

Japan, January 1927

In 1927, the Japanese were at an early phase of their aeronautical industrial development. The Kawanishi Company wanted von Kármán to design a wind tunnel for their use. There was no experimental wind tunnel in Japan. Much of the basic science of aeronautics was lacking and von Kármán had a major task to establish a basic understanding of aeronautics among his hosts. During his stay in Japan, von Kármán also instructed the Japanese how to make effective metal propellers.⁵ To do the wind tunnel design work, he insisted he had to have assistance. The Japanese agreed, and von Kármán's assistant, Erich Kayser, was summoned from Aachen to come to Japan to assist with the wind tunnel design work. In March 1927, von Kármán left Japan to return home. Kayser remained in Japan to work with the Japanese on the wind tunnel design and construction.

Aachen, Germany, 1928–1929

Meanwhile, the political environment of von Kármán's life in Germany was becoming increasingly unattractive. In his biography in 1956–1957, von Kármán soberly reported:

Although my work in Aachen was absorbing me fully, I could see ominous signs of impending disaster as early as 1928 in Germany. The growth of the anti-Jewish sentiment in the country, the strengthening of nationalistic spirit, and the progress of the Nazis were all portents of bad things to come.⁶

Late in 1928, additional significant events occurred when von Kármán visited the United States the second time. At Caltech, as he was completing an examination of the progress on the new wind tunnel, Dr. Millikan took him aside and asked whether he would accept the job of director of the new laboratory planned at Caltech. A short time later,

⁴ *Idem* at 123. The "Air Force" would have been more properly referred to at that time as the US Army Air Corps.

⁵ *Idem* at 133.

⁶ *Idem* at 140.

von Kármán reported, quite by coincidence, Dr. William Frederick Durand, head of the Mechanical Engineering Department at Stanford University near Palo Alto, California, told von Kármán he was retiring the following year, and Durand offered von Kármán his chair at Stanford.⁷

Although the offers were appealing and flattering, they were not immediately deemed acceptable by von Kármán for several reasons.⁸ Von Kármán was reluctant to change continents at this time in life (nearly age 50) to accept an academic position considered of lower social prestige in America than in Europe. As a reflection of the American press coverage of the time, his mother considered the United States a land overrun by misfits, rogues, and gangsters, and she said she would not consider moving there. In addition, von Kármán truly enjoyed teaching at Aachen and cherished the many friendships he had established throughout Europe over the years. Initially, with regret, von Kármán declined both offers from Stanford and Caltech.

The social and political conditions in Germany continued worsening throughout 1928 and 1929, and the ascendancy of the Nazis in Germany caused great concern to von Kármán. By late 1929, brother and sister, Theodore and Josephine, agreed that they should leave Germany. They eventually overcame their mother's reluctance to move to the land of misfits and gangsters. In October 1929, on the threshold of the Great Depression, von Kármán decided to accept the reiterated and higher salaried job offer from Millikan. In December 1929, the trio—Pipö, Theodore, and their mother—left Europe and moved to Pasadena, California.

Ever the conservative, von Kármán did not sever all ties with his homeland. As he explained in his biography,

I did not at that time sever my official connection with Aachen. My ties to Europe were too strong. Instead, I took a leave of absence promising that I would spend part of each year in Aachen. I did spend the summer of 1931 in Aachen and returned to Pasadena in the fall. I also visited Germany in 1932.⁹

The Nazi party became continually more oppressive in Germany, and in 1933, Adolph Hitler took over the government of Germany. At that point, the Ministry of Education required von Kármán either to return to Germany or to resign his position at Aachen. Convinced that he had little choice, given the situation in Germany, von Kármán resigned his post at Aachen in 1933 and turned full attention to his work at Caltech in California.

Pasadena, California, from 1930

Von Kármán continued working in aeronautical education and industrial consultations at Caltech throughout the 1930s and built a reputation for excellence in education and extraordinary perspicacity in consulting with industry and governments on matters involving aeronautics. Graduate students came from across the country to Caltech to study in the mid-1930s, including a young Texan named Frank Malina. Malina had earned a bachelor's degree in engineering at Texas A&M in 1934. He was offered a scholarship for admission to a master's degree program at Caltech. He would become one of the major players in the developing history of Caltech and would become a significant player in the foundation of the Aerojet Engineering Corporation.¹⁰

Frank Malina arrived at the Guggenheim Aeronautical Laboratory of the California Institute of Technology (GALCIT) in the fall of 1934 as a candidate for a master's degree in mechanical engineering.¹¹ Malina's graduate work was undertaken initially under the supervision of the GALCIT staff. He successfully completed his first year of studies and was awarded a Master of Mechanical Engineering degree in 1935. He immediately applied to pursue a master's degree in aeronautical engineering, under the supervision of Professor Theodore von Kármán, director of GALCIT. During the 1935–1936 school year, Malina was appointed assistant instructor on the GALCIT staff. Malina

⁷ *Idem* at 141.

⁸ *Idem* at 141–142.

⁹ *Idem* at 145–146.

¹⁰ F. J. Malina, *Memoir on the GALCIT Research Project, 1936–38*, at <http://www.olats.org/OLATS/pionniers/memoir1.shtml>.

¹¹ Some history of Caltech's Guggenheim Aeronautical Laboratory during the 1930s is well described in F. J. Malina, "The U.S. Air Corps Jet Propulsion Research Project, GALCIT Project No. 1, 1939–1946: A Memoir," in R. C. Hall (ed.), *History of Rocketry and Astronautics*, AAS History Series, Volume 7, Part II, at 153–201, Univelt, Inc., San Diego, 1986. Much of the material in the following paragraphs is drawn from the Malina memoir.

also established collaboration with von Kármán and Maurice A. (Tony) Biot to prepare the illustrations for their coauthored textbook on *Mathematical Methods in Engineering*, subsequently published in 1940.

When Malina had successfully completed his second year of studies in 1936, and had been awarded a Master of Aeronautical Sciences degree by Caltech, he immediately enrolled to pursue a doctorate under Theodore von Kármán. This effort would be focused on the concepts of rocket propulsion and the behavior of vertical sounding rockets. Malina and von Kármán were gradually becoming a team, working out basic mathematical and practical principles of rocketry.

Early in 1935, Malina had found a co-enthusiast for rocketry in William Bollay, also a student at GALCIT. In a seminar presentation in March 1935 at Caltech, William Bollay presented a description of rocketry work undertaken by Eugen Sänger in Vienna, Austria. He added commentary to the Sänger work, describing his own work and interest in rocketry. This seminar and its focus on rocketry were featured in a local newspaper article seen by a pair of local rocket enthusiasts not affiliated with Caltech. The pair of men came to Caltech and contacted Malina to declare their interest in the subject, seeking a contact at Caltech to help build a liquid rocket engine.

That is how Malina met John W. Parsons and Edward S. Forman in 1935. Because neither Forman nor Parsons was college trained, they lacked qualifications for appointment to the Caltech faculty. Malina, Forman, and Parsons visited von Kármán to ask for permission for Malina to work with the pair at Caltech informally, on a non-reimbursable basis, and von Kármán agreed.¹² Forman and Parsons agreed to this arrangement because it gave them access to personnel and resources to facilitate building experimental rockets. Soon, two other Caltech students, Apollo M. O. (AMO) Smith and Chinese student Hsue-shen Tsien,¹³ joined the Malina group, along with Bollay, Forman, and Parsons.

Col. Henry H. Arnold Visits Caltech

During 1936, the commanding officer of March Field, near Pasadena, came to Caltech to attend various meetings convened to discuss the problems being encountered by lighter-than-air vehicles in which the armed services were interested. Caltech Executive Director Clark Millikan introduced then Col. Henry (Hap) Arnold to Prof. von Kármán. In his biography, Von Kármán later wrote:

Arnold impressed me from the first. He was a stocky, broad-shouldered West Pointer with inquisitive eyes with a blunt but acute way of asking questions, which I enjoyed answering. He was also a literate man and endeared himself to me when I learned that like my own father he had written children's stories.

I met him again in 1938, shortly after he became Chief of the Army Air Corps, a famous meeting at which we discussed rockets as a means of assisting bomber take-off. There was never any doubt in my mind that he was the greatest example of the U. S. military man—a combination of complete logic, mingled with a far-sightedness and superb dedication.¹⁴

Subsequently, Brig. Gen. Arnold further endeared himself to von Kármán by agreeing in 1939 to arrange funding for a project von Kármán had been promoting for several years. Brig. Gen. Arnold was convinced that the US Army Air Corps had to reduce its research dependence on the availability of facilities owned by other agencies. With von Kármán's urging, he arranged funding for the design of the nation's most advanced wind tunnel. Arnold authorized the wind tunnel for Wright Field in Akron, Ohio. It was to be a 20-foot, 40,000 h. p. wind tunnel, the first of its kind.¹⁵

During 1936, Caltech had granted a research fellowship to Martin Summerfield, a prodigious student who had graduated from Brooklyn College with a bachelor's degree in physics at the age of 20. He was awarded a master's degree by Caltech in 1937 and a doctoral degree in 1941. During 1940, while rooming with Frank Malina at Caltech, Summerfield became interested and involved in the work of the GALCIT Malina group. Summerfield brought interest

¹² T. Von Kármán with L. Edson, *op cit. supra*, note 2 at 234–235.

¹³ Qian Xuesen was a scientist who made important contributions to the missile and space programs of both the United States and the People's Republic of China. The name he used while in the United States was Hsue-Shen Tsien or H. S. Tsien. A definitive biography of Qian Xuesen, his name after returning to China, is Iris Chang's book, *Thread of the Silkworm*, Basic Books, 1995.

¹⁴ T. von Kármán with L. Edson, *op. cit. supra*, note 2 at 225.

¹⁵ *Idem* at 226.

and capability related to propellant combustion in liquid fueled rockets. It is recorded that during the initial research period, Summerfield made fundamental discoveries regarding hydrocarbon fuel burning times and regenerative cooling. This knowledge moved the early work on liquid engines at GALCIT from the realm of technical impossibility to possibility.¹⁶

Rocket Research at GALCIT, 1935–1938

From 1935 to 1938, the six enthusiasts in the informal GALCIT rocket research group combed the literature on rocketry, propellants, and appropriate construction materials. They devised simple experiments to prove aspects of the materials and propellants they studied, and eventually actually built and tested small experimental rockets. Under the overall supervision of Professor von Kármán, Malina was the rocket research project leader; Parsons was a perspicacious and creative propellant expert, although not a formally trained chemist; Forman was the machinist handling materials and manufacturing activities; Bollay, Smith, and Tsien continually contributed hours of reading, analysis, discussion, and calculations to the work of the group.

Together, members of the small Malina group provided from personal resources the money and materials they could scrounge up to pursue their work on rocketry. It was not long (1937–1938) before the group was building and testing rocket engines, some of which drew official opprobrium when they exploded in Caltech facilities. The group, nicknamed the “Suicide Squad,” was banished to do their experimental work in the unpopulated Arroyo Seco near the institute (Figure 2). The informal GALCIT rocket research project continued into 1939. In September 1939, Hitler’s troops marched into Poland, initiating the Second World War.



Figure 2. John W. Parsons, Edward S. Forman, and Caltech graduate students Frank Malina, AMO Smith and Hsue-shen Tsien carry out their first rocket firing on Halloween, 1936, in the Arroyo Seco. [Credit: GALCIT]

Pasadena and San Diego, California, Summer 1938

The Malina group continued its studies and worked diligently to perfect a reliable rocket motor. However, as von Kármán noted in his biography, at that time “neither industry nor government had shown the slightest interest in the possible practical side of rockets.” In August 1938, one industrialist, Ruben Fleet, president of Consolidated Aircraft Co. of San Diego, approached GALCIT to request information on the possibility of using rockets to assist the takeoff of heavy aircraft. Following a visit with Mr. Fleet in San Diego, Frank Malina prepared a written report, with which von Kármán agreed, encouraging development of this type of rocket motor.¹⁷ In May 1938, USAAC Col. Harold (Hap) Arnold visited von Kármán’s labs at Caltech and at that time informally discussed uses of rockets for aircraft takeoff assistance.

Later in the year, Arnold was advanced to the rank of Brigadier General and was reassigned to headquarters duties in the USAAC. Arnold was reportedly “fascinated” with the idea in Malina’s report for Reuben Fleet. In the

¹⁶ Among others on the internet, for more information on Summerfield, see the biography on page 388 of volume 15 of *Memorial Tributes* (2011) compiled by the National Academy of Engineering. Find Summerfield on the alphabetical list of names and click on his name.

¹⁷ T. von Kármán and L. Edson, *op. cit. supra*, 2, at 243. See also the detailed account of the Fleet contact in R. Cargill Hall, “Selective Chronology: GALCIT/JPL Developments, 1926–1950,” 11; in the Papers of Frank Malina, Jet Propulsion Laboratory Archives, File 13.5; hereinafter cited as “Hall in Malina Papers.”

fall of 1938, Arnold invited Prof. von Kármán and Malina to attend a meeting to be held in Washington, to discuss Malina's concept. That meeting was of a committee, of which von Kármán was a member, under sponsorship of the National Academy of Sciences, to consider certain pending research problems faced by the USAAC. Among issues to be considered:

[Gen.] Arnold listed improvement of the visibility of the windows of bomber aircraft in icing conditions and the development of some form of assisted takeoff with rockets for large heavy bombers from small fields, such as one might expect to find on the Pacific Islands.¹⁸

The Washington committee meeting actually occurred in December 1938. A contract with Caltech resulted from that meeting to develop a work program directed toward "development of super performance aircraft." It was a \$1,000 study contract entered into in January 1939 to prepare a formal proposal and work plan to develop takeoff assistance systems for aircraft. Work on the program plan was completed in June 1939, and Caltech proposed a multiyear \$400,000 work program. The proposed work was acknowledged by the government as important, but the proposed cost was beyond available governmental funds. To facilitate progress, the proposal was phased in separate fundable components.

Research Enabling Super Aircraft Performance, 1939–1940

Technical developmental work commenced immediately on the phased program. In July 1939, Caltech received a \$10,000 contract to begin work on jet-assisted takeoff (JATO). This was the first governmental commitment of money for research on rocketry at Caltech. Work continued on rocket development into 1940 and by March, the work was beginning to yield positive results. On 15 June 1940, Malina, Parsons, and Forman submitted a Final Report for 1939–1940, on Jet Propulsion [Rocket] Research, GALCIT Project No. 1.¹⁹ The rocket engine being developed was a small, end-burning solid propellant rocket to be used a JATO.

International tension increased continually during 1940. The war in Europe escalated. German forces overran France and the Low Countries, and the Germans were bombing major cities such as Rotterdam. The US commitment to support of England increased, and in the summer of 1940, the US government inaugurated the draft into military service.²⁰

Andrew G. Haley (Figure 3), who had joined the US Army Officers Reserve in 1933, received a letter dated 21 March 1941 announcing his reappointment to the US Army Officers' Reserve Corps. The letter explained "This appointment is made in view of the fact that since the effective date of your present appointment you have qualified for appointment with eligibility for assignment, active duty, and promotion in peacetime." The letter of appointment acknowledged that Haley had previously served 14 days on active duty, referencing the period 12 to 25 April 1933, when he served as a reserve officer in the Contracts Section of the JAG Department's Military Justice Division. Haley signed the oath of office, confirming this appointment on 1 April 1941. On 22 May 1941, Haley was promoted to the rank of major in the US Army Officers' Reserve. He signed the oath of office confirming this promotion on 4 June 1941.

¹⁸ *Ibidem*.

¹⁹ Reference to this report and other contemporary and later events and reports can be found in Hall in Malina Papers, *op. cit. supra*, note 17. These papers are a rich source of relevant documents, including F. J. Malina, "GALCIT, the First 25 Years," File 12.24; "GALCIT, The First 10 Years," File 12.2; "GALCIT/JPL Developments 1926–1950," File 13.5; see also "An Interview of Frank J. Malina by Mary Terrall, Dec. 14, 1978, in the Archives of Caltech in Pasadena"; hereinafter cited as the Malina Interview.

²⁰ The *Selective Training and Service Act of 1940*, also known as the *Burke-Wadsworth Act*, Pub. L. 76–783, 54 Stat. 885, enacted 16 September 1940, was the first "peacetime" conscription in United States history.



Figure 3. Andrew G. Haley [Credit: Andrew G. Haley, Jr.]

Considerations of Rocket Production Arise

After completion of a number of successful JATO flight tests in August 1941, it was becoming increasingly clear that the development and testing of the rocket capability was maturing. The small group of GALCIT rocket experimenters started considering establishing a capability for production of the JATO units. Successful tests had been conducted at March Field, near Pasadena, demonstrating convincingly that jet-assisted takeoffs, using rocket boosters attached to aircraft, would shorten runway required lengths and significantly increase aircraft payload capabilities (Figures 4 and 5). In von Kármán's words, "test results at March Field with the Ercoupe [low-wing monoplane] exceeded our highest expectations. They showed that JATO could shorten takeoff distance by as much as 50 per cent."²¹



Figure 4. First American rocket-assisted takeoff (1941). (Credit: NASM)



Figure 5. Flight test crew for the Jet Assisted Take-Off (JATO) test flight. From left to right are: F.S. Miller, J.W. Parsons, E.S. Foreman, Dr. Frank J. Malina, Capt. Homer A. Boushey, Jr., Pvt. Kobe and Cpl. R. Hamilton. [Credit: NASA]

²¹ T. von Kármán and L. Edson, *op. cit. supra*, note 2, at 250.

When Malina brought to von Kármán the idea of creating a separate company to manufacture rockets, the matter was discussed for weeks among von Kármán, Malina, and their colleagues. Von Kármán reported that an independent business seemed like a good idea, but the group debated for weeks whether to license the JATO units to established manufacturers, make the rockets themselves at Caltech, or drop the issue of production and just become consultants to others.

On 7 December 1941, the Japanese attacked the US Pacific Fleet while it was anchored in Pearl Harbor, Honolulu, Territory of Hawaii. On the next day, the United States declared war²² on the Empire of Japan. The situation at Caltech, working on JATO development became inexorably involved in the national war effort. With regard to the question of manufacturing JATO units, von Kármán wrote in his biography,

I went forth to talk to some experts. Jack Northrop, who himself had started an airplane factory in a garage, didn't exactly say our idea was nonsense, but he wasn't too encouraging. I received similar answers from Cliff Garrett, founder and President of Air Research Corporation, and from several friends at Hughes Aircraft.²³

Von Kármán reported that the executives consulted did not see how a rocketry company could survive as an independent company with one customer—the government. These negative responses were considered but essentially ignored by the dedicated and emotionally committed Malina group.

While returning from a trip to Dayton by train in mid-February 1942, von Kármán and Malina discussed and recorded a plan to establish the required business enterprise as a partnership. Malina wrote to his parents on 16 February “On the trip Dr. Kármán and I laid out the set up for a company [partnership]. The next month will decide if we will or will not go through with it.”²⁴ Later in February 1942, at von Kármán's invitation, Haley visited with Theodore von Kármán, Frank Malina, and others in von Kármán's Pasadena, California, home to discuss the possible creation of a new company. In an interview done in 1978, Malina told his interviewer that Air Research had actually made a proposal at that time [early 1942], and

That's when Kármán pulled in Andrew G. Haley as a legal advisor. When he [Haley] came out here [from Washington, DC, to Pasadena] he said “Well, I don't think that's a very good offer they're giving you.”²⁵

Malina reported that the offer made was to take on the group as consultants if they would give up all their patent rights. Haley said,

Why don't you fellows set up your own company? I'd be willing to join you. All we have to do is put up about two hundred dollars apiece; we'll get incorporated in Delaware, and get going.²⁶

Creation of Aerojet, Pasadena, California, 1942

Describing these events in his biography, von Kármán wrote,

In January and February 1942, Malina, Haley, Summerfield, Forman, Parsons and I met in the living room of my home to lay the foundations of our rocket company. To show our seriousness of purpose we agreed to put up two hundred dollars apiece. This I might say was a considerable gamble in those

²² Public Law 77-328, 55 Stat. 795. On 11 December 1941, four days after the United States declared war against Japan, Nazi Germany declared war against the United States, in response to a claimed series of provocations by the United States, when the US was still officially neutral during World War II. Later that same day, the United States declared war on Germany.

²³ T. von Kármán and L. Edson, *op. cit. supra*, note 2, at 256.

²⁴ Malina Papers, File 22.1.

²⁵ Malina Interview, 10.

²⁶ T. von Kármán and L. Edson, *op. cit. supra*, note 2, at 251.

days for a theoretical professor, his former graduate students, and two young rocket tinkerers—only Haley had business experience.²⁷

Von Kármán also reported that on 19 March 1942, the incorporation papers creating Aerojet Engineering Corporation were filed with the government in the state of Delaware.²⁸ “Each founder agreed to contribute \$200. However, none of the Malina Group had the \$200. Haley agreed to advance \$2,500 to cover all the costs of getting the company started.”²⁹

Haley initially assumed the position of Aerojet corporate secretary so that he could return to what was at that time his private law practice in Washington, DC, leaving the fledgling company in the hands of President von Kármán, three vice presidents: Forman, Parsons, and Summerfield; and Treasurer Malina. Malina described the structure of officers of the new corporation in a letter to his parents, and identified von Kármán, Haley, and himself as the Board of Directors of Aerojet.³⁰

Corresponding with his family in Brenham, Texas, Malina described the period of 1941 and 1942 as a time of challenge nearing fruition of the work on “the project” and a period in which he and Dr. von Kármán traveled frequently to the east to visit Washington, DC, and Dayton, Ohio (Wright Field), for consultations and contract negotiations with government officials.

Malina never described the work to his parents, nor its purpose, maintaining a complete, self-imposed secrecy in his correspondence with his family. His letters referred often to long nights at work and frequently commented on the physical condition of Dr. von Kármán; usually mentioning his remarkable stamina and sometimes expressing concern about von Kármán’s durability and health under the demanding circumstances.

On 29 March 1942, one week after the incorporation of Aerojet, Haley sent the following unexpected letter to von Kármán.

March 29, 1942

Dear Doctor von Kármán:

I have just returned from a brief “flying” trip to Tacoma to arrange some personal affairs. While en route I received a telegram from the Army calling me to active duty on my reserve commission. The matter has been very precipitate and I have had no time to arrange the myriad things that need my attention and disposal.

It is with great regret that I must resign as secretary and director of Aerojet Engineering Corporation. My former office and secretary, however, will finish up the bookkeeping and formal details of the organization of the company and send you the books and records as the documents come in from Delaware. She will also take care of the stock stamps required by law. She will send my successor as [corporate] secretary the seal. I will complete the details on the trust certificates the stockholders have approved.

I suggest great caution in selecting a new director and secretary, because of the importance of the work we set out to do.

I hope to see you and Pipa [*sic*] soon. It is always a grand experience to spend an evening with you.

Respectfully,
Andrew G. Haley

The required period on Haley’s active duty did not have a stated duration, but it entailed all the obligations of an Army officer, including the required resignations from other organizations. This intervention of an active duty period would not deter Haley from later working with the company. His activation did require him to place himself on furlough from his law firm, but he did not formally terminate his relationship with the firm. On 30 March 1942,

²⁷ *Ibidem*.

²⁸ *Idem* at 259.

²⁹ *Aerojet, The Creative Company*, a composite history, Chapter I, p. I-9, S. F. Cooper Company, Los Angeles, 1997.

³⁰ Malina Papers, letter dated 22 March 1942, File 22.1.

probably prior to receipt of the Haley letter, Dr. von Kármán sent a confidential letter to Comdr. C. W. Bolster in the Navy Department's Bureau of Aeronautics. Von Kármán wrote:

In reply address not the signer of this letter, but:

Mr. Andrew G. Haley, Sec'y
Aerojet Engineering Corp.,
Earle Building, Washington, D. C.

March 30, 1942

Dear Commander Bolster:

I have received the papers in connection with our proposal for the jet reaction motors sent by the Bureau of Supplies and Accounts to our Secretary, Mr. Andrew G. Haley. Due to significant improvements in the jet units made during the last month, I have suggested a number of changes to Schedule 500-4887 (Aeronautics) and sent them to the Bureau of Supplies and Accounts and asked this Bureau to await your approval of the changes.

The changes were brought about by the replacement of gasoline by aniline as a fuel. A recitation of six reasons for the fuel replacement is included. The letter continues.

It was decided to raise the price of Item 1 to cover extra engineering services that the schedule requires in connection with the acceptance demonstration of Item 1 at the Naval Engineering Experimental Station.

To speed delivery, von Kármán then suggested that the Navy waive the acceptance demonstration recited under Item 2 of the Navy's order. The letter continues.

It appears to us now that reliability of the unit would be sufficiently proved by the acceptance tests of Item 1 and the successful completion of the forthcoming Army flight tests. However, if you desire the demonstration test of Item 2, we will be happy to comply.

We are ready to commence manufacture immediately upon receiving a letter of intent.

Sincerely yours,
Th. Von Kármán, President
Aerojet Engineering Corporation

On the same day, von Kármán sent a letter to Haley transmitting a copy of his letter to Cmdr. Bolster and explaining to Haley the proposed changes. In the letter, von Kármán asked Haley if it would be proper to use "Pat. Applied for" in reference to their rockets; von Kármán also asked Haley to provide a "corporate seal to affix to such papers as require it." He made a few additional administrative requests and then advised Haley:

The address 3330 East Colorado Street [apparently on the letterhead for the first time] refers to a very nice building [a former automobile dealership] we rented for a year. Monthly rent \$160; however location and space facilities are so superior to less expensive places that I decided to rent this.

Would you please take care of the Certificate at the bottom of page 9 in the schedule for bid?

With best regards,
Th. Von Kármán, President
Aerojet Engineering Corporation

It is clear from this short letter that von Kármán was relying heavily on Haley for administrative assistance, especially in managing the legal affairs of the company. With Haley's withdrawal, there would be a substantial weakening of the company management.

In the spring of 1942 [April, May, and June], even while serving on active duty for the Army, Haley was apparently commuting to California from Washington, DC, where he still lived with his wife and children and maintained an inactive status in the law office known as Porter and Haley. Haley was receiving Aerojet

correspondence at his law office address in the Earle Building in Washington, DC. Clearly, von Kármán was dependent on Haley's presence to manage Aerojet affairs. Malina, Summerfield, and the others were still active, but they were largely preoccupied by the technical work for which they were responsible, also supporting Caltech and its additional research and development (R&D) contracts. On 22 April 1942, writing on GALCIT letterhead, von Kármán wrote to Haley.

April 22, 1942

Dear Andy:

I am enclosing the [stock] certificates duly signed. The reason for the delay was my absence during the last week. ...

I received your telegram this morning, and I am glad that the contract will be awarded. We have already started with the manufacturing of the parts which need longer delivery time. The flight tests are going with excellent results and will be finished probably tomorrow.

I believe it would be advisable if you could come here about the weekend of May 9. I had the intention to go to Washington this week, however, I postponed my trip since I believe I will be able to do much more at a somewhat later date. Your coming here would have two objectives. First, we have to have a written agreement with the Institute [Caltech], and I believe you are the man to negotiate it. Second, we talked over the future program with the Army Air Corps representative who conducted the tests, and it appears that we have to make, in the near future, proposals to the Material Division for further development involving about 25 to thirty units for service tests. I should like to talk over these proposals with you, and after that, we have to go to Wright Field for negotiations.

Concerning the negotiations with the Institute, Dr. R. A. Millikan, who is the Chairman of the Executive Council, will return May 6 from the East, so that the first of the week of May 10 appears to be a good time for the negotiations. I would be very glad if you could make arrangements concerning your trip.

Yours as ever
Th. von Kármán

Among Haley's personal papers, the following imprecisely dated document appears. This carbon copy is informal evidence of a meeting of the Aerojet Board of Directors in early April 1942.

MINUTES OF MEETING OF THE BOARD OF DIRECTORS

Von Kármán Marango Street, Pasadena, California, on April, 1942.

Present: Dr. Theodore von Kármán and Dr. Frank Malina, constituting a quorum of the Board.

Upon motion, duly made, seconded and carried, it was **RESOLVED**: That the Board of Directors accepts with regret the resignation of Mr. Andrew G. Haley as secretary and director of the corporation.

The chairman then stated that the next business before the meeting was the selection of a director and a secretary to succeed Mr. Haley.

Mr. Theodore Coleman was nominated for director of the corporation, to hold office until his successor was elected. No other nominations having been made, the polls were duly opened, and all the directors having voted by ballot, the chairman declared the polls closed. Thereupon the directors there present examined the ballots and declared Mr. Coleman elected.

Mr. Frank J. Malina was nominated for secretary of the corporation, to hold office until his successor was elected. No other nominations having been made, the polls were duly opened, and all the directors having voted by ballot, the chairman declared the polls closed. Thereupon the directors present examined the ballots and declared Mr. Malina elected.

There being no further business before the meeting, it was adjourned pursuant to the call of the chairman.

On 29 April, Malina wrote in a letter to his parents “The past month has slipped away and with it our big spring job. The results were quite satisfactory and everyone is pleased. We have been struggling for this event for six years.”³¹ The rocket tests were producing positive results and the seriousness of going to production was weighing on all concerned.

Within a few months following incorporation (May 1942), the Army contracting office notified von Kármán that the Army decided not to renew its research contract in process at Aerojet. A precise account of the reason for the termination of the Army’s contract with the Aerojet Engineering Corporation is not recorded, other than in a historical anecdote later told to one of the authors in the early 1980s by an Aerojet official.

Apparently, in the spring of 1942, the Army sent auditors to Pasadena to review the books on the Army’s research contract being performed by Aerojet Engineering under von Kármán’s leadership. When the auditors asked von Kármán to show them the company books for an audit, he offered them his personal checkbook. Then von Kármán explained that when money was received from the Air Corps, he deposited it to his checking account. That was the money he used to purchase materials and to pay employees, with his personal checks. When the auditors returned to their offices with this intelligence, noting the nonexistence of any company books, personnel, payroll, or accounting practices, the contracting office issued its notice about May of 1942 that the JATO development contract in place, scheduled to end in June, would not be renewed.

To Dayton and Washington, May 1942

Von Kármán reported in his biography that when he received the notice of contract termination, he and Malina immediately traveled by train to visit Col. Frank Carroll, in charge of Air Corps research and development at Wright Field in Dayton, Ohio. Col. Carroll told them that the decision was made in Washington, and hinted that they might find an answer to the question of why the contract would not be renewed at Air Corps headquarters.

In a subsequent meeting with Col. Ben Chidlaw, in the Pentagon, when asked why Aerojet’s contract was being stopped, von Kármán reports that “Chidlaw sighed. ‘We like you very much Doctor, but only in cap and gown to advise us what to do in science. The derby hat of the businessman doesn’t fit you.’”³² According to von Kármán, Chidlaw recommended that von Kármán find someone who knew something about doing business with Washington and send him to represent Aerojet. Clearly, the auditors’ account of Aerojet’s dysfunctional management took its toll.

Von Kármán immediately called his friend, then the Army Air Corps’ commanding officer, Gen. Henry “Hap” Arnold, to ask the general to assist him by providing competent management skills to help run Aerojet. During that call, von Kármán suggested Andrew Haley, who was at that time a recently activated major on duty as chief of the Military Affairs Division of the Office of the Air Judge Advocate, USAAC, in the Pentagon. Von Kármán informed Gen. Arnold that Haley had helped set up the corporation earlier in the year. Gen. Arnold subsequently called Haley to his office and informed him that von Kármán had requested that Haley be sent to Pasadena to help manage the Aerojet Engineering Corporation.

Many years later, Haley described the ensuing exchange to biographer Shirley Thomas:

I assured General Arnold that I was quite happy with my Air Corps duties and was then planning to join the staff of a new command overseas. “Maybe you really have in mind a nice post in Greenland or Iceland,” he commented with a twinkle in his eye. The hint was too broad to be ignored, so I promptly accepted his opinion that my place was with Aerojet.³³

Before nightfall that same day, Haley was excused from duty in the Air Judge Advocate’s Office to permit him to develop a plan to assume the position of president and general manager of Aerojet Engineering Corporation in

³¹ Malina Papers, File 22.1, dated 29 April 1942.

³² T. von Kármán and L. Edson, *op. cit. supra*, note 2 at 259.

³³ S. Thomas, *Men of Space*, vol. 7, p. 140, Chilton Books, Philadelphia & New York, 1965.

California.³⁴ Haley proceeded immediately to visit Pasadena, to assess the situation, and to lay plans for his family to join him in California.

On 27 and 28 June, as directed by Gen. Arnold, to make the record show why Haley was being released from active duty, von Kármán wrote two letters addressed to the Commanding General, Materiel Center, Army Air Force, Wright Field, Dayton, Ohio, but marked for attention of Col. F. G. Carroll. The letters explained the background and reasons for a request to release Major Haley, for assumption of the role of managing the Aerojet Engineering Corporation. Col. Carroll, chief of the Experimental Engineering Section at Wright Field, forwarded these letters to the commanding general in the Pentagon on 16 July, with his favorable endorsement. On 20 July, the commanding general concurred in Col. Carroll's recommendation and requested that his office be advised of final action taken.

In a memorandum for record, dated 22 July, Major Haley agreed to and concurred in the release from active duty, and set forth the duties he expected to carry out upon assuming full control of Aerojet. Haley wrote:

My duties with Aerojet would include coordinating the work of the production, engineering and developmental staff; expediting the procurement of materiel; arranging for the expansion of the assembly-line facilities to meet requirements; making adequate arrangement with subcontractors; obtaining qualified additional personnel not now engaged in vital war work; maintaining liaison with the Army, Navy and aircraft manufacturing companies and coordinating on ordnance; maintaining the operation of the company within the framework of state and Federal laws; processing contracts and arranging for production within the requirements of the contracts; maintaining general administrative control; making necessary financial arrangements; arranging for personnel to succeed me upon return to active duty.³⁵

From a starting point with a handful of part-time help, Haley was expected to transform Aerojet from an idea on paper to an operational production firm producing highly sophisticated and explosive rocket devices at the earliest possible date. He had already started hiring essential staff personnel in June, and he would continue to expand the staff and management structure in a remarkably few weeks. Haley had a good grasp on what needed to be done. Now it was up to him to do it.

Haley's two children were ages six and four; Delphine would have to be enrolled in school; and his household and wife would have to be moved. He went ahead alone to California to begin to get matters in order. The family relocation would take place following the end of the school year, when a suitable home was identified. Haley continued on active duty for a few months, as he commuted between Washington, DC, and Pasadena, California, while the formal paperwork for his release was completed. He formally took his position as president and general manager of the Aerojet Engineering Corporation on 1 September 1942.³⁶

Shortly after Haley assumed the presidency of Aerojet, the US Congress, on 2 October 1942, adopted The Stabilization Act of 1942,³⁷ which was an act to amend the Emergency Price Control Act of 1942, to aid in preventing inflation, and for other purposes. The act authorized and directed the US president to issue an order stabilizing prices, wages, and salaries to the levels that they had been as of 15 September 1942.

Haley was in the process of creating a working staff within the Aerojet corporation, and he was hiring professionals who were not on the staff on 15 September 1942, so he had some clarification and negotiation to go through with the National War Labor Board. One of the key hires Haley made on 18 November 1942 was the appointment as Aerojet's business manager of William (Bill) Zisch, former secretary to Millikan and von Kármán. After several exchanges of telegrams and letters, and a visit to Washington, DC, by Haley, a satisfactory conclusion was reached on the issues of salaries for new managers at Aerojet.

A significant historical chapter in Aerojet's early history was then created after the fact. The Navy was extremely interested in the JATO capabilities and in the summer of 1942, it joined the Air Corps in ordering JATO motors from Aerojet. The work was accepted and engineering design and production planning proceeded, despite the fact that there

³⁴ T. von Kármán and L. Edson, *op. cit. supra*, note 2 at 259.

³⁵ Haley Materials, 22 July 1942.

³⁶ *Ibidem*.

³⁷ Public Law 77-729.

was no engineering division in place, there was no manufacturing division, there were no established production facilities, they all had to be created and put in place as the work was being done.

A remarkably creative and innovative process of documentation was implemented in the fall months of 1942, in some cases creating contracts to describe work that had been done and delivered months before the paper trail was even created. This process allowed actual programs to be described, quantified, accounted for, and recorded after the facts of the matter, but well within the active memories of the principals managing the work. It was a masterful combination of teleology with corporate management.

Multiple contracts and memoranda describing this period of activities are contained in the collected Papers of Andrew G. Haley, in the archives of the Smithsonian National Air and Space Museum Library in Washington, DC. Access to the papers may be arranged through the library at the Udvar-Hazy Center in Chantilly, Virginia.

There have been a number of creditable historical works that deal with Aerojet featuring the time of its creation, describing the years following WWII, and detailing the elaborate history of this remarkable company. Our purpose here is to clarify and validate the principals who devised, promoted, and accomplished the creation of the Aerojet Engineering Corporation.