Ralph J. Heintz: A Pioneer in Aircraft Avionics

While climbing through 1,000 feet, planes departing on Runway 28 from San Francisco International Airport today fly over The Shops at Tanforan in San Bruno, a location that early in the last century played a pivotal role in the early history of aviation in the Bay Area. In January of 1910, William Randolph Hearst sponsored the Aviation Meet at the Tanforan Horse Racing Track, the first air show in northern California. Among the spectators that day was Berkeley teenager, Ralph Heintz.

Heintz, like many teenagers in the Bay Area at the time, was an amateur radio enthusiast who, at the invitation of Earle Ennis, returned to Tanforan a few months later to witness the first air-to-ground radio transmission in the United States.

Ennis, the owner of a San Francisco radio equipment business, brought wireless telegraph equipment from his Wireless Specialty Apparatus Company. Heinz brought his electrolytic detector that he made by sanding one side of a dime and then adding a drop of sulfuric acid into an indentation made with a ball peen hammer. He then connected a short piece of platinum wire, a battery and headphones to make it work.

Heintz set up his equipment at the far end of the racetrack, away from everyone. Once airborne, the pilot in the experiment let out a 25-foot antenna and then tapped out a few letters on his telegraph key. Both Ennis and Heintz clearly heard the signals on the ground but there were no reporters among the handful of spectators present to officially document the feat. Heintz recalled that the plane was a wheel less skid-bottom Wright plane but the name of the pilot and exact date of the event are not known.

Earle Ennis conducted further tests in 1911, this time working with the U.S. Army. It was during this aviation meet that pilot Eugene Ely flew a Curtis Pusher from Tanforan to the deck of the USS Pennsylvania in San Francisco Bay. When financial setbacks eventually caused Ennis to close his radio equipment business he became a radio columnist for various San Francisco newspapers.

Conversely, Ralph Heintz' experience at Tanforan in 1910 was the beginning of a long career in the fields of radio communications and aviation equipment.

In 1917, Heintz interrupted his studies at the University of California (UC) to join the U.S. Army where he was assigned to the Air Section of the Signal Corps (ASSC) as a navigator and radio operator. While serving in Europe during WWI he was transferred to the British Royal Navy Flying Field at Cranwell, England where he worked with Lt. Commander J. M. Robinson, the inventor of the cross-looped direction finder. Robinson's invention of crossing two loops of antenna made radio direction finding possible in an aircraft. The Royal Navy equipped Handley Page bombers with the Robinson devices with the intention of bombing Berlin by homing in on radio stations. Heintz did lab work during the day and flew North Sea patrols at night, but the war ended before he flew any bombing missions.

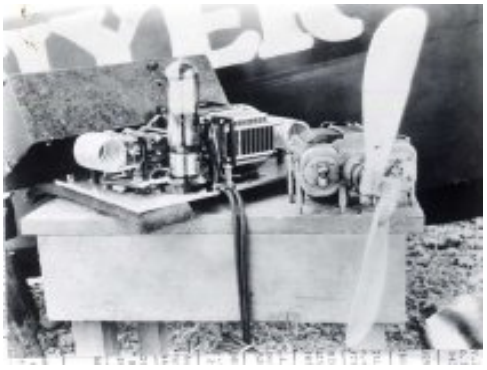
After WWI, Heintz graduated from Stanford University in 1920 with a degree in chemical engineering. Among his classmates was Frederick Terman. Like his father, Terman would become a professor at Stanford and be instrumental in growing the school's electrical engineering department. Today he is the Father of Silicon Valley. During WWII, Terman headed the Harvard Radio Research Lab, which was highly successful in developing systems to defeat German anti-aircraft efforts.

After a short time as a chemical engineer with Standard Oil of California, Heintz opened the Ralph M. Heintz Scientific Apparatus Company in San Francisco. He soon began building custom-made radio equipment for customers that included local radio stations, the Federal Telegraph Company and the U.S. Army.

In 1923, after learning of the Marconi Company's success in using high frequencies (shortwaves) for long distance communication, Heintz built the first such equipment for the Signal Corps. Two years later he was the first to equip a vessel in the Pacific Ocean with shortwave equipment. Around that time he also built equipment for publisher William Randolph Hearst that would facilitate the worldwide dissemination of news.

Building on his success, Heintz and a former classmate at UC, Jack Kaufman, formed Heintz & Kaufman (H&K) in San Francisco in 1926 where Heintz quickly developed a reputation for building top quality shortwave radio equipment.

In addition to their success in the marine radio field, H&K also established themselves in the growing field of aviation communications by way of a contest sponsored by James D. Dole, the 28-year-old founder of the Hawaiian Pineapple Company (later Dole). First prize was $25,000 to the first person who could fly from Oakland, CA to Honolulu, HI. Heintz installed his lightweight radio equipment: wind-driven generator, transmitter and a receiver, on Major Livingston Irving's orange Breese-Wilde monoplane, the *Pabco Flyer*.



Heintz & Kaufman 33-meter shortwave transmitter and wind-driven 400-cycle alternating-current generator. (Fig. 1)

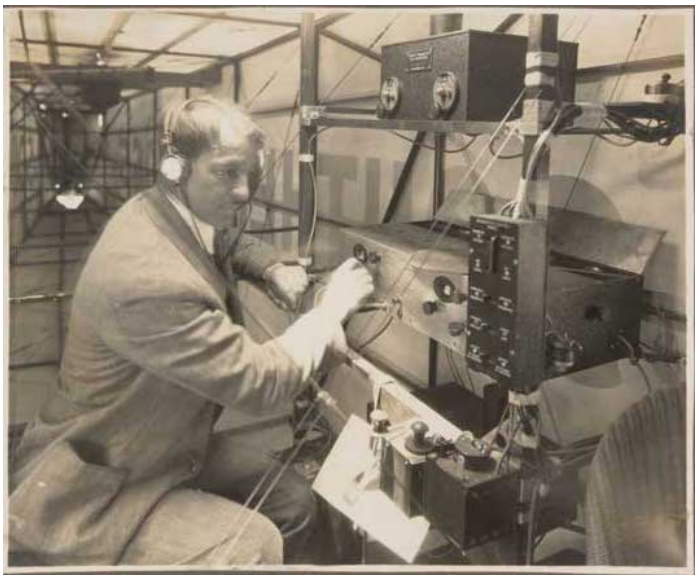
Eight competitors started the race on August 16, 1927. After the first plane returned with engine trouble and the second plane crashed on takeoff, the *Pabco Flyer* also crashed in the marsh beyond the runway. After repairs were made, Irving made another attempt, again crashing at the end of the runway. Of the eight contestants, only four made it past the coastline. The *Woolaroc* reached Honolulu in 26 hours and 17 minutes and the *Aloha* also completed the trip. The *Miss Dorian* and the *Golden Eagle* were lost at sea.

When the *Pabco Flyer* crashed, Heintz and his assistant, Fred Roebuck, removed their equipment and began installing it on the *Dallas Spirit*, a Swallow Special that had abandoned its first attempt. Two days later, pilot William Erwin and navigator/radio operator Alvin Eichwaldt, now equipped with Heintz's 50-watt shortwave radio, made a second attempt in the *Dallas Spirit* with the intention of flying a zig-zag route to search for the missing planes *and* to collect a $50,000 reward for finding them.

Fred C. Roebuck (left) and Ralph M. Heintz, Sr. (right) with *Pabco Pacific Flyer* at Mills Field (later SFO) on Aug 15, 1927. Note cut in wing for generator. (Fig. 2)

Ham radio operators were able to monitor Eichwaldt's transmissions in the 33.1-meter band. Also monitoring were Heintz, his wife Sophie and his old friend Earle Ennis, now a columnist for the *San Francisco Call* and Roebuck. Disaster struck approximately seven hours into the flight when the signal became high-pitched. When the noise stopped, Eichwaldt transmitted that they had been in a spin but had recovered. But soon the noise began again, ever louder this time followed by, "We are in a spin again…" and then complete loss of the signal. Word went out that the *Dallas Spirit* was lost at sea. Heintz concluded that the antenna had become fouled or wrapped around the tail.

Among those also listening that day was the *New York Times*, located 3,500 miles away and using a 200-foot vertical antenna stretched among the high-rise buildings of Times Square. The newspaper noted that hearing the distant transmissions was even more remarkable because the plane was equipped with *only* a 50-watt transmitter. Although the race to Honolulu was not successful for every contestant, it proved the usefulness of shortwave equipment in airplanes.



Radio Operator James Warner operating Heintz & Kaufman radio equipment aboard the *Southern Cross*. (Fig. 3)

Nine months after the Dole contest, H&K supplied radio equipment for the first successful trans-Pacific flight. The *Southern Cross*, a Fokker F.VIIb/3m tri-motor, left Oakland, CA on May 31, 1928 and arrived in Sydney, Australia on June 9 after stops in Honolulu and the Fiji Islands.

Charles Kingsford Smith and his relief pilot, fellow Australian Charles T.P. Ulm, and two Americans, navigator Harry W. Lyons and radio operator James Warner made up the crew.

Throughout their journey every expert said the H&K equipment was the finest they had ever seen. They could send and receive both long and shortwave; the shortwave to communicate to shore stations, the long wave to receive radio beacon signals and to communicate with ships at sea. In addition, its emergency radio transmitter was completely watertight, and the aerial could be lifted by means of a kite or a gas balloon.

Having already used Heintz & Kaufman shortwave equipment in his historic 1926 flight from Spitzbergen to the North Pole and back, Lt. Commander Richard E. Byrd also chose the same H&K equipment when preparing for his two-year expedition to the South Pole in 1929. The ground bases and dog sled teams also had H&K shortwave radios. Byrd's progress was monitored in New York and at the Dollaradio station near San Francisco.

In yet another historic flight, and after suffering equipment failures of other brands of radios, Sir George Hubert Wilkins chose H&K equipment for his 2,100-mile flight over the top of the world in 1928.

When approached by Boeing engineer Thorpe Hiscock to manufacture radio equipment for their planned Boeing Air Transport (later United Airlines) airline, Western Electric, who controlled the necessary patents, was not interested as they did not believe there was a future in passenger air travel. Consequently, Boeing turned to H&K who built the requested air and ground equipment. Upon learning of H&K's involvement, however, Western Electric went back to Boeing and told them they would build their equipment after all. Boeing then reneged on their deal with H&K and sold Heintz his equipment back for ten cents on the dollar.

One year later in 1929, Western Air Express (later Western Airlines) also engaged Heintz to equip their planes, ordering five Fokker F32 32-passenger transports for their Oakland to Alhambra (Los Angeles) service. The radio program for Western Air Express was headed by Herbert Hoover Jr. who, as a boy grew up on the Stanford University campus where he was a member of the very active ham radio operators club at the same time as Heintz and Fred Terman (circa 1920).

Formed in 1919 by General Electric, at the request of the Navy to ensure American dominance in radio, the Radio Corporation of America (RCA) controlled ship-to-shore and transoceanic communication. The Radio Trust, a monopoly of cross-licensing agreements between RCA, Western Electric (AT&T), GE, Westinghouse and the United Fruit Company (owner of Tropical Radio) was subsequently formed, giving RCA control over more than 2,000 patents. Because RCA refused to sell their tubes, small companies like H&K were forced to build their own … and RCA was not shy about suing companies, large and small, for patent infringement.

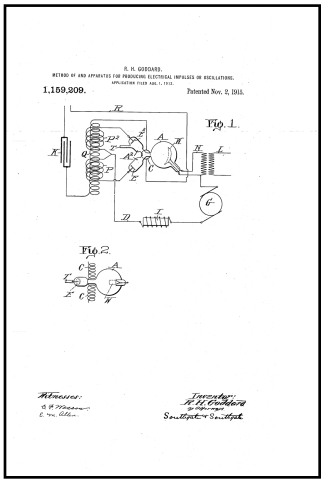
It was also in 1919 that the Dollar Steamship Company received permission from the Department of Commerce to establish its own wireless radio service, Dollaradio. H&K were subsequently brought on board to equip Dollar's 168 ships and ground stations throughout the Pacific.

The Dollaradio system was used for Dollar's company communications until 1934 when the government banned the operation of private radio systems. In response and to set up a commercial cablegram service, Dollar bought a majority share in H&K thereby forming Globe Wireless, which provided a commercial messaging service throughout the Pacific.

When H&K was a specialty radio manufacturer, they were ignored by RCA. When the larger Globe Wireless became a competitor to RCA's Radiogram business, however, RCA paid attention and filed a lawsuit against Globe/H&K for vacuum tube patent infringements. Through the Radio Trust, RCA had the rights to the de Forest audion tube, the first officially recognized three-element vacuum tube.

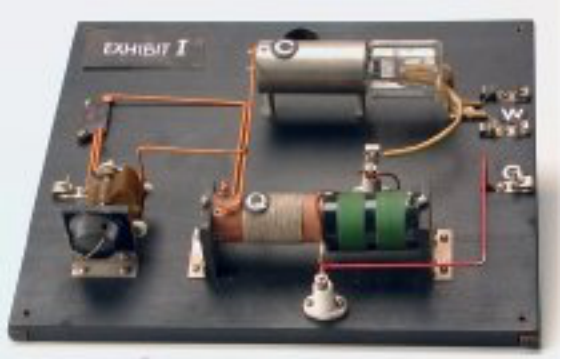
While working at Federal Telegraph in Palo Alto, CA in 1912, Lee de Forest discovered that his three-element audion tube could be used either as an oscillator to produce electromagnetic waves or as an amplifier. This discovery made possible the widespread use of radio and became the basis for all modern electronics. The three-element audion tube was such an important and valuable device that others working at the same time filed lawsuits claiming they had preceded de Forest. By 1920 de Forest had sold his patents to AT&T as the amplification capability of the tube enabled long distance telephone calls; AT&T had also cross-licensed the patents to RCA. It took almost 20 years to settle the lawsuits but, in the end, the Supreme Court ruled that de Forest was the first to develop a tube capable of being either an amplifier or an oscillator. The court set August 6, 1912, as the controlling date of the patent.

In preparing their defense against RCA, Heintz discovered that another patent had been filed, this one by Dr. Robert Goddard of Princeton University on August 1, 1912, five days *before* the de Forest controlling date. To study the effects of radio waves on insulators, Dr. Goddard had invented a three-element vacuum tube that could both oscillate and amplify. Although the court was aware of Goddard's work, they never considered it when awarding the patents to de Forest.


R. H. GODDARD.
METHOD OF AND APPARATUS FOR PRODUCING ELECTRICAL IMPULSES OR OSCILLATIONS.
APPLICATION FILED AUG. 1, 1912.
1,159,309. Patented Nov. 2, 1915.
Fig. 1.
Fig. 2.
Witnesses:
Inventor:
R. H. Goddard
by Munn & Co.
Attorneys.

Drawing submitted by Dr. Robert Goddard as part of his 3-element oscillating tube patent in 1912. (Fig. 4)

To prove the viability of Goddard's work, Heintz had his shop make replica tubes, duplicating as nearly as possible the materials and production methods of 1912. Heintz also produced nine breadboard exhibits, working examples of Goddard's drawings made to act as transmitters or receivers at working radio frequencies. Prior to the start of the trial the breadboard exhibits were placed on tables in an otherwise empty room in the Dollar Shipping building in San Francisco where RCA experts were invited to examine them. On the first day of the trial before any testimony was given, RCA dropped the case knowing that if H&K prevailed, RCA would be vulnerable to other companies attempting to bypass their patents. RCA ultimately agreed to a cross-licensing agreement with Globe/H&K, allowing them to sell their tubes on the open market. Ralph Heinz considered this victory over the powerful RCA monopoly to be one of his greatest accomplishments.



One of the breadboards made by Heintz & Kaufman as a working example of Goddard's 3-element tube design. (Fig. 5)

Concurrent with his work in radio communications in the mid-1920s, Heintz recognized that aircraft power could be produced at a much lighter weight using polyphase AC alternators rather than DC generators. Heintz began using them in his installations starting in 1925 and as aviation power requirements increased through the 1930s, he proposed the use of a 360-cycle AC polyphase alternator. After losing out to a competitor to supply the U.S. Army, Heintz complained to Congress who then split the contract between H&K and the competitor, Bendix. After the Bendix prototypes failed, however, Bendix bought the H&K contract for $150,000, the terms of which included the services of Ralph Heintz for two years. Heintz chaffed under the corporate culture of Bendix and at the end of the two years he returned to California.

During his time at Bendix, Heintz had observed that their aircraft starters were subject to overheating due to an internal clutch so after leaving Bendix he developed a starter using an external clutch that did not overheat. After finding a new partner in Bill Jack and forming Jack & Heintz (JAH-CO), Heintz received a large military contract from both the Navy *and* the Army for the JH-10 aircraft starter. At the time, the International Association of Machinists in San Francisco were trying to unionize the JAH-CO workers so despite already possessing a building in Palo Alto, and before the company was even operational, they moved the company to Bill Jack's hometown of Cleveland, Ohio.

Bill Jack presenting a Christmas turkey to a Jack & Heintz employee in 1942. (Fig. 6)

Having successfully launched and run other companies, Bill Jack oversaw personnel and production while Ralph Heintz oversaw engineering. On the personnel side, JAH-CO stood out as an exceptional company for the time in terms of working conditions and perks otherwise unknown until the modern era. New employees were given a complete physical and dental exam, a $2,500 life insurance policy, health insurance for their family, sick leave and a new pair of $15.00 work shoes. Each employee also received two pairs of overalls with their name attached, one hot meal on each shift, coffee in a personalized cup and donuts delivered to their work location. There were bowling leagues, dances and time off during their shift to go to the steam room for a massage. Employees could also enjoy a free two-week vacation at one of two company-owned resorts, Honeymoon Isle in Florida and Harbor Island on Lake Huron.

Rather than the usual 8.5-hour shifts and six-day workweeks, the JAH-CO workers voted to work 11.5-hour days and seven-day workweeks; many only took one day off per month. Hourly wages for women were $0.85 ($16.38 in 2024) and $0.95 ($18.31in 2024) for men. With overtime, the lowest paid apprentice made $400/month ($7.709/month in 2024). While absenteeism at other plants ran as high as 10-15%, at JAH-CO it was less than one percent. Additionally, productivity per worker and per square foot was higher, yet at a lower cost than any other factory during WWII.

On the engineering front, JAH-CO built aviation starters, generators, convertors, gyro flight instruments and auxiliary power supplies while the war. They made the A-3 Autopilot for the Army, eventually producing them twice as fast and at 65% of the cost of the original maker, Sperry.

Despite innumerable triumphs throughout his career, Heintz would make one more significant contribution to the world of aviation when he was chosen to design the guidance and flight controls of the JB-2 jet bomb. The contract to build the JB-2 jet bomb had been given to Ford and Republic Aviation after the Army reverse engineered a captured German V-1 bomb. Though the JB-2 missile was successfully tested at Eglin Field in Florida, none of the devices were ever used in combat.

After the war, Jack and Heintz sold their company and Heintz moved back to the San Francisco Bay Area where he worked from his home workshop doing consulting work for the burgeoning electronics and aerospace companies in the area. When his wife, Sophie, developed cataracts, he also worked with two local ophthalmologists to patent an intraocular surgical device. Heintz died in 1980 at the age of 88.