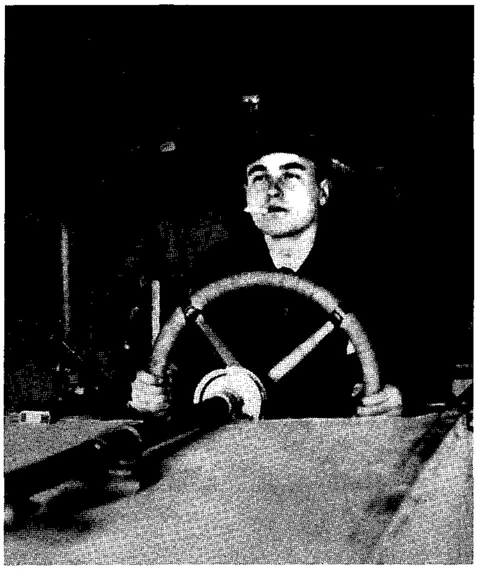
Norvin Rinek seated in cockpit.
Norvin Rinek No. 1 indoors.
(Author's Collection)

Voisin and Farman (background) at Reims, France air meet, August 1909.
(Time-Life Books)

A 1910 Rinek Model B-8 engine (Serial No. 102) in original condition, formerly flown by Robert Blackburn in England.
(Photo from Yorkshire Air Museum)



The 1909 RINEK VOISIN

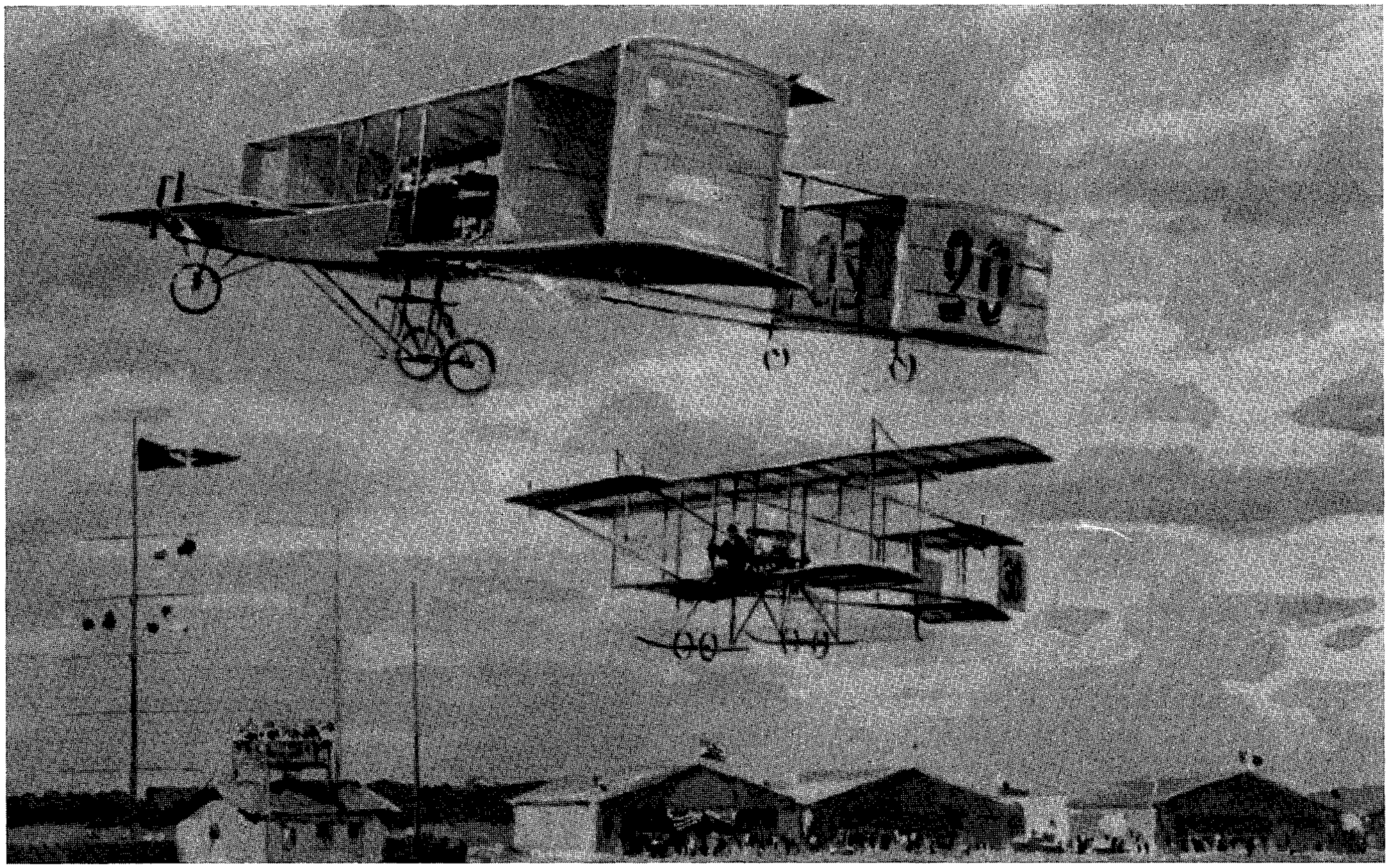
An Unusual Aircraft With an Advanced V-8 Engine

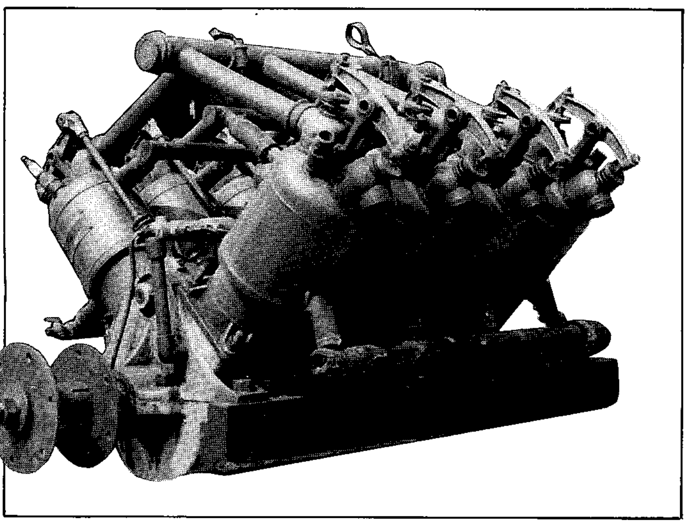
by Larry M. Rinek

THE DEVELOPMENT OF THE 1909 RINEK VOISIN, AN American-made pusher biplane based on the 1908 French Voisin standard design, and an associated family of advanced water-cooled Rinek engines is a historically significant and truly interesting story. Assembling the history has been a labor of love for me that required over 12 months of part-time yet intense research across the United States.

For years I had heard stories and rumors about this family aircraft from my father (an accomplished pilot who taught me how to fly).[1] While in Washington, D.C., in January 1991, I decided to see the aircraft for myself at the Smithsonian National Air and Space Museum (NASM). Unfortunately, by then the loaned aircraft had been moved to another museum. I later located a Smithsonian pamphlet with a 1980 view of the restored 1909 Rinek Voisin, as seen by thousands of visitors to the NASM Early Flight Gallery, in the company of famous Bleriot, Curtiss, Wright, and Lilienthal heavier-than-air craft. One official inventory of the NASM still lists the 1909 Rinek Voisin.[2] This exhibit was a source of pride which motivated me to dig into the story behind this remarkable machine. After discovery in a former family workshop in 1972, it was declared one of the oldest existent flying machines in original condition.[3] It is probably the only surviving original Voisin-type aircraft of this pre-World War I period and a fine example of early aeronautical engineering. My distant cousin behind this work (who I never had the pleasure of meeting), Mr. Charles Norvin Rinek (1888–1980), was one of America's true aviation pioneers who, until recently, has been all but unknown. Results of my historical research first came out in the form of two speeches presented to engineering colleagues in the SAE in California. This article will shed more light on his interesting story.

The article is organized first with a brief discussion on the background of the developer, Charles Norvin Rinek (who preferred to be called Norvin), followed by a review of his aircraft and finally the story behind his family of advanced water-cooled aircraft engines. Included with the story of the aircraft is useful background on the rich heritage associated with the design of the Rinek Voisin. We shall see that it reflects the thinking of various famous U.S. and international





aeronautical experimenters who flew before Norvin. This was a period of infancy for the aircraft industry (prior to World War I) when the market was quite small and daring ideas sprouted for both airframe and aircraft engine design, some successful and some best forgotten.

The Developer—C. Norvin Rinek proved to be an innovative self-taught engineer and businessman. With few exceptions, most of the early U.S. aviation pioneers (including the Wrights, Glenn Curtiss, Norvin Rinek, etc.) lacked formal science or engineering education at a college level yet many overcame this obstacle to produce exemplary mechanical designs. Besides Norvin Rinek's aeronautical engineering achievements, which are the main focus of this article, there were other notable accomplishments by Norvin in a variety of unrelated pursuits which indicate a well-rounded individual with a creative flair and high intelligence. Family photos of his fine collection of luxury motor cars in the 1930s testify to his business acumen running the family rope enterprise. A lifelong interest in things automotive apparently began with his first drive on the family estate at age 11 in 1899 where he can be seen in a family photo at the wheel of an imported French De Dion, which resembled a horseless carriage. (This was one of the very first automobiles in his hometown, Easton, Pennsylvania.[4])

Only child of the prominent and wealthy Easton businessman Howard Rinek (1852–1926), Norvin received an extensive private education. Howard Rinek was active in civic affairs and served as president of Easton Cordage Co. (later renamed the Rinek Cordage Co.), the family rope business founded by Howard's father Jacob Rinek (1805–1868) in 1840. Howard was also president of the Easton Transit Co. (horse-drawn trolley lines later electrified by Howard) and general manager of the local Edison Illuminating Co., which he brought to Easton (placing the city's first steam engine-driven DC generator in his basement). Thus, Norvin had a "tough act" to follow. It was Howard's wish that Norvin attend the local Lafayette College school of engineering. Reportedly, Norvin walked in the Lafayette front door and left by the rear door on the same day, never to return, stating that the professors asked "too many dumb questions," and the whole exercise "was a waste of time."[5] This showed an early streak of arrogance but also considerable self-assurance, for he believed he could master the subjects on his own. His mechanical achievements later vindicated that conviction. Nevertheless, dropping out of engineering school was not an act destined to please his father, Howard, with whom Norvin was to encounter considerable friction over the years.

Norvin was an early virtuoso in music, successfully playing the piano, harp, and violin and he collected such instruments for his home over the years. The local newspaper reported on March 9, 1909 (Norvin, age 20):

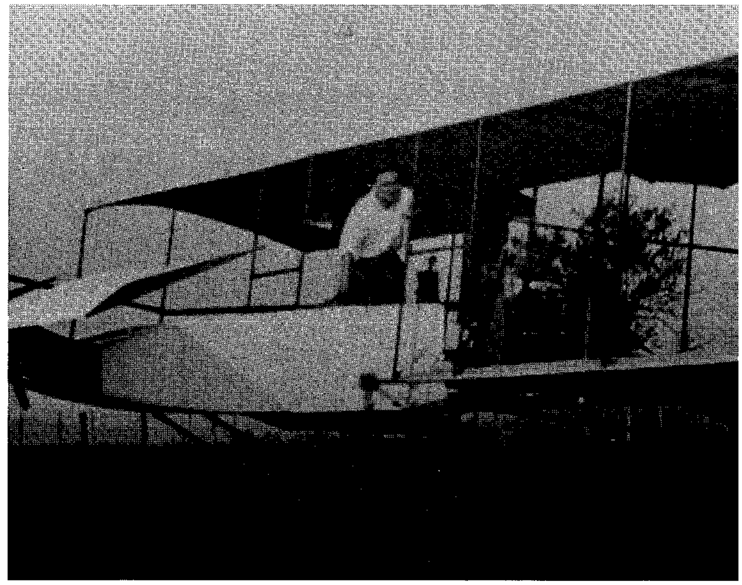
"In addition to mechanics, the Easton aeroplane designer is rounding into an exceptionally fine concert pianist. 'He is a very talented young musician,' explained Professor Charles Knauss, who has been his instructor during the past five years, 'and has a remarkable tenacity for music of the romantic school, showing a special interest in the productions of Chopin and Schumann.' "[6]

Along the same lines, fine arts were a natural outlet for Norvin. My inspection of his house (built in 1920 on the family estate and named Charnwood) in October 1991 revealed a large inventory of his exceptional bronze sculptures, oil paintings, architectural models, and such. We shall see later an example of his graphic arts in an ad for Rinek engines . . . he did all of his own advertising artwork for both the aero and rope businesses. Norvin also was involved in drama. I saw a manuscript for one of the plays he wrote (apparently for pleasure), with little or no intent in publishing or performing such.

Norvin's Charnwood home is adorned with things mechanical and electrical of his own design, including a four-story electric elevator (used by his ailing first wife, who eventually succumbed to muscular dystrophy). All of these non-aeronautical productions showed the remarkable creativity and complex human dimensions of this man.

We shall see later that although Norvin Rinek's aeronautical work was not commercially successful, he overcame this setback and did well managing the family rope business for decades. Around 1911, he reluctantly gave up his aeronautical pursuits and entered management training under his father, serving a tour in each department of the plant before becoming general manager of the Rinek Cordage Co. Clearly, he preferred to make things with his hands, rather than run a business.[7] Nevertheless, he assumed the presidency of the Rinek Cordage Co. in 1926 upon the death of his father and also earned a U.S. patent in the manufacture/design of rope in 1932. After paying off a considerable debt (e.g., $50,000 mortgage) owing at the plant in 1926, he was able to support his family rather comfortably and consistently make a profit up until his retirement in 1970 (at age 82) at which time the plant assets were sold, including his abandoned flying machine.

The Aircraft—C. Norvin Rinek's earliest dreams of flight occurred at age 14 in 1902 at the family cottage in the Pocono Mountains of eastern Pennsylvania.[8] He reportedly played with scale model gliders that he made from scrap wood around the same time of the Wright man-carrying glider experiments down at Kitty Hawk, North Carolina. Although the Wrights experimented largely in private, some publicity was getting out on their work and that of earlier glider experimenters such as California's John J. Montgomery and Germany's Otto Lilienthal, in the writings and lectures of Octave Chanute, which may have been a source of inspiration to Norvin.[9 10] Octave Chanute was a distinguished U.S. railroad engineer and bridge designer of French extraction who became very interested in aeronautics, designing with Augustus Herring a successful biplane glider flown in 1896.[11] Chanute served as a sounding board, mentor, and witness to many of the Wright brothers' early experiments, although it is clear that the Wrights did original work in many crucial areas, such as aerodynamic design (with the aid of their wind tunnel) and aircraft control technology. Unfortunately, Norvin did not have such a learned mentor as Octave Chanute handy and so had to work out the engineering problems largely by himself, or defer to the Voisin design (which contained a good deal of aeronautical guesswork).


Norvin Rinek standing in cockpit. (Author's Collection)

In 1906, at age 18 and a fresh dropout from college, Norvin Rinek began his aeronautical work with the financial backing of his father and the assistance of the machine department of the family's Easton Cordage Co. His first priority was development of aircraft engines. Two years later in 1908, with engines approaching workable form, he realized that the building of an aircraft would yield an appropriate testbed and marketing tool for his engines. Therefore, after reading a great deal (he studied and understood French) concerning the Voisin biplanes which dominated European aviation in 1907 and 1908, he procured plans and some components from the Voisin brothers (Charles and Gabriel). Norvin made substantial changes, principally in the materials of construction. Assembly was essentially complete in March 1909, and announced in various press reports.[12 13] Photos show Norvin in his aircraft in 1909 after it had been successfully flown. One photo in particular shows a dapper and self-confident young man at the controls (with a cigarette in his mouth). He later gave up the smoking habit and was consequently able to live to a ripe old age of 91. Another photo shows the complete Norvin Rinek No. 1 aircraft indoors at a family workshop (or hangar) with a rather early propeller design (short diameter and wide chord). We shall see later that his propeller work was much improved by 1910. In mid-1910, the aero business had advanced to the point that it could be spun off from Easton Cordage Co. which around the same time had reorganized into Rinek Cordage Co. Thus, the Rinek Aero Manufacturing Co. was incorporated with C. Norvin Rinek installed as president and Frank Buckman designated as secretary-treasurer.[14] Before getting into more specifics on the Rinek Voisin aircraft features, I wish to explore the rich heritage behind this aircraft design.

The Aircraft Heritage—It is appropriate to ask why an American would turn to France as a source for an aeroplane design. At this time (1906–1910) it must be remembered that France was the absolute center of the aviation world with the most pilots, the most flyable aircraft, the widest proliferation of wonderful aircraft engines, the most prizes awarded, the most public air meets, the most aeronautical publicity, and so forth. In short, this is where the action was. By contrast, around this time in the United States (1906–1907), we had just two experienced powered-aircraft pilots (the Wright brothers) with one flyable biplane and the Wrights were offering no public exhibitions whatsoever. It wasn't until 1908 (when Glenn Curtiss first won the *Scientific American* trophy with the *June Bug* Wilbur Wright provided a spectacular series of exhibitions in Europe, and Orville Wright provided U.S. Army demonstration flights at Fort Myer, Virginia) that substantial numbers of people could see successful U.S. airplanes.[15]

It's now fairly clear that the Wright glider designs, starting in the 1902–1904 time frame, greatly influenced the early French biplanes, such as the standard Voisin design modified by Norvin Rinek. In turn, the Wright designs owe a debt to earlier experimenters who proved out features now taken for granted in aircraft design. For example, Alphonse Penaud of France demonstrated in 1871 with rubberband-powered models the virtues of a tail-mounted vertical stabilizer for yaw stability around the vertical axis, and a dihedral angle for the main planes to help assure roll stability around the longitudinal axis.[16] The aircraft of Voisin, Langley, Wright, Santos-Dumont, and Montgomery all used the rear vertical stabilizer, but unfortunately Voisin declined to use a dihedral for many years. Another essential aerodynamic feature passed down from early designers to the Rinek Voisin was use of a curved or cambered wing (preferably parabolic in shape) placed at an angle of incidence (or attack) to the wind, proving superior lift performance. The work of the English engineer, John Smeaton (published in 1759) explains how cambered air foils, like that of a bird's wing, provides more lift and helped extract more work from a windmill.[17] It is now fairly well documented, however, that the first successful cambered aircraft wing design was demonstrated by John J. Montgomery in the August 1883 first flight (600 feet) of his new gullwing glider near San Diego, California (the first sustained and controlled flight by any man in a heavier-than-air craft).[18] Others had made earlier uncontrolled short hops with cambered-wing gliders (Mouilliard, etc.), but they don't qualify. About eight years later (1891), Otto Lilienthal began his pioneering man-carrying glider experiments in Germany with a similar cambered wing, also seen in Herring's 1891 scale model gliders, Chanute-Herring's 1896 glider, the Wrights' 1900-and-later gliders, and so forth on down to the Voisin brothers and Norvin Rinek. Montgomery and Lilienthal preferred monoplane configurations but the biplane configuration in Norvin Rinek's aircraft can be directly traced back to the Herring scale model gliders, then Chanute, then the Wrights. The Wrights judged biplanes to be superior to monoplanes in terms of structural strength (with Chanute's Pratt-type trussing) and lifting area.

Captain Ferdinand Ferber, an artillery officer in France, heard about the Wrights' glider experiments and alerted other French aerial enthusiasts such as Robert Esnault-Pelterie (who built a replica of the 1902 Wright glider) and Ernest Archdeacon, who financed construction of various early flying machines. In the spring of 1904, Archdeacon retained Gabriel Voisin, an architectural school graduate, as a test pilot and chief engineer for his replica of the Wright 1902 glider. Gabriel Voisin was described as follows:

"A native of Belleville, near Beaujeau, he was a dashing fellow and something of a lady's man. In later years, Voisin took delight in describing the conquests of his youth . . . my life,' he recalled, 'was full and I never knew boredom.' "[19]

Later, in 1905 Voisin designed and flew two new gliders of the cellular box-kite type, which had fixed vertical interplane surfaces in wing and tail units to give directional stability. The cellular box-kite design is usually traced to Lawrence Hargrave of Australia who demonstrated the man-carrying ability of the box kite in 1892–1894.[20] All of the early French biplanes from Voisin, Bleriot and Santos-Dumont had this feature. The June 1905 box-kite glider was towed by a speedboat down the Seine River in Paris. Gabriel Voisin was airborne for about 2,000 feet at an altitude up to 60 feet. Although dunked in the Seine River during a later flight in a glider built for Louis Bleriot in July 1905 and nearly drowned, Gabriel Voisin now had the "flying bug" which would later elevate him to considerable aviation fame. The July 1905 Bleriot glider was towed by a speedboat powered by the famous Antoinette fuel-injected V-8 engine later to dominate French aviation until the 1909 debut of the lighter Gnome rotary. In 1906, "Les Freres Voisin" (Gabriel and Charles), set up an aircraft business in Billancourt outside of Paris. Their first customer (Henry Kapferer) would only fund a 10-hp model that was a total failure in getting airborne. The No. 2 Voisin customer, Leon Delagrange, paid for use of the 50-hp Antoinette V-8 and by March 1907, Delagrange had the first successful powered Voisin flight. After this flight, Gabriel Voisin exhibited a profound cockiness (that would continue for decades) by stating:

"Our machine was far from being some kind of apocalyptic monster, but was a well-knit structure, thoroughly well thought out and not open to adverse criticisms."[21]

Of course, later the design received a great deal of well-deserved criticism, particularly for its lack of the stabilizing dihedral planes plus lack of pilot roll control due to the absence of ailerons or warped wings. For example, Dr. Crouch stated:

''Automatic or inherent stability was the goal of virtually all of the early European experimenters before 1908. Their most successful machine, the basic Voisin of 1907–1908, retained all the external features of the Wright airplane (biplane, pusher, canard). In terms of control, however, it was a much more primitive and dangerous craft.''[22]

Despite these shortcomings, the Voisin aircraft exhibited a certain reliability and was judged by knowledgeable historians as ''the first viable European aeroplane,''[23] and ''the machine which actually got Europe air-minded.''[24] Furthermore, in the hands of Henri Farman (Voisin's customer No. 3) and Delagrange, Voisin biplanes totally dominated European aviation headlines from 1907 through 1908, and were still winning prizes well into 1909. Farman was a French-born son of an English newspaper reporter stationed in Paris. He generally preferred the French spelling (Henri) for his name and later switched his citizenship from English to French. Henri raced cars and bicycles, then turning his energy to flying in 1907, he achieved sustained flights by October. Farman promptly modified his standard Voisin by adding the dihedral, cutting down the size of the massive box-kite tail and simplifying the forward canard elevator from a biplane (then still used by the Wrights) to a simpler monoplane. With this new configuration, Farman is best remembered as capturing the world-famous 50,000 franc ($9,300) Deutsch-Archdeacon Grand Prix d'Aviation (sanctioned by the Aero-Club de France) on January 13, 1908, by demonstrating the first public 1 km circular powered flight. In 1919, the Voisin factory produced a replica of Farman's Deutsch-Archdeacon prize-winning January 1908 Voisin and placed it in a museum outside of Paris in Meudon (original Musee de l'Air). This is believed to be the Voisin classic biplane second only to Norvin Rinek's in age.

In a typical arrogant fashion, after Farman's epoch performance on January 13, 1908, Gabriel Voisin said:

''At this moment none of our competitors was worrying us. We were indeed the only people in the world able to offer to those wanting to fly an airplane capable of flying more or less correctly, and although an array of plagiarists tried their best to equal us, not one could claim to approach the results we obtained.''[25]

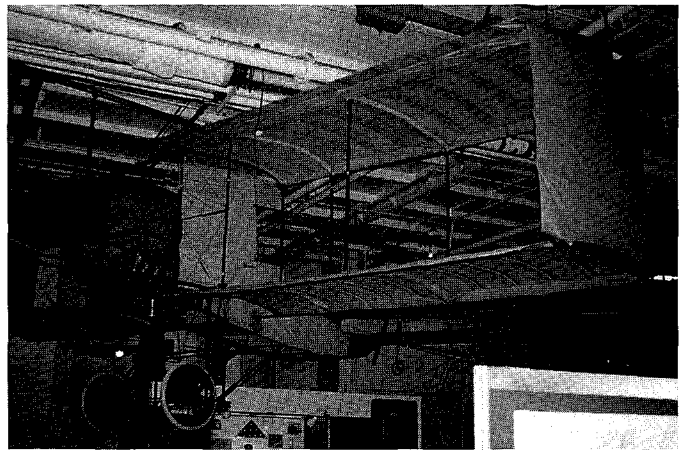
Voisin was either unaware at this point of the Wrights' powered flight achievements years before this event (despite Chanute's lectures and publishings in France advertising the success of the Wrights), or chose to ignore them.

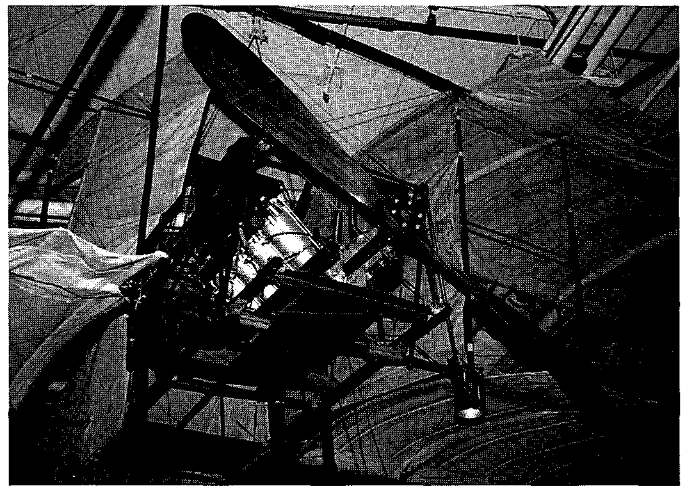
Witnesses to the Deutsch-Archdeacon prize flight reported wide, wobbly turns (at 10 m altitude) as the Farman-Voisin turned only with the rudder and dihedral, literally yawing or skidding around the course at the pace of 60 km/hour. As an author with piloting experience, I can testify that when a turn is initiated with rudder only, the nose of the aircraft shifts direction but the aircraft moves more or less forward in a different direction, setting up a yaw. It is still possible, however, to proscribe a wide arc and this turning maneuver remains today a good test of pilot skill. One actual pilot testimony as to the challenging handling of the Voisin gives us a good feel regarding what Delagrange, Farman, Ferber, the Englishman Moore-Brabazon, Harry Houdini (the magician), Norvin Rinek, and other fearless early Voisin pilots faced:

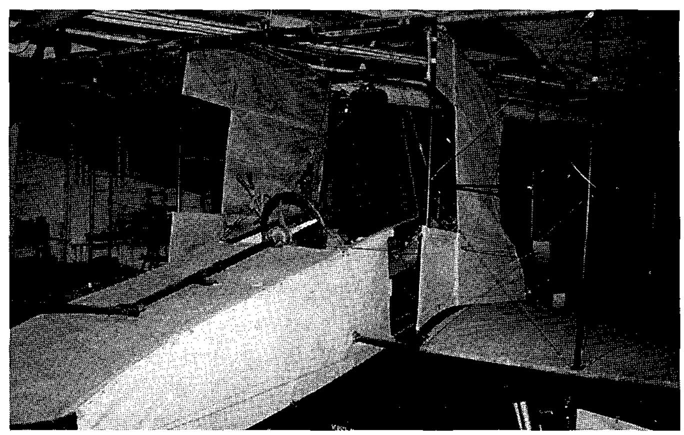
''One could just force it through the air,'' he said. ''The plane had no side control,'' the same critic recalled, ''so, if you tilted one side, you had to turn the rudder to force yourself back again onto level keel. It was quite a tricky maneuver.''[26]

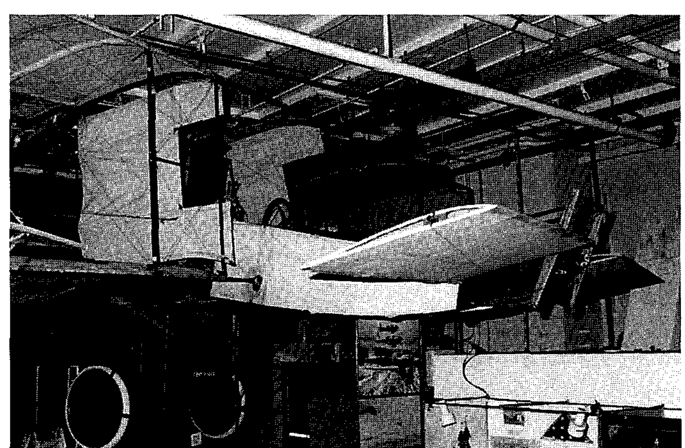
In other words, if the wind forced one side down, you turned opposite rudder, thereby accelerating the down wing(s), increasing lift on that side and restoring equilibrium. One pilot wrote in the *Scientific American* in 1911 on learning to fly:

''It is obvious that if the rudder will cause the machine to bank when it is swung over in one direction, it will right the









Right view of Rinek Voisin at Intrepid. **(Author's Collection)**

Right rear view. **(Author's Collection)**

Rinek engine underside view showing the prop. **(Author's Collection)**

Cockpit from distance. **(Author's Collection)**

Right front view with elevator detail. **(Author's Collection)**

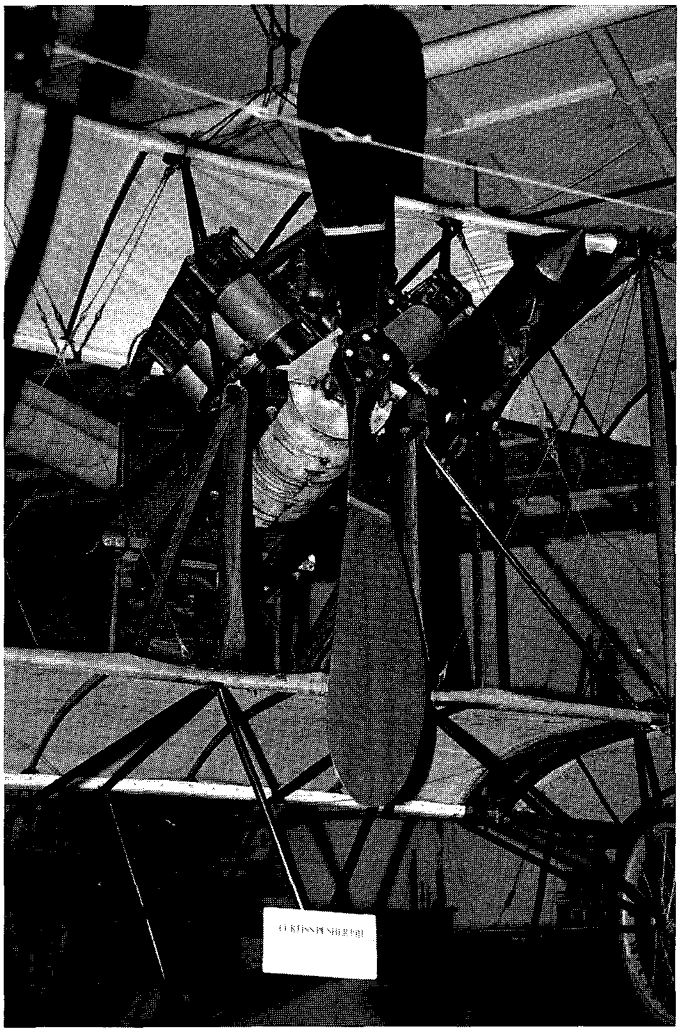
machine again when swung in the opposite direction. It is even possible to turn the machine on an even keel by anticipating the banking, simply by correctly using the rudder, which was necessary in the old Voisin machine flown by Farman in 1908, because it had no mechanical lateral control."[27]

Unfortunately, some Voisin pilots couldn't execute this maneuver with enough altitude at the slow speeds involved (30–40 mph) and crashed. Ferber crashed his Voisin in September 1909, becoming the first Voisin pilot fatality.

The Frenchman, Louis Paulhan, won a Voisin as a prize in Paris during 1908 and later crashed it (but survived) at the world's first great air meet at Reims, France, in August 1909. Shown is a *Time-Life* artist's rendition of a 1909 Voisin model flying at the Reims meet (by then a nose wheel had been added by Voisin to the undercarriage), with a Farman biplane flying in the background. Although the Voisin was the most populous aircraft flown at this great aerial spectacle in Reims during August 1909 (nine out of 28 aircraft entered), the newly independent Henri Farman aeroplane enterprise in 1909–1910 pushed the Voisins aside as the best-selling biplanes in all of Europe. Farman, you recall, was a devoted Voisin customer who made very useful modifications. In fact, by late 1908, inspired by Wilbur Wright's August–December 1908 flights in France, Farman added four workable ailerons (also known as "balancers" back then) and deleted the hideous side curtains from the main planes (which caused drift in a crosswind) from his Voisin so that he had the only aircraft with handling performance comparable to the Wrights.[28] Unfortunately, in late 1908 the Voisin sold an aircraft reserved for Farman to somebody else. In a huff, Farman set up his own aircraft business and by April 1909 had his first independent creations flying.

Besides the aforementioned modifications to his Voisins (dihedral, canard, tail, ailerons), Farman now converted from a heavy Voisin steel undercarriage to a lighter four-wheel undercarriage design with wood skids plus two or three movable rudder surfaces instead of the one rudder in Voisins. Farman later joined forces in 1912 with his brother Maurice (who was independently producing similar biplanes). In 1910, Henri Farman aircraft were successfully flown in the United States at various meets (e.g., Los Angeles, California, and Belmont, New York) winning substantial prizes for Louis Paulhan and the Englishman, Claude Graham-White. The Farman brothers continued to successfully produce aircraft (and engines) for decades, long after the Voisin brothers had stopped aircraft operations around 1920.

There is interesting further history concerning warped wings and ailerons (or hinged control surfaces on wings that



A 1911 Curtiss Pusher with front elevators displayed with the Rinek Voisin at the USS Intrepid floating Museum berthed in New York harbor in the Hudson River (right). The engine installation detail is shown (left).
(Olive Senn)

resembled ailerons). Press accounts show that Norvin Rinek, having probably recognized the control benefits of ailerons, added movable tips to the trailing edges of the main planes in March 1909 to his first aircraft.[29] He apparently removed them afterwards for legal reasons. If they were Farman-type ailerons, they likely drooped downward until takeoff when the airflow would cause them to extend upward to the horizontal position, due to one-cable operation (no return cable).

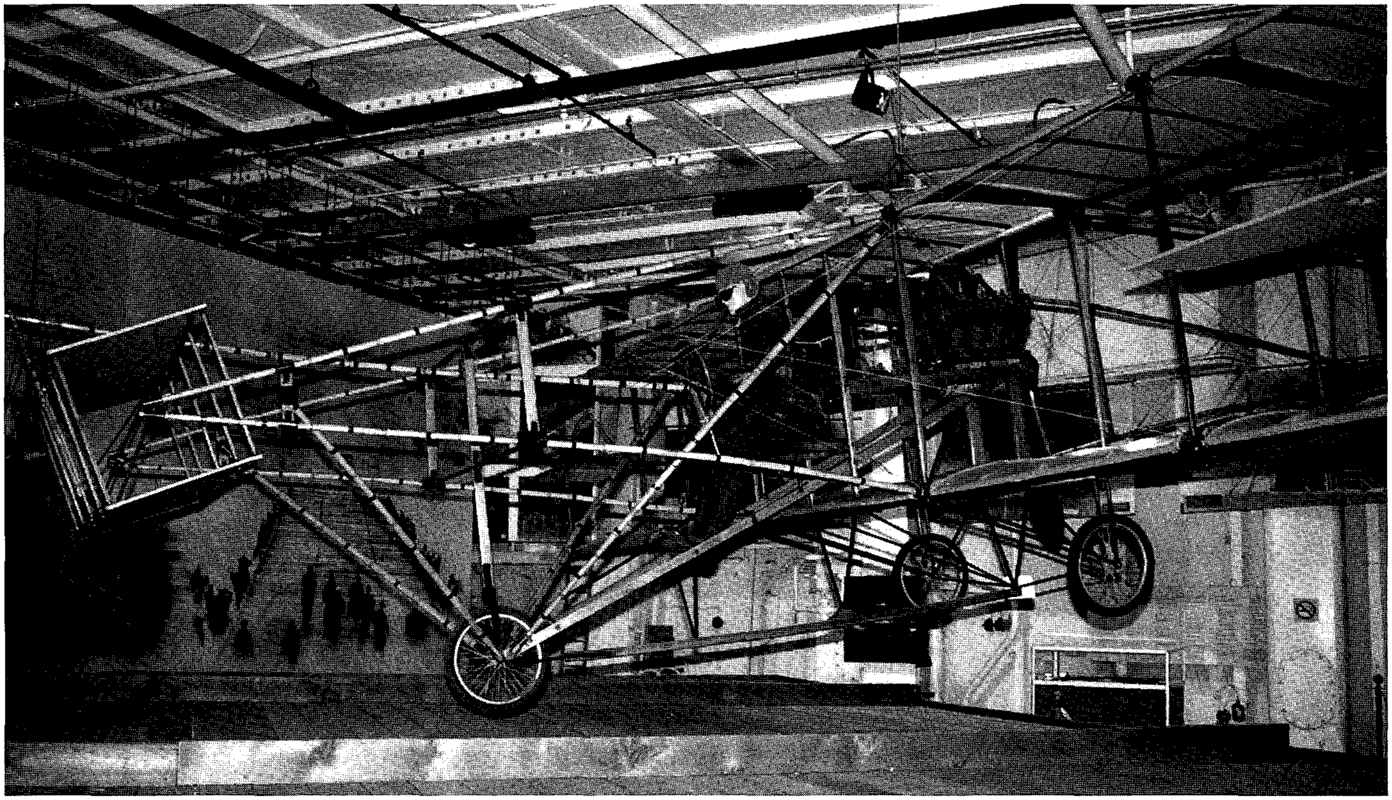
We saw earlier how impressed the Europeans became with the superior handling (e.g., tight figure eights) of Wilbur Wright's flyer in 1908 with wing warping. In light of this, Louis Bleriot immediately dropped his experimental work on ailerons (which he picked up from Santos-Dumont's experiments) and copied the Wright's wing warping (later used with success in the famous Bleriot XI monoplane that first crossed the English Channel). Although the Wrights best implemented the wing warping concept for roll control, earlier records show that Professor John J. Montgomery's glider designs dating back to 1883 were the first to have controllable wing warping (operated by cables to the pilot), a control concept he observed in birds.[30] Wilbur Wright independently developed wing warping with a helical twist in 1899, also after study of birds.[31] Drawings of Montgomery's second glider design of 1884, however, clearly show hinged control surfaces on the trailing wingtips retained in place by springs, an early forerunner of today's aileron.[32] In 1896–1897, Octave Chanute sponsored a glider design by Louis-Pierre Mouillard that featured controllable wingtip surfaces that served as differential drag brakes to aid turning and this design was later patented.[33]

The world, however, had not yet seen a true aileron which enabled the Wright-type roll maneuver. The next closest attempt was by Robert Esnault-Pelterie in a 1904 biplane glider design with experimental control surfaces on the leading edges of the lower plane which could be used in unison for pitch control and in opposition for turning.[34] He later abandoned such roll controls, favoring instead a dihedral with inherent stability.[35] By 1908, Bleriot, Santos-Dumont, and Farman had all experimented with trailing-tip ailerons, but it was Farman (as previously mentioned) who got this control to best emulate the Wrights' wing warping in Europe. Thus, Norvin Rinek was tempted to adopt the Farman type, or similar form of aileron.

Back in America, Alexander Graham Bell's Aerial Experiment Association (AEA) was aware of the European work with ailerons and in 1908 had such installed on the wingtips of the *White Wing* and the AEA's best-known aircraft, the *June Bug,* flown first by Glenn Curtiss.[36] Accordingly, the Wrights started to aggressively defend their 1906 U.S. patent on movable wing surfaces. By mid-1909, the *Golden Flier* and many successive Curtiss models had the ailerons moved to between the main planes (hinged to forward struts) to avoid infringement (the ploy failed—Curtiss was later held in January 1914 to have infringed on the Wright patent). Curtiss got better performance with interplane ailerons hinged from the rear struts, but the arrangement still induced more drag than wingtip ailerons. From October 1909 through 1910, pilots and importers of Bleriot, Farman, and other aircraft equipped with wing warping and ailerons were slapped with court injunctions by U.S. authorities at the behest of the Wrights. The standard Voisin design was practically the only one which did not infringe on the Wright patent. Therefore, it is most likely that Norvin Rinek restored his wings to the original Voisin design to avoid Wright patent infringement. Later, we will see a Rinek ad that promotes this freedom from infringement worries.

Voisin, of course, did not show such respect for the Wright designs. After the shock of Wilbur Wright's superior 1908 flight demonstrations in France converted some Aero-Club de France members (such as Ernest Archdeacon and Louis Bleriot) to admiration and support of the Wrights, a backlash began to appear. Sadly, both Voisin and Farman engaged in an unseemly xenophobic denigration of the Wrights' work. Farman reportedly said in a newspaper interview in August 1908, in reference to Wilbur Wright: "Our machines are as good as his."[37]

In actuality, although Farman was approaching Wright-type performance, all the early French designs were noticeably inferior in terms of aerodynamic design (lift and drag



aspects), propeller efficiency, turning radius, and such. The French, however, had superior engines at that time which enabled them to largely overcome these aerodynamic shortcomings.

Gabriel and Charles Voisin, furthermore, wrote to the French newspaper *Le Matin:*

"Where was aviation born? IN FRANCE," and in reference to the Wrights, ". . . they have also profited from French genius in large measure."[38]

Dr. Crouch made an interesting observation on Gabriel Voisin in regard to this issue:

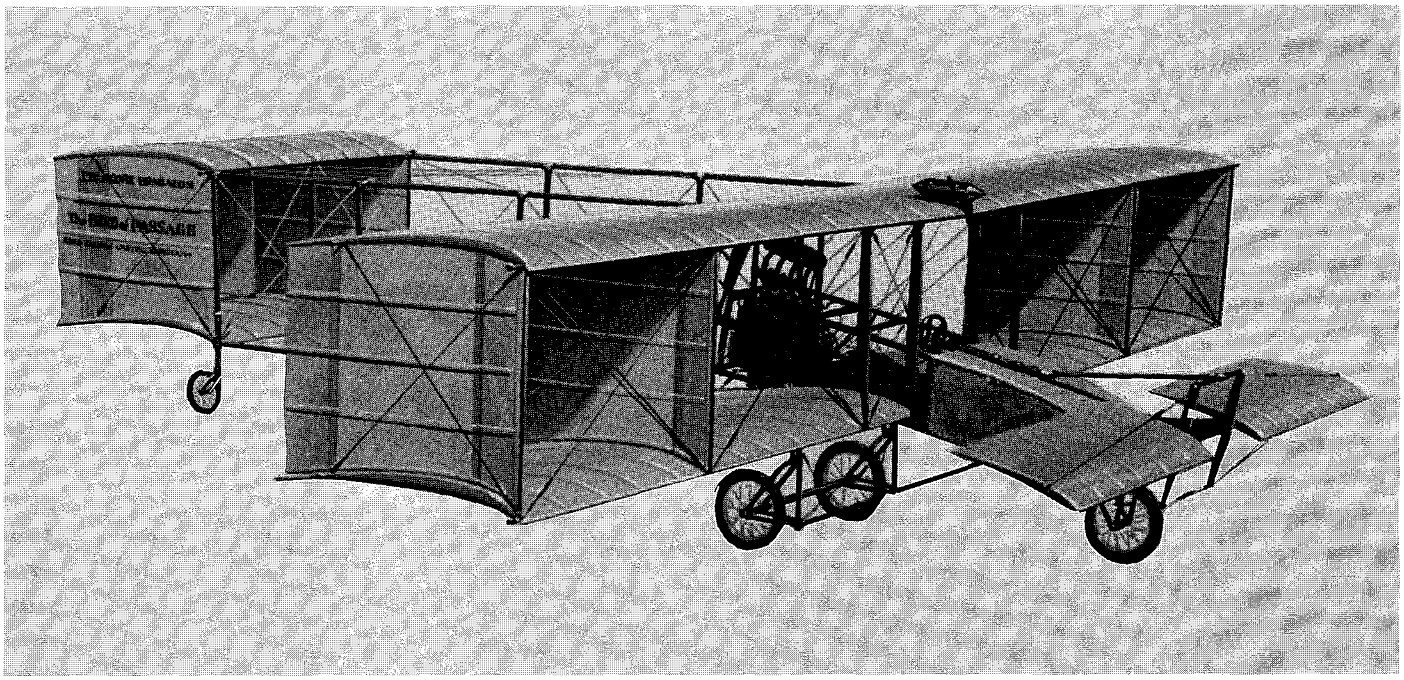
"A proud man, he could not admit that his work, the very appearance of this machine, had been shaped by what he knew of the Wright technology. To the end of life—he died at the age of 93 in 1973—he would refuse to accept that Wilbur and Orville had laid the foundation of French aeronautics."[39]

I wish now to explore the heritage of the canard on Norvin Rinek's Voisin design. Although not unique to the Wright brothers, they were the most successful early users of the canard, or forward elevator. Why was this control strategy selected instead of the more familiar and stable rear elevator? The main reason was that the canard offered exceptional maneuverability in terms of pitch control and early experimenters also believed the design to be stallproof.[40] The stallproof belief was later shown to be incorrect. As one test pilot wrote (after flying a modern Gyroflug canard-equipped light aircraft) in *Aviation Week*:

"Aircraft with canards are often touted as being safer by virtue of the forward wing stalling first and preventing the main wing from reaching critical angle of attack."[41]

What actually happens, according to this pilot, is that stall still occurs, but it's more of a "benign stall" (free of harsh buffeting) that is manifested by rhythmic pitch oscillation. The canard design did work well with a rail (Wright-type) launch. The principal disadvantage is the inherent lack of stability of a forward elevator that immediately invites pitch oscillation. The self-damping rear-mounted horizontal stabilizer and elevator, as seen on the feathered arrow and most aircraft today, does not suffer this problem. The Wrights encountered many painful crashes of their gliders and powered biplanes dealing with pitch oscillation, as considerable pilot skill was required to avoid overcorrection. In the August 1905 Huffman Prairie R&D flights outside of Dayton, Ohio, the Wrights finally improved the canard to the point that crash-free flights long enough to empty the gas tank were attained.[42] The fix involved more surface area for the elevator (83 square feet versus 53 square feet) plus a longer moment arm (about 12 feet instead of seven feet). In engineering terms, more force was available to the pilot at the center of pressure, and the period of oscillation was increased to the point that the pilot could better react or counter the undesired change in pitch. All of this discourse on the Wright canard experience is important because many of the famous French pioneering flying machines (Voisin, Santos-Dumont, Esnault-Pelterie, Ferber, etc.) were directly descended from Wright gliders equipped with the canard. Today, most ultralight aircraft and some general aviation aircraft use the canard control with success (in general, it works best with lighter and slower aircraft).

It is interesting to note that all of the Voisin, Wright, and Curtiss biplanes eventually had the elevator moved from the front (canard) to the rear, consequently enjoying better pitch stability as well as better visibility for the pilot. At the NASM Early Flight Gallery, a 1912 Curtiss D (Headless) pusher with rear elevator shared space with the 1909 Rinek Voisin for



many years. The Curtiss factory's famous exhibition pilot, Mr. Lincoln Beachey (the foremost U.S. stunt pilot in the 1910–1915 era) found that the Curtiss pusher handled beautifully after deleting the canard and using just the rear elevator. The 1910 Model B was the Wrights' first aircraft with a rear elevator. Voisin followed on some models by early 1911.

Some final remarks in this aircraft heritage subsection concern controls. Wilbur Wright, in a landmark 1901 Chicago speech to a group of engineers, neatly summed up the three elements needed for successful flying machine construction: 1) wings with sufficient lift; 2) a powerplant to move the wings forward, providing sufficient speed to generate lift; and 3) a means of controlling the machine in the air.[43] The Rinek Voisin had items 1 and 2 but was fairly deficient on item 3 (where the Wrights eventually excelled). Real-time control in three axes (pitch, roll, yaw) is a nontrivial engineering problem. By March of 1903, the Wrights had solved most of the control problems and applied for a U.S. patent. The genius of their approach was integrating roll control (wing warping) with yaw control (rudder), enabling the pilot to lean or roll the aircraft into a tighter turn more safely. Thus, the rudder control automatically helped counteract the drag induced by wing warping. Wilbur Wright intuitively understood, as a bicyclist, the similarity of aeroplane piloting with bike riding: the continuous need to maintain lateral balance (e.g., by weight shifting or wing warping) while steering a vehicle unstable in roll and yaw.[44] Unfortunately, the early Wright flyer control levers proved to be awkward, hard to teach, and therefore led to many unnecessary crashes for students. By contrast, the Curtiss layout with shoulder harness aileron controls and steering wheel rudder with push-pull elevator control was comparatively easy and instinctive to use. The Voisin and Rinek Voisin also used a steering wheel for both rudder and push-pull elevator control that responded to instinctive movements. Later, Voisin added foot pedal aileron controls but it's not clear where Norvin Rinek placed his short-lived aileron controls.

Finally, I noted with interest that by 1910–1911, even Gabriel Voisin had soured on the design of his classic biplane. An April 1911 article in *Scientific American* stated:

"The original Voisin machine, which was changed in every conceivable manner by different experiments, and which achieved its greatest success in the hands of Henri Farman, M. Gabriel Voisin believes reached its highest point of development last year. In his opinion, however, it is a dangerous machine in landing and is difficult to maneuver on the ground, being cumbersome and not at all strong if it is badly constructed. Finally, he does not believe it capable of further improvement."[45]

The Voisins, however, went on to reasonable success in the military market producing both scout/observation aircraft and pusher biplane bombers in substantial quantity (about 4,000) through World War I. Some of these bombers were bought for use in 1917–1918 by the U.S. Army forces in France. In 1914, a Voisin 3 bomber was credited as the first aircraft to shoot down an enemy aeroplane with a machine gun.[46] In the late 1980s, the Smithsonian's Paul Garber facility in Maryland began restoration of its Voisin 8 World War I bomber.[47] This is the only Voisin currently in the NASM inventory.

We've just seen a considerable measure of rich aeronautical history surrounding the 1909 Rinek Voisin design. It is now appropriate to explore the details of construction, including how Norvin Rinek modified the Voisin design and flew it.

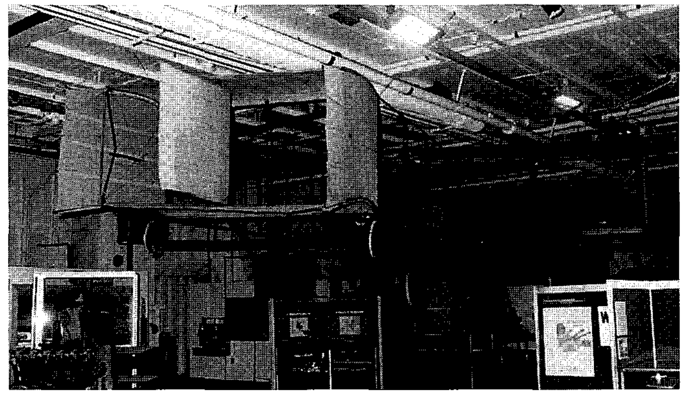
Rinek Airframe Features—As a reference for the following discussion of Rinek modifications, I present a factory standard 1909 Voisin, the Moore-Brabazon "Bird of Passage," as rendered by a *Time-Life* artist. Although the photo reproduction in this article is not colored, brown wood framing is evident in the color original all through the machine, with cast metal (aluminum) fittings at various junctions, such as in the tail boom members.

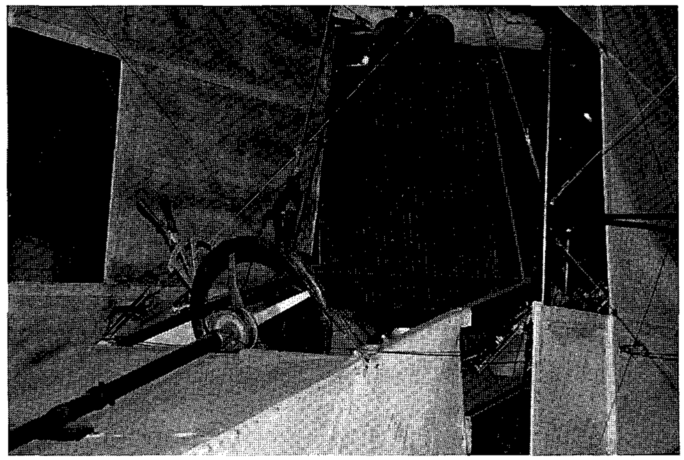
The principal Norvin Rinek improvement and modifica-

1909 Voisin "Bird of Passage." **(Time-Life Books)**

Tail/rudder detail. **(Author's Collection)**

Cockpit closeup. **(Author's Collection)**





tion to the standard Voisin design was replacement of fragile wood structures in the wing, empennage, and nacelle supports with stronger seamless tubular steel welded structures. Stiff and hollow beams, such as steel tubing, emulate the structure of bird's bones and can yield a light and strong flying machine. The 1909 Rinek Voisin was not the first example of a steel aircraft, as Langley's ill-fated 1903 *Aerodrome* had a welded-steel tubing fuselage,[48] and Robert Esnault-Pelterie's innovative (streamlined, enclosed) 1907 monoplane had a welded-steel tubing fuselage.[49] These earlier aerial experimenters, however, relied on mild carbon steel tubing. The genius of Norvin Rinek was to introduce to aviation the exotic and just commercially available chrome-moly alloy steel tubing (today's 4100 series) in his oxyacetylene gas welded assemblies.[50] Compared with typical aviation woods (such as birch or southern pine), a specimen of chrome-moly alloy steel is about 20 times stronger in tension and 15 times stiffer in terms of the modulus of elasticity.[51] Thus, alloy steel tubing can present the aircraft designer various key advantages over wood:

- Superior specific strength (strength/weight)
- Superior specific stiffness (stiffness/weight)
- Superior three-dimensional properties
- Freedom from rot and warpage
- "Forgiving" ductile failure in a crash, without dangerous splintering
- Ease of bolting assembly/disassembly for ground transit

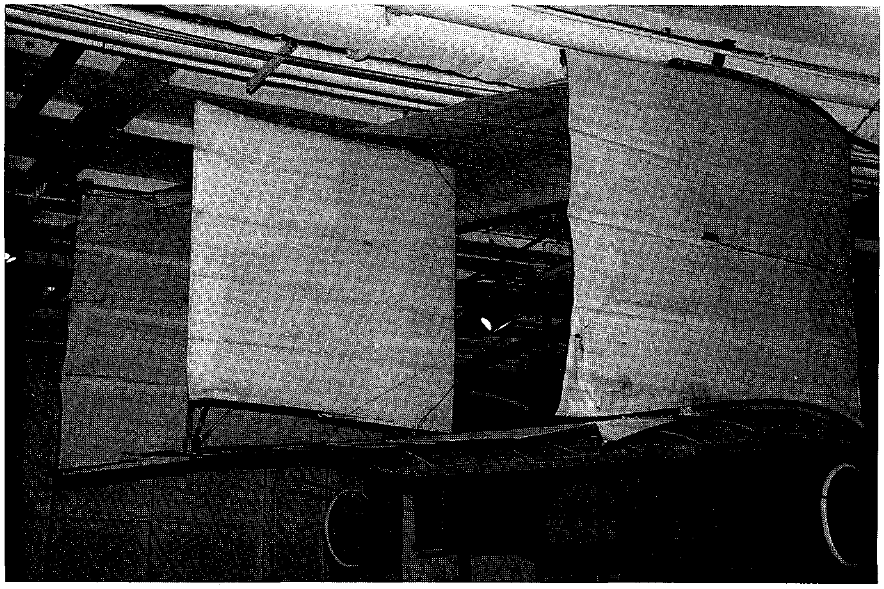
This alloy steel was costly, however, and difficult to work with (compared to wood). The alloy closest to that used by Norvin is today's AISI-SAE grade 4130 which is a medium-carbon, low-alloy steel containing about 1 percent chrome, 0.2 percent molybdenum, 0.5 percent manganese, and 0.3 percent silicon.[52] Seamless 4130 tubing purchased to current aerospace materials specifications (AMS) produces a minimum 125–150,000 psi tensile strength.[53] The final strength depends on heat treatment (tempering temperature following quenching).

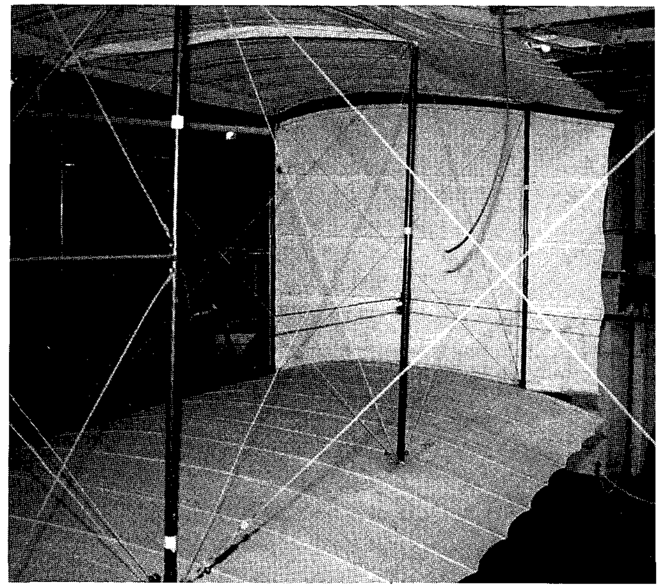
At the beginning of this century in the United States, seamless steel tubing was just arriving on the market in quantity. The seamless tubing market was accelerated by the boom in bicycle manufacturing, so in 1895 the first high-volume rotary piercing mill (Stiefel disc piercer, followed by Pilger rolling mill, followed by chrome-moly alloy drawing benches) was installed in Ellwood City, Pennsylvania.[54] The superiority of the 4130 steel tubing was such that it made sizable penetration into higher performance airplane construction until lighter aluminum monocoque designs prevailed in the 1930s. Many aircraft builders, however, continued to prefer the less expensive and easier to weld mild steel tubing. Perhaps the Voisin factory was influenced by Norvin Rinek's innovative use of tubular alloy steel structures. By 1911, Voisin was using nickel alloy steel tubing struts and such in a military model.[55] Even today, in light general aviation aircraft (such as the *Kitfox*) 4130 tubing is still used.

Tensioned steel brace wires were used extensively in the standard Voisin. We see these carried over to the Rinek Voisin, but with an upgrade: Norvin's use of novel light weight (two-ounce) turnbuckles for brace wire tensioning. The result is a modified Pratt truss biplane structure (Chanute's great contribution to aviation), in which the planes, struts, and brace wires behave as one strong beam.

Norvin Rinek retained the Voisin-type wood structures with cast aluminum fittings in the nacelle and fuselage areas. The use of flexible wood to accommodate and damp the vibrations of aircraft engines of that era (which did not generally use crankshaft counterbalancing) was a good idea, from an engineering point of view. These wood engine supports were also seen in most other brands of the pre-World War I years. From a safety point of view, however, the mounting of heavy engines on fragile wood supports (especially in pushers behind a pilot) could be a deadly layout. Quite a few pilots were crushed to death from behind in those days (after nosing into the ground) by heavy unsecured engines (and radiators). The fatalities got so bad in 1912 that both the U.S. Army and U.S. Navy grounded Wright and Curtiss pushers for a while.

I am inclined to believe that Norvin Rinek was able to assemble his airframe largely on his own, with some assistance from the Easton Cordage's machine department. One historical account reported that Voisin factory representatives possibly brought to Easton, Pennsylvania, some assembly advice and French components,[56] but this could not be confirmed by my other sources.





Photos taken at the Intrepid Sea•Air•Space Museum in New York show the restored aircraft. The aircraft is exhibited to appear as it actually flew in 1909, but I can say after close inspection in October 1991 that it's not presently airworthy. Some of this is probably related to the three moves and reassemblies of the aircraft (since original restoration) by different crews. Various wire bracings need attention as well as missing connections to the controls and the missing fuel/water connections to the engine. Upon first live glance from a distance, I was struck by its large and unusual appearance. I noticed that the side curtains were deleted from the main planes. Other historical photos (e.g., *Jane's 1910–1911*) show at least two interplane side curtains per side on the Rinek Voisin. The camber on the main and tail planes is clearly visible, as is the imposing box-kite tail structure. The center vane is the movable rudder. I noticed the cutouts in the cockpit side curtains for pilot visibility. Closing in on the cockpit I saw a flat board seat visible below the radiator, as well as the automotive-type steering wheel. In accordance with design practices of that era, no restraint system (such as seat belts) is evident. More than a few pioneering pilots actually fell to untimely deaths out of their cockpits (during maneuvers or in response to turbulence) that would have been preventable by simple restraints. A closeup of the steering wheel, which sharp reader eyes will note is not the December 1909 straight-spoke model.

A photo shows a sample of the felt covering on a steel spar over the cockpit. Maroon in color, this unusual felt was found on the original aircraft to be wrapped around all the exposed wing and tail structure tubing. I believe this to be perhaps Norvin's artistic touch, which also prevented serious corrosion of the framing (even after more than 60 years in storage). Another photo clearly shows the internal structure of the right wings, accompanied by liberal use of brace wires.

As formerly involved in landing gear manufacturing, I took special interest in the gear mounted under the Rinek Voisin. The original Voisin undercarriage swiveled or castored.[57] Norvin Rinek welded the structure, however, so that the two main wheels always line up with the longitudinal aeroplane axis, an arrangement preferred by many pilots. Castoring was retained in the tail wheels. Ground handling and taxiing must have been awkward at best. You recall that even Gabriel Voisin believed the aircraft to be dangerous upon landings. The main structure is connected to the airframe by two inboard telescoping struts supported by long coil springs. Tensioned brace wires run in various directions. Forward bracing with two struts runs up to the fuselage and the wheels (which are a typical motorcycle type of that era) are placed behind the landing gear centerline with a good measure of trail for stability. The rigidly welded supporting arms for the wheels are arranged as seen on the original Voisin design. The white tires (and those on the tail wheels) are not the originals. Evidently, after such extended age the originals became hard as stone and were replaced. The inscription on the white sidewalls say "Universal Tire Co., Elizabethtown, Pennsylvania."

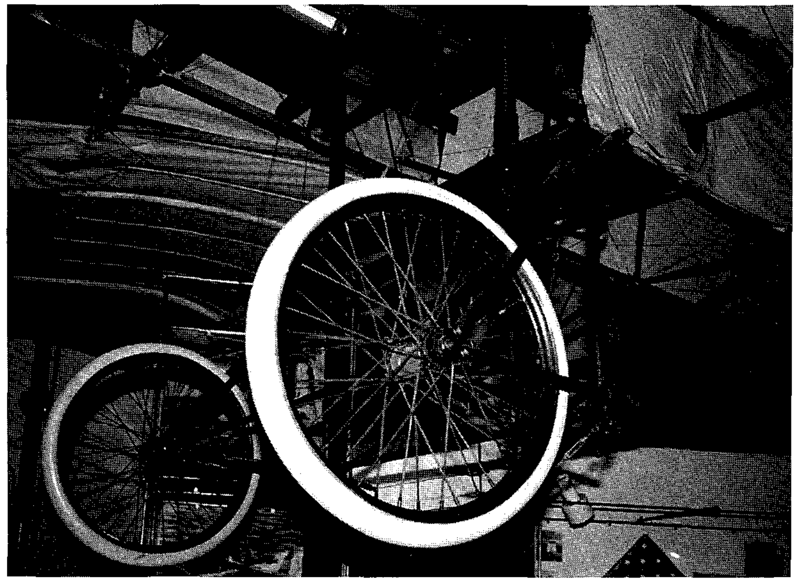
According to a couple of early publications, Norvin Rinek created two generations of aircraft, the second based on parts from the first.[58,59] The specifications for the late 1909 second version are seen in Table 1. The aircraft recovered and restored is probably this version, except for the V-8 engine, which appears to be an early 1909 version.

The specifications in Table 1 indicate a relatively large and heavy aircraft by early U.S. standards. In comparison with the 1909 Wright Military Flyer, for example, the Rinek Voisin was about twice as heavy. Owing to the steel structures, the Rinek Voisin is also about 300 to 400 pounds heavier than the original wood Voisin. If optimized with modern design engineering tools (e.g., finite element analysis), Norvin Rinek's alloy steel space frame would likely be considerably lighter. Thus, with only 50 hp or so, the Rinek Voisin would be a bit underpowered and not capable of great altitude. The aspect ratio of the wings is 5:1, which is close to the 1902 Wright target of 6:1. The big box-kite tail has a span equaling one-third of the main planes. In the course of my research, I saw one photo of an original 1907 Voisin with a tail section so large (two-thirds × main plane span) that it would qualify as a tandem wing layout.[60] The wing camber (1:14) is close to that of the Chanute-Herring biplane glider (1:12) and parabolic in shape but is more deeply curved than Wright aircraft

Tail/rudder closeup detail. **(Author's Collection)**

Right wing, internal bracing. **(Author's Collection)**

Landing gear, closeup detail. **(Author's Collection)**



of that era (1:20-25). Accounts vary as to the wing fabric in use, as noted in Table 1.

Aerial Results and Subsequent Developments—As indicated previously, the aircraft was first assembled in March 1909, but many refinements, taxi tests, and propeller adjustments lay ahead for the next six months. Local press reports indicate multiple attempts to find a suitable-length field for the first flight. The golf grounds of the Northhampton County Country Club was one site approved, then rejected. Eventually, Norvin settled on Sandt's farm in Forks Township outside of Easton. It is interesting that this site was later selected as that for Easton's municipal airport. Still, the field at Sandt's farm was marginal in length (given the weight and power of the Rinek Voisin).[61] Eventually, the field was lengthened (perhaps by removal of a fence), all preflight adjustments made and the first flight (about 100 yards) completed successfully on 6:30 P.M., September 3, 1909, before news reporters and other witnesses. The headlines reported by the two local newspapers on the following day were as follows:

''Norvin Rinek Flies
Covered Length of Testing Field in First Attempt with Aeroplane''[62]
''Rinek Airship Roars
First Trial of Easton-Made Aeroplane a Success''[63]

I am not totally surprised that Norvin got in the air on the first attempt, considering after all that the basic Voisin design was well-proven and had already logged two and a half years of successful flights in Europe. Still, this is a remarkable achievement for a novice pilot, particularly given the marginal power of his 1909 V-8 engines (in the engine discussion to follow, we'll review his noticeably better 1910 engine). Around 1973, the editor of the *Easton Express* (who was too young to have witnessed the Rinek first flight) set out to find a local old-timer that did eyewitness the September 1909 flight. He found such a man who was six years old in 1909. The boy witness was among a group of people that actually helped push the aircraft during the takeoff roll (an indication that more thrust was needed).[64] This witness is now, unfortunately, deceased (I would like to have interviewed him myself).

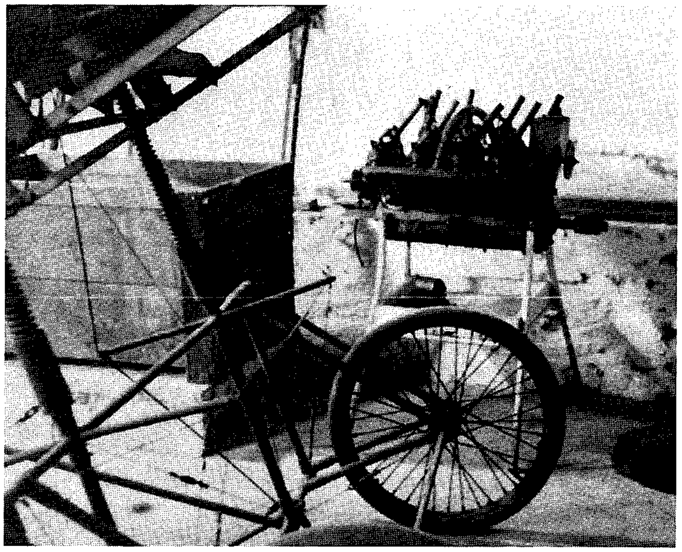
This flight was not the first by a Voisin-type aircraft in America. Farman brought his modified Voisin to the United States in July 1908 for a demonstration. His first attempt, on July 31, 1908, yielded an 11-second flight of only 420 feet at an altitude of three feet on Long Island, New York.[65] Subsequent flights in August were not much better and Farman was acutely embarrassed. He had hoped to publicly challenge the Wright brothers and had already done much better in Europe with flights of several km. Only two months later, Farman achieved a world-class flight in France (in the same Voisin) of 27 km at a 30 m altitude.

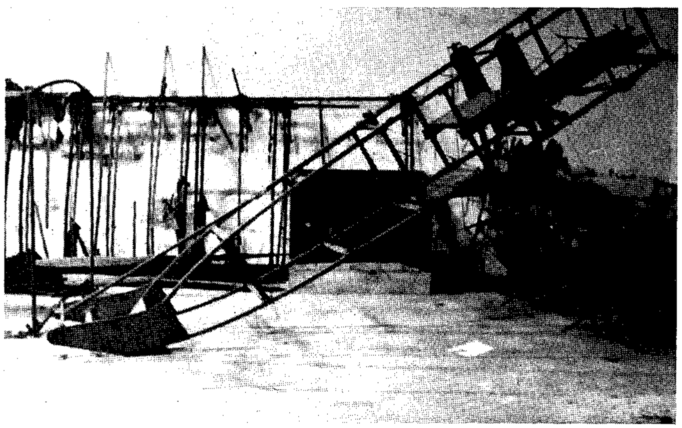
Another attempt at flight in the Rinek Voisin No. 2 on December 22, 1909, at Hempstead on Long Island, New York, was not successful. With Mr. J. Ernest Smith (the chief engineer of Easton Cordage) at the controls, the aeroplane crashed after rising for a moment, but Smith was uninjured.[66] After this event, no further press reports surfaced on flights of the Rinek Voisin. I heard family rumors, however, that up to six flights were completed.[67] Whatever the case, Norvin Rinek turned his attention in 1910 and 1911 to his blossoming engine and propeller business. He recorded some engine/prop sales (as we shall see later in advertising testimonials), but, despite being the exclusive U.S. sales agent for Voisin, he sold no aircraft. By late 1909, the basic Voisin was frankly obsolete in performance compared with available Curtiss, Farman, and Wright aircraft. The pre-World War I U.S. aeroplane market was fairly limited anyway. The U.S. military had not yet ordered any substantial volume, and the remaining small business was largely for exhibition purposes and wealthy hobbyist recreation. Thus, potential aviators were not lining up to buy what was advertised by Norvin as the ''aristocrat of flying machines.''

TABLE 1 — SPECIFICATIONS OF RINEK (VOISIN) II

Length	38 feet (11.5 meters)
Wings	Span 32.75 feet; Chord 6.5 feet; Gap 5 feet
Steering	Mono-elevator (Voisin), rudder in tail
Elevator[2]	Span 16.25 feet (5 m); Chord 3.25 feet (1 m)
Completion	December 1909
Weight	1,540 pounds complete (689 kilograms)
Propeller[1]	Diameter 7.5 feet (2.3 m); Pitch 4 feet (1.2 m)
Body	Steel tube chassis on motorcycle wheels
Tail	Span 9.75 feet (3 m); Chord 6.5 feet (2 m)
Wing Fabric	Rubberized silk[3] 1.75 ounces per square yard
Wing Camber	1:14

1. Materials listed by *Jane's* as steel plus aluminum sheeting (Voisin style), listed as "laminated" by *Aeronautics* (referring to wood).
2. The forward Voisin-type control surfaces were referred to as "equalizing planes," also known as a "canard" or "horizontal rudder."
3. The other sources report Rinek use of cotton duck with shellac and oil (possibly linseed) doping (H. Woodman, 1973).
Source: *Jane's All the World's Airships and Aircraft (1910–1911).*





Dismembered aircraft components (engine, etc.) as discovered in Easton, Pa. (1972). (Olive Senn)

Cole Palen's restoration begins in Delray Beach, Fla. (1973). (Olive Senn)

This commercial lack of success, coupled with the needs of the family rope business, eventually led Norvin to discontinue his aeronautical pursuits. The last straw was some unkind local press report that questioned Norvin's aeronautical work and his sanity.[68] Actually, quite a few aviation pioneers were considered at that time by society as unbalanced or irrational for wanting to fly like birds, so Norvin Rinek's situation was not unusual.

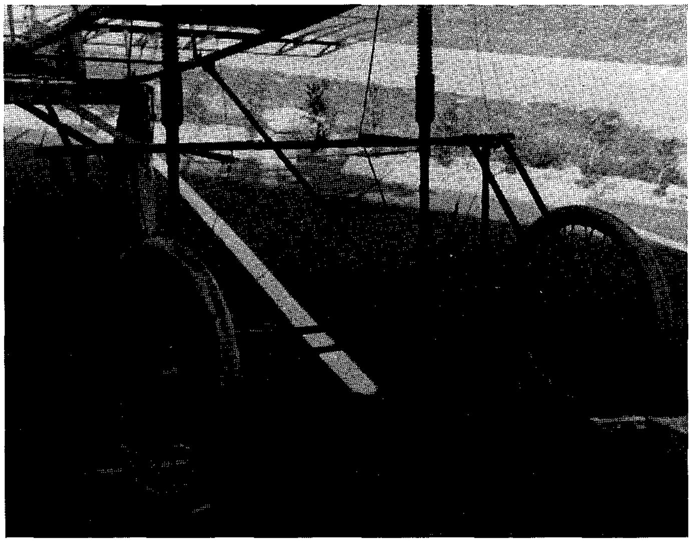
The one and only Rinek Voisin was dismembered in 1910 and along with three propellers was suspended from the rafters of a workshop at the Rinek Cordage Co., undisturbed for 62 years. The plant assets, including the abandoned aeroplane, were sold off in 1970 to local interests (Mr. Robert Ackerman, *et al.*). By 1972, word of this aircraft's existence had gotten to Mr. Cole Palen of Rhinebeck, New York, a renowned collector, and restorer of early aeroplanes (especially World War I vintage) displayed and flown at his Old Rhinebeck Aerodrome. He ventured to Easton and discovered the original aircraft unrestored, in pieces after removal from the rafters.

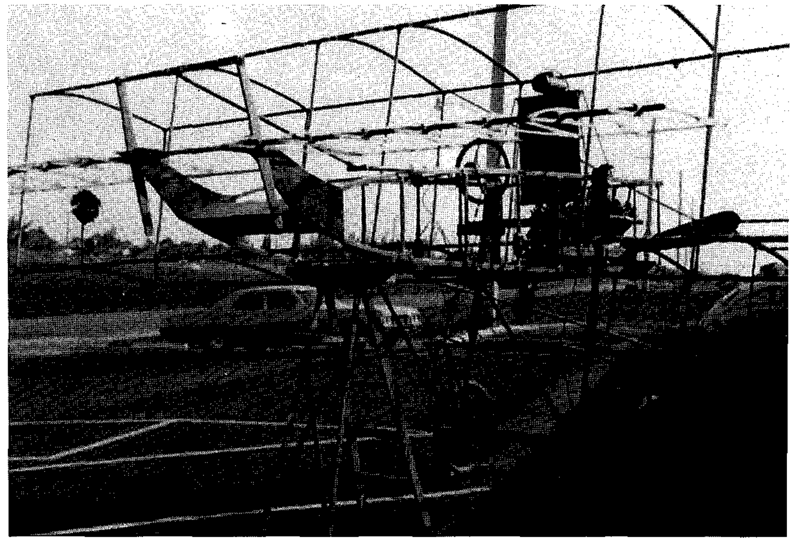
Cole Palen completed acquisition of the Rinek Voisin from Mr. Ackerman at the end of 1972, and began the careful restoration at his Delray Beach, Florida facility in early 1973. Mr. Palen's early 1973 letter appeal to Norvin for background information on the aircraft went unanswered.[69] Photos show the aircraft in various stages of assembly and restoration. The photos in original color show the maroon felt over most of the steel tubing. The original wood components and steel tubing were fairly well preserved after 62 years of dry storage, and this helped the restoration efforts. The engine was rebuilt with the help of a local machinist near Cole Palen's Rhinebeck facility. Although he originally planned to fly the restored Rinek Voisin, Mr. Palen later reconsidered, which was probably wise given the aircraft's dangerous handling reputation. I believe the completed restoration was displayed in his Rhinebeck museum for a period before it was offered on loan to the Smithsonian NASM.

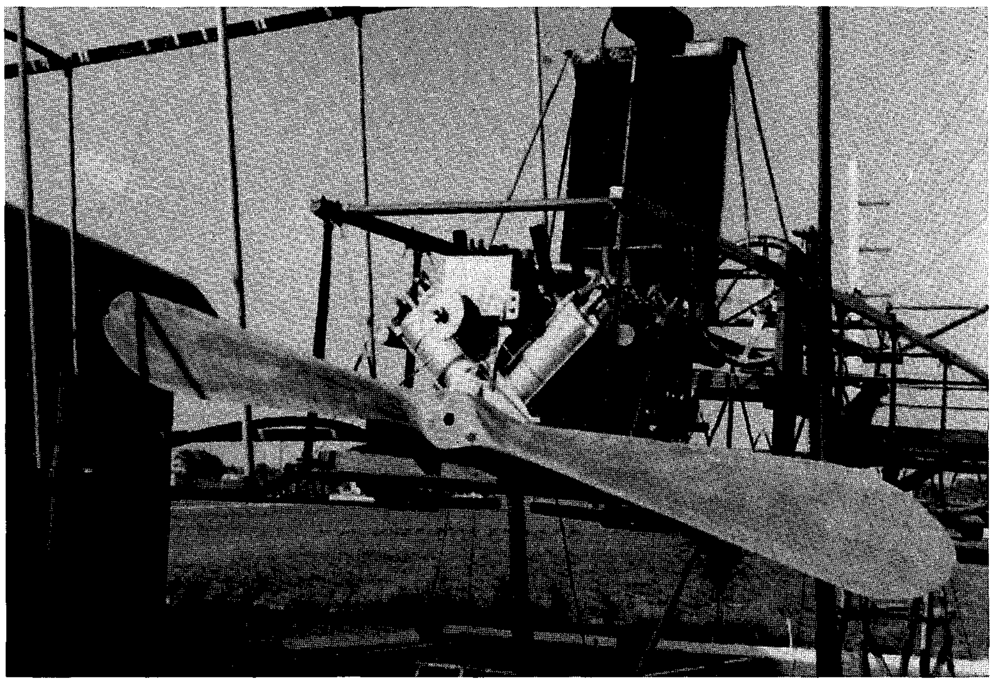
In the Rinek family archives is a 1978 letter from Dr. Tom D. Crouch (then NASM Curator of Astronautics) to Norvin Rinek asking for background on the aircraft prior to its display in the new Early Flight Gallery in 1979.[70] Regrettably, this letter too went unanswered. Norvin just did not want to talk or write about his pioneering aviation work. The Smithsonian staff, nevertheless, was able to find some basic historical data as seen in the floor exhibit associated with the 1979–1987 Rinek Voisin display. Notice the parallel presentation in the floor exhibit on the Voisin brothers. The Rinek Voisin aeroplane photo insert on the Smithsonian floor exhibit, some readers will note, is a more complete version of that presented previously. The January 1910 *Aeronautics* originally published this photo, describing it as Norvin's No. 2 aircraft on test at Long Island. Notice again the deletion of side curtains between the main planes in the floor exhibit. The Smithsonian aerial exhibit, however, had the side curtains restored, four in total. The two side curtain configuration was reportedly that of the 1908 Delagrange Voisin.[71]

Some members of the Rinek family did eventually discover the Smithsonian exhibit (quite by accident) and Norvin did not want to publicize it (even to his wife). My inspection had to await a trip to the Intrepid Museum in New York, where the Rinek Voisin has been on display since 1987. I was fortunately able (with the aid of an Intrepid curator) to spend hours with the aircraft on a day in late October 1991 when the museum was officially closed.

The Engine Family—Norvin Rinek's key aeronautical interest (and contribution to the art) was in the field of engines. The Rinek Voisin aeroplane served more or less as a testbed to prove and refine his engines and propellers. The evidence indicates that Norvin Rinek, with no training in mechanical engineering, designed, machined, assembled and tested a family of 15 innovative water-cooled V-8 and I-4 four-cycle gasoline engines. The design focus concerned light weight with advanced materials of construction (regardless of cost); high thrust force per rated horsepower (e.g., generous torque at low rpm); and superior reliability. Entirely too many aeroplane engines of that era had a tendency to fail in the air. Thus, Norvin Rinek paid attention to these issues and consequently earned a measure of respect for his engines. The editorial staff of the New York-based *Aeronautics,* in a 1911



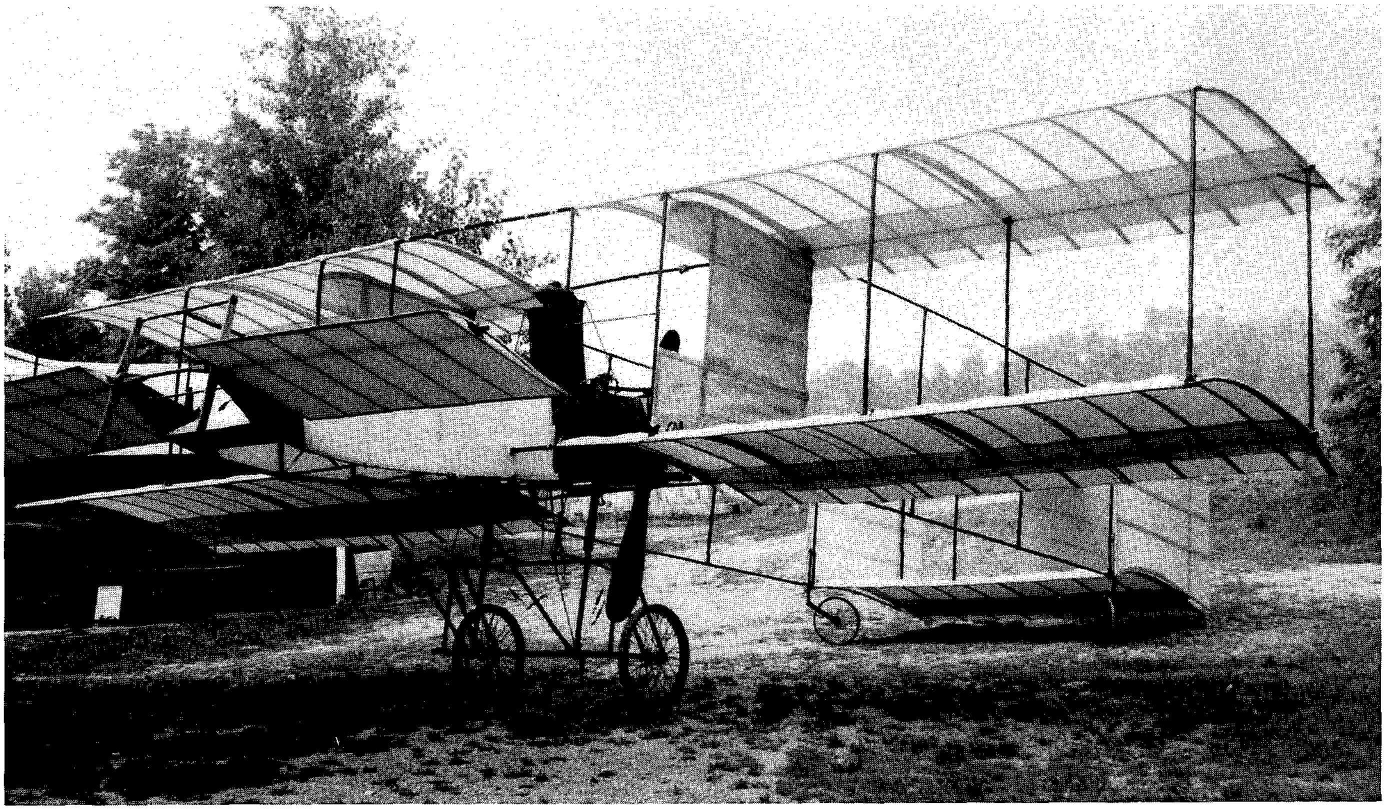




article on eight-cylinder engines, wrote this glowing account on the Rinek V-8:

"Even to the uninitiated in the art of mechanical design, the new eight-cylinder Rinek engines appear a beautiful piece of mechanism, the weight especially having been reduced to a point where they feel it would not be safe to go any lower. The Rinek Company are fortunate in occupying a unique position as engine builders at the present time, inasmuch as the experience they have gained through their exhaustive experimenting and refining has enabled them to produce a type of engine which America should well be proud of. Outside of the Curtiss Manufacturing Company, located at Hammondsport, the Rinek Company, we believe, was the first to go into the building of lightweight engines for aviation purposes, so one can see they have been in the field for an appreciable amount of time."[72]

Production Engines and Propellers—A rear view of the restored Rinek V-8 engine (one of two known to survive; the other is a 1910 Model B-8 on exhibit at the Yorkshire Air Museum in England) is shown with original propeller. This engine appears to be an earlier 1909 model that lacked some of the more advanced features to be discussed shortly. This propeller (with a diameter of 7.5 feet and a pitch of four feet) was probably a 1910 model, and showed good attention to proper design and efficiency. Norvin experimented with a series of metal and wood propellers changing shapes, blade area, and pitch to optimize production of thrust with the lowest losses. Originally, he worked with the strange and forgettable Voisin-type design which involved aluminum sheet blades riveted to tubular steel supports tied to a steel hub. The French designs of this era typically yielded only about five-pound thrust/hp. Some crude French props had four flat "fan" blades pitched at an angle. Eventually, Norvin upgraded to laminated and hand-shaped hardwood propellers with a cambered airfoil cross-section and helical twist. The airfoil shape was useful in enhancing performance, as the Wright brothers observed that an aeroplane propeller was merely a rotary wing spiraling through the air (and thus



should be designed to lift). The helical twist is needed to accommodate the fact that the relative wind strikes a rotating prop at a changing angle as you move outward from the hub (and the circumferential velocity advances). The 1910 Rinek prop also exhibits a double tapered chord dimension, incorporated in current designs. The result was delivery of 6–7 pound maximum thrust per hp at about 1,200 rpm and forward velocity of 30–40 mph. This was quite respectable efficiency for that era, but not quite in the world-class category of the Wright brothers. They used two contrarotating large diameter (8.5–9 feet), slow turning (300–400 rpm) props and therefore incurred low slippage losses, yielding about 11-pound total thrust/hp.

The original 1910 Rinek engine catalog lists laminated propellers as packaged wtih each engine offering such thrust as:

- Over 200 lb (210 lb typical) with the 30 hp I-4
- Over 310 lb (385 lb typical) with the 50–60 hp V-8

Most likely, the Rinek Aero Manufacturing Co. used in 1910 a propeller manufacturing sequence similar to that described for the well-known French Chauviere propellers in 1911[73]:

1. Well-seasoned ash planks are cut, oriented, and centered
2. The planks are glued and clamped
3. After drying, the staircase-shaped assembly is smoothed and hand-shaped by skilled artisans with chisels
4. The blades are measured and then finished by polishing
5. The propeller is statically balanced and retouched as required
6. A special varnish coating is applied.

Readers may be aware that a principal advantage of wood for propellers, besides inherent lightness, is the ease of shaping the complex curves. They were also believed to fail gracefully with some warning to the pilot. They can delaminate or split, however, and one remaining original Rinek propeller now in my possession shows some evidence of such delamination. Unfortunately, it was a wood propeller failure of this nature (splitting) that led to Orville Wright's serious crash at Ft. Myer, Virginia, in October of 1908, killing his passenger, Lt. Tom Selfridge (the world's first powered aeroplane fatality).[74] Some French and British prop designs avoided delamination failure by using solid one-piece wood construction.

TABLE 2 — THE RINEK ENGINE FAMILY

Model	Vintage	Configuration	Weight[1]	Bore	Stroke	Displacement	Rated HP	1910 Price[4]
—	1909	V-8	275	3.75 in. (97 mm)	4 in. (102 mm)	353 cu.in. (5.81)	30–45[2]	—
—	1909	V-8	300	4.5 in.	4.5 in.	572 cu.in. (9.41)	40–60[2]	—
—	1910	V-8	—	—	—	—	80–90[3]	$2,000
B-8	1910	V-8	275–285 lb	4 in. (102 mm)	4 in. (102 mm)	402 cu.in. (6.61)	50–60[2]	$1,500
B-4	1910	I-4	130	4 in. (102 mm)	4 in. (102 mm)	201 cu.in. (3.31)	30	$ 900

1. Including all accessories, such as water pump, but excluding a radiator.
2. At 1,200 rpm.
3. At 1,300 rpm.
4. F.O.B. Easton, Pennsylvania.

Note: Engine brands stated in literature were Easton Cordage (1909) and Rinek (1910-1911).

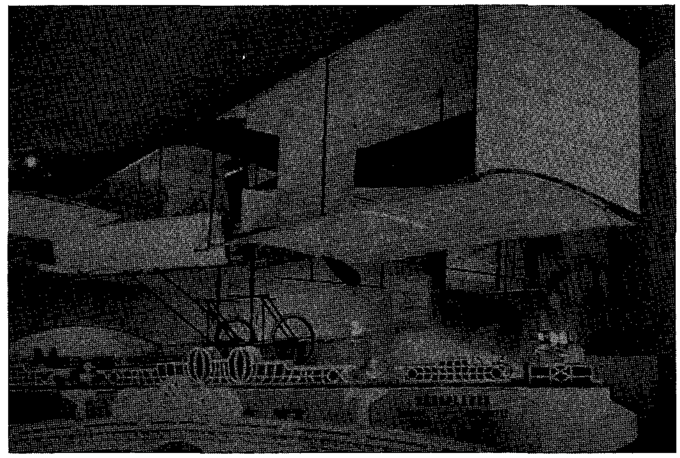
All models quoted in this table had standard cast iron cylinders and pistons.

Sources: *Aeronautics* (July 1911), *Jane's All the World's Aircraft and Airships* (1910-1911), *Scientific American* (July 1911), Rinek Aviation Engines (1910), notes of Mr. Hugo Bytebbier/Mr. William Lewis.

Front quarter view, restored Rinek Voisin. (Olive Senn)

Restored Rinek Voisin on display at NASM. (Smithsonian)

Smithsonian floor exhibit. (Author's Collection)



Back to the Rinek engines, the principal configuration favored by Norvin was the classic 90° V-8, which is reputed to offer a fine smoothness of power delivery attributed to its perfect primary balance and even firing order. Although 1909–1911 directories, catalogs, and ads mention the alternative I-4 configuration, I've yet to uncover photographic evidence of Rinek I-4 production. The 30-hp I-4, as well as a 90-hp V-8, may have been "phantom" engines awaiting an order before production. This practice of listing unproduced models as "bait" for sales was commonplace among aircraft engine producers of that era.[75] See Table 2 for a listing of known specifications on the Rinek engine family. The prices indicated were fairly steep by 1910 standards.

The 1909 restored Rinek V-8 engine was photographed from various angles. Evident are such features as:

- Cast aluminum crankcase/oil pan (light and strong)
- OHV cross-flow cast aluminum cylinder heads (an advanced layout, whereas many others were still using F-type cylinder heads in iron or steel heads)
- Post-tensioned steel tie rod assembly of cylinder heads to crankcase (usually lighter than bolted massive castings)
- Schebler carburetor (updraft, single venturi, sophisticated for this era)
- Spun copper sheet water jackets (a floating and quickly accessible design, yet claimed "leaktight")
- Low-restriction exhaust (short stacks, as was common in 1909–1910)
- Gear-driven Bosch magneto ignition (state-of-the-art reliability for aeroplane engines of that era)
- "Reliance Special" aviation spark plugs (one per cylinder; later the industry used for reliability dual magnetos with two plugs/cylinder)
- Mechanical exhaust valve actuation
- Automatic (vacuum) inlet valve actuation.

Not visible are such internal features as:

- A camshaft with lobes keyed and pinned on a hollow chrome-nickel alloy steel shaft
- Machined gray iron pistons and (wet) cylinders
- Manganese bronze connecting rods (integral bearing material)
- One-piece forged chrome-nickel alloy steel four-throw (pairs at 180°) crankshaft with double ball thrust bearings at the propeller end (no counterbalancing was standard practice up to the 1920s)
- Main bearings fabricated from Parsons white brass (standard bearing material at that time)
- Pump lubrication (plus splash on 1909 models) with a wet sump (an eccentric off the crankshaft operated a plunger pump to 25–30 psi)
- Oversized nickel-alloy steel valves inclined at 20° from vertical, with tapered valve springs and collar/cotter spring retention
- An estimated compression ratio of 4–5:1 (typical of that era, given the poor 40–70 octane gasoline available)

By 1910, certain advances were incorporated in production by Norvin that allowed delivery of more power with less weight and displacement:

- Movement of spark plugs from the side to the top center of the cylinder heads (shorter flame travel, less chance of detonation with higher compression)
- Replacement of automatic inlet valves (which were low on power—that got worse with altitude, owing to inefficient short duration and low lift, and they were prone to sticking) with mechanical-actuated inlet valves
- Application of a clever push-pull cam and "tappet rod" design with a single rocker arm and fulcrum that worked both inlet and exhaust valves
- Movement of exhaust to the outboard side, inlet to the inboard side (a more common V-8 layout, this allows a shorter and less restrictive intake manifolding)

The push-pull rod actuation for the valves was especially intelligent and allowed use of fewer parts (less weight) in the valve train (albeit with a more complex machined double-acting cam). Valve springs plus helper springs near the tappets removed "play" from the valvetrain and restored valves to the closed position. The only other early aircraft engine known to the author with this push-pull single-rod valvetrain arrangement was introduced at virtually the same time (in 1910); the Le Rhone seven-cylinder rotary made in France (Le Rhone later merged with Gnome).

The El Arco radiator was responsible for cooling the 1909 Rinek V-8 with straight water (ethylene glycol coolant was not commercially available from DuPont until the 1930s). Commonly mated with engines of that era, the El Arco radiator apparently used vertical brass fin tubes in an automotive-type configuration. I noticed that competing Wright flyers used a lower-drag slim-profile vertical radiator.

The intake manifolding arrangements were in a constant state of flux. As evidenced in representative engine ads, the V-8 manifolding changed often, and probably with each engine produced. In this embryonic era of aeroplane engines, each engine was likely to be a handmade "one off" (even with good sellers, such as the Curtiss models), so Norvin Rinek apparently changed designs at will.

Direct propeller drive was standard on Rinek and most other engine brands at this time. They were typically operated at low rpm (1,000–1,400). Later, engine designers determined that an engine optimized for higher rpm operation (e.g., 3,000 rpm) with crankshaft gear reduction to the prop shaft could yield substantial weight savings. So, by late World War I (long after Norvin exited the business), geared engines were becoming quite common, although gearbox reliability was a definite weakness.

Experimental Engines—Many of the mechanical aspects of the Rinek V-8s were considered relatively modern, or advanced for a 1909–1910 design. The production Rinek V-8 engines with standard cast iron cylinders and pistons were moderately light by comparison to competing brands (see Table 3). That is, some makes were heavier (e.g., Renault, Fiat) and some were lighter (e.g., Curtiss, Hall-Scott). According to family sources, an aluminum-intensive ultra-light Rinek V-8 (perhaps an experimental model) with cast aluminum cylinders fitted with steel liners was supposedly produced.[76] Some independent corroboration of this development was uncovered in a historical archive in Pennsylvania describing the work of the Rinek Aero Manufacturing Co.:

"The engines designed and built by the company were the first 8-cylinder water cooled engines built in the country, being built entirely of aluminum alloy."[77]

If produced as rumored, the "all-aluminum" Rinek V-8 would have been way ahead of the competition in terms of lightness. The reported specific weight was 2.33 lb/hp, a figure not bested on water-cooled four-cycle aircraft engines until well into World War I with such engines as the famous *Liberty* V-12 (2.1 lb/hp). My research of early aircraft engine history did not uncover another aluminum cylinder design until the advent of the 1914 Hispano Suiza in Europe.

Another rather advanced feature (with anti-friction benefits) reportedly in the experimental 1910 aluminum Rinek V-8 was all ball-bearing mains.[78] One other pioneering aviation user of the ball main bearing design was the costly 1910 French E.N.V. family of V-8 engines.[79] Because of cost, lubrication, reliability, and supply problems, ball-bearing mains were not specified more commonly on production aircraft engines until World War I (in, for example, the British Napier Lion W-12 and French Peugeot engines). Discussions with an early aircraft engine expert indicate that it is possible to place ball-bearings on a one-piece crankshaft by snaking oversized bearings over the throws and pinning them with

TABLE 3 — SELECTED PRE-WORLD WAR I AIRCRAFT V-8 ENGINES

Country	Make/Model	Vintage	Cooling Sys.	Power (hp)[1]	Weight (lb)[2]	Specific Wt. (lb/hp)
USA	Aircraft	1911	Water	80	210	2.6
France	Antoinette	1906	Water	24	110	5.0
France	Antoinette	1906	Water	32	93	2.9
France	Antoinette	1907/8	Water	50	150 plus	3.0 to 4.0
USA	Boland[4]	1911	Water	60	262	4.4
USA	Boulevard	1911	Water	64	255	4.0
USA	Curtiss/B-8	1907	Air	40	150	3.8
USA	Curtiss/E-8	1909	Water	100	350	3.5
USA	Curtiss	1911	Water	50	250	5.0
USA	Curtiss	1912	Water	60-80	NA	NA
USA	Curtiss/OX series	1913	Water	90	400	4.4
France	E.N.V.	1910	Water	80	364	4.5
France	E.N.V.	1910	Water	60	287	4.8
France	E.N.V.	1910	Water	40	155	3.9
Italy	Fiat	1908	Air	50	342	6.8
Italy	Fiat/555	1912	Air	NA	NA	NA
USA	Hall-Scott	1911	Water	60	265	4.4
USA	Hall-Scott/A-2	1912	Water	65	260	4.0
USA	Hall-Scott/A-3	1911/12	Water	80	270	3.4
USA	Hall-Scott/A-4	1912	Water	125	NA	NA
France	Renault	1909	Air	35	242	6.9
France	Renault	1909	Air	55	550	10.0
France	Renault	1910	Air	50	373	7.5
France	Renault	1913	Air	80	463	5.8
USA	Rinek	1909	Water	30-45	275	6.9-9.2
USA	Rinek	1909	Water	40-60	300	5-7.5
USA	Rinek/B-8	1910	Water	60	280	4.7
USA	Rinek	1910	Water	50-60	115-138[3]	2.3[3]
USA	Rinek	1910/11	Water	80-90	NA	NA
UK	Sunbeam	1913	Water	150	425	2.8
UK	Wolseley	1909	Water	50	350	7.0
UK	Wolseley	1910	Water	90	326	3.6
USA	Wright	1910	Water	50-60	NA	NA

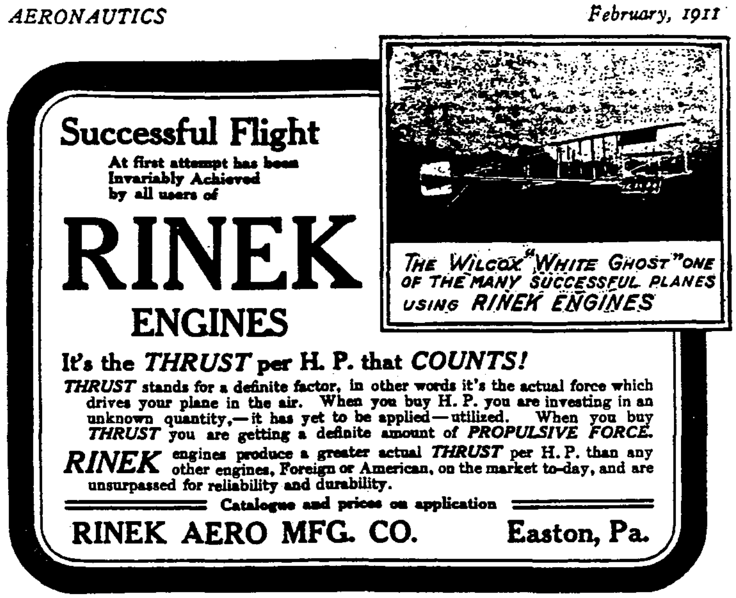
NA = not available

1. Manufacturer's rating, usually estimated on a mathematical basis rather than dynamometer tests. The 90-hp Curtiss OX-2, for example, usually delivered much less power (e.g., 78 hp) on the dynamometer.
2. Ready-to-run installed weight, but may exclude radiator, etc.
3. Estimated results for rumored aluminum cylinder engine with steel liners.
4. Merged with Aeromarine by 1913.

Sources: *Aeronautics* (July 1911), *Scientific American* (July 1911), *Aircraft Piston Engines* (1981), *World Encyclopedia of Aero Engines* (1989), notes of Mr. Hugo Byttebier/Mr. William R. Lewis, Mr. John A. Rinek, 1910 catalogs for Rinek and E.N.V. engines.

multipiece metal inserts between the bearing IDs and crank journal ODs.[80] Norvin Rinek may have used this approach. He already had in production, you recall, ball thrust bearings on the propeller end, a practice later shared by such other engines as the famous Curtiss OX-5 V-8 built by the thousands through World War I.

Engine Advertising—Returning attention to the Rinek engine ads, we see some testimonials regarding satisfied customers. If he could have got a "big name" user (instead of amateurs) to fly with his engine, the marketing success may have been better. The most well-known U.S. pilots, however, mainly flew Curtiss and Wright aeroplanes with captively produced engines. Notice that the 1909 Easton Cordage V-8 configuration is close to that of the restored engine, but was probably not sold to the public. The better models, such as the 1910 B-8, were clearly more appealing. Notice the last of the Easton Cordage ads before conversion to Rinek Aero Manufacturing that Norvin claims his aeroplane to be "the only type machine not infringing the Wrights' patents." Norvin showed great respect for the U.S. patent system as his



grandfather held two rope patents in the 1800s and, as stated previously, he was awarded his own rope patent in the 1930s. One ad described propellers of "phenomenal efficiency." This was typical of the rich prose in ads written by Norvin. Another featured a testimonial regarding an amateur pilot's flight in what appears to be a Curtiss copy aircraft with a Rinek engine. The new ad theme was high thrust per hp. The large Rinek displacement coupled with mild valve timing (e.g., zero overlap cam) helped assure the big torque at low rpm needed to swing large props with high thrust.

Some ad artwork found in family archives was intended to be advertised in one of the 1910 issues of the British periodical *The Aero*. A B-8 Model V-8 is pictured, along with the graceful Antoinette French monoplane (fitted with the competitive Antoinette V-8). The associated ad copy, somewhat amusing, is transcribed verbatim below (the ad asks whether your engine can stand the racket):

"If it doesn't, don't you think it's about time you pass it along, and cut out that never-ending expense for repairs, together with the anxiety of not knowing what's going to happen next?

"If you don't, well—you may be lucky to wake up even in a hospital!

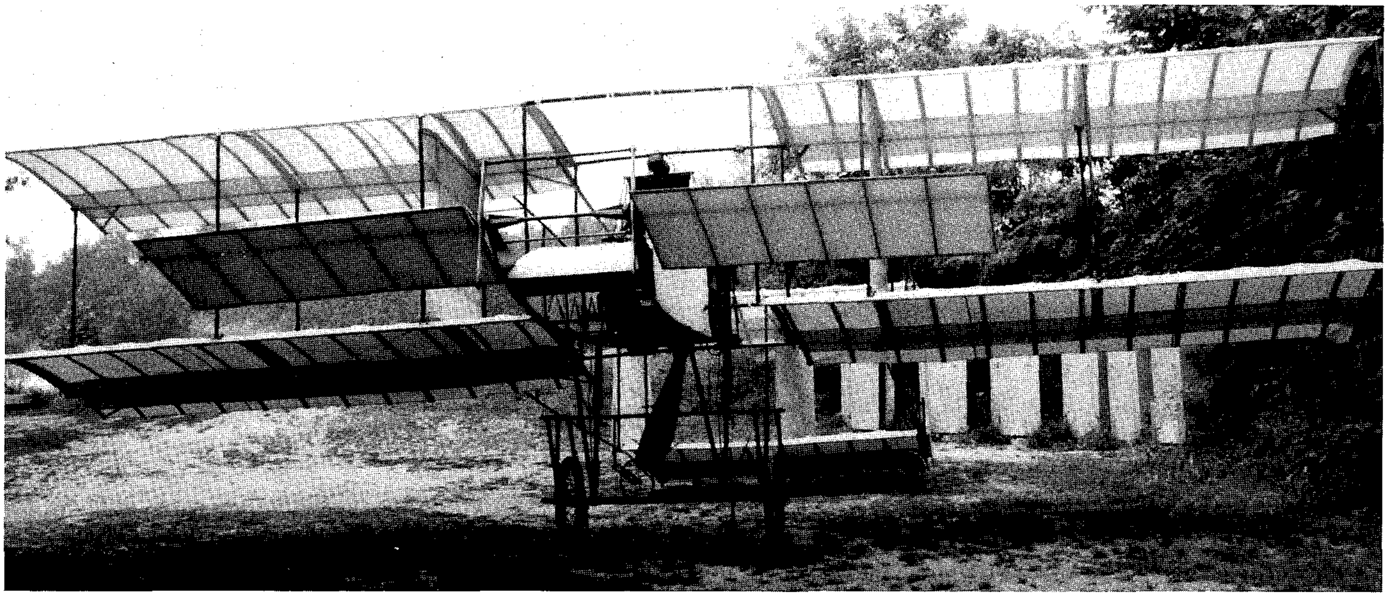
"Seriously, tho, no matter how fine a plane you may have, if you've been unfortunate enough to invest in a power plant that's likely to go 'dead' at any moment, you might as well once and for all give up the idea of ever entering the professional ranks.

"Ask any one Who's wise. You can't do good work with poor tools, you know.

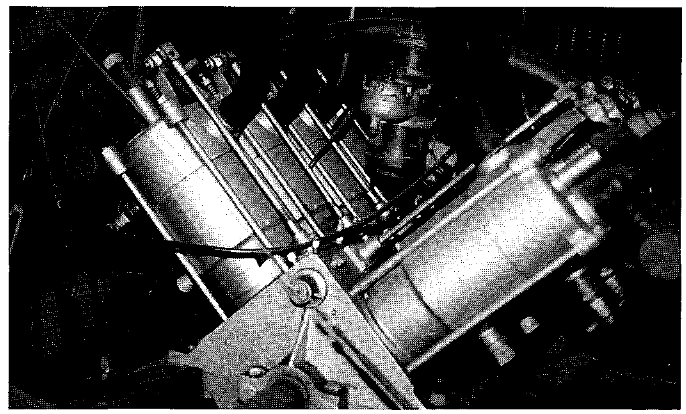
"RINEK engines stand the racket because they are built for REAL SERVICE. Being built for REAL SERVICE, the materials most suitable, regardless of cost, MUST enter into their construction to enable them to withstand the terrific strain of wear and tear demanded of the aviation engines to-day.

"Equip your plane NOW, Mr. Would-be Birdman, with one of these famous engines, and the troubles, breakdowns, and uncertainty you are now experiencing will vanish for good never to return.

"With the good, healthy roar of a RINEK engine at your back, it will be up to you then, personally, to deliver the



Front view, restored Rinek Voisin. (Olive Senn)



Rinek engine closeup detail. (Author's Collection)

goods.

"Don't take any more chances, but let us hear from you NOW. If you're within visiting distance, don't write for particulars—just tell us you're coming on to see the REAL THING—we'll be only too glad to give you a trial run, or better still, put you in touch with one of the many satisfied RINEK users who have MADE GOOD."

RINEK AERO MFG. CO.
Office and factory, EASTON, PA.

The upbeat, high-reliability theme was perhaps an example of marketing hype, but the ad copy provides direct insight as to Norvin Rinek's style of writing and thinking regarding the aviation business.

Concluding Remarks—Table 3 emphasizes the quantity of V-8 engine competition forced by Norvin Rinek. He faced additional engine competition from radials, I-6s, 2-strokes, and such. Although commercial sales of his engines (and aircraft) in the United States were overshadowed by better-known brands, such as Curtiss, Hall-Scott, and Wright, his contribution to early U.S. aeronautical engineering remains solid. This opinion is not just mine; other aviation historians and engineers who have reviewed the findings tend to agree. For example, Mr. Wesley R. Smith (who is now preparing a comprehensive Putnam-style book on all U.S. heavier-than-air aircraft and engines through 1918) wrote to me the following in May 1991:

"In sum, I believe the aeronautical work of Charles N. Rinek is of some significance. The construction techniques he used made his airplane much more than a simple copy of a standard Voisin pusher. His engine designs were, as you correctly point out, of relatively advanced design and construction."[81]

C. Norvin Rinek died of pneumonia in 1980 at the age of 91, outliving most of his principal aviation contemporaries (Voisins, Farman, Wrights, Curtiss, and so forth). I will not be so bold as to equate Norvin Rinek's aeronautical work with that of the famous names just mentioned. Still, in the course of my research I was struck by the amazing parallels (coincidence?) in the life and work experiences between, for example, Norvin Rinek and the Wright brothers. These documented parallels include:

- An early life fascination with mechanical and aeronautical things (engines, model and glider building)
- A social awkwardness throughout life
- A lack of serious interest in higher (e.g., college) education
- Interest in owning and tinkering with fine motor cars
- Musical inclinations (playing instruments)
- Business problems marketing their aeroplanes
- Prominent, well-educated and demanding fathers
- Strong appreciation of high efficiency, high quality materials, and elegance in design
- Fabulous sense of humor
- Intense love and care for their respective ailing mothers
- Gifted writers
- Intense involvement in respective family businesses
- Difficulties with the press on aeronautical work
- U.S. patents in their respective fields of expertise
- High intellect
- Scale model railways built on their respective family estates

Largely at his own insistence, Norvin Rinek's aviation accomplishments went all but unknown for about 70 years. I have sought to illuminate his story and I hope the readers agree that it is both interesting and noteworthy. I welcome correspondence from any and all aviation enthusiasts who may have something further to add on the 1909 Rinek Voisin and Rinek family of engines. □

ACKNOWLEDGEMENTS

Sincere expressions of thanks go out to my U.S. network of sources, without which this story could never be completed. These information sources include John A. Rinek (my father), Dorothy Rinek (Norvin Rinek's surviving widow), Cole Palen, Olive M. Senn, Ben Kizer, Wesley R. Smith, William R. Lewis, Joe and Carol Ayers, Jerry Roberts (Intrepid Museum Curator), Timothy Cronen (Smithsonian Archivist), Ray Wagner (San Diego Aerospace Museum Archivist), and Leo Opdycke (*WWI Aero* Publisher).

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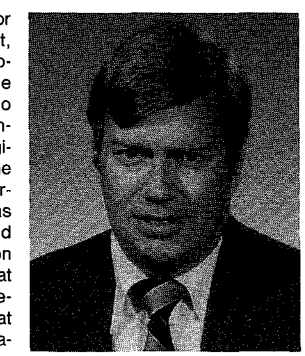
ABOUT THE AUTHOR



Larry Rinek has been employed as a senior consultant in the transportation (e.g., aircraft, automotive) and mechanical/electrical equipment practice area at SRI International (the former Stanford Research Institute) in Menlo Park, California, for about 18 years. While earning a B.S. *(cum laude)* degree in industrial engineering and an M.B.A. in marketing at UCLA, he began his career in the Southern California aircraft/aerospace industry, working at such firms as Jet Propulsion Laboratory (spacecraft) and Menasco Mfg. Co. (aircraft landing gear). Upon graduation from UCLA and prior to his career at SRI, he was a USAF officer posted at Los Angeles AFS (El Segundo) with a unit (AFSCF) that operated various defense satellite tracking stations, CH-53 helicopters and C-130 transports. While connected with the USAF, he had the brief opportunity to fly such aircraft as the T-33 jet trainer, KC-135 jet tanker, and B-52 jet bomber (simulator) on an orientation basis. An avid model airplane builder as a youth and holder of a student pilot license, Mr. Rinek successfully soloed on many occasions in the family's 1945 vintage Piper J-3 Cub. After the aircraft was sold, however, he declined to pursue a full private pilot license. He is an active member of the SAE and AAHS.