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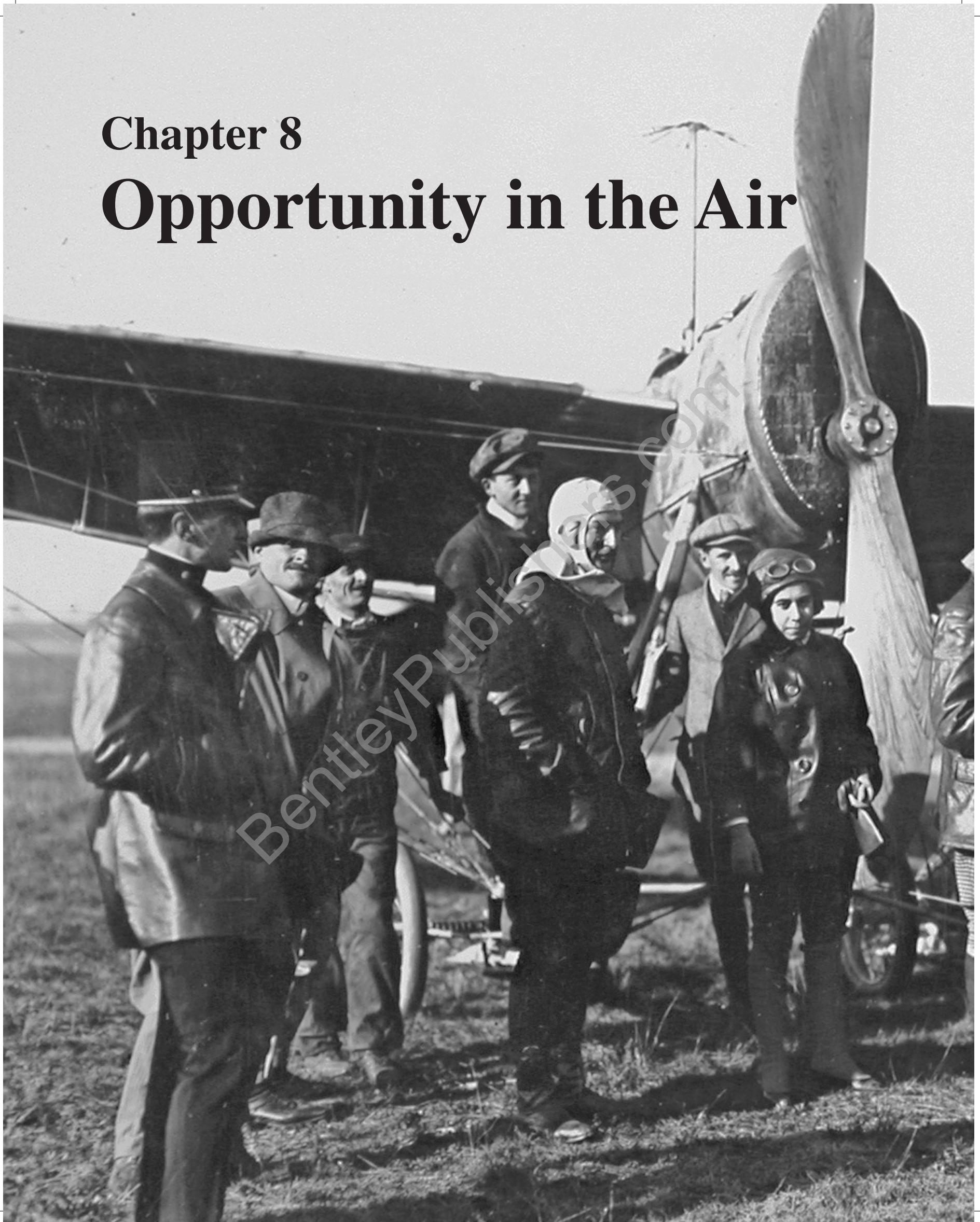
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## Chapter 8

# Opportunity in the Air





PREVIOUS PAGE: *Posing in front of a racing version of the Lohner-built Etrich Taube in 1911 were the elite of Austria-Hungary's budding aviation industry. Between fieldglass-wearing Ferdinand Porsche and Eduard Fischer, the latter in light coat, stood Camillo Castiglioni. At the left of the propeller was Lilli Steinschneider, the Dual Monarchy's first female flyer. A 120-horsepower Austro-Daimler six powered the craft with its distinctive oval fuselage section.*

THIS PAGE: *Technicians in the Wiener Neustadt workshops proudly displayed the 13.9-liter Aéro-Daimler six and the propeller it was capable of driving. The new halls planned for electric-vehicle production by Emil Jellinek now served ideally to produce aviation engines.*

**F**erdinand Porsche was aloft early, not with powered craft but with an Excelsior gas balloon. In 1909 he had a number of flights, indeed adventures, learning about navigation in this new medium. Once he found himself blown almost to Hungary, while on another occasion he opened his luncheon package to discover he'd taken his wife's newly purchased bodice instead. Struggling to gain altitude in another flight, he had to throw everything overboard, including lunch, to avoid clouting a tower. His worst experience was a flight that threatened to rise too fast and burst the balloon because a relief valve had stuck. Porsche clambered up in the rigging and managed to free it in time.

The engineer's aviation interest was encouraged by Eduard Fischer, who joined him in these flights. Fischer was an investor in a company, the Austrian-American Rubber Factory,<sup>1</sup> which made special rubberized fabric for balloons and airships. Its principal shareholder and investor was short, round-faced Camillo Castiglioni, who was born in 1885 in Italian-populated Trieste, on the Adriatic, which then was part of Austria-Hungary. At the age of only 25 in 1910 the freewheeling Castiglioni was the principal of a venture that could take him into the automotive and aviation industries at a time of hectic growth for both.

Castiglioni's company supplied the fabric for Austria's first fully maneuverable airship, built to the designs of Major August von Parseval. Working in Berlin on nonrigid airships since 1906, von Parseval saw his first Austrian ship completed in 1909. Commissioned by the military, it was built at Fischamend, on Vienna's East Side, by the Austrian Motor Aircraft Company.<sup>2</sup> This was effectively a joint venture between the Castiglioni enterprise and Austro-Daimler, with Ferdinand Porsche among its board members. Thus Austro-Daimler had a major role in its construction, including not only its engine but also the tubular structure of its four-passenger control car.

For the 11.5-foot pusher propeller of the Parseval, as the 160-foot airship was known, Porsche provided a unique four-cylinder T-head engine weighing, with its radiator and accessories, 880 pounds. Its cylinders were separate castings, spaced to allow its crankshaft to have five main bearings. Each crank throw inhabited its own sump so lubricant would be available whenever the airship, and its engine, were at odd angles. With dual ignition its output was 70 bhp.

The four's flywheel served as the fan for its own radiator and also drove, through a belt, a blower that helped inflate the hydrogen-filled gas bag. Great

1. The Österreichisch-Amerikanischen Gummi-Fabrikations-Gesellschaft.

2. The Österreichische Motor-Luftfahrzeug Gesellschaft.







LEFT: *The Excelsior balloon gave Ferdinand Porsche and Eduard Fischer their first aviation experiences during 1909. A substantial crew was needed to control the lighter-than-air machine when it was near the ground.*

FACING PAGE: *Eduard Fischer, left, and Camillo Castiglioni led companies that helped pioneer aviation in Austria-Hungary, the first with fine Porsche-designed engines and the second with airship-skin fabrics. Pictured in 1909, both were important business partners of engineer Porsche.*

care was taken to isolate the engine from the inflammable gas, including triple enclosures of both inlet and exhaust piping. A chain coupled the engine to the slower-running propeller.

The Parseval first emerged from its huge construction hall at Fischamend on November 26, 1909. Ferdinand Porsche himself tended its engine during a 20-minute jaunt. Two days later, on a Sunday, it caused great excitement by rumbling above the capital, rounding the spire of St. Stephan's cathedral. In September of the following year it was one of the stars of Wiener Neustadt's aviation

meeting, fighting a headwind to cover the 26 miles from Fischamend. The Parseval was in service until 1914, when the cost of making needed repairs was judged uneconomic.

The Austrian Motor Aircraft Company built two more large airships. The first was to a French design originated in 1902 for the Lebaudy brothers. Its Austro-Daimler engine, driving two twin-blade propellers, was akin to the Parseval's but uprated to 100 bhp. Measuring 230 feet in length in its final version, the Lebaudy machine was anything but "fish-form" with its sharp nose. In March

1911 it made a successful flight to Linz with Ferdinand Porsche at its engine's controls. Also built to the order of the military, the Lebaudy airship was mustered out of service in 1913.

The third airship, largest of all, was an ambitious private venture by engineer Hans Otto Stagl and First Lieutenant Franz Mannsbarth. Its 300-foot length was subdivided into four interconnected gas chambers. Two gondolas with a walkway between them carried 150-horsepower Austro-Daimler engines, four-cylinder units with individual T-head cylinders. Each drove a pair of 13-foot propellers. From each engine a shaft and bevel gears drove another propeller whose angle of attack could be adjusted in flight for control purposes.

Built with the aim of commercial service, the Stagl-Mannsbarth airship had a passenger gondola that could carry 25. It was capable of altitudes in excess of 8,000 feet and a 20-hour mission at a speed of 37 mph. No commercial contracts or military interest came its way, however. All these nonrigid airships had proven difficult to control and prone to hydrogen leakage. As well, the army quickly realized, they were an attractive target for ground fire. From 1912 the military sourced only heavier-than-air craft. In 1914, after 56 flights, the Stagl-Mannsbarth machine was dismantled.

WHAT THE DUAL MONARCHY'S army wanted, the Austrian Motor Aircraft Company would provide. The new air age flew directly to the doorstep of Ferdinand Porsche. The Steinfeld, the level plain that was home to Wiener Neustadt, was ideal as an airfield. Its open spaces were already well-known to the military, which used parts of it as an artillery test range. Early in 1910 hangars were erected at its flank. The first to rent a double hangar, and to move his budding manufactory there from Vienna in mid-February, was Ignatz "Igo" Etrich.

Etrich, whose father was a textile manufacturer in Bohemia's Trautenau, had taken up the idea of another Austrian, Franz Wels, that the uniquely stable gliding properties of the seed of Java's zanonina vine would provide a suitable basis for the design of an aircraft. Starting in 1904, their experiments with gliders and powered models were promising. Wels and Etrich parted company in 1909, when the latter made a short, straight hop with his first man-carrying aircraft on the Steinfeld in July. He replaced its Anzani engine with a Clerget and on October 29, 1909, made a proper controlled flight, the first ever for an Austrian aircraft.

With its wings still zanonina seed-shaped, Igo Etrich called his 1909 monoplane *Sperling*, or Sparrow. For 1910 he undertook a major redesign in a larger aircraft he called the *Taube*, or Pigeon. Assisting him in its erection was Karl Illner, a skilled mechanic and locksmith who had an aptitude for flight. In April Illner qualified for Austria's third pilot's license and in May he made a 68-minute flight in the *Taube*. This was achieved with the French Clerget engine, but Etrich—in addition to aiding Porsche with the design of his Prince Heinrich entries—had already been in touch with the Austro-Daimler engineer about more powerful and reliable engines to power his aircraft.

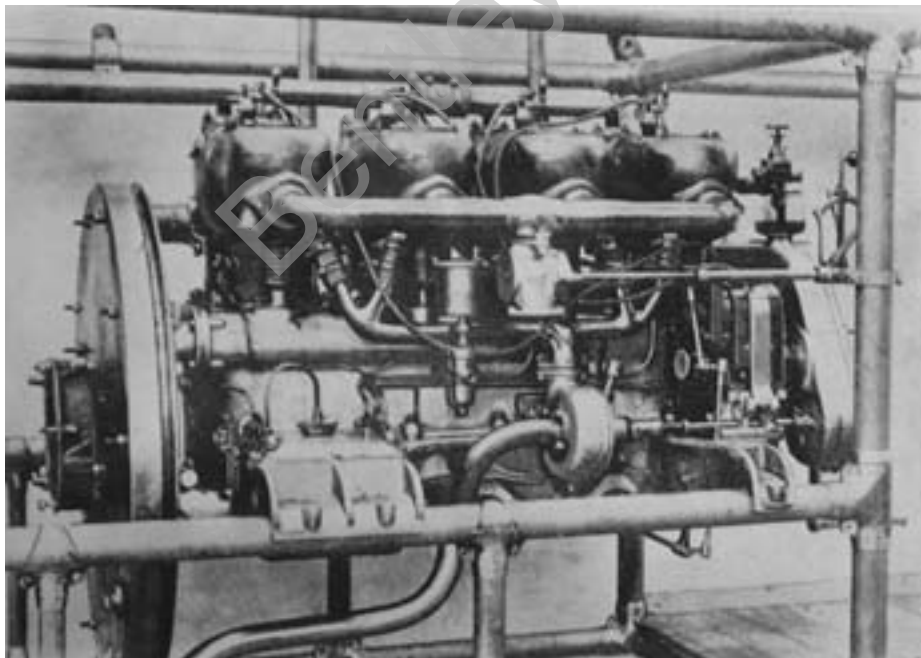
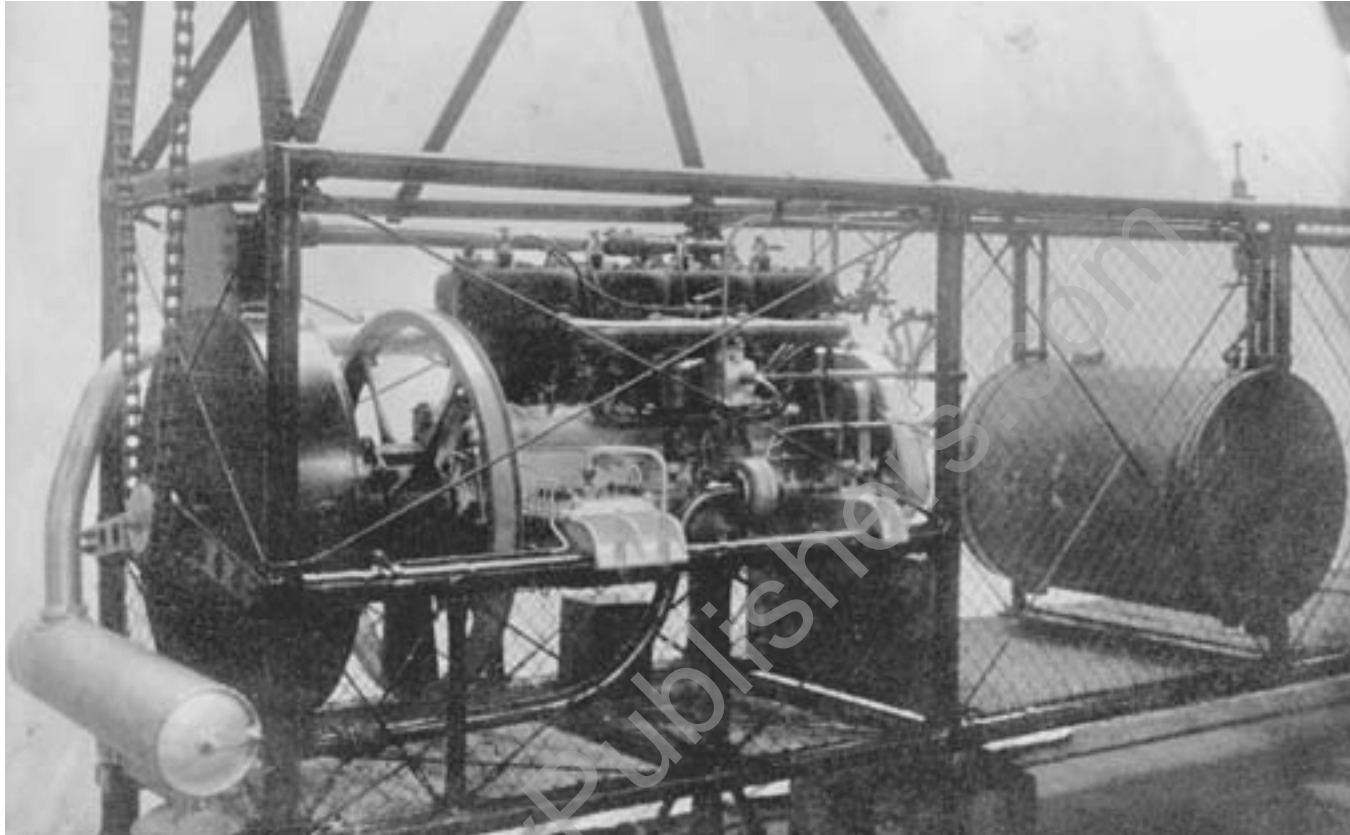
The creation of an all-new aviation engine was yet another task for Ferdinand Porsche in the hectic early months of 1910. Etrich and Illner were eager to have it for their new *Möwe*, or Gull, a smaller monoplane built expressly for racing. When Porsche couldn't provide it in time for a meeting at Budapest in June, he readied a flight version of one of his Prince Heinrich fours instead. Its weight was given as 660 pounds and its power as 40 bhp at 1,450 rpm. This performed well in the air but the *Möwe* suffered an accident on the ground in Hungary and couldn't compete.

Finally at the end of August the first purebred Austro-Daimler aero engine was ready. Like Porsche's Prince Heinrich four, it was an appealing and ingenious engine that showed meticulous attention to detail and an acute awareness of the state of the current art. Porsche's first four-cylinder unit measured 100 x 120 mm for 3,770 cc and scaled a svelte 180 pounds. Although originally planned for 35 horsepower it ultimately produced 48 at 1,600 rpm. Closely following the first engine was a larger four measuring 120 x 140 mm for 6,333 cc. This developed 65 bhp at 1,350 rpm and a maximum of 70 at 1,500 rpm. It weighed 210 pounds. Initial production was chiefly of the larger engine.

Novelties abounded in Ferdinand Porsche's first heavier-than-air engines, which were similar in design. He gave them four individual cylinders on an aluminum crankcase with six mounting bearers, in which white-metalled main bearings

were held by individual caps. This allowed the aluminum bottom cover to be a simple oil pan that could be removed for inspection, in the aircraft, without disturbing the bearings. The main and big-end bearings were small, on the order of 40 mm, to allow the crankshaft to be exceptionally light. Pistons were thin-wall cast iron. Porsche offset the cylinders from the crankshaft centerline





ABOVE: Carried by the Parseval gondola's tubular structure, its Austro-Daimler four showed the flywheel that also served as the fan for its circular radiator. A roller chain took the drive to a high-placed three-bladed propeller.

LEFT: Looking deceptively massive, Porsche's engine for the Parseval airship of 1909 had individual cylinders and five main bearings. This was the carburetor side of the T-head engine, producing 70 bhp.

FACING PAGE: For the Parseval airship of 1909 Austro-Daimler produced not only the engine but also the structure of the entire gondola. Among those celebrating its completion in the airship hall at Fischamend were Austro-Daimler's Otto Stahl, standing on the right in motoring cap and goggles, and to his right Ferdinand Porsche. To the left of Stahl was Camillo Castiglioni, while chauffeur Henschel was at the far left.



toward the downstroke (right) side of the engine by 18 mm, in the manner known as *désaxe*, to reduce piston side thrust and encourage smoother running.

Adjacent to the center main bearing Ferdinand Porsche arranged a spiral drive from the crankshaft to a cross shaft which drove the water pump on the right and the ignition on the left. His reason for this was to get these accessories out of the way so that the airplane designer could take a drive from either or both ends of the engine, if he wished. The ignition was a combined magneto and coil unit to spark two plugs per cylinder. A single camshaft ran inside the crankcase on the right, with its gear drive taken at the normal propeller end of the four. A bevel drive from the tail of the camshaft turned the Friedmann lubricator on the engine's left rear quarter.

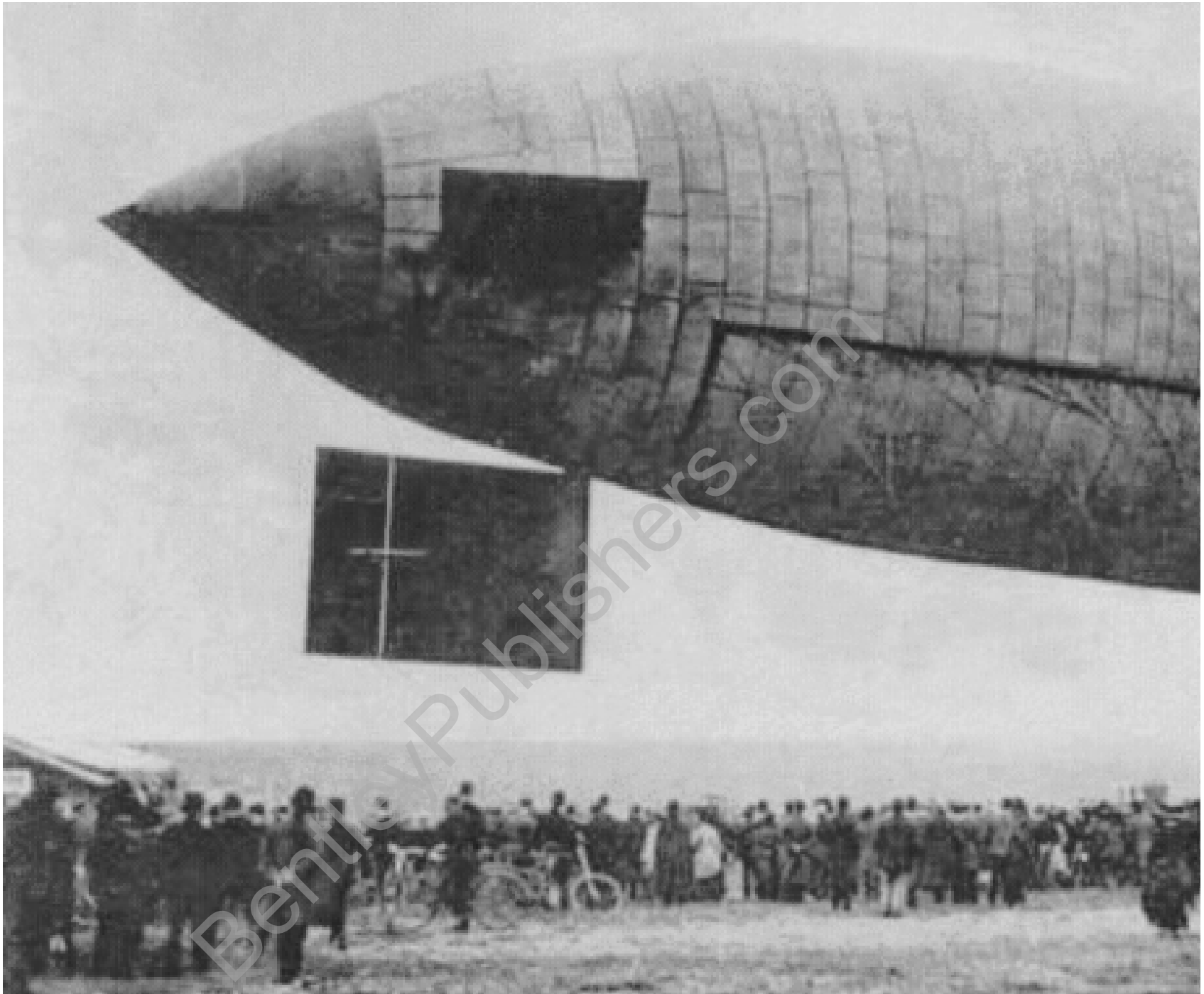
At its top end Porsche's first heavier-than-air engine resembled his 1910 Prince Heinrich design only in having inclined overhead valves in a hemispherical combustion chamber. Its single camshaft was located not in the head but in the crankcase.

Here, as in overhead-cam technology, some prior examples were worthy of study.

An early advocate of inclined overhead valves was the Belgian firm of Pipe, which introduced such an engine in late 1904. An ex-Daimler engineer, Otto Pfänder, inclined his Pipe valves at a 100-degree included angle and operated them by pushrods and rocker arms from two camshafts in the crankcase. Brussels-built Pipe cars and engines were displayed at motor shows in both Vienna and Berlin in 1906 and were actively marketed in Austria-Hungary. They showed both speed and style in climbs of the Semmering. Pipe's fortunes declined after Pfänder was killed during trials for the 1907 Kaiserpreis, in preparing for which Porsche had his own Mixte misfortunes. Others, including Benz, developed racing models with similar pushrod-operated vee-inclined overhead valves.

A direct antecedent of the cylinder head of Porsche's four was Fiat's Grand Prix racing car of 1905. This placed two large vee-inclined valves in the head, equally disposed at a 60-degree





included angle. The valve stems were very short and light because neither required a closing coil spring. Instead, a single leaf spring was mounted atop the head, curving down at both sides to effect the closing of both valves. Above this, on a central pivot, was a single long rocker arm that tilted back and forth to open both valves. Unlike Fiat, Porsche ingeniously anchored the leaf spring to the bottom of the rocker arm in such a way that its effect was stronger on the closed valve and lessened on the valve that was being opened.<sup>3</sup>

The rocker arm was operated by a vertical rod attached to a pivot on its right or inlet side. The vertical rod was a push-and-pull

rod. When it was pushed up by the tappet at its bottom end the rocker opened the exhaust valve, and when pulled down it opened the inlet valve. In Fiat's patented design the pulling down, against the leaf spring's pressure, was achieved by an even stronger coil spring, at the tappet, that pressed the latter against the cam lobe. Here too Porsche found a much more elegant solution. He controlled the push-pull rod with two cam lobes side-by-side. With this desmodromic control one cam lobe pushed the rod upward while another, working through a bell crank, pulled it down.

3. Austro-Daimler was granted a patent on this innovation.



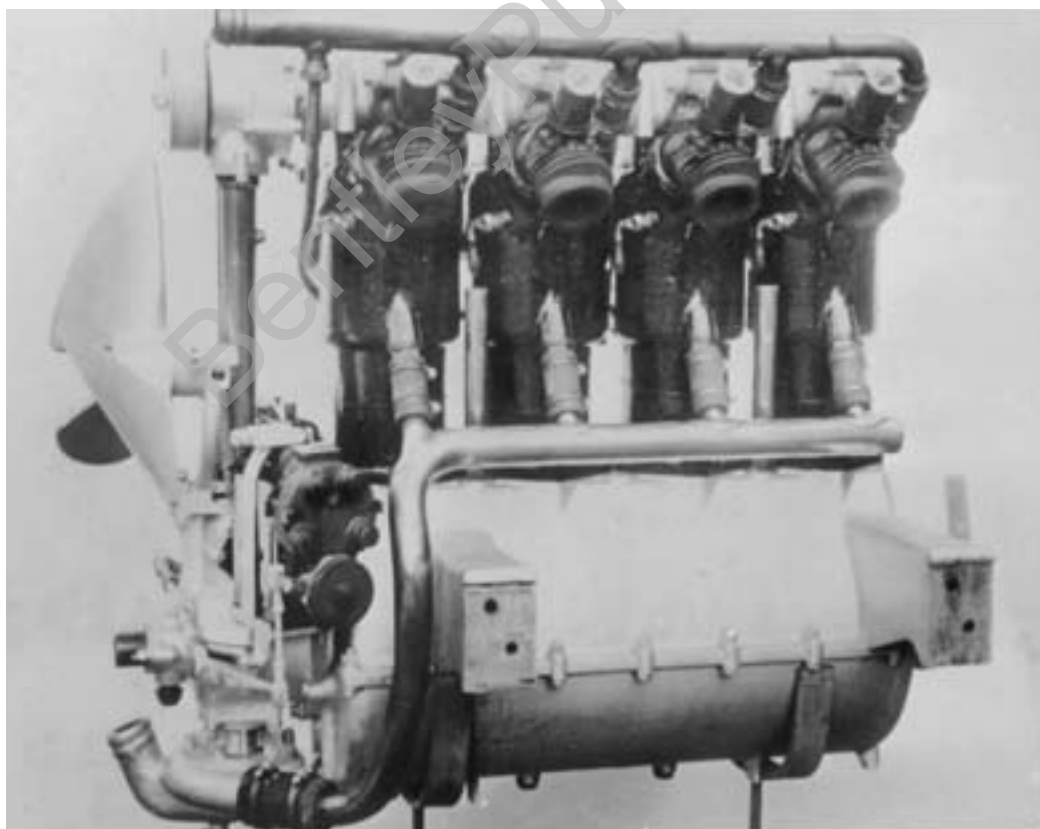
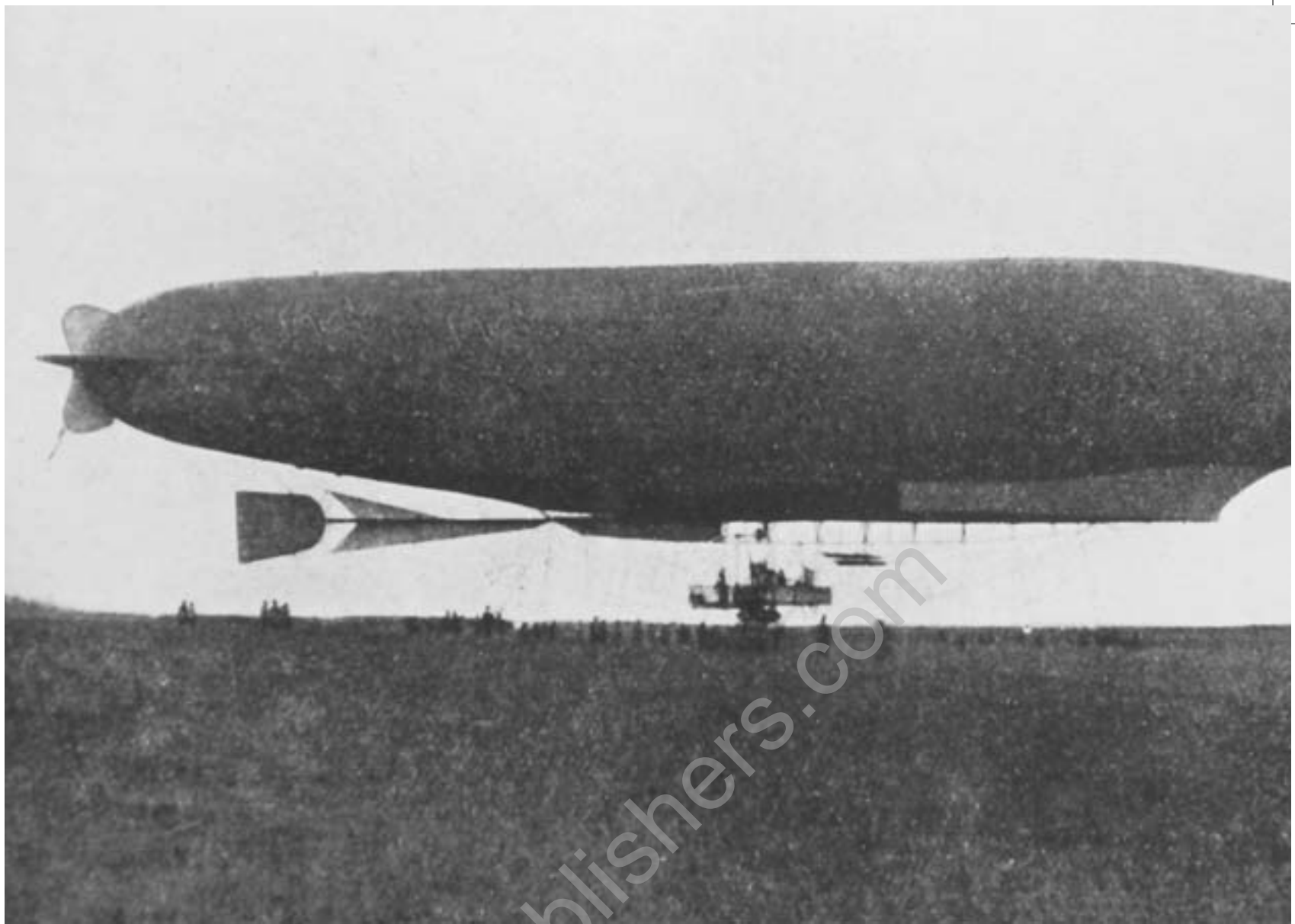
LEFT: Austria-Hungary's first airship, the Parseval of 1909, was 160 feet long. Understandably it caused great excitement when it flew over Vienna on November 28, 1909, under Austro-Daimler power.

To take advantage of its good bore-surface properties, fine cast iron was used for the cylinder. While the exhaust-valve port and guide were integral with the head, the inlet valve was carried by a screwed-in cage. When this was removed, the exhaust valve could be dismantled without having to tear down the cylinder. During the evolution of subsequent versions of this design Ferdinand Porsche found that the iron that was ideal for the bores was brittle enough that the flanges at the cylinder bases could break away. He invented and patented the idea of a screwed-on steel collar at the cylinder's base that provided a more secure anchorage. Lest the screw threads be a source of failure, he

bathed them in molten tin or zinc before assembly to provide a cushioning effect.

The iron cylinders were cast without water jackets. Porsche's process for forming the jacket began with the casting on the cylinder's outer surface of a volume that represented the planned water capacity. The cast-on material was metallic, of an alloy that melted at less than water's boiling point.<sup>4</sup> Then the cylinder was suspended in an electrolytic bath of copper until a thickness of

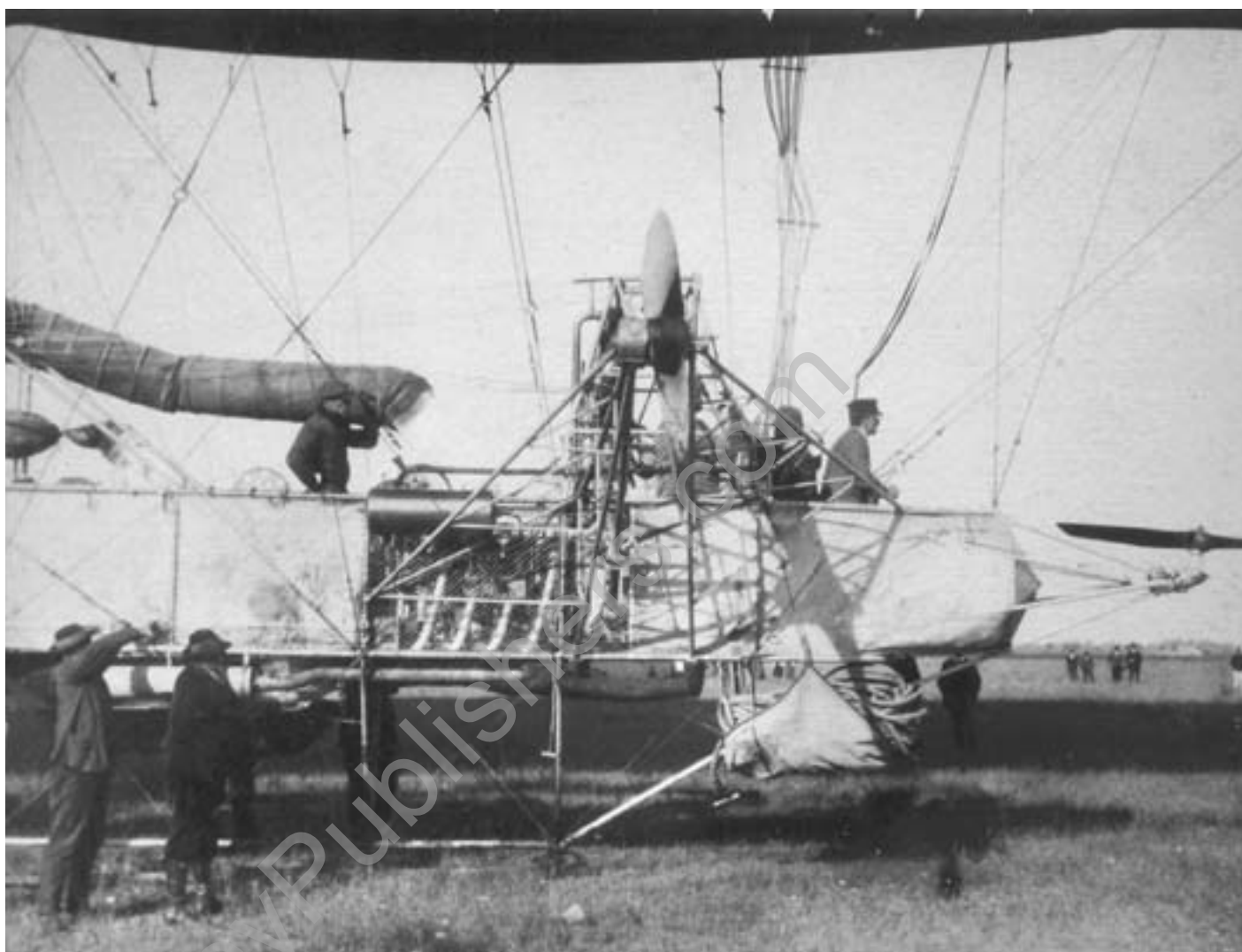
4. The author hasn't been able to identify this alloy, but it was likely to be tin-based.



ABOVE: To a French design by Lebaudy the Austrian Motor Aircraft Company at Fischamend built this airship in 1910. Its 230-foot hull was powered by an uprated version of the four-cylinder Austro-Daimler engine used in the Parseval craft.

LEFT: As a stopgap to power Igo Etrich's new racing M $\ddot{o}$ we in the early months of 1910 Porsche produced this airborne version of the four used in his Prince Heinrich entries. An accident to the aircraft meant that it never had a chance to show what it could do in the air.

FACING PAGE: A starboard-side view of one of the power gondolas of the Stagl-Mannsbarth airship showed the shaft drive to one of its twin propulsion screws and its horizontal maneuvering airscrew at the front. Exhaust pipes and silencer from Porsche's four-cylinder engine were triple-walled to keep heat away from the hydrogen gas bags.



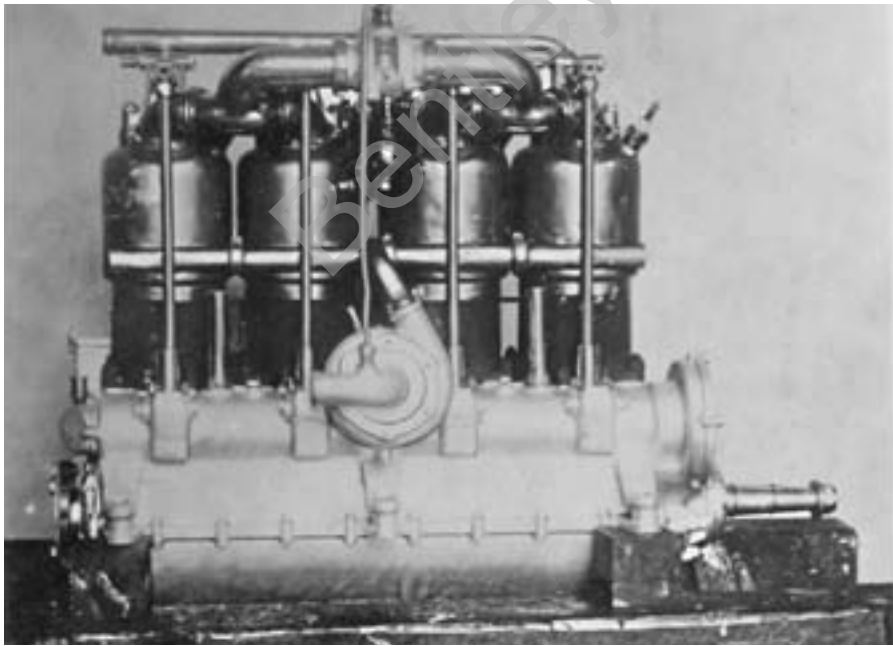
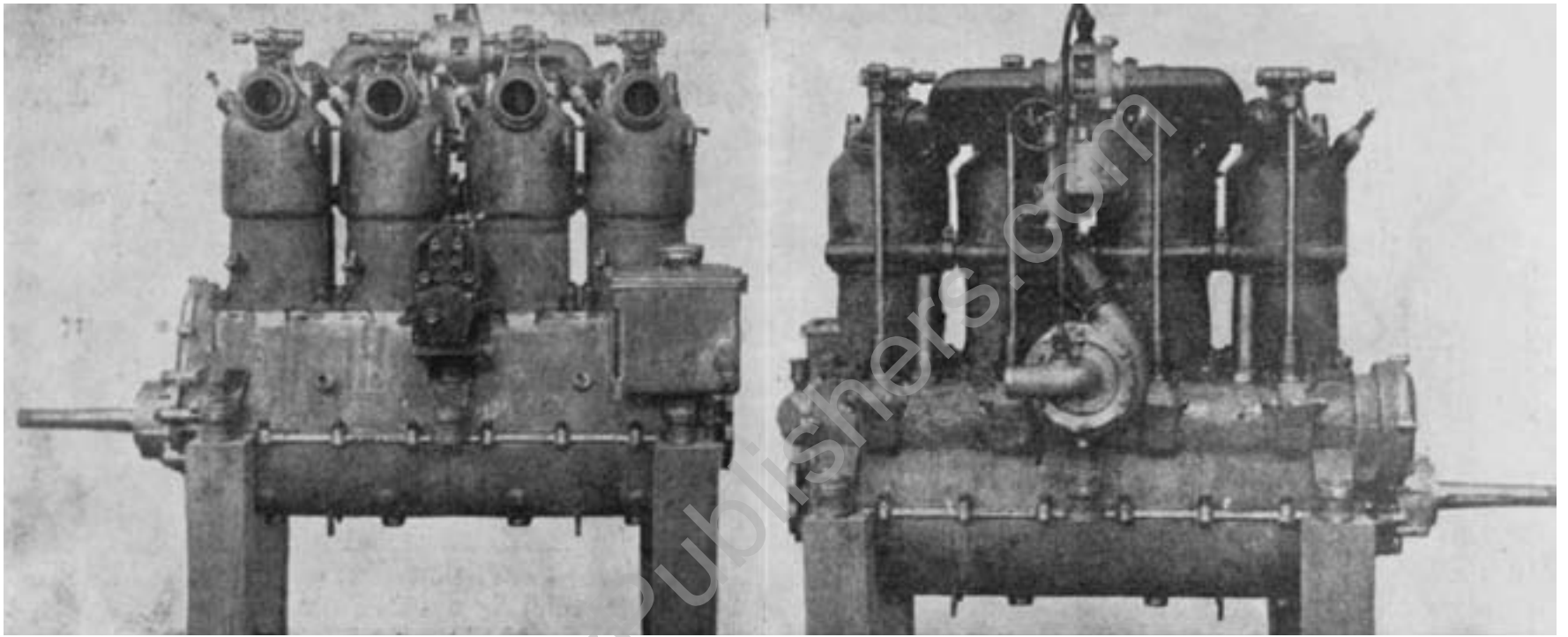
1.5 millimeters had been deposited, about one-sixteenth of an inch. Finally, in boiling water the internal metallic former melted away. The copper water jacket remained.

Icing of the inlet manifold was prevented by a warm-water jacket around it at the carburetor inlet. The carburetor itself was a special Porsche design for aviation. Instead of a conventional float to control fuel flow he used a ring-shaped float in a bowl that surrounded the jet. This assured a more consistent supply of fuel with the plane at different attitude angles and g loadings. Ahead of the cockpit an inverted-vee radiator also served as a pylon for guy wires for an aircraft's wings.

Here, in sum, was an engine prepared for its mission with great care. When Vienna's AAZ visited Wiener Neustadt in September it also saw the gondolas and engines of the Stagl-Mannsbarth airship under construction and the first elements of the electric-drive A-Train being completed. Elsewhere were vehicles, of course, including a wheel-motor chassis for the Vienna fire department.

Small wonder that its reporter was moved to remark, "One can see that progress has set out its stall in the Daimler works. Rather than get bogged down by routine, one keeps abreast of the times." This was a tribute to the company's uncommonly versatile and forward-looking technical chief.

UNLIKE SOME OF HIS AERO-ENGINE RIVALS, who produced what were known as "five-minute wonders," Ferdinand Porsche placed heavy emphasis on durability. Before committing his new units to the air he ran them with the load of a propeller for ten hours. In pole position to receive one was Igo Etrich, who fitted it to his *Möwe* racer. Its first test hops began at 6:00 A.M. on August 28, with Karl Illner as pilot. He and Etrich were happy with 28 minutes of air time, but Porsche wasn't. He needed his engine to be tested more thoroughly. Illner went up again for 31 more minutes. A final hop at the end of the day was cut short by a trail of smoke. Illner



THIS PAGE: *A major step into a new world for Ferdinand Porsche was the creation of his first dedicated aircraft engine, the four-cylinder unit of 1910. The ingenious central positioning of its magneto and water pump allowed drives to be taken from either end of its crankshaft.*

FACING PAGE: *In 1906 Pipe of Brussels exhibited its chassis and advanced overhead-valve engines at Berlin and Vienna. Ferdinand Porsche had ample opportunity to contemplate the advantageous features of Otto Pfänder's design.*

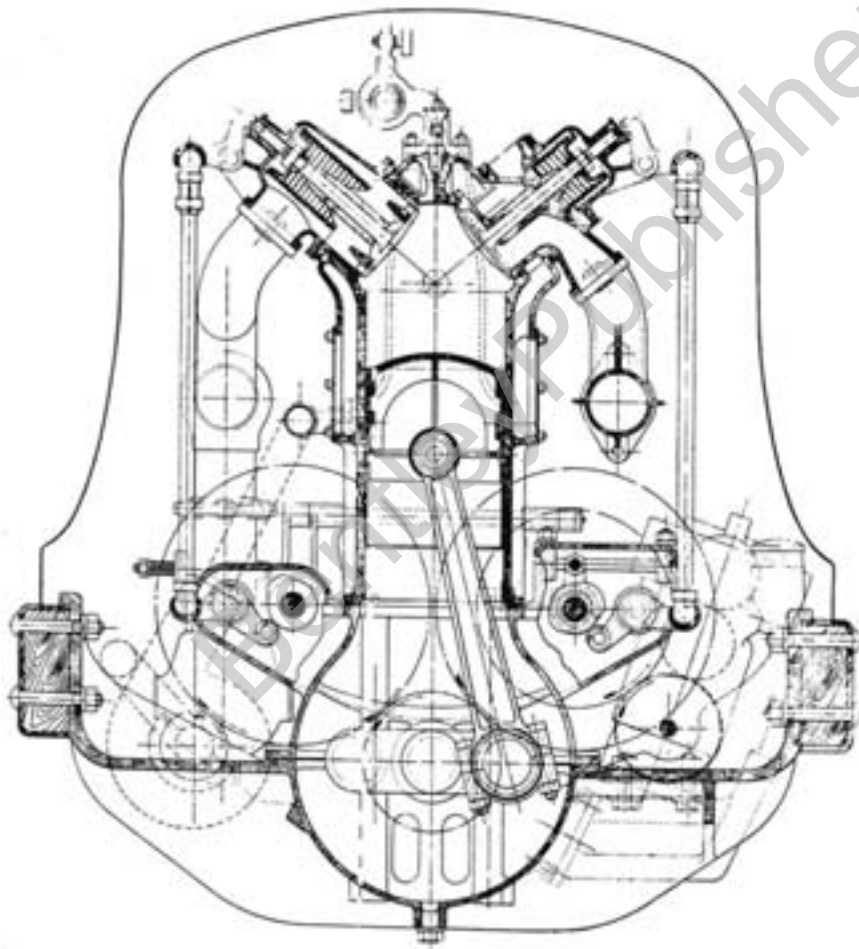
landed safely, only to find that a mechanic had forgotten to top up his engine's water supply. The Aëro-Daimler had shown its mettle by completing the flight undamaged.

A few days later another flyer, Adolf Warchalowski, received his engine and fitted it to his biplane. Previously, he said, six men could easily hold his plane against its engine's full power. This was no longer possible. Both his aircraft and the *Möwe*—whose propeller wasn't yet adapted to the new engine—reached 50 mph top speeds, and Warchalowski flew successfully with a passenger, the intrepid Count Schönfeld.

Although still in their baby shoes, Porsche's aero engines were prominent at Wiener Neustadt's September 17–19, 1910, flying meet. On the 19<sup>th</sup> the gathering was graced with a visit by Kaiser Franz Josef, who examined the machines with great interest

and then met the flyers. Seeing Porsche among the dignitaries he asked, "You now have a great deal to do with aviation?" "Yes indeed, your majesty," the engineer answered. "The four best pilots at Wiener Neustadt are using our engines, and the orders are so numerous that we can only fill them with difficulty." This was putting it mildly, because the crankshaft in the engine of one of the competitors on the Sunday had only been machined the Wednesday before.

So comprehensively did Aëro-Daimler-powered aircraft sweep the board at the three-day Wiener Neustadt meeting that AAZ concluded that "since the engine is the heart of an airplane, one can well say: these aircraft have won thanks to their Daimler engines. One can speak of a glittering success for Austro-Daimler in Wiener Neustadt's flying meet without being in the least guilty



LEFT: Late 1904 saw the introduction of pushrod-operated vee-inclined overhead valves by Belgium's Pipe, the work of German engineer Otto Pfänder. Good performances by Pipe autos showed this layout to have advantages for high-output engine design.

FACING PAGE: Fiat's 1905–06 racing car actuated its inclined overhead valves with push-and-pull rods in a manner that Porsche emulated in his first aero engines. However, he made significant improvements in the engineering of his Aëro-Daimler valve gear.