

The Austro Modern. Designers and Industrialists in the Innovation Network Austria - Czechoslovakia - Germany 1900 to 1939



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1 Abstract

The countries of Central Europe cannot simply be understood as catching up with Western modernization. Rather, the article shows how technical developments proceeded in the car factories Lohner in Vienna and Austro-Daimler in Wiener Neustadt, and how the light and powerful gasoline engine drove aircraft construction (the Taube by Etrich) and airship construction. Austria was the leader in aircraft construction around 1910. The creative milieu in Vienna is evident from the fact that the headquarters of the Lohnerwerke was a mere 150 meters from Sigmund Freud's practice. On the technical level, the innovations of Ferdinand Porsche are described, who first built electric cars at the Lohner company before turning to gasoline-powered automobiles at Austro-Daimler in Wiener Neustadt, where he became technical director in 1908 and made a name for himself designing racing cars. Austria achieved a leading international position in the field of racing cars. On the strategic level, the work of Camillo Castiglioni is discussed, who established links with the financial world, raised capital and developed strategies for founding and managing companies. For example, Castiglioni founded Motor-Luftfahrzeug-Gesellschaft in 1909 and became a director of Austro-Daimler in 1909. The paper develops a model that depicts the interplay between Porsche, the technical innovator, and Castiglioni, the strategic innovator, and explains the success of Vienna's unique innovation network around 1910. The paper gives an outlook on the interwar period. The innovation scene shifted to the newly founded state of Czechoslovakia. The article touches on the Tatra 87 automobile (exhibited in the Pinakothek der Moderne in Munich) from the Tatra factories in Nesselsdorf and the innovative production concepts of the Bata shoe factory in Zlín, which went far beyond Fordism. These contributions to Czech modernism were forgotten due to 6 years of German occupation from 1939 to 1945 and subsequent 40 years of communist rule.

2 Introduction

So far, the literature on Vienna around 1900 has focused on the aesthetic refinement of intellectual discourse in the center enclosed by the Ringstrasse. But already beyond the Ringstrasse, one finds industrial ventures in the Alsergrund, such as the Lohner automobile works, in addition to the Studelhofstiege and Sigmund Freud's practice. However, the top achievements in technology and factory organization, with which industrialists, designers and inventors in Vienna, but also in Bohemia, Moravia and Austria in general appeared in the period 1900 to 1939 and radiated to Berlin and Stuttgart, are little known and shall be presented here. We start from the thesis of the architectural historian Martin Kohlrausch that the countries of Central Europe cannot simply be understood as catching up with Western modernization, but have made independent contributions to modernity and focus here on the history of technology. ¹

The life of Ferdinand Porsche - who became famous as the designer of the People's Car (Volkswagen) - serves as a guide, with many of his activities taking place in Vienna and Wiener Neustadt. Between 1900 and 1918, Austria became an important center for automobile and aircraft development. Around the person of Porsche, a dense network of industrialists and inventors emerged in Austria, Bohemia and Moravia in the sectors of automobiles and aircraft, which has remained unnoticed until now and which will be reported on here.

The contribution is intended to fit into the debate about "modernity". This refers to the rapid expansion of industrial production at the end of the 19th century with the associated new technologies in the field of transportation (railroads, automobiles and airplanes), means of communication (telegraphy and telephone) and new media (mass press, radio), which shaped the explosively growing large cities, created new settlement structures of large working-class neighborhoods and favored the rise of polarizing mass parties on the political stage. ² The term "Viennese Modernism" is used in literature to describe how the apolitical generation following the founding generation of the liberal 1860s in Vienna around 1900 strove for refinement in the aesthetic fields of literature, music, painting, philosophy, and architecture. Ludwig Wittgenstein, the son of a steel industrialist, is representative of this generation. ³

The state of research on this aesthetic dimension of Viennese modernism, which has been documented by Jürgen Nautz and the author, among others, is to be expanded here to include the field of technical history.⁴ Geographically, the innovation view is to be extended from Vienna to Bohemia and Moravia. The following map gives an overview of innovation in Austria, Bohemia and Moravia. It can be seen that the innovations originated in the provinces. The connection between the Skoda plants in Pilsen and Austro-Daimler in Wiener Neustadt is intended to point out the interconnections between the two plants in terms of personnel and capital.

Innovationen aus der Provinz

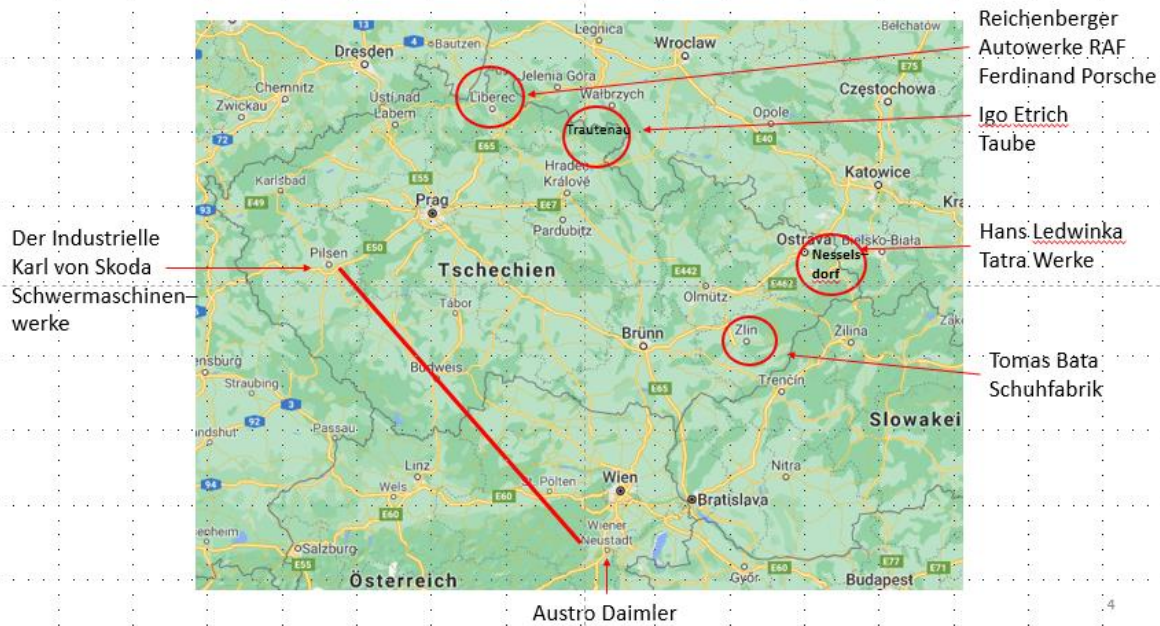


Figure 1: Innovation events in Austria, Bohemia and Moravia. The map is based on Google Maps.

In Bohemia and Moravia, the Skoda heavy machinery and armaments factory in Pilsen, the Nesselsdorf automobile factory near Ostrava and the Bata shoe factory in Zlín are particularly noteworthy. They formed a focal point of "Czech Modernism", which also included Czech art, the literary activity of Franz Kafka in Prague and the life of the mathematician Kurt Gödel from 1906 to 1923 in Brno.⁵ After the disintegration of Greater Austria in 1918, the emergence of the new state of Czechoslovakia in 1918 was associated with deep grievances against the old powers and met with massive anti-Czech propaganda by national-conservative politicians in Germany, Austria and Hungary, which obscured the top achievements of Czech modernism. Also 40 years of communist rule in Czechoslovakia, during which the Pilsen Skoda Works had been renamed Lenin Works, contributed to the oblivion. The communists also renamed the Bata shoe factory to Svit, thus erasing the Bata brand name. Czechoslovakia's deliberate turn towards modernity can also be seen – this will be formulated here as a preliminary thesis – as a cultural demarcation from the traditional appearance of the former superpower Austria.

The innovation events in Austria and the Czech Republic are to be characterized here by the generic term "Austro Moderne". However, Austro Moderne also took place in Germany. Here, the development laboratory of Ferdinand Porsche in Stuttgart and the production of airplanes and the Tropfenwagen of the Viennese designer Edmund Rumpler in Berlin are to be emphasized. The aim of the paper is to make the top achievements visible again. To this end, the comprehensive concept of Austro Moderne is developed, something that had previously been lacking in standard works on the history of automobiles and aircraft.⁶ An important theme of the modern era was the pursuit of

speed. In this paper, too, races and competitive flights are at the center of the discussion. Ferdinand Porsche was virtually obsessed with developing racing cars.

This text is based on the evaluation of the available literature on the biographies of the industrialists and inventors as well as on the publications of the automobile magazine "Allgemeine Automobil Zeitung" (hereinafter AAZ) published in Vienna and the magazine of the ADAC (Allgemeiner deutscher Automobilclub), the "ADAC Motorwelt" published in Munich.⁷ The reports of the daily newspapers on the automobile exhibitions in Prague, Vienna and Berlin were evaluated. The available biographies often show an inability to take a broader view of Austro Moderne. For example, the extensive Rumpler biography by Jörg Kranzhoff (2004) avoids this topic completely, just as the biographical sketches by Erich Ledwinka (1985) do not draw any cross-references among the inventors, for example between Porsche and Ledwinka.

2 Ferdinand Porsche at Austro Moderne

Ferdinand Porsche, who was born in Maffersdorf, near the North Bohemian town of Reichenberg (since 1919: Liberec), in 1875, was a leading figure of Austro Modernism.⁸ Reichenberg was not only characterized by textile factories but later also the location of the Reichenberg Automobile Factories (RAF), which produced a wide range of passenger cars and trucks since 1907, and the North Bohemian Automobile Club.⁹ Reichenberg shone in the 1920s with an ultramodern flagship store of the Bata shoe factory on Tuchplatz (compare Figure 20 below). Porsche came into early contact with the electrification wave of the late 19th century. His father's plumbing business laid electricity networks in private houses. In Reichenberg, he attended a course on electricity at the local trade school.¹⁰ He pursued early automotive interests when, in Maffersdorf, he used a spring balance to determine the required tractive force of horse-drawn vehicles.¹¹ Porsche took up an apprenticeship in 1893 at the Vienna company Vereinigte Elektrizitäts AG Bela Egger, where he quickly rose to become head of the test room and assistant in the calculation office. At the same time, he became a guest student at the Technical University of Vienna.¹²

At the end of the 19th century, the Viennese carriage manufacturing company Jacob Lohner & Co initially experimented unsuccessfully with gasoline- or diesel-powered carriages and then switched to electrically driven carriages in collaboration with Vereinigte Elektrizitäts AG. It was there that Ludwig Lohner, the owner of Jacob Lohner & Co, met Ferdinand Porsche, hired him to head engine development at his company in 1897, and sent him to Paris for automotive training. France was the leading automobile country in Europe until 1914.¹³ In 1899, Porsche applied for a patent in Vienna for the extremely innovative concept of an electric wheel hub motor for vehicles, which made power transmissions and gearboxes superfluous and sat directly in the wheel hub. The motor was first used when Porsche developed a 5 hp battery-powered electric passenger car, known as the "System Lohner Porsche," in Ludwig Lohner's company, with both wheel hub motors of 2½ hp each driving the front wheels. For a short time, the motors could even be overloaded to 7 hp each. The

car was an exhibit in the Austrian pavilion at the 1900 Paris World's Fair and was hailed by the exhibition manual as an "epoch-making innovation."¹⁴ The car was marketed as an elegant city car. This electric passenger car was followed by gasoline-electric hybrid cars to increase range.¹⁵ However, the wheel hub motor could not keep up with the increase in performance of gasoline engines, and this market segment had to be abandoned in favour of the gasoline engine. The Lohner company maintained the best contacts with the court, as evidenced by the fact that Ferdinand Porsche, as driver, was able to demonstrate the Porsche Mixte car to the heir to the throne, Archduke Ferdinand, during the 1902 imperial maneuver.¹⁶

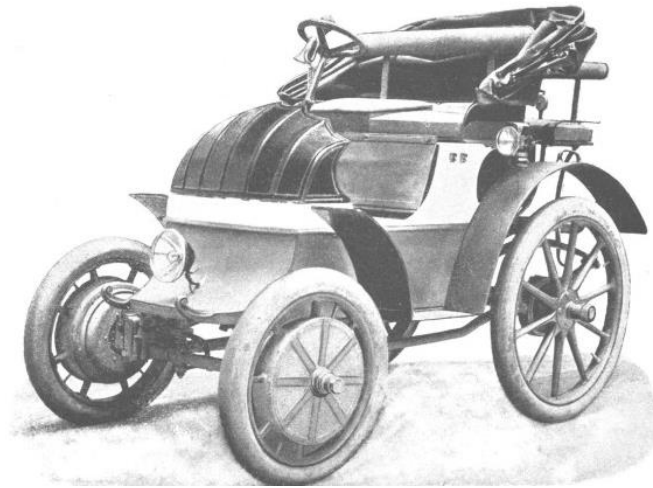


Figure 2: Battery-powered car by Lohner with wheel hub motor of the year 1900.¹⁷

At the Lohner company, Porsche supervised production to ensure the highest quality. The workshops were located in the industrial town of Floridsdorf near Vienna, which was also the center of locomotive construction, and were divided into a locksmith's shop, wainwright's shop, forge and foundry on 38,000 square meters. With the exception of tires and accumulators, the company produced everything itself. The following picture shows a view into the department for wheel hub motors, where the most modern American machine tools were installed.¹⁸

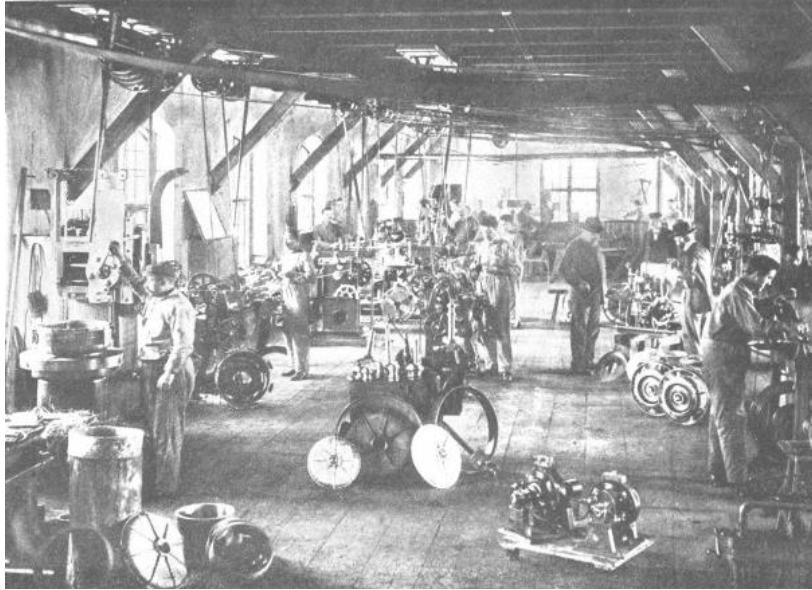


Figure 3: View of electric motor production at Lohner's plant in 1901. ¹⁹

After working for the Lohner car manufacturing company, Ferdinand Porsche moved in 1906 to the Österreichische-Daimler-Motoren-Gesellschaft m.b.H. car factory in Wiener Neustadt, which had been founded by the Stuttgart Daimlerwerke as an Austrian branch in 1899 in a different corporate form. Since 1900, this company had produced Daimler automobiles, which had been manufactured entirely in Wiener Neustadt. ²⁰ In 1906, this company changed its name to Österreichische-Daimler-Motoren-Gesellschaft m.b.H., in which the Stuttgart parent company Daimler held a 25% share, and from 1908 onwards gave itself the marketing designation "Austro-Daimler", partly in order to gain better access to procurement orders from the Austrian military. As stipulated in the 1908 shareholders' agreement, Ferdinand Porsche was appointed as Technical Director and Wilhelm Strauss, who had come as "Factory Director" from the Skoda engineering and arms manufacturing company in Pilsen, was appointed as Managing Director. ²¹ This is how Austro-Daimler's first relations with Pilsen developed. Camillo Castiglioni became director of Austro-Daimler in 1909. ²²

Austro-Daimler's production range also included racing cars, trucks, buses and fire engines, some of which were equipped with electric hub motors. In order to achieve larger series and stimulate technical progress, the Stuttgart parent company passed on orders for trucks addressed to it to Austro-Daimler for production. ²³ With the development of racing cars, Porsche succeeded in gaining recognition for Austro-Daimler's technological status among international experts. Austria drew level with the leading automobile country, France, where Porsche was still in 1897 for automotive training. At the third Prinz Heinrichfahrt in 1910, which covered 1900 km from Berlin to Nuremberg, Strasbourg and Bad Homburg, Austro-Daimler racing cars took the three first places. ²⁴

Unlike the German military, Austria relied on a fleet of motorized trucks, known as trains, for supplies and on motorized artillery even before 1914. As early as 1902, the army made test runs

with Austro-Daimler trucks from Vienna to Przemyk and Krakow. ²⁵ The Austrian Army encouraged the cooperation of the Bohemian Skoda concern, which manufactured heavy guns in Pilsen, with Austro-Daimler, where motorized tractors for heavy guns were to be developed. For the cooperation, Skoda and Austro-Daimler established a community of interest in 1911. ²⁶ While working at Austro-Daimler, Porsche developed another application of his electric wheel hub motor for the Austrian army. He incorporated the wheel hub motor into a road train for the Austrian Army in 1913 that was gasoline-electric powered (a 150 hp gasoline engine drove a generator) and could carry supplies as well as heavy weapons by both road and rail. ²⁷ Neither the German military nor the German railroad companies ever had a comparable train. The following illustration shows the train in 1914.



Figure 4: Porsche's gasoline-electric road train in 1914. ²⁸

The engineering and arms manufacturing group Skoda in Pilsen transformed its cooperation with Austro-Daimler into a group company and thus expanded its product range in the direction of the automotive industry. The Czech industrialist Karl von Skoda from Pilsen, the owner of Skoda-Werke, acquired the shares of Stuttgart's Daimler Werke in Austro-Daimler in 1912 and appointed Porsche as general director of Austro-Daimler. In the 1920s, when the Czechoslovak car industry was struggling with sales problems as a result of the new customs borders created since 1918 and had to merge, Skoda bought up the well-known Laurin & Klement car plants in Jungbunzlau (from 1919: Mladá Boleslav), 60 km northeast of Prague, which had already taken over the Reichenberger Automobilfabriken (RAF) in 1913, in 1925 and changed the Laurin & Klement brand name to Skoda.²⁹ The Skoda engineering group thus now also owned an automobile branch within Czechoslovakia.

When Porsche began designing the Volkswagen in his development laboratory in Stuttgart in 1934, the Volkswagen project was one among many other commissions from his office, which had previously worked out Volkswagen-like studies for NSU and Zündapp. But unlike those projects, the interests involved in the Volkswagen project were diffuse and conflicting. The project spun off among numerous interest groups, including the major German automakers, the Reichsverband der Deutschen Automobilindustrie as the formal client, the Reich Ministry of Transport, and Hitler's directive to implement a sales price of 1000 Reichsmarks. The automakers feared unwelcome

competition in the new Volkswagen and therefore pursued the project rather dilatorily. All attempts to find a way to realize the low selling price of 1000 Reichsmarks failed, as neither the upstream suppliers were willing to grant tangible discounts for the production of the Volkswagen, nor were solutions to reduce costs by downsizing the design successful. Porsche relied on cost advantages through large-scale production based on the model of Ford's factories, which he had been able to study during visits to America.³⁰

In the years 1934 to 1937, Porsche assembled many employees from Austro Moderne in his Stuttgart design office as senior designers for the Volkswagen.³¹ For example, the designer of the famous four-stroke boxer engine for the Volkswagen, Franz Reimspieß, came from Austro-Daimler. Porsche had actually intended a two-stroke engine for the Volkswagen, which would have been simpler in design and cheaper to produce. However, during test drives, this engine did not prove to be capable of continuous high speed operation on the new autobahn. The autobahn posed a challenge for many car plants, as the engines did not prove to be "autobahn-proof".³²

Ferdinand Porsche abandoned his role as an apolitical designer of Austro Moderne when he gained personal access to Hitler in 1934, rising to become a leading figure in the Nazi power apparatus to push through the Volkswagen project against the reluctant German auto industry. He even renounced his Czechoslovakian citizenship in 1934 at Hitler's request to appear Nazi compliant.³³ In his speech at the Berlin Auto Show in February 1936, Hitler praised him as a brilliant designer.³⁴ On July 11, 1936, Porsche demonstrated a prototype of the Volkswagen to Hitler and his entourage in the Obersalzberg decision-making arena typical of the Nazis. Porsche and his son-in-law Anton Piëch held the top positions as managing directors at the Volkswagen plant built in Wolfsburg in 1938 until 1945;³⁵ Porsche ruled over the largest automobile plant in Europe, which had, however, produced only a few motor vehicles until 1945.

4 Aircraft development at Austro Moderne

The fields of innovation in vehicle and aircraft construction overlapped around 1910. Both the automobile and the aircraft required gasoline engines. Many entrepreneurs and inventors in the automotive sector turned to aircraft construction.³⁶ The automobile as an adventure machine was supplemented by the airplane as an adventure machine, and racing drivers mutated into airplane pilots. This development could also be observed internationally in France and Germany. As a result of its leading position in the construction of gasoline engines, France was also the European leader in aircraft construction. The Frenchman Blériot crossed the English Channel for the first time in 1909 with his plane Blériot XI. Since 1909 public demonstrations and competitions took place in France (in Reims) and in Germany (in Berlin-Johannisthal), in Austria since 1910 (Flugfeld Wiener Neustadt), which were called "Flugtage", after a German airplane could only perform a short aerial jump at a Flugtag in Kiel in 1908.³⁷ Developments in the construction of airships and airplanes overlapped. Initially, airship construction led the way, but it was overtaken by aircraft construction

from 1910. Airplanes proved to be faster and more maneuverable than airships, they were easier to launch and were less sensitive to winds.

The network around Ferdinand Porsche expanded to include inventor Igo Etrich, industrialist Edmund Rumpler, and financial investor Camillo Castiglioni. The requirements for aircraft engines were different from those for automobile engines. The engines had to be lightweight and ensure continuous operation for several hours without failure. The AAZ took account of the expansion of the field of innovation from automobile to aircraft construction when it carried the subtitle "Allgemeine Flugmaschinen-Zeitung" from November 28, 1909. The following illustration shows the advertising for aircraft engines by the Vienna branch of Automobilwerke Karl Benz from Mannheim and proves their turn to the aircraft sector.

Austro-Daimler also became involved in the aircraft business, which was initially limited to airships for the military, and founded Motor-Luftfahrzeug GmbH in 1909 together with the balloonist and director of the Österreich-Amerikanische Gummiwerke in Vienna, Camillo Castiglioni. On the strategic level, Camillo Castiglioni established links with the financial world. He raised capital and developed strategies for setting up and managing companies, drew up visions for the aircraft industry, and in 1909 became a director of Austro-Daimler. It was thanks to his foresight that the provincial town of Wiener Neustadt created Austria's first airport ("Flugfeld"), where Etrich and Porsche worked together, and Austro-Daimler became a leader in the construction of aircraft engines.³⁸ Following on from Witte's theory of a team of promoters, the interaction between Porsche, the technical innovator, and Castiglioni, the strategic innovator, explains the success of Vienna's unique innovation network around 1910. The joint, sensational sightseeing flight around Vienna's St. Stephen's Cathedral in the first Austrian military airship "Parsifal" by Porsche and Castiglioni on December 4, 1909, throws light on this interaction.³⁹

Flight of Porsche and Castiglioni around St. Stephen's Cathedral on December 4, 1909

The airship's usefulness to the military was limited, however, because airships were not allowed to fly in strong winds. A windless day had therefore been chosen for the demonstration flight of the "Parsifal". In addition to Castiglioni, Ferdinand Porsche was also on the board of Motor-Luftfahrzeug Gesellschaft, which produced airships for the military, with Austro-Daimler developing and manufacturing the engines and Österreich-Amerikanische Gummiwerke supplying rubber sheets for the airships. Motor-Luftfahrzeug GmbH produced military aircraft from 1915 as Österreichische Flugzeugfabrik AG (OEFFAG) with the participation of Skoda in Wiener Neustadt.⁴⁰ Likewise, the Viennese company Lohner expanded its program from vehicle construction to aircraft construction and now called itself "Wiener Aeroplan- und Carosseriewerke Jacob Lohner & Co". Igo Etrich had his pigeon (Taube) produced there from June 1910.⁴¹ The Lohner aircraft works developed a biplane with angled wings called the "Lohner-Daimler Pfeilflieger" and equipped with a 60 hp engine from Austro-Daimler. On June 22, 1911, it became the first aircraft to fly the Vienna-

Budapest route without a stopover. The flight took Rittmeister von Umlauff two hours and 22 minutes and he won the prize money of 10,000 crowns. It was about twice as fast as the Orient Express from Vienna to Budapest, as the AAZ pointed out in its report. ⁴²



Figure 5: Benz company advertising for aircraft engines. ⁴³

Igo Etrich, born in 1879 in the Bohemian town of Trautenau (from 1919: Trutnov) as the son of a textile manufacturer, first experimented with flying gliders based on Otto Lilienthal's principle with his father in Trautenau before designing a motorized Etrich I aircraft in Vienna, which made its first ascent on the Wiener Neustadt airfield on November 29, 1909.⁴⁴ This ascent represented the first ever powered flight in Austria by an Austrian aircraft.⁴⁵ In his autobiography, Etrich noted that he would have put his father's considerable sum of about 200,000 gold crowns into the project. The improved version of Etrich I, the Taube, made its breakthrough in 1910. The Taube was not merely a copy of a Western aircraft type, but an innovation in its own right. It was widely recognized in Austria and Germany as a reliable aircraft that was not very sensitive to crosswinds and was also widely copied as a military aircraft. "Germany was in a state of pigeon fever," found Rumpler biographer Jörg Kranzhoff. ⁴⁶

The pigeon first soared in May 1910 at the Wiener Neustadt airfield and was equipped with a 40 hp engine from Clerget.⁴⁷ It was at this airfield that Ferdinand Porsche expanded his network and, as a

member of the airfield committee, made contact with Igo Etrich, who commissioned him to equip the aircraft with a light, powerful and reliable gasoline engine from Austro-Daimler.⁴⁸ Etrich's pigeon took part in the Kaiserflugtag in Wiener Neustadt on September 18, 1910 - as the following illustration shows - where other designs of flying machines were also on display. Ludwig Lohner, Ferdinand Porsche and Igo Etrich gathered in front of the Emperor's box and were presented to the Emperor. The Emperor expressed his satisfaction that the first engine flight in Austria had been made by an Austrian pilot on an Austrian flying machine (meaning the Etrich I). When asked, Porsche was able to tell the Emperor that his company, Austro-Daimler, was equipping numerous aircraft with engines.⁴⁹ Igo Etrich's pilot, Karl Illner, completed a flight from Vienna to Horn and back on October 10, 1910, covering a total distance of 160 km.⁵⁰ This won him the prize money of 20,000 crowns from the city of Vienna. When Illner took off for his flight on the Simmeringer Heide, Ferdinand Porsche was also registered as a spectator.⁵¹

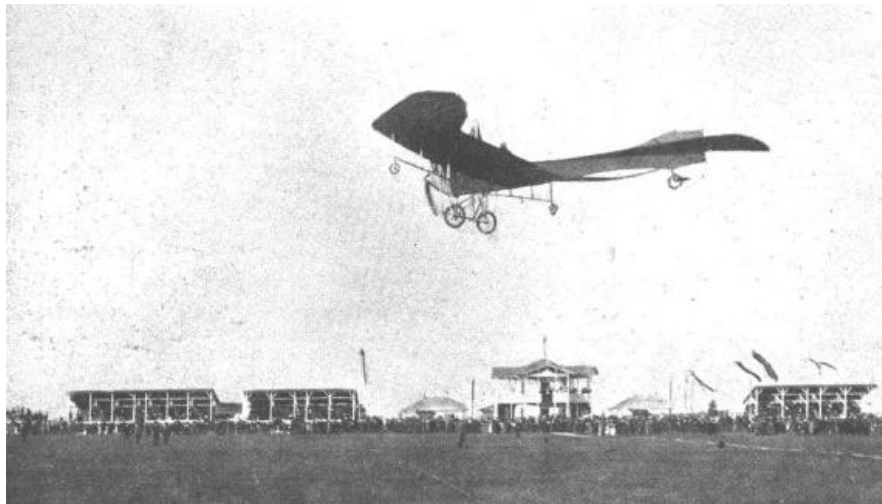


Figure 6: The pilot Karl Illner in the Etrich-Taube at the Kaiserflugtag on September 18, 1910. in Wiener Neustadt.⁵²

The influences of Austro Moderne radiated to Berlin when the aircraft industry developed there at the beginning of the 20th century. The following illustration shows an invitation to the first public flying day at Berlin-Johannisthal airfield on the occasion of its opening on September 26, 1909.



Figure 7: Poster for the opening of the Berlin-Johannisthal airfield in 1909 ⁵³

The person of Edmund Rumpler shows the connections from Berlin to Austro Moderne. Rumpler, born in Vienna and trained as an engineer there and working as engineer in Nesselsdorfer automobile works in Moravia, took the decision to become active in the new business field of aviation in Berlin. He developed the six-cylinder Aeolus aircraft engine in 1907 and founded the company "Edmund Rumpler - Luftfahrzeugbau" in Berlin in 1908. In 1910, he signed a license agreement with Igo Etrich for the reproduction of the Taube at the Berlin-Johannisthal airfield. ⁵⁴



Figure 7A: Rumpler (left) and Etrich (center) in front of a pigeon at the Berlin-Johannisthal airfield in 1910 ⁵⁵

However, the first two pigeons to soar there had been brought disassembled by train from Vienna to Berlin. This shows Austria's leading role in aircraft construction. Rumpler terminated the license agreement in 1911 and doubted Etrich's invention contribution to the pigeon. Etrich subsequently failed to obtain protection for his invention in Germany at the German Patent Office. ⁵⁶

Etrich's Taube was easy to fly because it was not very sensitive to crosswinds. This contributed to its great success in Germany as well. By 1914, the German military had equipped about 50% of their aircraft with the Taube model. The Taube also caused a sensation when the aviator Hellmuth Hirth won a prize of 50,000 marks offered by the Kathrein coffee company in June 1911. He was the first aviator to fly the 540 km distance from Munich to Berlin in less than 6 hours. After the initial successes of the pigeon, however, it turned out that it was difficult to maneuver when it came to conducting aerial combat in wartime conflicts. ⁵⁷

The aircraft manufacturer Edmund Rumpler, who was now able to reproduce the Taube license-free, received numerous orders for the Taube from the German military. Other aircraft factories in Germany also participated in the construction of the pigeon, such as the Deutsche Flugzeugwerke in Leipzig and the Kondor Flugzeugwerke in Essen. ⁵⁸ The following picture shows Rumpler Flugzeugwerke with completed pigeons in Berlin-Johannisthal in 1913.

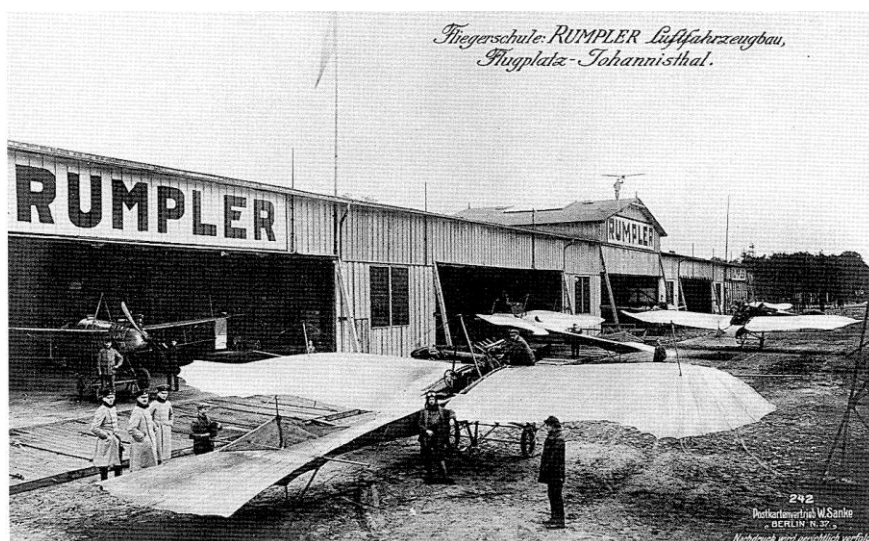


Figure 8: The Rumpler Flugzeugwerke in Berlin-Johannisthal in 1913 (postcard). ⁵⁹

In order to participate in the business of aircraft for the German army, Igo Etrich founded the Brandenburgische Flugzeugwerke in Briest near Brandenburg on April 1, 1914, together with local investors, and produced the technically superior biplanes there. The designer and managing director was Ernst Heinkel, who founded his own aircraft company in Rostock in 1922. The financial investor Camillo Castiglioni – previously a business partner of Igo Etrich with his company Motor-

Luftfahrt-Gesellschaft in Vienna – merged various aircraft companies in Germany and Austria into one group and bought the Brandenburgische Flugzeugwerke in 1915. ⁶⁰

Rumpler died of natural causes in Berlin in 1940. As a person of Jewish origin, he was threatened with persecution by the National Socialists. However, he was under the personal protection of Aviation Minister Göring, who had flown Rumpler's aircraft in the First World War. A memorial plaque at Dernburger Strasse 9 in Berlin commemorates his home.



Figure 9. Rumpler Memorial plate in Berlin

5 The designer Hans Ledwinka at Tatra

An outstanding figure of Austro-Modernism is Hans Ledwinka, whose work was honored by the Technical Museum Vienna in an exhibition in 1978.⁶¹ Like Porsche, he also received an honorary doctorate from the Technical University of Vienna. He became chief designer of the "Wagenbau-Fabriks-Gesellschaft" in Nesselsdorf (from 1919: Koprivnice), 20 km south of Moravian Ostrava, in 1921. Like Edmund Rumpler, Ledwinka grew up near Vienna and received a technical education in Vienna. He worked intermittently as a designer at the Nesselsdorf wagon factory from 1897, where he met Edmund Rumpler, who designed the first Austro-Hungarian automobile to be built in series there in 1898 – a vehicle called the President. ⁶² In 1906 Ledwinka was appointed head of the automobile department of the Nesselsdorfer Wagenbau-Fabriks-Gesellschaft.⁶³ The director of the Nesselsdorfer Wagenbau-Fabriks-Gesellschaft, Hugo Fischer von Röslerstamm, was in close contact

with Ludwig Lohner in Vienna. Both were founding members of the Austrian Automobile Club, which supported the network of innovators. ⁶⁴ Thus, Nesselsdorf is an important node in the network of innovators. The following illustration shows a view of the Nesselsdorf car plants in 1900.



Figure 10: Advertisement of the Nesselsdorf car works in 1900. ⁶⁵

In 1923, the Nesselsdorfer Wagenbau-Fabriks-Gesellschaft merged with the Ringhoffer AG wagon factory located in the Prague district of Smichov and appeared with the Tatra brand name. Initially, the new company was based in Vienna, which was later moved to Prague. ⁶⁶

The biographies of Porsche and Ledwinka show remarkable parallels. Both were rather self-taught without engineering studies at the TH Wien. Both received an honorary doctorate from the TH Wien, Porsche in 1917 during WW1, Ledwinka in 1944 during WW2, probably for their involvement in the armaments production of their respective plants. For his cooperation with the German occupation forces, Ledwinka was sentenced to prison in Czechoslovakia in 1948.

Before Ledwinka returned from Autowerke Steyr to the Nesselsdorf car factory as chief designer in 1921, he checked the tensions between the German and Czech ethnic groups in the factory with a visit. There, the workforce of 3000 was 75% Czech. ⁶⁷ While until 1918 Germans formed the elites in the economy and administration of Bohemia and Moravia and German was the official language, while Czechs vainly demanded national autonomy in the Austrian Empire, after 1918 relations between the two ethnic groups turned around and Germans had to submit to Czechs. ⁶⁸ In 1923, Ledwinka brought out the Tatra 11 small car, which, including its successor, the Tatra 12, was successfully built in numbers of 25,000 until 1930. With its air-cooled boxer engine, it already possessed an important element of the later Volkswagen. ⁶⁹ In order to secure sales in Austria, which was shielded by protective tariffs, Tatra built an assembly plant there in 1921. Similarly, the sales company Detra, including an assembly plant, was founded in Frankfurt a.M. for the German market. ⁷⁰ In the 1930s, Ledwinka designed a four-axle, 72-seat gasoline-electric high-speed railcar, which began running in 1935 as the "Slovak Arrow" on the 400-km route between Prague and Bratislava, reaching 130 km/h. The train's speed shrank from one to two hours. Travel time shrank from 7 hours to 4 ½ hours. ⁷¹

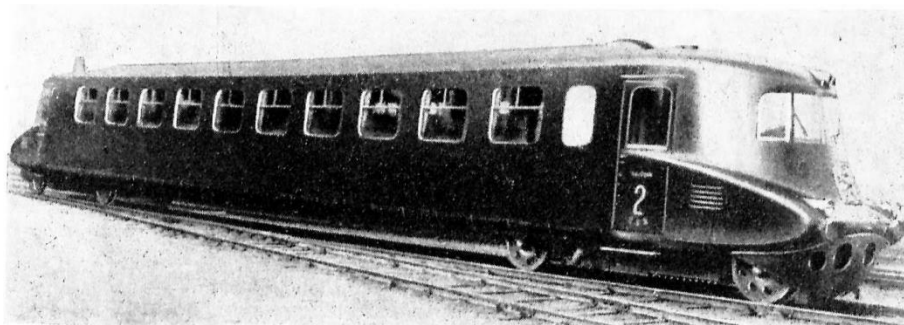


Figure 11: The Slovak Arrow of Tatra. ⁷²

Hans Ledwinka's Tatra 77 automobile became his masterpiece and an icon of Czech modernism. Specimens of its successor Tatra 87 are in the Museum of Modern Art in New York and the Pinakothek der Moderne in Munich, and in many technical museums around the world, such as the National Museum of Technology in Prague and the Transport Center of the Deutsches Museum in Munich, from which the following image is taken.



Figure 12: Tatra 87 in the transport center of the German Museum in Munich

Source: Wiki commons.

The Tatra 77 was not merely a catch-up modernization of Western models, but was also considered a technological tour de force in the West. When the Moravian Tatra works launched its innovative Tatra 77 in 1934, it caused quite a stir at the motor shows in Paris, Prague, Vienna and Berlin. Tatra confidently displayed a red-painted example of the Tatra 77 at the 1934 Vienna Motor Show.⁷³ For the first time, the Tatra 77 combined the design principles of streamlined shape (with an extravagant tail fin), rear engine, and air cooling in a serial production vehicle - "a car so completely different from the norm," as the Prague Daily Gazette found on March 6, 1934, on the occasion of the Prague Motor Show – principles later found in Ferdinand Porsche's Volkswagen. The AAZ emphasized the streamlined shape and spoke of a "fully streamlined car."⁷⁴ The fact that it achieved a top speed of 145 km/h with an engine of just 60 hp was even considered a sensation! The German press also spoke favorably of the Tatra 77, which was exhibited at the Berlin International Automobile and Motorcycle Exhibition in March 1934 on the Tatra stand between the Ford and GM stands. The "peculiar design attracted general interest," noted the Berliner Morgenpost on March 16, 1934, adding that the car was built "in almost perfect streamlined form." The Tatra chief designer, Hans Ledwinka, was able to demonstrate the rear engine of the Tatra 77 to Hitler at the International Motor Show in Berlin on March 4, 1934.⁷⁵ The AAZ called the Tatra 77 the best piece of this exhibition. The Tatra 77 with two front headlights was built in a run of just 105 units until 1935. Despite its avant-garde design, the Tatra 77 had constructional shortcomings. It was built as a wooden body on a tubular steel frame and weighed almost two tons. Only the Tatra 87 used the lightweight construction of a self-supporting steel body.

The successor type Tatra 77a with three front headlights and three seats per row was produced in the years 1935 to 1936 in a run of only 150 copies. The driver's seat was provided in the first row in

the middle. This was an uneconomical small series. Here Ledwinka also resembles Porsche, both of which tended to expensive experimental studies. The successor to Tatra 77a, the Tatra 87, also with three front headlights (but only two seats in each row), was produced from 1936 through all the economic, social and political turmoil of the war and post-war period until 1950 in a run of over 3000 units. 76

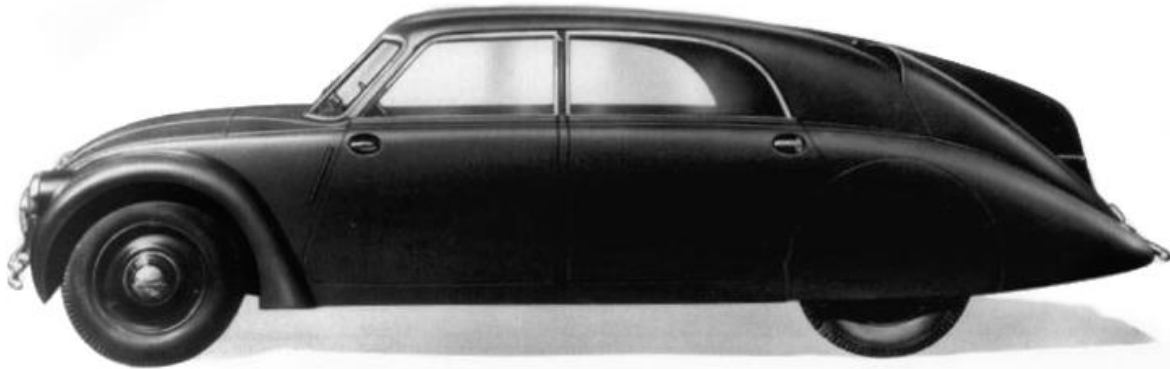


Figure 13: The Tatra 77 - The Icon of Czech Modernism (Source: Wiki Commons).

The successor model Tatra 87 was built until 1950.

Hardly any biographies address the question of the relationship between Ledwinka and Porsche. Only Schmarbeck states that there were no formal relations, but that the two designers knew each other well and held discussions and exchanged ideas at trade fairs and car races.⁷⁷ The following illustration shows Porsche and Ledwinka as joint visitors to the 1935 Masaryk Race on the Masaryk Ring near Brno. The Ring was opened as a race track in 1930 and named after the first president of Czechoslovakia, Tomas Masaryk.



Figure 14: Porsche and Ledwinka at the Masaryk Race near Brno in 1935, together with the Czechoslovak racing driver Elisabeth Junek. ⁷⁸

6 The role of the streamline in Austro Moderne

The literature has not yet examined the role of the streamline in Austro Moderne.⁷⁹ It is true that the Tatra 77 was the first production vehicle to combine the features of streamlining, rear engine and air cooling. However, the discussion about the streamline shape in aircraft and automobile construction already dominated the entire 1920s. Because of the ban on aircraft production in Austria and Germany under the Paris Preliminary Agreements, many aircraft factories turned back to automobile production after 1918 and pushed the issue of streamlining.

The first to apply the streamlined shape from aircraft construction to automobiles were Paul Jaray and Edmund Rumpler. They thus demonstrated the leading role of Austro Moderne. Both of their lives show remarkable parallels. Both came from Vienna and received their technical training there. Both worked in aircraft construction before 1918. Jaray applied for a patent on the "streamlined car" in 1921. This was opposed by Rumpler, who claimed the invention of the streamline for himself and sued Jaray.⁸⁰ Jaray exploited his streamline patents in exploitation companies in Geneva and New York and provided impetus for the design of the Tatra 77.⁸¹ To market his patents, he listed a total of 40 advantages that the streamline made possible in automobile construction. The first two were: A reduction in the required operating materials by 25% to 45%. Further: An increase of the maximum driving speed by 15% to 25%.⁸²

Edmund Rumpler – with his experience as an aircraft manufacturer— turned away from the usual construction designs for automobiles and introduced the streamline of the body as a design

principle. In September 1921, he presented his "Tropfenwagen" (waterdrop car) at the Berlin Motor Show and caused quite a stir, as the AAZ pointed out in its report on the show.⁸³ On his advertising postcard shown below, Rumpler claimed: "They fly".

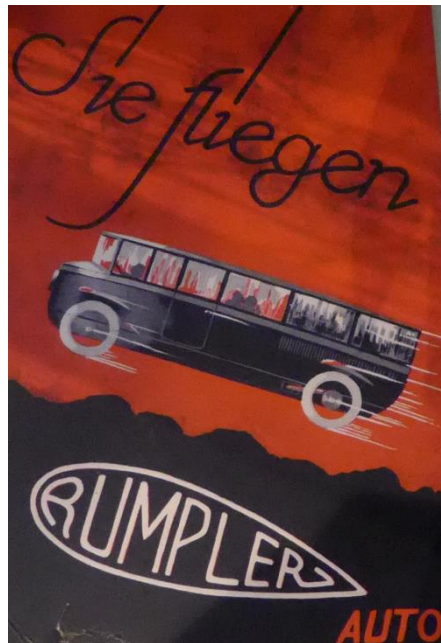


Figure 15: Rumpler advertising postcard 1925⁸⁴

The body tapered to a point at the rear like a waterdrop. The drop car was the first car to have a curved windshield. In the body he placed the elements: The car could seat 4 to 5 people in the front, while the engine was located in the rear. Instead of fenders, horizontal fender deflectors were mounted, which looked like stubby wings and gave the car a futuristic design. The following picture shows the drop car.⁸⁵



Figure 16: Rear of the Rumpler drop car (Deutsches Technikmuseum Berlin, photo private 2015).

Rumpler had the Tropfenwagen produced in his workshops in Berlin-Johannisthal and licensed it to Benz-Motorenwerke in Mannheim, which produced a racing car in the shape of a waterdrop in 1923, the Benz RH 35.⁸⁶ Rumpler was unable to achieve market success with the Tropfenwagen because the engine was considered unreliable and the car had too high a selling price. Even a more moderate version with curved fenders, which he had produced starting in 1923, did not bring success. In 1925, he ceased production and his backers lost their capital. In 1926, the film director Fitz Lang, who came from Vienna, was able to use the cheaply acquired remnants of the Tropfenwagen to add futuristic elements to his film *Metropolis*.⁸⁷

In 1934, Ferdinand Porsche brought out a racing car for the Autounion, built at the Horch works in Zwickau, which combined the features of streamlining and rear engine. The following illustration shows this car. Hitler's government had subsidized with three hundred thousand Reichsmarks this design, known as the "P-Wagen." As the Porsche biography by Pyta et al. attests, Porsche, in a delegation from the Autounion, held a meeting with Reich Chancellor Hitler on May 10, 1933, to solicit subsidies for the construction of the racing car. With a technical presentation on shifting the focus of the planned racing car to the rear, the maverick Porsche was able to impress the eccentric Hitler and persuade him to divide the subsidies for racing car construction, which were actually intended for Daimler, between Daimler and Autounion.⁸⁸ For the designer Porsche with his office in Stuttgart, the development of the racing car within a year was a logistical challenge of distributed locations, because the construction of the car took place in the Horchwerke in Zwickau, but the testing of the car took place on the Nürburgring. The first public presentation was again in Berlin at the AVUS on January 12, 1934.

Porsche staged a publicity coup with the demonstration of the P-Wagen. At first glance, the date of Friday, January 12, 1934, was in the middle of winter and unfavorable for the demonstration of a racing car. Nevertheless, racing driver Hans von Stuck took the P-Wagen out for a test drive on the Avus in Berlin in front of selected Nazi officials who had gathered at the South Curve. Hitler had also announced himself as a spectator. The Saturday editions of the Berlin press reported in detail on the test drives on the Avus ("great Avus sensation").⁸⁹ This gave Porsche an image boost shortly before Hitler's speech at the upcoming Automobile Exhibition in Berlin in February 1934 and drew attention to his design office. Porsche linked the two opposing market segments of the racing car and the Volkswagen when he immediately used the image gain he had achieved to draft an exposé on the planned Volkswagen for the Reich Ministry of Transport on January 17, 1934, combining the streamlined form of the racing car with the Volkswagen. In the exposé, Porsche envisaged giving the Volkswagen a streamlined shape as well. In fact, Porsche had the body of the Volkswagen tested in the wind tunnel in Berlin-Adlershof.⁹⁰ As early as 1911, during test drives with an Austro-Daimler racing car, Igo Etrich, drawing on his experience as an aircraft designer, gave Ferdinand Porsche a hint about the reduction of air resistance in the case of tapering rear sections. Porsche followed his advice and was able to increase the top speed of the racing car from 130 km/h to 160 km/h with an appropriately shaped tail section.⁹¹

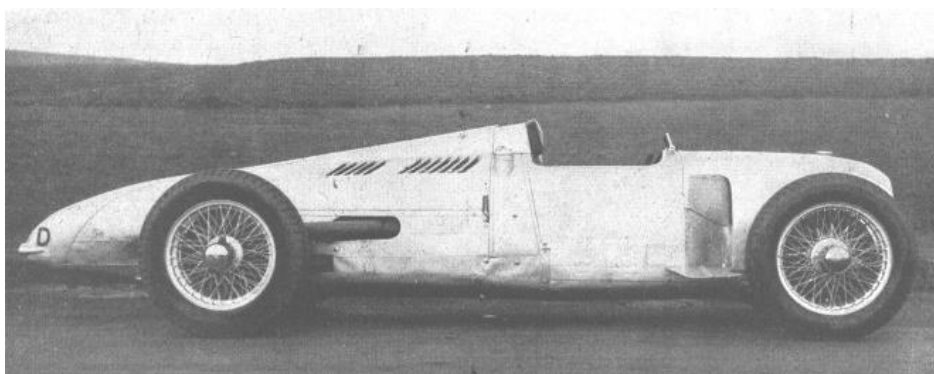


Figure 17: Porsche's design of a racing car for the Auto-Union in streamlined form in 1934.⁹²

At the Berlin International Automobile and Motorcycle Exhibition in March 1934, not only did the Tatra 77 appear in streamlined form, but also a four-cylinder DKW, the shape of which "approximated the complete streamline," as the Berliner Morgenpost wrote on March 16, 1934. The following illustration shows the DKW.

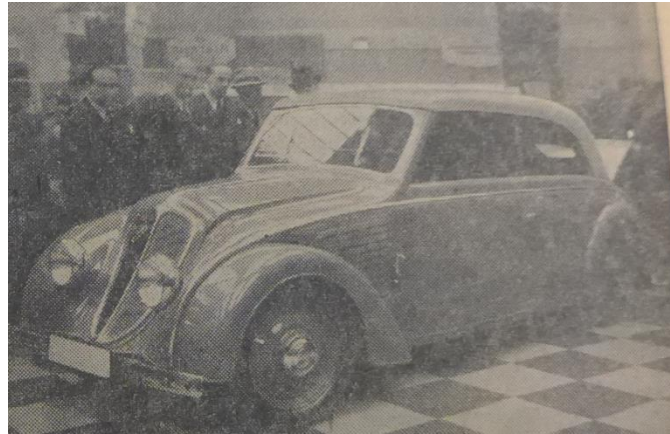


Figure 18: The DKW in streamlined form at the Berlin International Automobile and Motorcycle Exhibition in March 1934.⁹³

However, the general public was initially unwilling to accept streamlined cars. Rather, conventional car bodies predominated in the 1920s. The following illustration shows a new design from the Nesselsdorfer Autowerke in 1921.

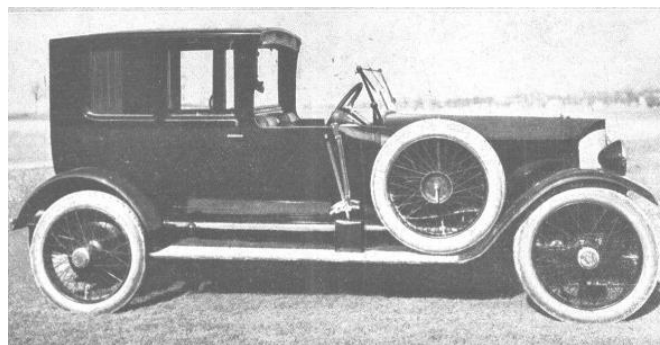


Figure 19: Conventional design of the car from the Nesselsdorf car works in 1921 as a coupe limousine.⁹⁴

Even at the Berlin International Automobile and Motorcycle Exhibition in March 1934, the public still "rejected so-called streamlined cars as unattractive," as the Berliner Tageblatt pointed out in its trade fair report on March 8, 1934.

Forerunners of the streamlined cars could already be observed before 1915. In 1914, the Italian Count Marco Ricotti gave the Alfa Romeo 40-60 HP automobile, following the approaches of Italian Futurism, a closed streamlined aluminum body called Aerodinamica.⁹⁵ In 1913 in Vienna appeared an automobile in closed zeppelin form, the 35/75 HP Charron.⁹⁶ Also, in 1914, experiments were conducted in Vienna with tapered tail shapes to reduce drag.⁹⁷ Likewise, experiments with the streamlined shape were carried out in Germany. One example is Max Lochner's "Opel Egg" from 1912.⁹⁸

7 The contribution of Bata to Austro Modernism

Just as Tatra developed as an innovative enterprise in the Moravian province, the Bata shoe factory in the small town of Zlín, 100 km northeast of Brno, unfolded as another center of Czech-Modernism in the 1920s and 1930s. This strand of modernism has been studied primarily by architectural historians.⁹⁹ At this point, this view will be expanded to include the innovative organization of production, which goes far beyond the Fordist approach and thus represents an independent contribution of Czech modernism, without merely catching up with Western modernism. Around the production of shoes, Thomas Bata built a conglomerate that also established links with the automobile and aircraft cluster of Austro Moderne. Thus, he took up the production of car tires in his rubber factories and in 1931 merged his aircraft activities into a subsidiary ZLAS, which operated the airfield near Zlín, maintained airlines and started producing airplanes.¹⁰⁰

Thomas Bata transferred shoe production, which until then had been organized by hand, into processes of industrial division of labor and mechanization.¹⁰¹ The factory in Zlín, which included work and life in an integrated concept with a workers' settlement and was built in the style of industrial modernist architecture, made Bata widely known. Zlín was the venue for the 1935 Congress of CIAM, the International Congress of Modern Architecture, and became a pilgrimage site for architects.¹⁰² Bata departed from the concept of centralized operations. Instead, the individual production steps of shoe manufacturing were grouped into workshops that were controlled semi-autonomously by key figures, specifications of input and output variables, and transfer prices. By implementing the principle of loose coupling of semi-autonomous workshops for the first time in industrial history, Bata took on a pioneering role in industrial history, since in the 1930s the notion of the special productivity advantages of a hierarchical large-scale enterprise prevailed both in the capitalist West and in the young Soviet Union.

Bata used its distribution network to synchronize production with sales throughout Europe.¹⁰³ With this approach, it took a leading role in the European footwear industry, which had previously organized its sales through independent retailers. Bata covered major European cities with a network of representative flagship stores for its products. The following picture shows the ultra-modern flagship store in Reichenberg.



Figure 20: Bata Flagship Store in Reichenberg at Tuchplatz 1936 (postcard)

Bata also stood out with innovative solutions in the administration, such as the vertically movable executive office conceived as an elevator. The following picture shows the administration building with this elevator at the corner of the building.

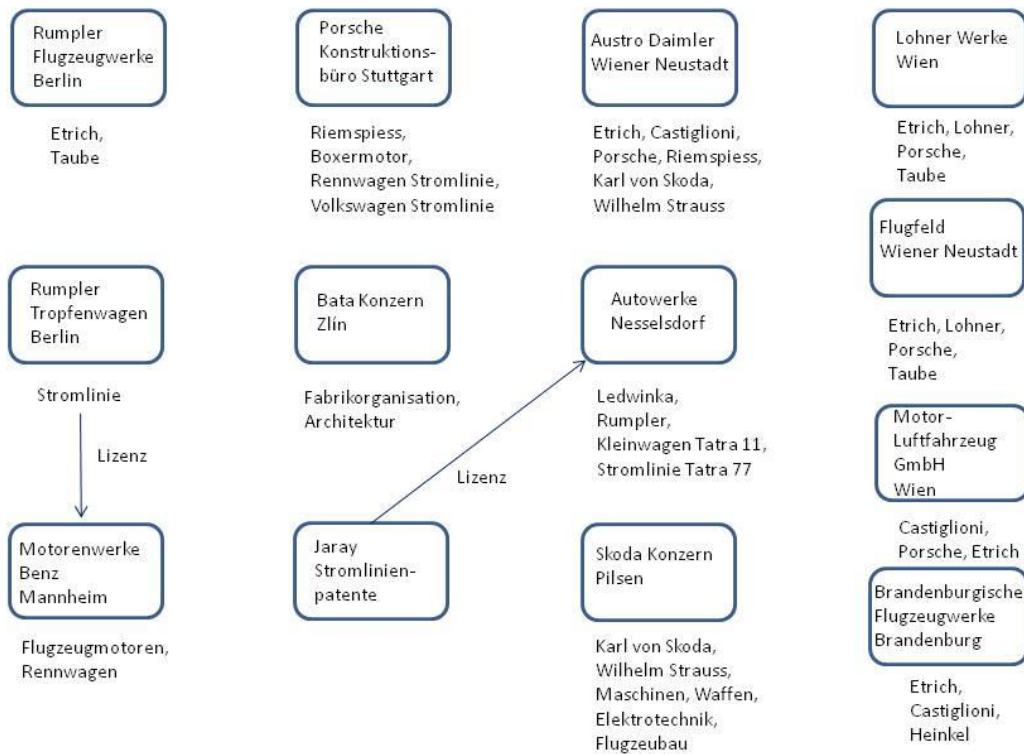


Figure 21: The Bata administration building in 1938. ¹⁰⁴

40 years of communist rule in Czechoslovakia caused Bata's innovations to be forgotten. The Bata shoe factory in Zlín was nationalized and renamed Svit. Moreover, following the Soviet cult of personality, in 1949 the city of Zlín was renamed Gottwaldov after the Czechoslovak president Gottwald. The names Bata and Zlín – icons of Czech Modernism – which were important for the transmission of the Bata story, were thus extinguished. The concepts of decentralized corporate management returned to Western Europe in the 1980s – not from Czechoslovakia but from the Japanese automotive industry under the name "Toyota Production System" (Lean Production).

8 Appendix diagram of the Austro network

Das Netzwerk der Austro Moderne



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- 4 Allan Janik and Stephen Toulmin: *Wittgenstein's Vienna*, New York 1973. Nautz, Jürgen and Richard Vahrenkamp, (eds.), 1996. *Die Wiener Jahrhundertwende: Influences, Environment, Effects*, Vienna: Böhlau, 2nd edition 1996.
- 5 Bucher, Willi, 1988. *czech art of the 20s + 30s - avangarde and tradition: Mathildenhöhe Darmstadt, 20 November 1988 to 29 January 1989*, Darmstadt: Mathildenhöhe, 1988. Rainer Stach, *Kafka. The Early Years*, Frankfurt, 2014. Materials on Kurt Gödel in Brno are available at <https://www.physics.muni.cz/~godel/tribute2020/>.
- 6 Edelmann, Heidrun: *Vom Luxusgut zum Gebrauchsgegenstand - Die Geschichte der Verbreitung von Personenkraftwagen in Deutschland*, Frankfurt 1989. Möser, Kurt: *Geschichte des Autos*, Frankfurt 2002. Merki, Christoph: *Der holprige Siegeszug des Automobils 1895 - 1930: Zur Motorisierung des Straßenverkehrs in Frankreich, Deutschland und der Schweiz*, Vienna 2002.
- 7 The German edition of the AAZ published in Berlin was not included. The Vienna edition of the AAZ is available in digital form at the Vienna National Library. Unfortunately, the German edition has not been digitized. ADAC is the abbreviation for Allgemeiner Deutscher Automobil Club. ADAC *Motorwelt* was published under the name "ADAC Motorwelt" until issue 39 of the 1933 edition. Then an adaptation to the National Socialist ideology took place: from issue 40, 1933, the magazine came out, without an explanation in the editorial, as "DDAC Motorwelt" until the end of 1933 and then as "Motorwelt" until August 1944. DDAC refers to Der Deutsche Automobil Club, in which Jewish citizens were excluded. A statement in the editorial on the subordination of the DDAC to the National Socialist Motor Vehicle Corps (NSKK) is found in issue 1, 1934. The DDAC moved into a palace in downtown Munich directly behind the Feldherrenhalle, *ibid*.
- 8 Numerous biographies are available on Porsche, e.g. by Osteroth, Reinhard: *Ferdinand Porsche: der Pionier und seine Welt*, Reinbeck 2004, who has also evaluated documents in the Porsche Museum. Accounts of Porsche's early years in Vienna are mostly based on the biography of Porsche's nephew and secretary Ghislaine Kaes, which can be viewed as a typescript in the Porsche Archive and is published in short form in Kaes (Kaes, Ghislaine: *Ferdinand Porsche*, in: *Etzold, Hans-*

Rüdiger: *Der Käfer. Die Käfer-Entwicklung von 1934 bis 1982 vom Urmodell zum Weltmeister*, Stuttgart, 1984, pp. 39-62), and based on the memoirs of Ferdinand Porsche's son, Ferry Porsche, see Haug, Gunter: *Ferdinand Porsche: ein Mythos wird geboren*, Landhege Verlag, 2012. Many biographies unhistorically create a Porsche myth and ignore its problematic role in the Nazi regime, as Lackner (Lackner, Helmut: *Mythos Krupp, Mythos Porsche. Zwei Ausstellungen im Vergleich*, in: *Technikgeschichte* 80 (2013), pp. 161-173)) criticized. Porsche's birthplace in Maffersdorf was bought by Skoda in 2014 and refurbished as a museum.

9 See RAF advertisement in the AAZ of March 6, 1910. Seper, Hans, Martin Pfundner and Hans Peter Lenz: *Österreichische Automobilgeschichte*, Klosterneuburg 1999, p. 104.

10 Osteroth, 2004 (see footnote 5), p. 18.

11 AAZ interview with Ferdinand Porsche, in: Pinczolits, Franz: *Austro Daimler: Paul Daimler und Ferdinand Porsche - Pioniere des Automobils*, Wiener Neustadt: Weilburg-Verlag, 1986, p. 37.

12 Kaes 1984 (see footnote 5), p. 40.

13 Köppen, Thomas: *Die Unternehmensstrategien der städtischen Kutschenfabriken zu Beginn des 20. Jahrhunderts am Beispiel der Wiener Hof-Wagenfabrik Jakob Lohner & Co*, in: *Zeitschrift für Unternehmensgeschichte*, 38. Jahrg., H. 3, 1993, pp. 176-185, p. 179. Köppen refers to the Jacob Lohner company throughout as Jakob Lohner. Seper et al. 1999, (cf. footnote 6), pp. 35f. Merki, 2002 (see footnote 3), pp. 50-58.

14 Malkowsky, Georg: *Die Pariser Weltausstellung in Wort und Bild*, Vienna 1900, p. 431.

15 Kaes 1984 (see footnote 5), pp. 42-52; Köppen (see footnote 10). Seper et al. 1999 (see footnote 6), p. 77. On the history of the electric car, see Mom, Gijs: *The electric vehicle: technology and expectations in the automobile age*, 2004.

16 AAZ 19 October 1902, p. 7 with photos.

17 Source: AAZ, February 25, 1900, p. 5.

18 Report on the Lohner company in the AAZ of May 19, 1901, pp. 9-13.

19 Source: AAZ of May 19, 1901, p. 11.

20 See the factory report with photos from the AAZ of May 27, 1900.

21 Seper et al. 1999 (cf. footnote 6), p. 85. Pfundner, Martin: *Austro Daimler und Steyr: Rivalen bis zur Fusion; die frühen Jahre des Ferdinand Porsche*, Vienna 2007, p. 36, p. 44. Introducing the term "Austro" as a marketing designation was also used by other car companies for their Austrian subsidiaries, such as Fiat.

22 The role of Emil Jellinek in shaping the Mercedes brand will not be discussed here, as Jellinek was initially heavily involved in France, see Gundler, Bettina: *La Mercédès - Ein automobiles Leitbild am Beginn des 20. Jahrhunderts*, in: Möser, Kurt, Marcus Popplow und Elke Uhl (eds.): *Auto.Kultur.Geschichte*, Stuttgart, pp. 33-44. Like Castiglioni, Jeklinek played the role of power promoter at Daimler, giving the staid Swabian designers access to the market of the rich upper class on the Cote d'Azur and providing decisive impetus for the design of racing cars.

23 AAZ August 5, 1906, p. 38. See also Pinczolits, Franz: *Austro Daimler: Paul Daimler und Ferdinand Porsche - Pioniere des Automobils*, Wiener Neustadt: Weilburg-Verlag, 1986, pp. 51-58.

24 AAZ June 10, 1910, p. 1. Porsche was one of the drivers. See also Pinczolits (see footnote 20), pp. 62-68. On the importance of car racing for the early history of the automobile, see Möser, Kurt: *Geschichte des Autos*, Frankfurt 2002, p. 71.

25 Pinczolits (see footnote 20), p. 17.

26 See the report on the use of the Trains during imperial maneuvers in AAZ of August 5, 1906. Pfundner, 2007, (cf. footnote 19) p. 33, p. 45f. As early as 1903, Paul Daimler at Austro Daimler received an order from the Austrian military to develop a traction engine for heavy artillery.

27 AAZ, April 19, 1914, p. 24f. Osteroth, 2004, (see footnote 5) pp. 46-56.

28 Source: AAZ of April 19, 1914, p. 25.

29 Sievers, Immo: *Skoda - 100 Jahre Automobilbau*, in: *ATZ - Automobiltechnische Zeitschrift* (107) April 2005, pp. 612-615, here p. 614. Seper et al. (compare footnote 6) 1999, p. 104. Lenin Werke (ed.): *1859 -1959. 100 years in the service of technical progress (Skoda)*, Pilsen 1959. Schmarbeck, Wolfgang: *Hans Ledwinka*, Graz, 2nd edition 1997, p. 75.

30 Osteroth, 2004 (see footnote 5), pp. 137-184.

31 Mommsen, Hans and Manfred Grieger: *Das Volkswagenwerk und seine Arbeiter im Dritten Reich*. Düsseldorf 1996, p. 74. Pfundner 2007 (see footnote 19), p. 85.

32 The first German autobahn from Bonn to Cologne dates from 1932, see Vahrenkamp, Richard: *Der lange Weg zur Autobahn Köln - Bonn. Transport Policy and Motorway Construction in the Rhineland 1925 to 1932*, in: *Geschichte im Westen*, Vol. 26, 2011, pp. 178-189. Etzold, 1984 (see footnote 5), p. 180. Dinklage, A.: *Autobahnen verlangen andere Motoren*, in: *Die Autobahn*, Heft 14, 1934, p. 638.

33 Kaes 1984, p. 52. Porsche's Czechoslovakian citizenship remains largely unmentioned in the Porsche literature.

34 *Motorwelt*, issue 4, 1936, p. 4 (cf. footnote 4).

35 Mommsen and Grieger (cf. footnote 28), p. 104, pp. 925-938. Osteroth (cf. footnote 5), 259. Müller 1999 (Müller, Fabian: *Ferdinand Porsche*, Ullstein, Berlin 1999), p. 81, notes that Anton Piëch carried 10 million Reichsmarks from the Volkswagen treasury with him as he fled the approaching Allied troops in April 1945. Many biographies fail to mention the fact that Porsche was the managing director of the Volkswagen factory, for example Lesueur 2006 (Lesueur, Patrick: *Mythos Volkswagen*, Cologne 2006) and the *Festschrift der Stadt Wolfsburg 1988* (*Festschrift of the City of Wolfsburg: Wolfsburg 1938 to 1988*, Wolfsburg 1988).

36 See Möser Kurt: *Grenzerfahrungen - Mobilitätsbegeisterung für Auto. Flugzeug und Boot im frühen 20. Jahrhundert*, 2013, in: Möser, Kurt, Marcus Popplow und Elke Uhl (eds.): *Auto.Kultur.Geschichte*, Stuttgart 2013, pp. 19-32.

37 Günther Schmitt and Werner Schwipps, 20 chapters of early aviation, Berlin: transpress, 1990. Museum für Verkehr und Technik, eds, Hundert Jahre Deutsche Luftfahrt, Berlin 1991.

38 Reinhard Schlüter: Der Haifisch. Aufstieg und Fall des Camillo Castiglioni, Vienna 2015, p. 47. Schlüter's study is an important contribution to the appreciation of Castiglioni, as he is always mentioned with an anti-Semitic undertone in the festschrift literature on Porsche.

39 In the AAZ of December 5, 1909, a photo of the round flight was shown on the front page. Eberhard Witte introduced the model of the promoter team, consisting of a specialist promoter and a power promoter, see Eberhard Witte: Organization for Innovation Decisions - The Promoter Model, Göttingen 1973.

40 Pfundner, 2007 (see footnote 19), p. 50. Haberfellner, Wernfried and Walter Schroeder: Wiener-Neustädter Flugzeugwerke Gesellschaft m. b. H. (Entstehung, Aufbau und Niedergang eines Flugzeugwerkes), 3rd edition. Weishaupt, Graz 1999. Castiglioni also appeared as an investor in the automotive industry after 1918 and took over the majority of Austro Daimler.

41 Kranzhoff, Jörg: Edmund Rumpler, Wegbereiter der industriellen Flugzeugfertigung, Bonn, 2004, p. 43. The AAZ of October 16, 1910 contains an advertisement of the "Wiener Aeroplan- und Carosseriewerke Jacob Lohner & Co" on page 37. In the advertisements of the AAZ before this date, the Lohner company presented itself merely as a body shop.

42 AAZ, June 25, 1911, p. 52f. Danzinger, Eduard: Aus den Anfängen des österreichischen Flugzeugbaues, in: Blätter für Technikgeschichte (22) 1960, pp. 172-188, here p. 187.

43 Source: AAZ, March 2, 1913, p. 23. Benz 1913. The commemorative publication by Harry Niemann in 1994 on the 150th anniversary of Karl Benz omits the subject of aircraft engines altogether (see footnote 79).

44 Danzinger, Eduard: Aus den Anfängen des österreichischen Flugzeugbaues, in: Blätter für Technikgeschichte (22) 1960, pp. 172-188, here pp. 172f.

45 AAZ, December 5, 1909, p. 43.

46 Kranzhoff, Jörg: Edmund Rumpler, Wegbereiter der industriellen Flugzeugfertigung, Bonn: Bernard & Graefe, 2004, p. 75. Etrich, Ignaz: Die Taube: Memoiren des Flugpioniers Igo Etrich, 1879-1967, Vienna: Waldheim-Eberle, 1962, p. 35.

47 Danzinger 1960, p. 174.

48 Etrich, Ignaz: Die Taube: Memoiren des Flugpioniers Igo Etrich, 1879-1967, Vienna: Waldheim-Eberle, 1962, p. 19, p. 23, p. 35. Haberfellner, Wernfried and Walter Schroeder: Wiener-Neustädter Flugzeugwerke Gesellschaft m. b. H. (Entstehung, Aufbau und Niedergang eines Flugzeugwerkes), 3rd edition. Weishaupt, Graz 1999.

49 AAZ, September 25, 1910, p. 10.

50 AAZ 25. September 1910, p. 2.

51 AAZ October 16, 1910, p. 2.

52 Source: AAZ of September 25, 1910, p. 11.

53 Source: www.VintageAd.com.

54 Kranzhoff, Jörg: Edmund Rumpler, Wegbereiter der industriellen Flugzeugfertigung, Bonn: Bernard & Graefe, 2004, p. 46.

55 Tanja Dietl: Rise and fall of the "Taube", Blog of the Deutsches Museum at <https://www.deutsches-museum.de/blog/blog-post/2019/11/08/aufschwung-und-absturz-der-taube/>

56 Kranzhoff, Rumpler, p. 129.

57 Tanja Dietl: Rise and fall of the "Taube", Blog of the Deutsches Museum at <https://www.deutsches-museum.de/blog/blog-post/2019/11/08/aufschwung-und-absturz-der-taube/>

58 Schmidt and Schwipps, (as footnote 37), p. 70.

59 Source: Lecture by Gerd Kley on 6. 11. 2014 at the Technikmuseum Berlin on the subject: The buildings of the Deutsche Versuchsanstalt für Luftfahrt (DVL) in Adlershof from 1912 to 1945.

60 Salz, Hanus: Igo Etrich - Flugpionier, Flugtechniker, Flugbegeisteter, in: Salz, Hanus and Harald Waitzbauer (eds.): Im Flug über Salzburg: Igo Etrich und der Beginn des Flugwesens in Salzburg, Salzburg, Amt der Salzburger Landesregierung, Landespressebüro, 1993, pp. 9-60, p. 22, p. 46.

61 Seper, Hans, Helmut Krackowizer, Alois Brusatti: Österreichische Kraftfahrzeuge von Anbeginn bis heute, Welsermühl, Wels 1984. Museum catalog for the exhibition of the Technik Museum Wien 1978 on Hans Ledwinka.

62 Seper et al. 1999 (cf. footnote 6), p. 39f. A photo of the production of the President can be found in Schmarbeck 1997 (cf. footnote 62), inside cover, with details of the persons involved, including Rumpler.

63 Ledwinka, Erich: Sudetendeutsche Pionierleistungen im Kraftfahrzeugbau, in: Richard W. Eichler (ed.): Sudetendeutsche Beiträge zur Naturwissenschaft und Technik - Schriften der Sudetendeutschen Akademie der Wissenschaften und Künste, vol. 2, Verlagshaus Sudetenland, Munich 1981, pp. 195-206, here p. 197.

64 Seper et al. (compare footnote 6) 1999, pp. 45 - 50.

65 Source: AAZ of February 25, 1900, p. 13.

66 <http://www.geschichte-der-technik.de/technisches-museum-tatra-koprivnice> (accessed March 10, 2021).

67 Albeck, Egon: Dr. tech. h.c.. Hans Ledwinka - Ein Pionier des Automobilbaus, in: Blätter für Technikgeschichte, 1961, pp. 63-95, here p. 75.

68 Mommsen, Hans: 1897 - Die Badenikrise als Wendepunkt in den deutsch-tschechischen Beziehungen, in: Detlef Brandes (ed.): Wendepunkte in den Beziehungen zwischen Deutschen, Tschechen und Slowaken 1848-1989. Verlag Klartext, Essen 2007, pp. 111-118.

- 69 Albeck, Egon: Dr. tech. h.c.. Hans Ledwinka - Ein Pionier des Automobilbaus, in: Blätter für Technikgeschichte, 1961, pp. 76-81. The engine sat in the front section, the drive was to the rear wheels.
- 70 Schmarbeck, Wolfgang: Hans Ledwinka, Graz, 2nd edition 1997, p. 68.
- 71 A.A.O., P. 91.
- 72 Photo based on Albeck, Egon: Dr. tech. h.c.. Hans Ledwinka - Ein Pionier des Automobilbaus, in: Blätter für Technikgeschichte, 1961, pp. 63-95, here p. 91.
- 73 AAZ, April 1934, p. 7.
- 74 The question of whether the body of the Tatra 77 was actually tested in the wind tunnel before series production is open.
- 75 See fair report in the March 1934 AAZ and <http://www.aerotatra.czweb.org/hitler.jpg>.
- 76 Bröhl, Hans Peter: Paul Jaray Streamline Pioneer, Bern 1978, p. 133.
- 77 Schmarbeck, Wolfgang: Hans Ledwinka, Graz, 2nd edition 1997, p. 121.
- 78 Photo after Schmarbeck, Wolfgang: Hans Ledwinka, Graz, 2nd edition 1997, p. 121. The Czechoslovak racing driver Elisabeth Junek was celebrated in the country and was considered an icon of the newly founded state of Czechoslovakia.
- 79 On the design history of automobiles, see Schmidt, Gert: Verlockungen der Form-Sozial- und kulturwissenschaftliche Anmerkungen zu Designgeschichte des Automobils, in: Möser, Kurt, Marcus Popplow und Elke Uhl (eds.): Auto.Kultur.Geschichte, Stuttgart IZKT 2013, pp. 83-92. On the history of the streamline, see Hucho, Wolf-Heinrich: Design, Technik und Aerodynamik des Automobils, in: Möser, Kurt, Marcus Popplow and Elke Uhl (eds.): Auto.Kultur.Geschichte, Stuttgart IZKT 2013, pp. 93-102. Kieselbach, Ralf: Stromlinienautos in Europa und USA, Stuttgart 1982.
- 80 Siemers 2002, p. 364f.
- 81 Sievers, Immo: Revolutionärer Fahrzeugkonstrukteur. On the 125th birthday of Hans Ledwinka, in: ATZ - Automobiltechnische Zeitschrift, (105) April 2003, pp. 498-502, here p. 501.
- 82 Bröhl, Hans Peter: Paul Jaray Streamline Pioneer, Bern 1978, p. 63.
- 83 Rumpler, Edmund: Das "Tropfen"-Auto, in: AAZ (Vienna), October 16, 1921, pp. 13-16. AAZ, October 2, 1921, p. 21.
- 84 Archive Deutsches Technikmuseum Berlin, released by the archive.
- 85 Kubisch, Ulrich: Automobile aus Berlin: Vom Tropfenwagen zum Amphicar, Berlin: Nicolai, 1985, p. 58.
- 86 Niemann, Harry: Benz & Cie : on the 150th birthday of Karl Benz, Stuttgart, 1994, p. 135.
- 87 Kubisch, Ulrich: Automobile aus Berlin: Vom Tropfenwagen zum Amphicar, Berlin: Nicolai, 1985, pp. 62-64.

88 Wolfram Pyta, Nils Havemann, and Jutta Braun: Porsche, Munich 2017, p. 71.

89 DDAC Motorwelt, issue 2, 1934, January 26, page 11. The Vossische Zeitung of January 13. January 1934, page 19, reported who was present at the demonstration: Porsche, Director Oertzen of Autounion, Hitler's adjutant Wilhelm Brückner, NSKK leader Adolf Hühnlein, Chief Government Councillor Eras of the Reich Ministry of Transport, Reich Sports Leader Tschammer, the president of the DDAC Egloffstein, Sports President Kroth, and representatives of the Reich Ministry of Propaganda, see also Osteroth, 2004 (cf. Footnote 5), p. 139. Osteroth shows there the linkage of the race car project and with the Volkswagen project. See also Pyta et al., p. 77, where only the press success is presented, but the Nazi connotation is omitted.

90 Etzold, (see footnote 5), p. 37. Mommsen, Hans and Manfred Grieger: Das Volkswagenwerk und seine Arbeiter im Dritten Reich. Mommsen and Grieger refer to the wind tunnel at Berlin-Dahlem. They probably meant the wind tunnel at Berlin-Adlershof. On the test of the driving characteristics of the Volkswagen at Professor Kamm's Stuttgart institute, see Potthoff and Schmidt 2012, p. 136.

91 Etrich, Ignaz: Die Taube: Memoiren des Flugpioniers Igo Etrich, 1879-1967, Vienna: Waldheim-Eberle, 1962, p. 36f.

92 Source: AAZ, February 1934, p. 8.

93 Berliner Morgenpost March 16, 1934.

94 AAZ, October 23, 1921, p. 17.

95 AAZ of February 1915. See also the Alfa Romeo Museum (www.museoalfaromeo.com) and Hönscheidt, Walter and Stefan Knittel: Alfa Romeo. Die Geschichte, Teil 1: Die Merosi-Epoche 1910 bis 1927, Zyklam Verlag, Frankfurt-Unterliederbach 1986.

96 AAZ, April 13, 1913, p. 57.

97 AAZ, December 27, 1914, p. 29.

98 Sievers, Immo: Die Entwicklung der Stromlinien-Karosserie, in: ATZ - Automobiltechnische Zeitschrift (104) April 2002, Issue 4, pp. 364-369, here p. 364.

99 Martin Kohlrausch: Imperiales Erbe und Aufbruch in die Moderne. Neuere Literatur zur ostmitteleuropäischen Stadt, in: H-Soz-Kult, 16.11.2015, <http://hsozkult.geschichte.hu-berlin.de/forum/2015-11-001>. Winfried Nerdinger: Zlin - Modellstadt der Moderne, Munich 2009.

100 Bezouska, Paul and Detlef Billig: Zlín - die Erfolgsstory der mährischen Flugzeugschmiede, in: Fliegerrevue extra, 19, 2007. Mau, Hans-Joachim: Tschechoslowakische Flugzeuge, Berlin 1987.

101 Vahrenkamp, Richard: Von Taylor zu Toyota - Rationalisierungsdebatten im 20. Jahrhundert, second corrected and expanded edition, Eul Verlag, Cologne 2013.

102 Sevecek, Ondrej und Martin Jemelka: Company Towns of the Bata Concern, Stuttgart 2013. Nerdinger 2009.

103 In Berlin, according to the 1932 Berlin Address Book, Bata's flagship store was located at Leipziger Strasse 77.

104 Source: Moravian National Archives Brno.
