AUTOMOTIVE HISTORY REVIEW

AUTUMN 2012 ISSUE NUMBER 54

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From the Editor

I never cease to be amazed at the wide-ranging interests and historical research of our members. This issue is no exception. We begin with the tale of the Minsheng truck, China's attempt to enter the field of commercial motor manufacture in the 1930s, with the help of an American engineer, no less —who knew! *Erik van Ingen Schenau* is a scholar of automobiles in China, and in this instance he helps bring to print a story recorded and preserved by the family of that engineer, Daniel F. Myers.

Just when you think everything worth writing about the Volkswagen Beetle has been written, along comes another perspective. *Peter Engelhard* is an economist, and from that viewpoint he explores the way in which the new *Käfer*, the Beetle, fit comfortably into the postwar German car market, rather than blowing it apart.

It has long been a pleasure for *Automotive History Review* to publish the work of students who receive our Richard P. Scharchburg Student Paper Award. This issue carries Andrew Mabon's 2011 winning entry, about the automobile and its effect on Downtown America. Lest you think it odd that the car is presented in a negative light in a publication that usually celebrates its history, remember that criticism is an essential part of thorough research.

We've all heard about Henry Ford's "village industries" in Michigan, his populist bent for creating small industrial plants in rural locations to make parts for his Dearborn-based production plants. We tend to forget, though, that not all those plants were in the Wolverine State. *Daniel Strohl* tells us about one in the Albany, New York, area, and, what's more, part of it is still operating.

To round things out, *Malcolm Jeal* takes on the vast subject of mass production, or, as he puts it, "volume-production" of motor cars. A scholar of the early industry world-wide, Malcolm reminds us that Mr. Ford neither invented nor pioneered volume-production, and compares the progress of Britain, Continental Europe and North America in achieving that goal.

In conclusion, I again thank my indefatigable proofreaders, *Pat Chappell, Tom Jakups, Steve Wilson* and *Rubén Verdés*. Their eagle eyes picked up countless gaffes that the editor's missed, and I could not satisfactorily complete my job without their help.

- Kit Foster

Made in China - today. Despite years of exploration and negotiation, Chinese-built automobiles have yet to reach the American marketplace. However, they are already commonplace in other parts of the world. This Chery Tiggo, a small sport utility vehicle, was photographed by the editor on the streets of Nairobi, Kenya, in August 2010.

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Front Cover: Germans enjoy a picnic with their new Volkswagen. Bundesarchiv, Bild 146-1985-114-21.
Back cover: Presenting the first Minsheng truck, Liaoning Trench Mortar Arsenal, China, June 19, 1931. Myers Family Archives.

Made in China
Daniel F. Myers and the Minsheng Truck

By Elizabeth Myers Macinata, Josephine B. Howe and Erik van Ingen Schenau

Introduction

Cars and trucks appeared in China in the 1910s and 1920s, first in the "concessions," those parts of the country occupied by foreigners. Especially in Shanghai, with a French, English and International concession, automobiles started to become common, mostly owned by foreigners. Local dealers emerged, and, as was quite common at that time, cars were sometimes assembled locally. One of the cars assembled in China in the 1920s was the Studebaker Light Six, with bodywork from the Shanghai Horse Bazaar and Motor Company Limited, which made a small series of these vehicles. One of these Studebakers has survived and can be seen in the Studebaker National Museum in South Bend, Indiana, USA. Between the big cities on China's east coast there was hardly any connection, no roads, just tracks, quite different from Europe or the United States at that time. Trucks, needed for transport between these cities, had to be sturdy and didn't need to go fast. This influenced the construction because they had to be different from European or U.S trucks. Truck chassis could be used as a base for buses, needed for public transport in the cities.

Daniel F. Myers, in a photo taken in Shenyang in 1931. Myers Family Archives.

In that light, the idea of constructing a truck factory was logical, and several Chinese politicians were thinking in that way. It was finally Mercedes-Benz who managed to build trucks in significant quantities in China, in 1936. They were not the first to try, however. That fell to an American, Daniel F. Myers.

The American Engineer

Daniel Myers was born on June 17, 1889, on a farm in Knox County, Indiana, near Vincennes. His mother left his father when he was seven years old, taking with her Daniel's siblings but leaving him with his father and other relatives. Daniel dropped out of school after the eighth grade to support himself and his invalid father by farming. He married in 1914 and his first child was born in 1915. In 1916, a bad farming year, Myers left the farm to take his chances in automotive factory work. He moved to Wabash, Indiana, and found a job with the Service Motor Truck Co., where he was paid 18½ cents per hour. He had a willingness to work hard, an inherent talent for designing, and he soon obtained an education in mechanical engineering by means of International Correspondence School courses. Within ten years he had become Chief Engineer. By 1927, the Service company had merged with the Commerce Truck Co. of Ypsilanti, Michigan, and the Garford Motor Truck Co. of Lima, Ohio, to form Relay Motors Corporation. Myers moved with the company to Lima, Ohio. A year later he became Relay's factory representative to their western territory and moved to Omaha, Nebraska. By 1929 he became dissatisfied with this work and decided to resign from Relay.

When he returned to Lima to make his final report, he discovered that the factory refused to accept his resignation. He agreed to continue in his job for a short while longer; and, while on a trip for the company to St. Louis, he received a telegram from Relay's assistant sales manager asking if he would be interested in going to China. He wasn't. However, he was urged to return immediately to Lima, and when he arrived he found a Mr. Walter Mitchell from China waiting for him. Mitchell had been authorized by Marshal Zhang Xueliang to obtain the services of an American engineer to set up and engineer a truck manufacturing factory in Mukden (Shenyang), Manchuria (Dongbei, North-East China). He saw Myers as just the man for the project. Myers had been recommended to him by the Society of Automotive Engineers, the Timken Axle Company, and the Ross Steering Gear Company. Myers made conditions he thought Mitchell could not meet, but two days later, Mitchell phoned asking that he come that night to sign a contract to spend a year in China. Myers had committed himself so he signed the contract.

A Truck for China

China in the 1920s was mostly ruled by warlords. Since June 1928, Manchuria had been ruled by a 27-year-old warlord named Zhang Xueliang, known as the "Young Marshal," who had succeeded his father, Zhang Zuolin, after the latter's assassination. Between 1925 and 1930 Manchuria was seen as China's best hope for modernization. It was the richest section of China at that time. Immediately after his succession, the Young Marshal publicized the aims for his regime as the development of people's education, the unification of China, and the industrial development of Manchuria. One

Above, Mukden (Shenyang) at the time that Daniel Myers arrived in China. Postcard from China Motor Vehicle Documentation Centre archives.
Below, the gate of the Liaoning Arsenal. The principal buildings are seen inside the gate. CMVDC archives.

project was the building of trucks. The Young Marshal set aside a section of the Fengtian Trench Mortar Arsenal for this purpose and renamed this Arsenal as Liaoning Trench Mortar Arsenal. Arsenals were weapons factories, and the Shenyang complex was China's largest weapons factory. He put the Director of the Liaoning Arsenal, General Y.C. Lee (aka Li Yichun), in charge of building up the truck factory. In April 1929, General Li sent a delegation to the Austin facilities in Longbridge, Birmingham, England, to study automotive production. Later that year he sent Mr. Mitchell, the American advisor and chief-engineer of the gun section of the Arsenal who spoke perfect Chinese, to the United States to find a reliable automotive expert who could act in an advisory capacity to develop a truck suitable for use in China. It was on this trip that Mitchell found Daniel Myers.

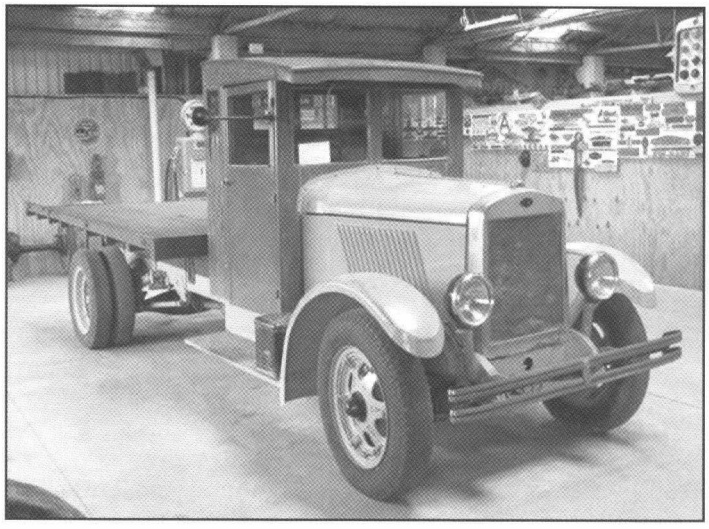
Myers embarked from Los Angeles on October 19, 1929, and arrived in Shenyang on November 17. He began work that day. Before leaving the United States, he had ordered five American trucks to be shipped to Shenyang for testing purposes: a Relay Model S11B, a Relay Model 40A; a Diamond T Model 290, a Diamond T Model 302 and a Moreland Ace. His first task was to supervise the uncrating and assembly of those trucks. The Relays had been packed with great care. All loose parts were wrapped in paper, and the crates themselves were lined with waterproof paper. There was no damage. The Chinese were impressed and assembly began immediately. On the other hand, the Diamond Ts had been poorly crated, and suffered considerable damage, while the Moreland was inoperable. Shipped with water in the cooling system, it had frozen while on the docks, cracking the cylinder head.

By the end of January 1930, assembly of the test trucks was completed. Myers made drawings for the cabs and bodies. Chinese woodworkers employed by the factory built them out of wood by hand, so it was not until April that the cabs and bodies were completed.

Designing for the Market

The project, as Mitchell initially described it to Myers, was to buy an American truck design, adapt it to the specific requirements of China, and then assemble the units sent from American producers. As the project evolved, however, Myers learned that the Chinese desired a completely new Chinese-designed truck. The main reason for this change was the difference between the roads in the United States and China at that time: there were virtually no roads at all in China. China needed strongly-built, powerful trucks with low gear ratios. The major components were to be purchased from American manufacturers, but the design, assembly, and many of the materials were to be totally Chinese-made.

The formative stages of the project took 18 months. The first few months were spent testing the imported trucks and their individual units for suitability to Chinese conditions, designing Chinese trucks using the parts found to be suitable, and converting some of the Arsenal equipment from shell and gun production to truck manufacture.



Relay S11B truck, which became the basis for the new Mingsheng truck. Photo from CMVDC Archives, taken at Bill Richardson Truck Museum, Invercargill, New Zealand.

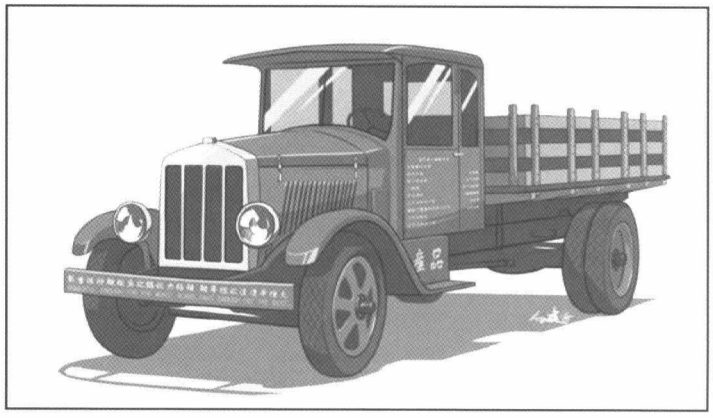
During this period, Myers designed two new truck models. The larger Model 100 was a heavy truck intended for long-distance hauling on the poorest roads. On a 160-inch (4,046 mm) wheelbase, it was to have a gross vehicle weight of 10,000 pounds (4,500 kg). A 70-bhp, six-cylinder Buda H298 engine was chosen as the powerplant. The smaller Model 75 was a light truck, with 130-inch (3,302 mm) wheelbase and 5,500-pound (2,495 kg) GVW. A Buda J214, 61-bhp six was selected for power. (See sidebar, page 10, for full specifications.)

Myers figured every aspect of construction, made the layouts, sketched every detail of the parts, wrote the parts lists, trained six draftsmen to assist him, checked their work, designed the dies, helped install and set new equipment, organized a filing system, wrote out each purchase order, and acted as receiving inspector for the parts and other materials. By mid-February 1930, he was ready to build the prototype models. The budget called for Mex $750,000 for the initial year's production of 165 trucks. The Young Marshal signed the application for a guaranteed capitalization on April 8.

The budget figure calls for some explanation. The "Mexican dollar," correctly known as the peso, has a long history in regional and international commerce. In the 1700s, it was widely used in the United States, and approximated the U.S. dollar in value, since both were based on the weight of silver in their respective coins. In fact, the Spanish dollar, similar to the peso, was the first world currency. The Chinese yuan was at par with the Spanish dollar, Mexican peso and other eight-real silver coins (pieces of eight) used in the 19th and early 20th Centuries, particularly in Manchuria. The Mexican dollar, or peso, was equivalent to about 34 U.S. cents in 1930.

Chung Shan or Minsheng

Several names were given to the trucks, and even now it is not clear which name was finally used. The original name was Magna Lux (Guanghua) but that was rejected by the Young Marshal in favor of Fengtian, the Chinese name for Mukden. By September 1931, the truck was called variously

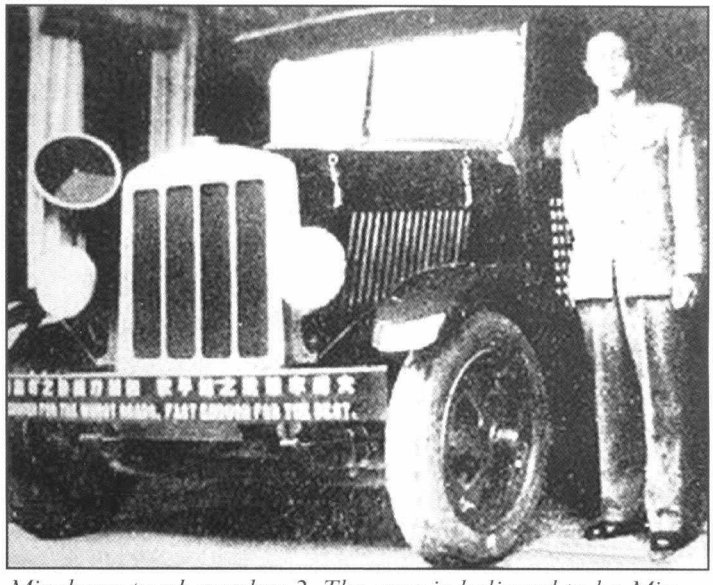


The Minsheng truck, in a rendering by Felix Bai (Bai Enguan), a Chinese car designer and journalist.

"Chung Shan" (Zhongshan, in memory of Sun Yat-sen, China's first president) and "Minsheng" (people's livelihood), the two names by which it is known today.

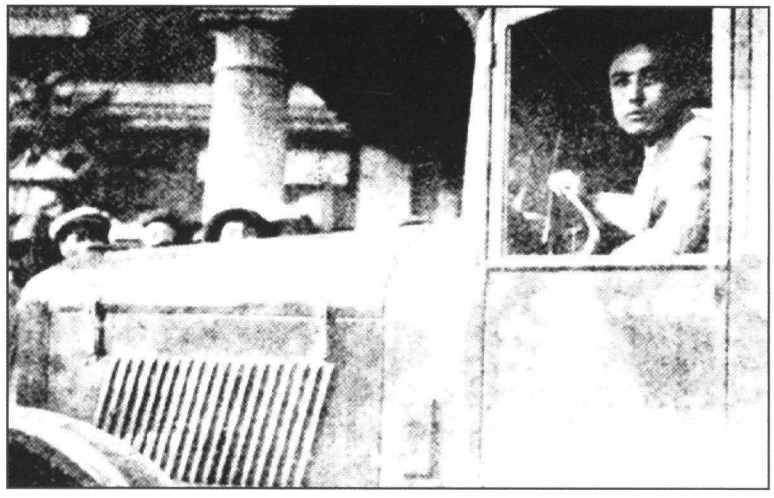
In July 1930, General Li authorized the first set of specifications to be sent to different American manufacturers for price quotations. Half a year later, orders for parts had been filled and shipments were en route from the United States. Myers had ordered the American-made engines, transmissions and other components, with the request that a small number of each be shipped immediately so that the Arsenal might build one or two experimental vehicles. The manufacture of many of the parts they were to make in China had begun. In the meantime, the whole Arsenal was being converted into an extremely well-equipped factory on the pattern of modern American automobile factories of the period. A sales program was incorporated into the project, a parts repair and service station was into the developmental stage, and a modest parts catalog had been compiled and published.

By early 1931, the project had fallen six to eight months behind schedule because of delayed shipment of parts. Parts were held up in the Japanese port of Dairen (now



Minsheng truck number 2. The man is believed to be Minister of Industry and Commerce H.H. Kung, who visited the Good Roads Show at Shanghai in September 1931. Photo from CMDVC Archives.

Dalian) and the Chinese port of Qinhuangdao. Consequently, at the end of Myers' first year in China, the Arsenal was only just ready to assemble the first truck, so he agreed to extend his contract indefinitely. Myers had another order for automotive parts placed with the American manufacturers. Business was bad in the United States as the Depression deepened, and all were seeking foreign orders wherever possible. Myers wrote to assure them that the Arsenal hoped to place additional orders during the year. Without exception, Myers received from his vendors the same consideration and prices that he would have received had the Arsenal been an American truck builder. One interesting sidelight on these transactions is that there was not one cent of "squeeze" (kickback) paid by any company supplying the Arsenal with units.



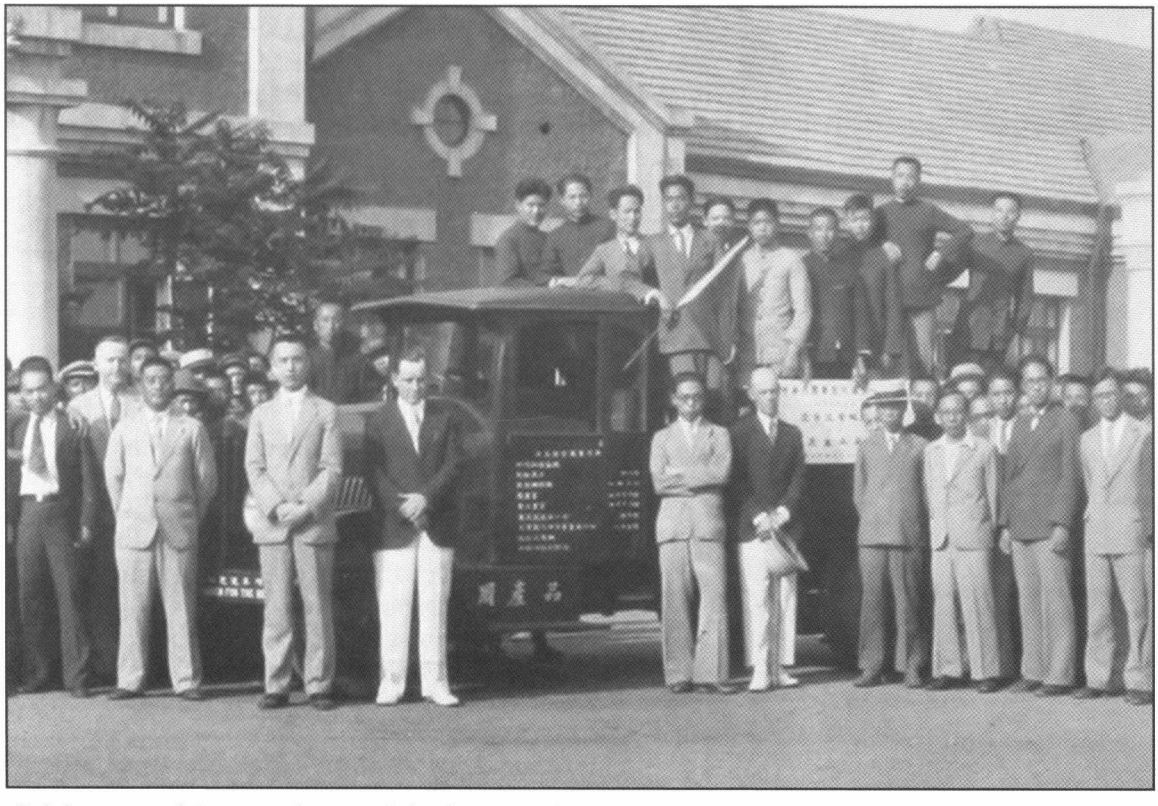
General Li Yichun at the wheel of the first Minsheng truck. CMDVC Archives.

Early on, the Arsenal truck factory started a kind of "factory museum." The very first edition of each part made in the factory, large or small, was highly polished or painted and placed in this museum. Later, they were to be moved to a planned Shenyang Industrial Museum in a building that Myers and a Russian-born German designed. When completed in the winter of 1930-31, the building was the most modern in Shenyang. It had poured concrete pillars and interior pilasters that were cast hollow to contain the drains for the saw-tooth style roof.

Actual assembly of the first prototype of the Model 75 began in May 1931. At that time, Myers was also investigating the use of alcohol and vegetable oil in internal combustion engines because gasoline was very expensive in China. The Young Marshal intended to present this first truck at the National Conference in Nanjing, organized by the Guomindang (Kuomintang, National People's Party). However, delays in production and the failure of the conference prevented the Young Marshal from doing so.

Test and Production

Assembly of the first prototype truck was completed on May 21, 1931. It was started and, much to the amazement of everyone, it ran – but just for a few hundred meters. Then a bearing in one of the universal joints froze. Someone had filled it with hard axle grease instead of the specified heavy engine oil. On June 1 the truck was subjected to its first long-distance test. It ran perfectly in a test drive of over 160 km. Loaded with a two-ton cargo plus all the men who could pile on, the Model 75 averaged one liter of petrol for 4.5 km. (about 11.25 U.S. mpg). This was extremely good, considering the condition of the road. By the end of the week the factory regular production of the Model 75 began. Production of the larger Model 100 was to await further testing. There is no evidence that it was ever built.



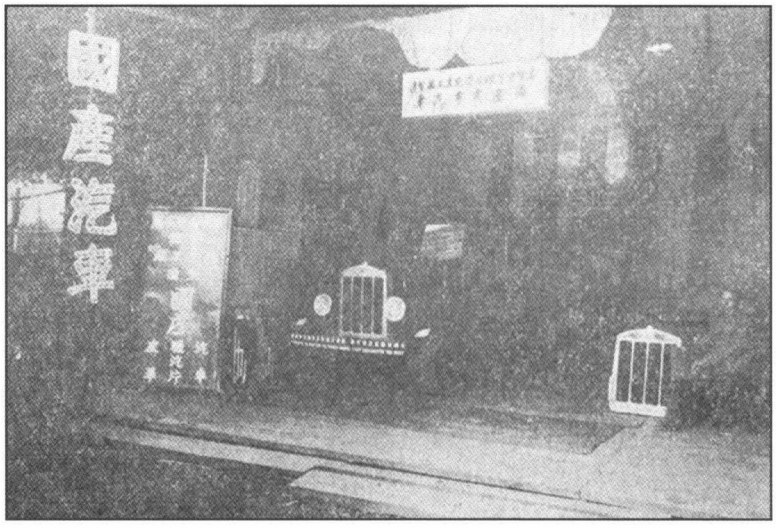
Celebration of the completion of the first Minsheng truck. Daniel Myers is standing in front (in white trousers), to the right of factory director General Li. Myers Family Archives.

Extremely proud of their accomplishment, the Arsenal employees prepared a grand celebration for the truck. They painted the prototype fire-engine red and presented it on June 19, 1931, with a slogan on the front bumper in Chinese and English:

"Powerful enough for the worst roads, fast enough for the best." Speeches were made by General Li and other factory officers to the assembled government officials and the more than 1,500 staff and workmen of the Arsenal. Cheers filled the air for the Republic of China, the factory, the Young Marshal, the truck, and Daniel Myers. This first truck was to be preserved in the planned Shenyang Industrial Museum, but was stored temporarily in the Arsenal compound. The truck was suitably decorated with inscriptions stating that it was the first Chinese-built motor truck.

The first production truck (this time painted brown) was ready in August and sent to a large exhibition in Shanghai, the First National Good Roads Show, and was placed in the central exhibition hall. On the first day of the exhibition, September 12, the booth was visited by Republic of China Minister of Foreign Affairs C. T. Wang (Wang Zhengting, also known as Wang Cheng-t'ing) and Minister of Industry and Commerce H. H. Kung (Kong Xiangxi, also known as Kung Hsiang-hsi).

By September 13, a second production truck was made and the factory was running 10 trucks down the assembly line, with several others to follow. As the assembly continued, Myers planned to move toward making more and more parts at the Arsenal. For the first trucks, only the major units were bought from foreign manufacturers: engine, rear axle, transmission and steering gear. Basic materials, such as sheet metal, steel bars and forging billets were bought from local producers. There were 666 kinds of parts in the first trucks, of which 464 were made at the Arsenal and 202 imported. The local content was 70 percent, a very high rate. It was Myers' hope that the factory would be making everything except the engines and the rear axles within two years.

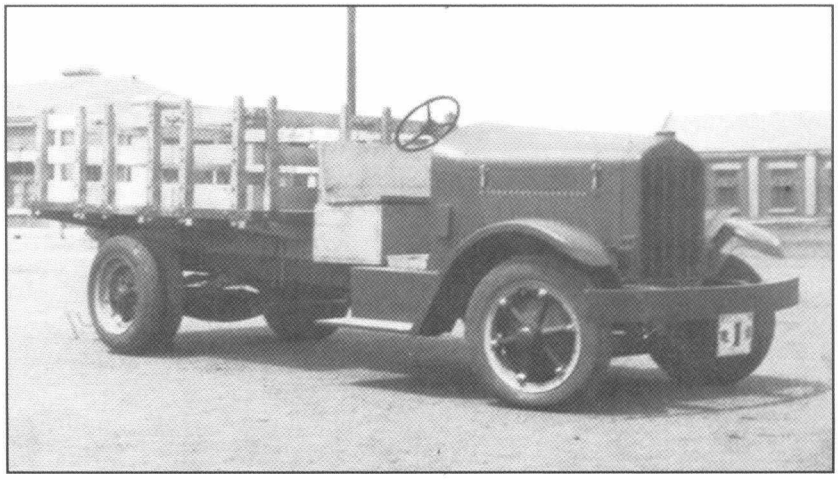


The Minsheng booth at the First National Good Roads Show, Shanghai, September 12 to October 2, 1931. The second truck is shown opposite a display radiator. Because it was in Shanghai, the truck escaped capture by the Japanese. Photo from October 1931 Good Roads Monthly.

The Japanese Intervene

On September 18, 1931, the Japanese Army began open aggression against the Chinese in Manchuria. Soon after 1:00 AM on the 19th, a bomb was thrown into the guard house of the Liaoning Trench Mortar Arsenal, killing three men. The Japanese soldiers bombed the office building and bayoneted 21 sleeping workmen in the dormitory. By evening 40 to 60 workmen had been murdered. Five nearly completed Model 75 trucks and the parts for 40 more were taken. Although the Chinese kept voluminous records of the project, everything on carefully prepared scrolls, these records were in the office building and so were burned when it was bombed. All blueprints and design work were destroyed or taken. The next day, Myers saw the five nearly-completed Model 75 trucks being driven around town full of Japanese soldiers. The five imported American trucks and 30 Chevrolet trucks for which the Arsenal factory was making the bodies were taken. All moveable machinery, including the leather belts, was also removed. The trucks were later used in the Japanese campaigns for the subjugation of Manchuria and Jehol (Rehe).

The one Model 75 truck that had been sent to the Good Roads Show was still in Shanghai. Shocked by the news of the invasion, people in Shanghai held a protest motor vehicle rally with that truck in front, clearly marked with a sign "Truck Made in China!" After the rally, the truck was taken to the Chiao Tung University (Jiaotong University) in Shanghai for safekeeping.



Minsheng truck number 1. Note the grille has one more vertical slat than the second model seen at the Good Roads Show. Photo from the Myers Family Archives.

Back in Shenyang, the Japanese occupied the factory, which was, in fact, an up-to-date automotive factory capable of turning out 165 heavy-duty trucks per year. The factory was equal in many ways to any American motor truck assembly factory. It was possible to actually make more of the components in this factory than usually were made in American assembly plants at that time. In 1934 the Japanese Dōwa Jidōsha Kōgyō KK (Dōwa Automobile Company), producing military armored cars, was established in the factory.

For Daniel Myers the story wasn't over. At first he stayed in Shenyang. In the first days after the attack he hid 28 Chinese from the Japanese while the Japanese looted their houses, including C. F. Wang (Wang Cheng-fu), Director of the

Model of the Minsheng truck at the new Beijing Auto Museum, which opened in May 2011. Felix Bai photo.

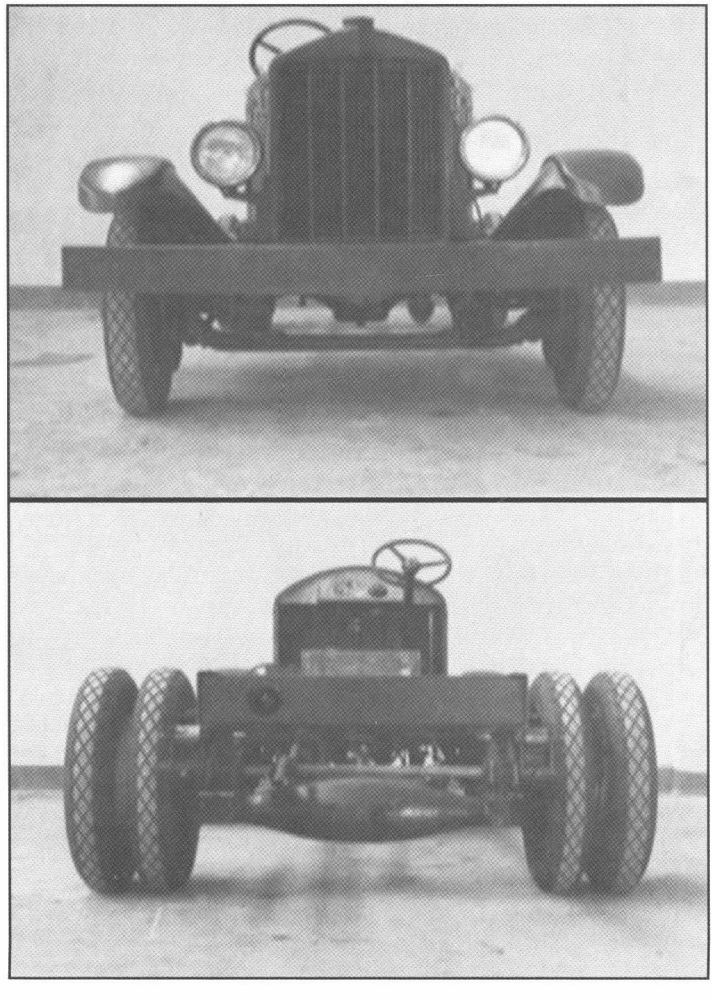
Fengtian Mining Administration, his wife, and four of their five children. In 1932, the Japanese authorities in Shenyang approached Myers three times through representatives of the Japan Air Transportation Company, asking him to resume his work at the truck factory, only for them and not for the Chinese. Although he had no intention of accepting that job offer, Myers met with the Japanese authorities in late February 1932. He reported what he learned of their plans for the factory in a covert message to his Chinese associates in Beijing. On May 26, 1932, Myers sent a report about the Japanese attack on the truck factory to the Inquiry Commission of the League of Nations (the Lytton Commission).

Biding Time in Beijing

Though Myers was certain that truck-making in Shenyang was now impossible, he felt sure that sooner or later he would be making trucks again in some other town in China. At the end of 1932, Myers moved to Beijing. He was still an employee of, and being paid by, the Young Marshal, who was in Beijing when the Japanese attacked Manchuria. He pursued the idea of organizing a Sino-American manufacturing company, which he thought could be registered as a "Federal Incorporated" concern under one of the treaties with the United States, to build trucks in China. He thought that with foreign capital in the organization, the company would be protected from seizure by the Japanese. The American partner could be an existing American truck manufacturer who could control 51 percent or more of the stock of the company.

The second shipment of parts for the 45 trucks that were to have been built next by the Arsenal factory reached Newchwang (now Yingkou) after September 19, so the National City Bank of New York, through whom it had been ordered, was able to hold it there and have it shipped later to Tientsin (now Tianjin), a harbor city 150 kilometers (93 miles) southeast of Beijing. In this way, the parts were prevented from reaching Shenyang and the Japanese invaders. The Young Marshal agreed to build those 45 trucks: 30 of the Model 75 and 15 of the Model 100. General Li, now in Tianjin, located a plant there where the trucks might be built, and on December 30, 1932, Myers prepared for him an estimate of the cost of finishing those trucks, about Mex $100,000 to finish the 30 small trucks and perhaps another Mex $50,000 for the 15 large ones. It was decided that the parts that were to have been made in Shenyang by the Chinese themselves could be ordered from American vendors. Myers approached his former employer, Relay, knowing that they had a large surplus of such parts. He knew that the Model 75 that had been exhibited at the Good Roads Show in Shanghai and had escaped the Japanese take-over could be used as the model for building the trucks.

On March 12, 1933, Myers' boss, the Young Marshal, resigned his post as Commander-in-Chief of the Chinese Northern Armies; in April he left China for an extended stay in Europe. The plans to build those 45 trucks were set aside. Although frustrated by this delay and uncertain of his future, Myers continued to receive his salary according to his original contract with Zhang, so he spent his time producing



Front and rear views of the first Minsheng chassis. The lozenge-shaped axle is Relay's unique drive system, which used spur gears in the wheel hubs for additional mechanical advantage. National Archives, courtesy Pal Negyesi.

Technical Details of Daniel Myers' Vehicle Designs

Model 75 Truck

Engine: Buda J214, 6-cylinder gasoline L-head.
Bore, stroke and displacement: 3 3/8 x 4 in. (86 x 102 mm) 214 cu. in. (3,519 cc).
Max. hp.: 61 (45 kW) @ 3,000 rpm, torque 183 Nm @ 950 rpm.
Weight: chassis 2,700 pounds (1,225 kg), body + load 2,800 lb. (1270 kg).
also given: 2,000 lb. (907 kg), gross vehicle weight 5,500 lb. (2,495 kg) or 10,100 lb. (4,581 kg), front axle 2,500 lb. (1,134 kg), rear axle 3,500 lb. (1,588 kg).
Dimensions: wheelbase 130 in. (3,302 mm) or 142 in. (3,607 mm),
body length 6 ft. (2,743 mm).
Tires: pneumatic (front and rear) 30 x 5, 32 x 6 optional. Rear dual pneumatic.
Transmission: 3 or 4 forward speeds, 1 reverse.
Clutch: single dry plate (10 in., 254 mm), or multiple dry discs.
Speed: standard 22- 25 mph (35-40 km/h), maximum 30- 40 mph (48-64 km/h).
Gear ratio: 6.8:1 or 7.75:1, transmission low gear 4.15:1.
Springs: front center 30-in. (76 cm) or 42-in. (107 cm), rear center 40-in. (100 cm) or 54 in. (137 cm), front width 2-¼ in. (6 cm), rear width 3 in. (8 cm). 15 leaves.
Fuel consumption: 10.4 mpg (24 L/ 100 km).

Model 100 Truck

Engine: Buda H298 6-cylinder gasoline L-head.
Bore, stroke and displacement: 3-3/4 x 4-1/2 in. (95 x 114 mm, 4,888 cc).
Max. hp.: 70 (52 kW) @ 2,100 rpm, torque 233 Nm @ 900 rpm.
Weight: chassis 4,600 lb. (2,087 kg), body + load 3,000 lb. (1,361 kg) also given: 5,400 lb. (2,449 kg), gross vehicle weight 10,000 lb. (4,536 kg) or
13,300 lb. (6,033 kg), front axle 3,000 lb. (1,361 kg), rear axle 7,500 lb. (3,402 kg).
Dimensions: wheelbase 160 in. (4,064 mm) or 164 in. (4,166 mm),
body length 12 ft. (3,658 mm).
Tires: solid (front) 36 x 5, (rear) 40 x 8 or 40 x10.
Transmission: 4 forward speeds, 1 reverse.
Clutch: single dry plate (12 in., 305 mm), multiple dry discs.
Speed: standard 18- 20 mph (29- 32 km/h), maximum 25- 48 mph (40- 77 km/h).
Gear ratio: 8.5:1 or 8.8:1, transmission low gear 5.35:1.
Springs: front center 39 in. (99 cm) or 60 in. (152 cm), rear center 40 in. (100 cm). or 60 in. (152 cm), rear width 3-1/2 in. (9 cm). No. of leaves: 17.

Three-wheel Cyclecar

Engine: "Myers Special" two-cylinder, two-stroke gasoline, non-reversible with special intake valve.
Bore and stroke: 2-5/8 x 3 in., (67 x 76 mm, 532 cc).
Transmission: 2 speeds forward, 1 reverse, sliding gears in aluminum case.
Drive: bevel-gear jackshaft with differential, double chain (two pairs of roller chain) to the rear wheels.
Wheels: cast aluminum with 26 x 3 clincher tires.
Steering: worm-gear, 12-in. cast aluminum wheel with laminated wood rim. Single front wheel steers, driver occupies front seat middle.
Gear ratio: about 9.42:1 in high gear, capable of 18 mph (29 km/h).
Weight: about 750-800 pounds (340-363 kg).
Selling price: $550 to $650 local money, then about US$155-185.

There are many differences among specifications we found in Daniel Myers' materials. Possible reasons are:

(1) Myers originally started with the specifications of the US trucks.
(2) He lost all his papers about the Chinese trucks during the Japanese attack.
(3) He probably wrote down a lot of information just from memory.
(4) He had to resize the vehicle which stayed in Shanghai.

periodic revisions of his engineer's estimate of the cost to build the 45 trucks, and exploring factory location options.

When the Japanese reached Jehol (Rehe) and threatened Beijing and Tianjin, Shanghai seemed a better option than Tianjin. In early March 1933, Myers met with the head of the Chinese Chamber of Commerce of Shanghai and six of the big Chinese bankers. He found that the Chamber was willing to undertake the organization of a very large company of Shanghai bankers for the purpose of manufacturing trucks, motor cars, and farm implements. Most of these bankers had a financial stake in a large vacant arsenal, the Lunghua Arsenal, which had been abandoned some years before, and they thought this could be a proper location for such an undertaking. However, by October Myers learned that the Chinese Chamber of Commerce had decided it would not be profitable to open this factory in that arsenal. By this time he had produced about ten revisions of his engineer's estimate with no discernible effect. His contract had expired, and he decided to return to the United States.

A Change of Direction

In December, however, he changed his mind. In his spare time during 1933, Myers had started work on the design of a small cycle car. He believed that there was a big market in China for a light, cheap, Chinese-built car, something that the people could afford and that was light enough and small enough to go where imported motor cars could not go. Some of Myers' Chinese friends, including C. F. Wang, became interested in this car and offered him financial backing. By January 1934, he had completed the design and was ready to construct a prototype. His intention was to have all of the car parts, except the tires, made in China. He contracted to have the parts made in a small Chinese machine shop in Beijing under his supervision. He was anxious to get the little car running so that it might be seen as an example of what could be done in China.

His cycle car was to have a 532 cc two-cylinder, two-stroke engine (which he named the "Myers Special") and a two-speed forward, one reverse transmission. It was to have just three wheels. The driver would be seated in the middle of the front seat. It was to have a curb weight of 340 to 365 kg (750 to 800 pounds) and a maximum speed of 29 km/h (18 mph).

Myers was thinking of making a four-wheel version later.

In May 1934, Myers started assembling the prototype, but made very slow progress because the parts being produced for him in the Beijing machine shop were of poor quality and had to be remade repeatedly. In July, Myers moved to Shanghai and took a job as technical advisor and service manager of Cathay Motors, a Studebaker/Pierce-Arrow dealership there. According to his contract with Cathay Motors, he was to be permitted to make use of the shop facilities to complete and experiment with his small motor car. In addition, Cathay Motors wanted him to design and produce a small experimental four-wheel, four-cylinder motor car that might form the basis of a future agreement between Cathay Motors and Myers. As it turned out, Myers spent all his time getting their service department straightened out and had no time to work on his own cycle car. In December, the directors of Cathay told Myers that they did not intend to pursue their manufacturing plan. When Myers' six-month contract with Cathay expired at the end of December he resigned.

In November 1934, while still working for Cathay Motors, Myers was asked by the Republic of China's Ministry of Finance to help inspect some government-owned Reo trucks in Nanjing. On January 4, 1935, he was appointed to the position of Technical Advisor to the Trust Department of the Central Bank of China, under the authority of now Minister of Finance Dr. H. H. Kung, regarding the development of automotive and other industries, and the purchase of motor vehicles and certain goods used in government factories. The Executive Council had just approved a plan to establish a new motor truck factory to manufacture motor vehicles for the army and other purposes, and Myers hoped to be involved in that project.

One of Myers' first proposals to Dr. Kung was for a small motor car – an assembled unit for which parts and sub-assemblies would be imported – to be designed and constructed in Shanghai for general sale and distribution in China. His proposed general specifications for this car were as follows: four-cylinder, four-cycle, water-cooled engine; three speeds forward, one speed reverse transmission; spiral-bevel gear-type driving axle with differential; cam and lever steering gear with ball-joint linkage; semi-elliptic leaf springs; steel channel, riveted and welded frame; all-steel two-door body and wire wheels. This car was to be bigger than the cycle car on which Myers had been working. It was to be approximately the size of such existing British vehicles as the Standard, the Austin Ten, and the 10-hp Ford.

Myers also proposed a line of two-ton army transport trucks of sturdy construction but lighter than the Minsheng Model 75 built in Shenyang in 1931. He investigated the possibility of using diesel engines in these trucks out of concern for the rising cost of gasoline in China.

American-Sourced Parts for Minsheng Trucks

Vendor	Name of unit	Their model designations
The Buda Company	Engine	J-214 and H-298
Relay Motors Corp.	Rear axles	20 and 30
Ross Gear & Tool	Steering gears	180 and 320
Clark Equipment	Transmissions	107 and 312
	Front axles	319
Borg & Beck	Clutches	QL-10 [19? partly illegible] and QL-12
Goodyear Tire	Tires & Rims	Type "K" rims
Autolite Electric Co.	Generators, starters, coils & distributors	
Zenith-Detroit Corp.	Carburetors	114-1/2 and 130 (downdraft)
Truscon Steel Corp.	Frame side rails	
USL Battery Corp.	Storage batteries	17 plate truck and bus
Wagner Electric	Hydraulic brakes	
Overseas Motor Corp.	Head and tail lamps	Guide Lamp Co., "Guideray"
	Speedometers	AC truck type
Service Spring Co.	Springs	
The Gibson Co.	Miscellaneous tools, wiring cable and radiator hose	

In April 1935, Myers addressed a class of automotive engineering students at Chiao Tung University in Shanghai, where the one surviving Model 75 was stored.

That same month, Myers rented a building across the street from his home on Avenue Joffre (now Huaihai Zhong Lu) in which to assemble his cycle car. In this building he set up a small machine shop equipped with a lathe, drill press, grinder, and all the small tools needed to run the shop. He furnished a small room above the shop in which to do the drafting. He hired a lathe man to run the shop and a part-time helper for the lathe man. By the second half of 1935, Myers was building the prototype of the car, which he hoped to have ready before the first of the year 1936. However, by October several factors made Myers rethink the feasibility of his car-building venture. One was the steep drop in the value of the Chinese currency which Myers thought would decrease the Chinese market even for his relatively inexpensive car. Another was that Myers had spent most of his savings on the development of the car and was having difficulty covering his living expenses on the salary he received from the Central Bank of China, which was more honorary than lucrative. Myers does not mention his development of his cycle car in his letters after 1935. He may never have finished even one prototype. There is no photo or drawing of it among his surviving papers.

The Road Home

As a result, Myers began to consider returning to the United States. He wrote to his acquaintances in the US automotive

industry for advice on securing a job there. In these letters he expressed his disappointment that, so far, nothing had come of his efforts of the past three years to help the Chinese government establish another automotive assembly plant. When his contract with the Central Bank of China was about to expire at the end of December, however, he was asked to stay on for another six months at a higher salary, and he agreed.

Myers thought that his lack of success in persuading the Chinese to establish another automotive assembly plant was due to opposition from somewhere within the Nationalist Chinese Army. In January 1936, however, he learned that the Army was beginning to show interest in such a plant, and that Dr. S. C. Wang (Wang Shou Chin), a technical advisor to the Army, was to be sent to the United States to find and purchase for importation to China a plant equipped to manufacture every component of automotive vehicles. This was on the assumption that China would be able to produce vehicles entirely with parts made using the equipment of that plant. Myers advised against that plan on the grounds that few, if any, American plants actually manufactured all the components of the vehicles they produced; and that what China needed was the kind of industrial development that would put her unemployed to work, not a high production plant with automatic machines that would replace her potential skilled workers. Nevertheless, Myers arranged for his associates in the U.S. automotive industry to help Dr. Wang in his search. As it turned out, the Chinese government cancelled Dr. Wang's trip to the United States so that he could attend to other more pressing matters. During 1936 Myers also advised on the purchase of trucks and tanks, on alternative fuels, and on the establishment of courses in automotive maintenance and repair, and he taught automotive engineering at Chiao Tung University (Jiaotong University).

In December 1936, Myers was authorized by Dr. H.H. Kung to take a temporary leave of absence from his advisory position in order to supervise the Motor Transport Service of the Central Aviation School, Shien Chiao, Hangchow, China. He began that new assignment in January 1937.

Myers left Shanghai for the United States in early August 1937, to escort a daughter to her university and to bring himself up to date on the U.S. automotive industry, so he was not in Shanghai when the Japanese invaded that city on August 13. However, his wife and son were there and Myers spent many frantic days trying to determine their fate. They were evacuated to the Philippines but Myers was not reunited with them until November 14, when they were able to sail to Los Angeles. While waiting for them, once he knew they were safe, he continued his advisory work by visiting U.S. automotive plants to learn of the latest developments in the automotive industry. In January 1938, after settling his family in the U.S., Myers returned to work, first in Hong Kong, where the Central Bank of China had relocated, and then, in 1939, in Chongqing to assist with the building of the Burma Road. In 1941 he went to Washington, D.C., to help the Chinese appeal to the Lend-Lease Administration, through the Chinese Defense Supplies Corporation, for road-building equipment and trucks needed to maintain the Burma Road. Although this appeal was successful, few of the goods thus obtained reached China for various reasons, including the Japanese conquest of North Burma early in 1942. In early 1944, the Chinese Defense Supplies Corporation closed its office in Washington, D.C. Myers was offered a job with the Chinese Embassy but instead decided to take a job with the Studebaker Corporation and, later, the General Tire and Rubber Company. He retired in 1955.

Prior to his death in 1973, Myers wrote in his memoirs of this decision as follows: "So I ended my work with the Chinese after almost fifteen years of rather hard and perhaps, ineffective effort to promote Industrialism in a country not yet ready for it." Despite this indication that Myers may have considered his work in China a failure, his memoirs, written for his children and grandchildren, inspired them to preserve his records of that work. Those records have informed this article which, the writers hope, will contribute to an understanding of what occurred at the dawn of the Chinese automotive industry.

Elizabeth Myers Macinata is the daughter of Daniel E. Myers. She began work on this project in 1972, while working toward a Masters Degree in East Asian History at Indiana University, using her father's unpublished letters as primary sources.

Josephine B. Howe, a retired Japanese-English translator, is a granddaughter of Daniel E. Myers. She began indexing his letters while house-sitting for him prior to his death in 1973; in her retirement she continues to do so, with second copies she made to facilitate the use of these letters by Chinese automotive history researchers.

SAH member Erik van Ingen Schenau *is Director of the China Motor Vehicle Documentation Centre, located in Ortaffa, France. Having researched automotive developments in the People's Republic of China since 1966, he founded the Centre in 1972, following a career in social work and the travel industry. The Centre presently has a large library of Chinese auto reference material and photographs. Erik contributed to the award-winning* Beaulieu Encyclopaedia of the Automobile *and writes regularly for European and Chinese car magazines, as well as publications on the Chinese auto industry offered by the Centre.*

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The Milwaukee Sentinel, June 14, 1931.
Time magazine, June 22, 1931.
Automotive Industries, August 8, 1931.
Republic Daily (Minguo Ribao) , September 13, 1931.
Shenbao Daily, September 23, 1931.
The Goods Road Monthly (Daolu Yuekan), October 1931.
Beijing Qiche Bao, 25-11-1994.
Most of them, and more articles and photos, were gathered by Erik van Ingen Schenau at the public libraries of Beijing, Changchun, Shanghai and Shenyang.

Internet articles

There are some (but not many) Chinese and English language articles on the truck project circulating on the web.

An appeal for photos and brochures.

Information in China about the Minsheng truck is almost entirely lost. The Japanese destroyed the complete factory archive in Shenyang. Even Chinese language newspapers in the public library of Shenyang were burned by the occupiers. The war with Japan, the Chinese civil war and the "Great Proletarian Cultural Revolution" of 1966 (during which it was very unsafe to keep anything related to foreign countries) are the reasons that there is practically nothing left of the truck project, except for some poor newspaper cuttings and two photos kept by Daniel Myers' family.

Daniel F. Myers sent letters to a great number of American parts and truck companies, some accompanied by photos of his truck. We wonder if it is possible to find any of these photos, in old archives of these companies or in their heritage. Some names: Gramm Motors, Relay Motors Corp., Service Motor Truck, The Buda Company, Zenith-Detroit Corp., Moreland Motor Truck, Ross Gear & Tool Co., Society of Automotive Engineers Inc. (New York City), Service Spring Company, International Harvester Company and many more.

There must have been a Chinese language brochure (or catalog) which was sent to Mr. Guy Wright at The Buda Company, Harvey, Illinois; Mr. W. E. Murphy, Relay Motors Corp., Lima, Ohio; and Mr. F. F. Chandler, Ross Gear & Tool Co., Lafayette, Indiana. These brochures were sent on September 13, 1931.

If you find any of these photos or brochures, contact the authors by email (erik@chinesecars.net) or mail: Chinese Motor Vehicle Documentation Centre, 2 Rue des Remparts, 66560 Ortaffa France. This material will be of great help in reconstructing the project and the truck itself.


THE REPUBLICAN DAILY NEWS
民國日報
全國路市展覽大會
各省市廳局特派路市展覽大會代表公鑒
交通公司啟事
五和染織廠啟事
上海華慈恩
購門券之意義有三
一、教育
二、娛樂
三、贈品
明日開幕
會場當路

An advertisement for the Good Roads Show in Shanghai in September 1931. There was a lottery that one could enter to win one of the three pictured cars: a Buick sedan, Model A Ford sedan or a Morris Minor Saloon. Several ads were published during the opening days, found in the Chinese and English language newspapers.

Making Room for Beetle

Volkswagen's Impact on the German Motor Industry

By Peter Engelhard

Introduction

Economic theory teaches that the rise and fall of companies is driven by market forces and entrepreneurial acumen. Nevertheless, economic history is full of examples of non-market-driven industrial development. Non-market-driven industrial development usually takes place when the government plays the role of the entrepreneur and investor. Key infrastructure systems, like postal services or railroad networks, were established by the government in many capitalist countries. Under socialist rule, government-planned industrial development was usually much more comprehensive. Oftentimes, it entailed the creation of entire industrial sectors from scratch. For example, Stalin forced the Soviet Union into industrialization by ramping up huge steel mills, power plants and other state-owned enterprises. Fascist regimes in Europe and other parts of the world also tried to foster rapid economic modernization by means of central planning and the establishment of government-owned industrial facilities. Most fascist economies of the 1930s were based on private property. The government's industrial ventures formed non-market islands in an otherwise market-driven economy notwithstanding the fact that government intervention and central planning tended to claim a fast-growing fraction of economic life (Barkai 1988, p. 150 ff.; Tooze 2007, p. 197 ff.). One of the most prominent examples for a fascist non-market industrial venture is the Volkswagen plant that was originally created by the Nazi government in the late 1930s.

Volkswagen is a particularly interesting case for industrial history. It was artificially planted into an existing, market-driven domestic automotive industry. The implant turned out to be the largest and technically most advanced facility within the German motor industry of the 1930s and it remained so throughout the 1950s. World War II prevented the Volkswagen plant from becoming operative under Nazi rule. Nevertheless, it was still there when the Nazis had left after Germany's total military defeat in 1945. In post-war Germany, the Volkswagen plant had to find its place within a market-based automotive industry. To state this the other way around, the German car market had to digest a forceful new player which began as a voluntary non-market creation.

In this article we analyze how the Volkswagen plant was integrated into Germany's post-war economy.

The Beginning of the Volkswagen Story

Volkswagen's "spiritual" roots reach back into the early days of European fascist movements. The automobile had been an avant-garde cultural icon for most European fascists since the 1920s. It reflected the movement's inherent conflict between retrogressive attitudes and aggressive modernism (Payne 2001, p. 573 ff.). Also, within the German Nazi movement ideological visions contained American-style mass manufacturing and mass motorization. The idea of promoting a "people's car" was first mentioned by Adolf Hitler when he opened the 1934 International Motor Exposition in Berlin on March 7 (Burnham 1992, p. 10; Lewandowski 1998, p.8). Actually, the project was the offspring of successful lobbying by Ferdinand Porsche's engineering office.

The association of the German motor industry, "Reichsverband der Automobilindustrie (RDA)," could hardly refuse to form an expert committee with the task to evaluate how Porsche's idea could be implemented. The committee's members represented the Adler Werke, Daimler-Benz, Auto Union, BMW, MAN and, last but not least, the engineering company Dr.-Ing. F. Porsche GmbH. Foreign owned Adam Opel AG (General Motors) and Ford Werke AG (Ford Motor Company) were excluded from the project, though at that time they surely were much better acquainted with the art of mass manufacturing passenger cars (Lewandowski 1998, p.4; Oswald 1982, p. 381).

Despite Hitler's wishes, the Volkswagen project was rather unpopular among the members of the RDA industry committee. There were objections to Porsche's technical concept. Even more concern was raised by the fact that the incumbent manufacturers were utterly unfamiliar with the project's intended scale. Government plans foresaw an initial output capacity of 175,000 cars per year – to be extended to 500,000 units later. The entire German car market hardly exceeded 200,000 cars per year. The new plant would have distorted the existing market structure and most probably squeezed out incumbent players. The Volkswagen's future sales price was fixed at 990 Reichsmark—a dumping price, according to most contemporary experts, which could not cover production costs (Mommsen and Grieger 1996, p. 64 ff.; Etzold 1984, p. 12; Burnham 1992, p. 12; Lewandowski 1998, p. 11).

Nevertheless, the political imperative to go forward with the Volkswagen project was obvious. In 1934, RDA and Porsche's engineering office agreed to build a number of prototypes. These turned out to be technically feasible and the project gained further momentum, despite the motor industry's reluctance (Burnham 1992, p. 11; Mommsen and Grieger 1996, p. 85 ff.).

In July 1936, the industry committee suggested creation of a separate industrial entity for the Volkswagen project. Franz Josef Popp, founder and CEO of BMW, had the idea to entrust the Nazi labor organization "Deutsche Arbe-

itsfront" (DAF) with building and selling the new car. DAF was able to mobilize necessary funds because it disposed of the assets of the former German labor unions which the Nazis had dissolved in 1933. Furthermore, incumbent car manufacturers speculated that a kind of market splitting could protect their own commercial position against the Volkswagen: The right to buy a Volkswagen would be reserved to the members of DAF, mainly blue and small white collar workers. Traditional passenger car buyers (upper middle class and commercial customers) would remain with the traditional manufacturers (though it appears questionable whether this strategy would still have been feasible once the first used Volkswagens came to the market) (Volkswagen AG no date, p. 4; Etzold 1984, p. 12; Barkai 1988, p. 217 ff.; Mommsen and Grieger 1996, p. 32 and 64).

The Volkswagen plant's cornerstone was laid on May 26, 1938, near the small city of Fallersleben in Northern Germany. The plant layout and equipment very much resembled Ford's River Rouge complex. Ferdinand Porsche and some of his colleagues had studied River Rouge while traveling in the United States. Their intention had been to become acquainted with the principles of mass production of cars (Burnham 1988, p. 12; Mommsen and Grieger 1996, p. 107 f.).

Only around 10,000 civilian Volkswagens ("KdF-Wagen") came off the lines before the new plant was converted to wartime production. The output of light military vehicles grew to approximately 55,000 units through 1945 (Lupa 2002, p. 4; Burnham 1992, p. 10; Lewandowski 1998, p. 17 ff.). The Volkswagen plant was the only German car plant which continued to manufacture light vehicles right through to Germany's final surrender in 1945 (Blaich 1987, p. 16). Under occupation by Allied Forces, it remained the almost exclusive supplier of new cars in the British and American administrative zones. In 1946 and 1947, Volkswagen's output amounted to approximately 10,000 units per year, which were shipped to Allied or German authorities. New passenger cars were in short supply all over Europe at that time. Consequently, the British military administration decided to continue operations at the Volkswagen plant in order to cover at least a fraction of Germany's immediate post-war motorization needs with domestic resources – although the plant had been earmarked for dismantling under the Allied authorities' 1946 "Industry Level Plan." However, the rigid Plan was soon abandoned and the Volkswagen plant remained in operation (Lupa 2002, p. 11).

Laying the Volkwagen plant's cornerstone, at a new town near Fallersleben, May 26, 1938. Bundesarchiv, Bild 183-H06734.

Market Conditions After World War II

Private sector demand for passenger cars began to resume after the 1948 currency reform and the following liberalization of markets. Output reached pre-war levels in 1951 and domestic sales followed two years later, in 1953 (not counting passenger car production and sales in Eastern Germany). In Western Germany, the market size remained more or less at pre-war levels until the mid-1950s. Then production in Western German car plants as well as domestic sales began to surge and the industry grew at a pace never experienced before (Figure 1, page 16). It was the era of an unprecedented automobile boom in Germany, which would continue well into the 1960s.

One of the key drivers for the sales boom on the domestic new car market was demand by private households. Before the war, private households accounted for little more than one-fifth of all new passenger car sales. Almost four-fifths accrued to the industry, small businesses, self-employed professionals and the public sector. Shortly after the war, private household demand for new cars had fallen to almost negligible quantities. Table 1 on page 16 indicates that in 1950 it still accounted for a meager 6.5 percent of total new car sales and did not reclaim its former role before 1955. Then, however, private households turned into the fastest-growing group of new car buyers.

In addition, the supply-side structure of the German passenger car industry changed drastically after the war. Volkswagen was an artificial implant into an existing structure of incumbent manufac-

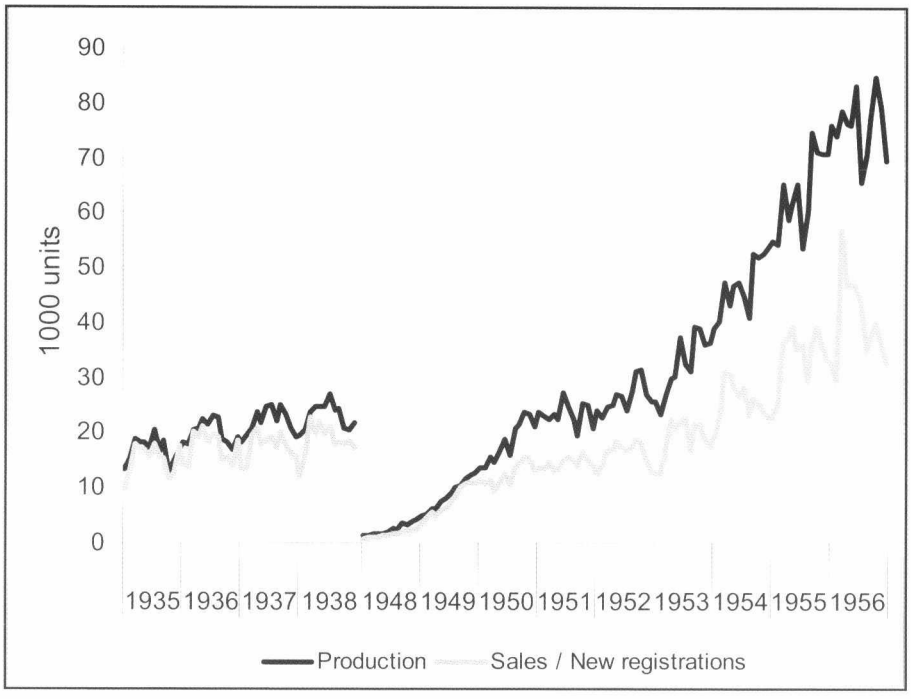

Figure 1. Monthly Production and Sales of Passenger Cars in Germany (After 1948 West Germany Only)

		1938	1950**	1955	1960	1965	1970
Commercial & public sector*	%	77.4	93.5	78.0	65.2	60.7	57.8
Private Households	%	22.4	6.5	22.0	34.8	39.3	42.2
Thereof "white collar"	%	78.8	86.4	67.8	54.7	55.2	59.0
Thereof "blue collar"	%	5.6	1.1	25.2	39.5	44.8	41.0
Thereof others	%	15.6	12.5	7.0	5.8	0.0	0.0

** incl. banks and energy industry ** without Bavaria and Baden-Württemberg*

Table 1. New Passenger Car Sales by Type of Buyer

Car	Base price	Wheelbase	Engine size	Annual sales	Market share
	[RM]	[mm]	[cm^3]	[1,000 units]	[%]
Fiat 500	1,900	2,000	570	~1.6	1.1%
Fiat 1000	2,600	2,300	995	~2.9	1.9%
AU-DKW Sonderklasse	3,100	2,600	990	~2.7	1.8%
Hansa H 1100	2,950	2,700	1,088	~4.0	2.7%
Hanomag Garant / Kurier	2,600	2,472	1,097	~4.5	3.1%
Ford Eifel	2,600	2,286	1,172	~13.0	8.9%
Adler Trumpf Junior	2,700	2,630	995	~13.3	9.1%
AU-DKW Meisterklasse	2,200	2,600	692	~17.4	11.9%
AU-DKW Reichsklasse	1,700	2,600	589	~22.0	15.0%
Opel Olympia	2,500	2,370	1,288	~23.0	17.1%
Opel P4 / Kadett	1,800	2,337	1,074	~40.0	27.3%
Total				~144.4	100.0%

Table 2. The Market for Passenger Cars up to 1.5 Liters Displacement in the Late 1930s

turers and it was now that it began to realize its commercial potential.

The Volkswagen car was placed in the market segment for small or compact cars which typically comprised engine sizes up to 1.5 liters. Cars of up to 1.5 liters displacement also constituted the most important segment of the German market during the 1930s and continued to do so during the post-war era. Tables 2 and 3 summarize the prices, basic technical specifications and approximate sales potential of all relevant cars in this category.

In the late 1930s, General Motors' Opel and Auto Union had dominated the market for small and compact cars. In the early 1950s, however, Volkswagen attained a market share of 44 percent, while Opel fell back to 17 percent. Ford and Opel together now achieved a market share which formerly had accrued to Auto Union. Measured against its former role, Auto Union's DKW brand now played a more or less subordinate role.

The West German market for new small and compact cars was completely restructured. At first glance it appears that Volkswagen's advent was a disaster, particularly for Opel's and Auto Union's market positions. However, if one considers absolute sales numbers and takes into account Opel's and Auto Union's postwar capacity constraints, the story gets much less dramatic.

In the early 1950s Opel sold 40,000 fewer units than in the late 1930s. This equaled the pre-war sales volume of the Opel Kadett, a model that the company could no longer offer because its production lines had been dismantled and relocated to the Soviet Union (Scharmbeck and Fischer 1996, p. 123). In contrast, Opel sold almost the same number of Olympia compact cars in the early 1950s as it had in the late 1930s, approximately 23,000 units per year. Opel's post-war new car sales were thus more or less in line with the company's available production capacities. Even without the advent of the Volkswagen it could hardly have sold significantly more cars.

Another post-war loser was Auto Union, which now could sell only 15,000 units annually. Auto Union's original manufacturing capacities were all located in the Soviet occupation zone and were completely lost to business in Western Germany. A new plant was set up in Düsseldorf in 1950 but the company never managed to regain its former market position. Also this setback can be explained by the fact that Auto Union had to re-establish itself from scratch in Western Germany due to the effective loss of pre-war production facilities.

Other once-prominent producers like Adler and Hanomag never resumed passenger car manufacture after the

Car	Base price	Wheelbase	Engine size	Annual sales	Market share
	[DM]	[mm]	[cm^3]	[1,000 units]	[%]
Champion	2650	1800	250	1000	0.7%
Renault 4 CV	4250	2300	760	1000	0.7%
Gutbrod	4300	2000	593	2000	1.5%
Fiat 500	4900	2000	570	3500	2.5%
Borgward-Goliath	6400	2300	688	4000	2.9%
Borgward-Lloyd	3500	2000	293	10000	7.3%
AU-DKW Meisterklasse	5800	2350	684	15000	10.9%
Ford Taunus	5600	2387	1117	18000	13.1%
Opel Olympia	6400	2395	1488	23000	16.7%
Volkswagen	4800	2400	1131	60000	43,60%
Total				~137.5	100.0%

Table 3. The Market for Passenger Cars up to 1.5 Liters Displacement in the Early 1950s

war. It is very likely that the advent of the Volkswagen and expected overcapacities were a key reason why Adler ultimately left the automotive business.

The "Abandoned Car Sales Potential"

Manufacturing capacities that Opel and Auto Union lost, and which disappeared due to the market exit of Adler and Hanomag, add up to a new car sales potential that had been effectively abandoned after the war. This "abandoned car sales potential" (Figure 2) could be utilized by Volkswagen to move into the market without squeezing the remaining incumbents' positions. We estimate that the abandoned post-war sales potential accounts for 92,500 new passenger cars per year.

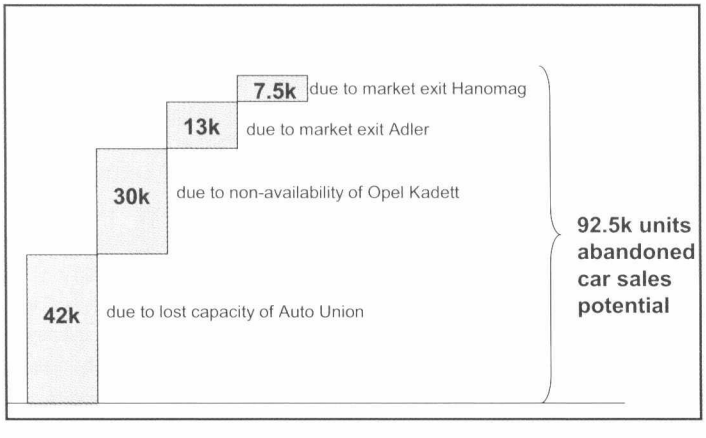

Figure 2. Abandoned Car Sales Potential (K units)

Now compare the size of the "abandoned car sales potential" to the evolution of Volkswagen's post-war sales (Figure 3). It was large enough to absorb all of Volkswagen's domestic new car sales until 1953. In the early years it even provided some headroom in the market to digest sales of the re-established Auto Union and Borgward's new Lloyd and Goliath small cars. Consequently, incumbent Opel (Opel Olympia) and Ford (Ford Taunus) were effectively sheltered from encroachment by new market entrants until 1953.

It is important to note that the point when the "abandoned car sales potential" was exhausted (1953) closely matched with the time when the German motor boom began to blossom (1954). Almost exactly when the "abandoned car sales potential" could no longer give sufficient headroom for incumbent and new players, nascent mass motorization and market expansion stepped in to do so. Market expansion after 1954 was strong enough to support additional new car sales for Volkswagen as well as for incumbents Opel and Ford.

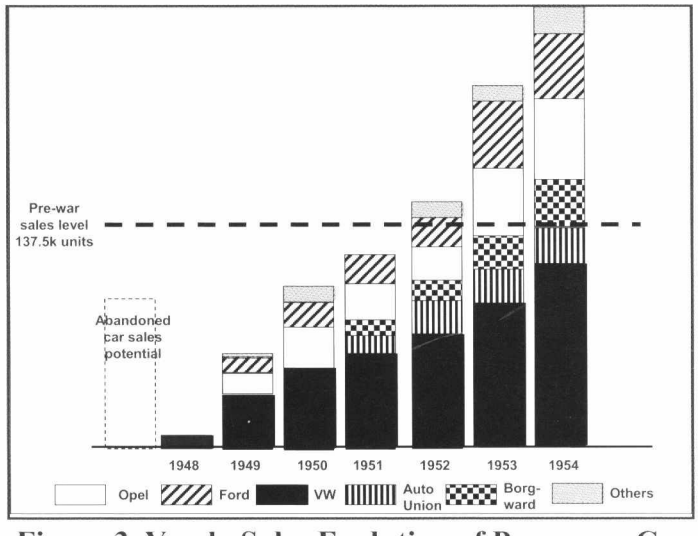

Figure 3. Yearly Sales Evolution of Passenger Cars up to 1.5 Liters Displacement by Year and Brand

Volkswagen's new car sales grew extremely strong between 1954 and 1960, on average an additional 33,000 units per year. Ford and Opel performed less strongly, though still respectably, with sales growing by 15,000 and 11,000 units per year, respectively. The Borgward group's sales of Lloyd and Goliath small cars accelerated quite impressively around 1955 but soon began to falter. Finally, Auto Union's sales growth was sluggish for most of the period.

In the earlier years of the German motor boom (1954 to 1960), Volkswagen was the leading new car supplier, not

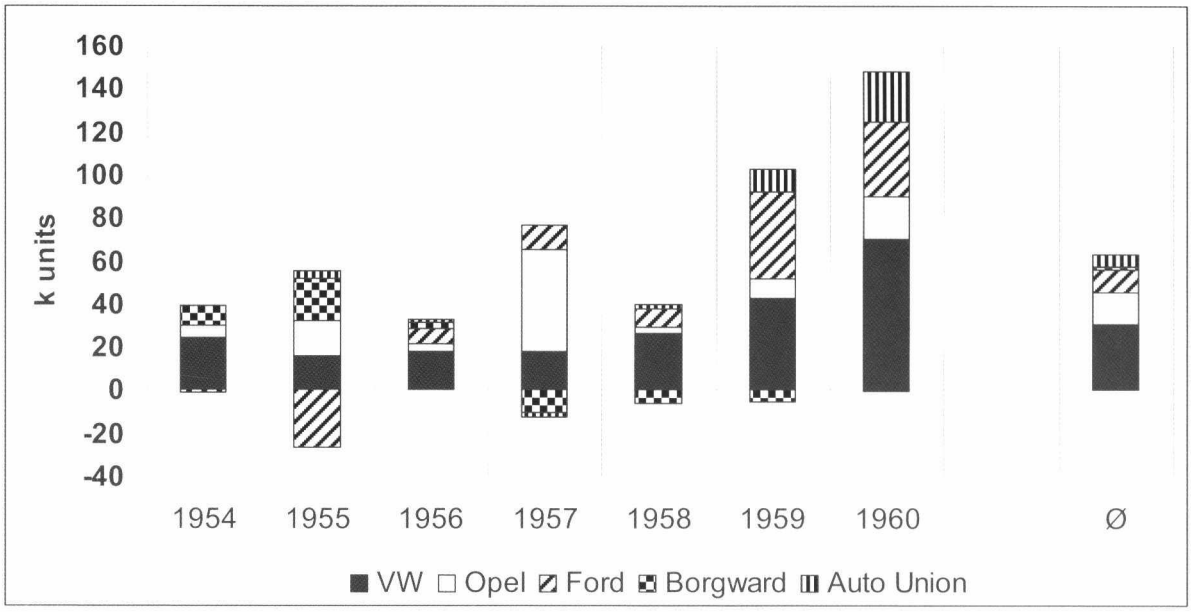

Figure 4. Annual Increase and Decrease of New Car Sales in Germany Selected Brands 1954-1960

only in terms of absolute sales volumes but also in terms of growth rates. To attain and maintain such a role in a still immature market normally requires rather aggressive pricing policies, which ensure superior affordability (Figure 4).

Volkswagen's Post-war Pricing Policies

Figure 5 illustrates the evolution of base prices for the most important offerings in the German new passenger car market (up to 1.5 liters displacement) between 1948 and 1960. The Volkswagen was much cheaper than competing products from Opel, Ford and Auto Union. Only Borgward's Lloyd sold at a lower price than the Volkswagen. However, the Lloyd was much smaller and technically less sophisticated than the Volkswagen. Now follow the slope of price trajectories over time. With the exception of 1951-52, when the cost of raw materials soared because of the Korean War, the Volkswagen's base price was lower year after year. But it stopped falling soon after the German motor boom had set in. So did the base price of Opel's Olympia and Rekord series, while Ford and Auto Union showed little regularity in their post-war pricing policies.

The underlying lever for Volkswagen's pricing policies was a strictly "Fordist" way of organizing production and the product line-up. The Volkswagen's technology basically remained the same for many years. Figure 6 demonstrates that there was only one significant step forward in terms of product development during the 1950s, when the 30 hp. engine became available in 1954. By keeping product technology basically constant, Volkswagen bet on rising output volumes and declining average unit costs.

None of Volkswagen's competitors followed such a purely "Fordist" strategy of mass production. Still in the early years after World War II their offerings in the small and compact car market were very close to the Volkswagen in terms of basic technical specifications like wheelbase and engine performance. Later, however, they strove to make their products better perform, larger and more sophisticated than the Volkswagen. Figure 6 also shows that except for Volkswagen and Lloyd, wheelbase and engine performance of all major products in the market for passenger cars of up to 1.5 liters successively increased during the 1950s. Hence, Opel and Ford moved up-market and were then in a better position to justify higher prices. By doing so, they created a healthy competitive distance from the low-priced Volkswagen. This strategy also leaned more towards traditional customers (i.e. commercial buyers, business people and self-employed professionals), whose ability to pay was comparatively high since they could claim tax deductions for the purchase and operation of passenger cars. For private households, Opel and Ford became accessible later: during the 1960s or 1970s when higher incomes allowed them to migrate from the basic Volkswagen (or Lloyd) towards more sophisticated and more reputable cars.

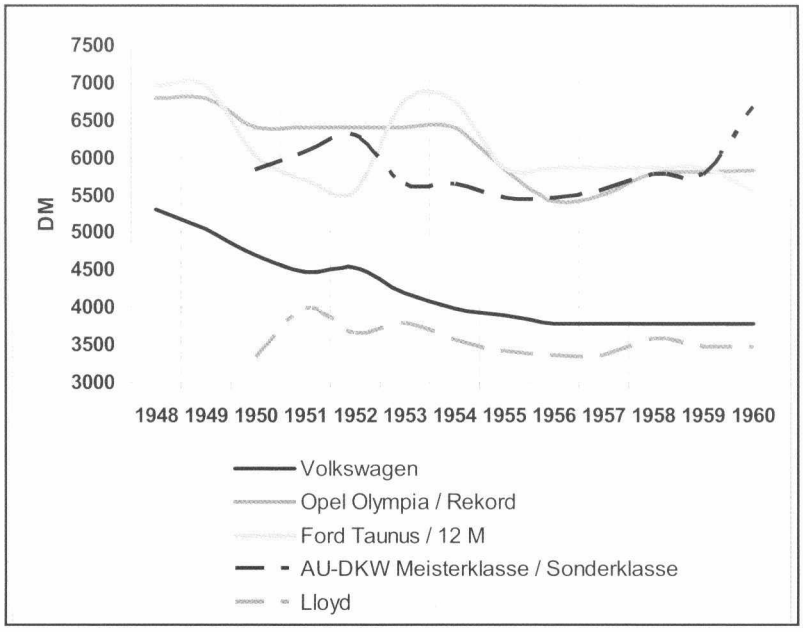

Figure 5: Evolution of Base Prices of Selected Passenger Cars up to 1.5 liters Engine Displacement

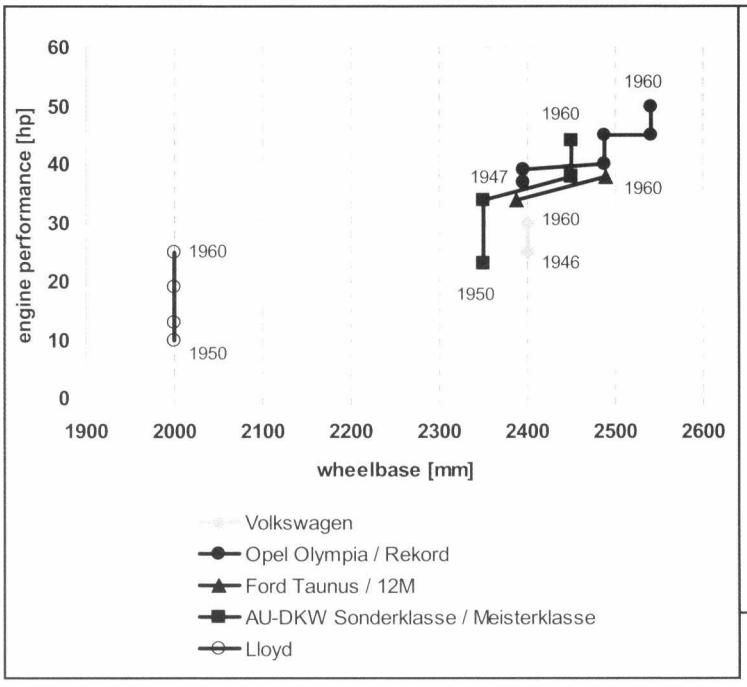

Figure 6: Evolution of Engine Performance and Wheelbase of Selected Cars

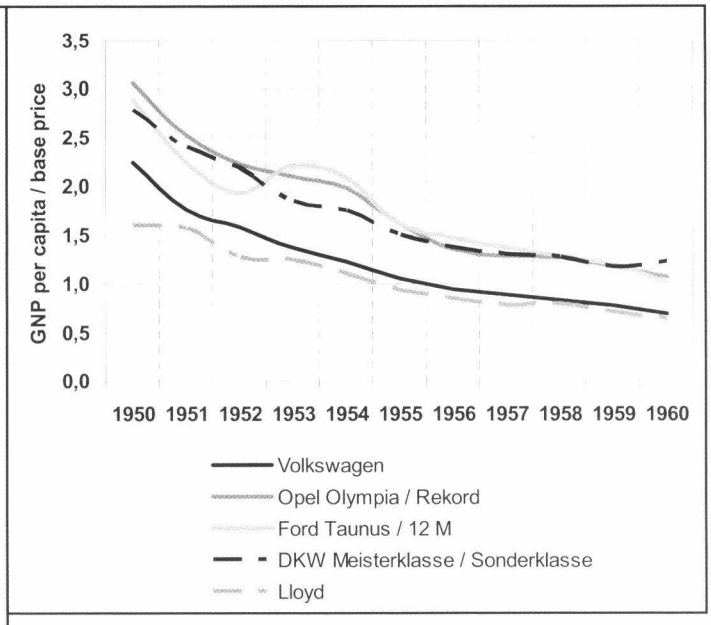

Figure 8. Development of Affordability of Selected Brands in the Market for Cars with Engine Displacement up to 1.5 Liters

Affordability

Pricing policies and product modification are parameters that car manufacturers can exploit in quest of increasing sales figures and greater market share. On the other side, there are macroeconomic parameters beyond the manufacturer's immediate control which nevertheless influence the affordability of products. Especially in emerging car markets, like Germany in the mid-1950s, affordability plays a key role for a brand's success. Nevertheless, from the manufacturer's point of view, affordability is a rather fragile and intricate issue since it is simultaneously determined by car prices and per capita or household income.

The broadest measure for the public's general income situation is the Gross National Product (GNP, also known as Gross Domestic Product in some countries) per capita. Figure 7 illustrates that during the 1950s overall income levels in Germany strongly improved. Annual GNP per capita grew from a frugal level of little more than 2,000 DM in 1950 to almost 5,500 DM in 1960 – on average 10 percent per year!

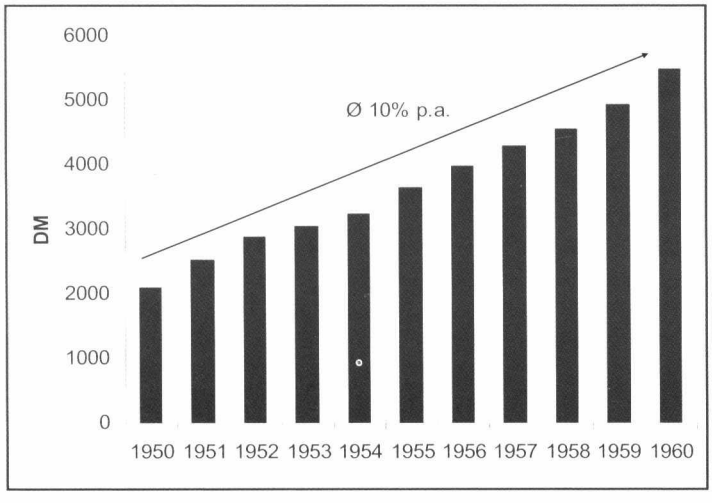

Figure 7. Development of GNP per Capita in Western Germany, 1950-1960

Overall affordability of a specific new car can be approximated by relating its base price to GNP per capita (GNP per capita / base price). This measure reflects the fraction of the average annual GNP per capita which is needed to purchase it. The development of the Volkswagen's and main competing products' affordability over time is illustrated by Figure 8.

In 1950, a German buyer had to spend 1.6 times the average annual GNP per capita to purchase the Lloyd small car, 2.2 times GNP per capita for the Volkswagen and 3.1 times GNP per capita for the Opel Olympia. Hence, in 1950 even the cheapest new car in the marketplace was very expensive when measured against the general income level at that time. Only a decade later, affordability relations had improved significantly. In 1960, just 0.7 times GNP per capita was sufficient to afford a new Volkswagen, 224 percent less than in 1950. The purchase of a decent new car was now within reach of the broader public.

We estimate that in the early 1950s a private household needed an annual income of more than 12,000 DM in order to purchase a new Volkswagen. Households in this income bracket accounted for fewer than one percent of all German households. The fraction of private households which could afford a new Volkswagen remained very low throughout the early 1950s (Figure 9). After 1954 it increased from year to year. In 1960, an annual income of around 9,000 DM was sufficient to buy a new Volkswagen, which now almost 20 percent of all households did.

Note, however, that the annual household income required to purchase a new Volkswagen (gray line in Figure 9, page 20) did not fall further after 1956, but remained more or less constant. This leads us to the question how

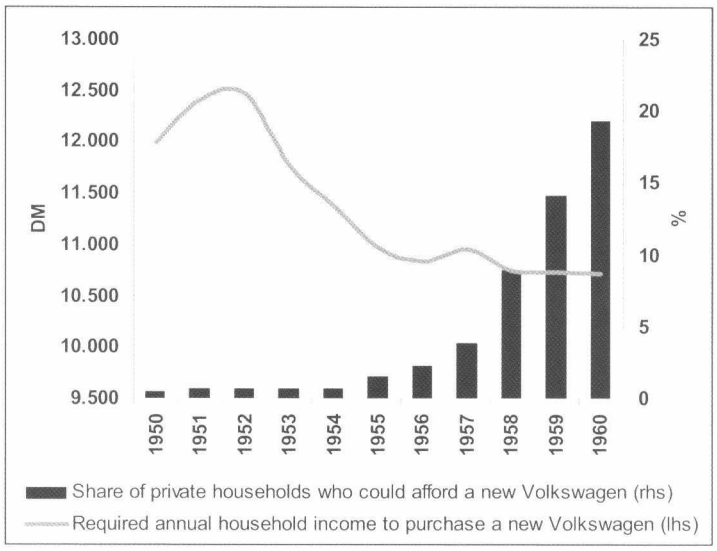

Figure 9. Share of Private Households Affording a New Volkswagen and Respective Income Threshold

much Volkswagen played the role of a market-maker during the 1950s, and to what extent it simply rode the wave of an expanding economy.

We decomposed the Volkswagen's affordability into its main drivers: GNP per capita and sales price (Figure 10). In 1951 the Volkswagen's affordability improved by 26 percent over 1950. Five percentage-points of the total increase resulted from a lower base price, 21 percentage points from a higher GNP per capita. In 1952, the price impact on affordability was slightly negative. Price had the most substantial positive impact on the Volkswagen's affordability in 1953 and 1954 and still a minor positive impact in 1955 and 1956. After 1956, however, any improvement in the Volkswagen's affordability was entirely borne by increases in GNP per capita, while the price-impact remained neutral.

By lowering the product price, Volkswagen pushed affordability of its product during the pre-take-off and early take-off phase of the German motor boom. If one considers that Volkswagen was by far the largest supplier of new passenger cars in Germany it becomes clear that Volkswagen's pricing policies had a positive catalytic effect for the entire development of the German car market during this period. One may say that this helped sustain market volumes during the early 1950s and ignited a self-sustained trend towards mass motorization after 1954. Thus, Volkswagen played the role of a market maker. Once this task had been accomplished, Volkswagen obviously changed the pricing strategy. Instead of further pushing affordability by continuing price cuts, the company preferred to "ride the wave" of increasing demand which now was sufficiently fuelled by rising GNP and a more even income distribution.

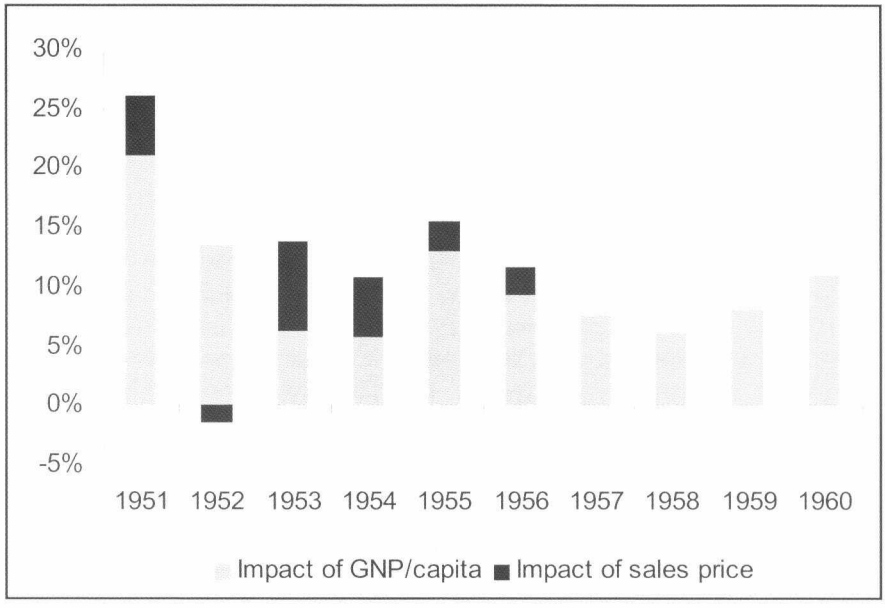

Figure 10. Decomposition of Annual Increases in Affordability of the Volkswagen by Main Impacts

Conclusion

The Volkswagen was an artificial element within Germany's passenger car market: initiated by political will and not by market considerations. The sheer size of the Volkswagen plant which had been built up by the Nazi regime, as well as its technical sophistication, had the potential to severely distort the established motor industry and to squeeze incumbent manufacturers. The squeeze-out of incumbents, however, did not materialize. Between 1948 and 1953 the advent of the Volkswagen in the commercial new car market was cushioned by the "abandoned car sales potential" – a gap in the industry's supply structure which occurred due to market exit (Adler, Hanomag) or war-related capacity losses (Auto Union, Opel). The "abandoned car sales potential" was sufficiently large to absorb Volkswagen's domestic new car sales. Furthermore, major incumbents like Opel or Ford were flexible enough in their marketing efforts and product strategies to avoid direct competitive confrontation with the Volkswagen. Last but not least, it needs to be emphasized that Volkswagen played a positive role as a market-maker during the early post-war years.

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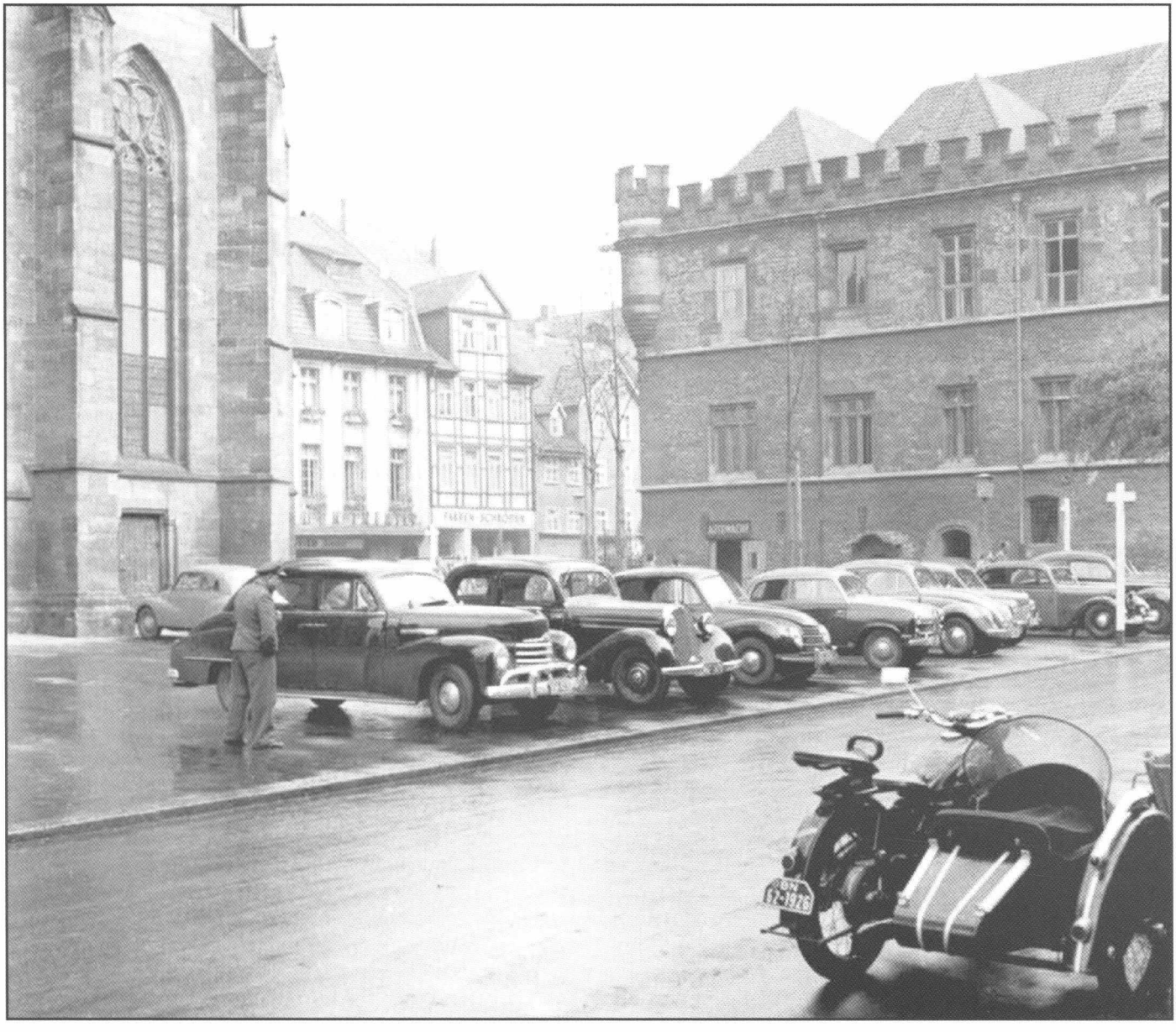


Volkswagen infiltrates the German auto market. Göttengen, 1953, left to right: Opel Kapitan, Mercedes-Benz 170S, DKW, Lloyd, Volkswagen, Renault 4CV and Adler. Bundesarchiv, Bild 146-1985-114-21 .

The Automobile, the Interstate and Suburbia

New-found Freedom at the Expense of Downtown in 20th Century America

By Andrew J. Mabon

Abstract

This article seeks to analyze the history of how the automobile's role in United States society ultimately shaped and later re-shaped the physical environment. As early as the mid-19th Century, city-dwellers were already on the move away from the urban core to expansive and pristine suburban locales prompted by public street car lines. Forming a star-shaped pattern around the city center, suburbs emerged, thus beginning a century of dramatic shifts in our nation's demographics. By the end of the Great Depression in 1939, the rapid and unprecedented acceleration of automobile ownership in the United States gave rise to a nascent highway system that marked the beginning of the end for the old industrial centers, and indeed all major urban areas in America. By the 1950s and most especially the 1960s, an increasingly automotive American culture had brought with it the excesses of aggressive highway construction, profound urban decay, and environmental strain. The effects of these issues are further explored in this paper with a case study of Pittsburgh, Pennsylvania, the hometown of the author.

Introduction

The United States of America has a long, entrenched tradition of individual freedom, an entrepreneurial spirit, and the belief in land ownership as paramount to a committed electorate. In the colonial era and later, the independent U.S. cities like New York, Boston, and Philadelphia sprang up as central hubs of artisans, bankers, and merchants—the ingredients necessary to an enterprising, capitalist economy that was further justified by a constitution that promoted extensive personal liberty. Thomas Jefferson, however, regarded cities as a threat to the essential functioning of a republican democracy, believing that democracy was "intrinsically anti-urban." From the earliest days of his political career up to his death, Jefferson envisioned the young nation as one of yeoman farmers shunning the metropolitan lifestyle of the Old World. Alexander Hamilton, in glaring contrast, lauded the city as an example of the greatness of a nation and its economic prowess, looking to great European cities like London and Paris as examples. Though these influential statesmen lived in a very different America, the battle between the suburb, or Jefferson's countryside, and Hamilton's urban center remains an issue of prominent contention. The great flames of this battle have been fanned over the past 60 years by the proliferation of the automobile culture which has in turn enabled the proliferation of the suburb north, south, east, and west on an out of control level. While some have commended the suburb as a means of escape from a confining city existence since the early 20th Century, this paper will examine the many detriments this population diffusion has had on urban areas in the United States. The topics that will be analyzed to lend to this argument will be a look into the formation of pre-World War II suburbs through various modes of transportation and related infrastructure, how the suburban-auto culture boomed post-World War II, the strains these satellite cities place on the original urban core, and finally, a brief case study into the disastrous effects of suburbanization in Pittsburgh.

Suburbia

To begin, a brief history into the idea of a "suburb" must be explored in order to comprehend the larger perspective of this essay. While the automobile inarguably provided the means of mass population movement out of the city, the suburb was not a direct off-spring of this technological innovation, but rather is rooted in over 200 years of American history. Drawing on the traditions inherent in a vast, open landscape, early settlers of this nation wanted space to live, raise families, and prosper economically; thus, the confining nature of the city prevented this sort of egalitarianism in business. As a result, many early colonists sought economic pursuits that were, as Jon Teaford describes, "incompatible with the policies... of the central city" (2008, p. 1). Teaford argues that it has always been an American phenomenon to want to live outside of an urban center, and in keeping with the nostalgic notion of the "American Dream," this indeed is true. However, it is hard to imagine that, had early colonial businessmen observed how extremely detrimental the suburban Levittowns, the mass-produced post-World War II housing developments, became to the cities, they would still continue their moves further west into the frontier – land that would later transform into Walmarts, parking lots, and Applebee's. Having established a background history into the idea of the suburb in American culture, we now move into discussing the practice of it in the early years.

Pre-automobile suburbs of the 19th Century still relied heavily on modes of public transportation – early on the ferry and later the street car – in cities such as New York and Chicago. When the introduction of ferry service began in 1838, the Hoboken Land and Improvement Company established Hoboken, New Jersey which quickly became a "thickly-settled embryo city on the periphery of New York City," while nearby Long Island and Staten Island fast transformed into "...bedroom communities of New York where weary Gotham entrepreneurs could retreat at the end of each

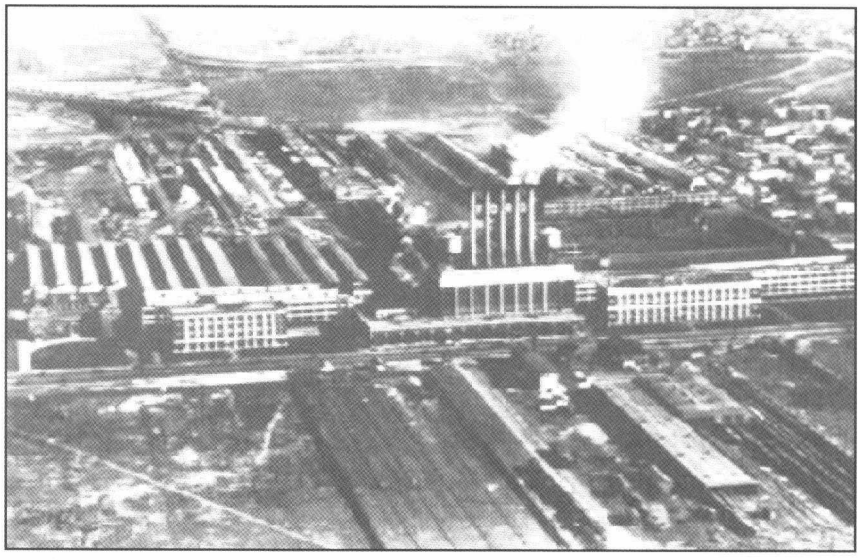
Henry Ford's Model T was the catalyst that most profoundly encouraged suburbanization. This is a 1920 Runabout. From the editor's collection.

day" (Teaford 2008, p. 3). As early as the 1830s, the urban center was already contending with its population spreading out into what were to become dense metropolitan areas. The suburbanization of these areas of New York and New Jersey bear many, almost exact similarities to how suburbs could be described in the late 20th Century—phrases like "embryo city on the periphery" convey an image of a separate living space where people wake up and make the daily morning commute into downtown, a process that became culturally homogenous in American society with the arrival of the automobile. Chicago was another city that much later witnessed suburbanization through new transportation innovations, this time the railroad: "Chicago was emerging as the nation's premier rail center, and… a leader in the development of railroad suburbs." These early suburbs developed in a linear, star-shaped pattern close to rail lines that carried city dwellers to new suburbs such as Hyde Park and Riverside in the south and Austin in the west; with the opening of the Chicago and Milwaukee Railroad in 1855, New York and Philadelphia suburbs would soon "meet with a rival" (Teaford 2008, p.4). Cities, before contending with automobile-encouraged mass suburbanization, permitted new community incorporation liberally, resulting in literally thousands of independent villages and townships on urban fringes with the hopes of metropolitan cooperation. Chicago's Cook County witnessed the creation of ten new municipalities each decade between 1860 and 1890, while Pittsburgh's Allegheny County saw creation of 65 "independent cities and boroughs" by 1910 (Teaford 2008, p. 12). Ironically, 19th Century urban infrastructure actually encouraged suburbanization through ferry service and rail in stark contrast to later efforts, where the city has sought to bring its metro population back into its limits with mixed success. Whether or not American cities were ready, suburbs were on the rise and with the automobile on the move, and they had to play ball.

Though the ferry and rail lines provided the first mechanical transport to suburban areas, it was the automobile that facilitated this demographic shift most significantly. Suburbs had indeed appeared on the landscape, but without the car, they really didn't present much of a threat to the manufacturing, trade, and tax base of the central city. The coming of Henry Ford's Model T in 1908 was the catalyst that most profoundly encouraged suburbanization, sounding the early death knell of the city center— a cheap, quality automobile could now be mass-produced that "released the potential home buyer from confining his choice of residence to one convenient to a bus or trolley" (Jackson 1985, p. 181). Most Americans in white middle-class enclaves like Shaker Heights in Cleveland and Shorewood in Milwaukee, however, did not view this nascent auto culture as detrimental or ominous to their downtowns, and even to city governments "the dense swarms of motor vehicles nosing their way into every major downtown at this time seemed to be a sign of urban vitality" (Lazare 2001, p. 161). Failing to see this new technological innovation as a harbinger of doom that it would become in later decades, cities widened streets, built new parking facilities, and developed an auto-centered infrastructure that not only signified a surrender to the automobile but also enabled people to travel, live, and work further and further from the urban core. Urban historian Daniel Lazare argues that 1923 marked the very beginning of what he calls the "auto-suburban age," a time when car ownership was soaring in the United States such that from that point onward, the number of motor vehicles doubled every 15 to 25 years (Lazare 2001, p. 217). This rise in automobile ownership is no doubt a contributing, if not direct cause of the slowing population growth of the urban center during the same period: Cleveland city, for example, grew at a rate of 11.8 percent between 1920 and 1930, while the surrounding metro area grew 28 percent. St. Louis' metro area grew 20 percent, more than three times that of the city itself (Teaford 2008, p. 18). It is evident through these numbers that the automobile, unlike any method of transportation preceding it, mobilized urban population diffusion from the city into new suburbs.

A Matter of Industry

What perhaps should have alarmed the city center most about this interwar mobilization was that these new, first-



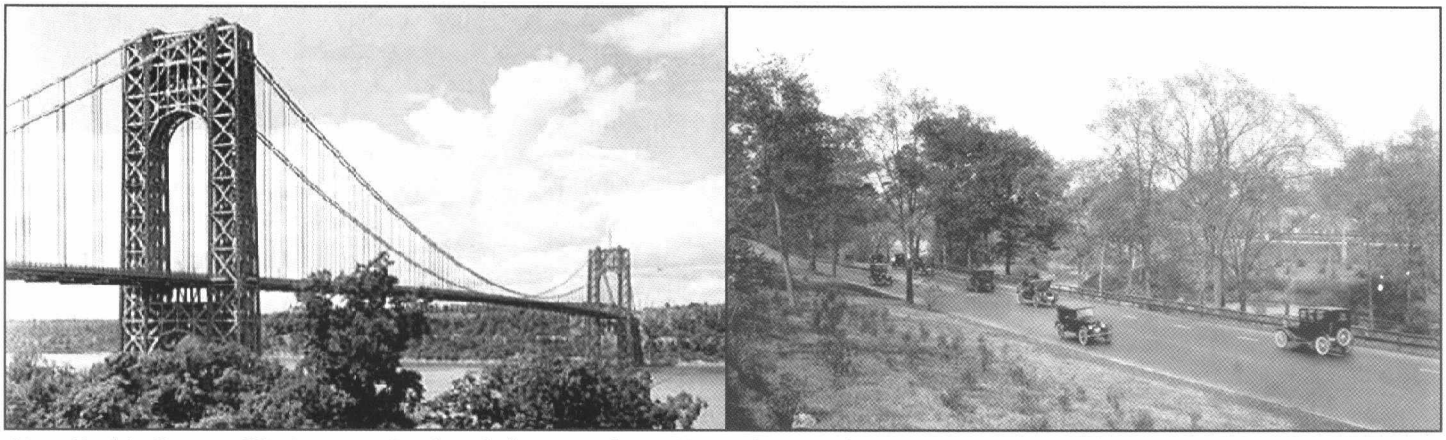
Highland Park, the Detroit suburb that was home to the Model T plant, grew tenfold in population between 1920 and 1930. Editor's collection.

tier suburbs were centered on industry— industry that once focused within urban limits and established them as regional economic powerhouses. The automobile not only provided the individual the opportunity to leave the confines of the urban center, but also sucked out manufacturing and production, an aspect of suburbanization that would destroy the city further in later decades. Detroit is one instance of this mass suburbanization of industry, and it should not be entirely surprising as it was the seat of U.S auto manufacturing. Ford's Model T was produced in Detroit's Highland Park suburb, one that grew in population in just ten years (1920-1930) from 4,120 to 46,499 (Teaford 2008, p. 29). The Los Angeles oil industry in the 1920s acted as a sort of suburban vacuum to that city's core, as "employment opportunities at derricks, refineries, and tank farms in industrial suburbs like Whittier and Fullerton" resulted in a mass exodus to the metropolitan fringe in what would become the largest American city west of the Mississippi (Jackson 1985, p. 178). Pittsburgh, Pennsylvania was another major urban center that experienced population and industrial diffusion to the suburbs: in 1900, the city itself accounted for 58 percent of the metropolitan population, while just 20 years later, this number fell to 45 percent as industry and businessmen had the means, through the automobile, of settling further and further from the city center onto more spacious land. Edward Muller describes Pittsburgh's industrial suburbanization thoroughly: "Together with Beaver, Butler, and Washington Counties, Pittsburgh's manufacturers and those who left the city for, or originally built in, outlying industrial suburbs and satellites, formed the nation's... fifth largest metro area" by 1920 (Mulford 2001, p. 58-73, 66). Though the automobile was a new addition to American culture and suburbs were still in a developmental stage, old industrial cities like Detroit and Pittsburgh were on the chopping block, and gone were their days of economic glory. Growth of early industrial and residential suburbs provides a glimpse into the future of this urban demographic phenomenon that rocketed to new heights during the post- World War II era.

In order for automobile ownership and a suburban lifestyle to become a reality for all Americans, especially after the war, a highly developed infrastructure was required. This infrastructure, this lifeline of the automobile, is none other than the seemingly harmless highway— the flat, peaceful-looking linear pattern of concrete and asphalt that in the inter-war years opened up the American landscape first to widespread vehicle ownership and later to mass suburbanization once World War II ended and the GI's returned home. In the early 1920s, the majority of roads in America were little more than dusty trails, and even in cities "streets were more nearly obstacle courses than thoroughfares" that transformed into swamps during rain storms and frozen wastes in winter (Jackson 1985, p. 162). The likes of Ford and Sloan could not accept this situation should they desire the automobile to be purchased by the American public, and "what auto manufacturers needed... was a system of intra-urban transport, i.e. diffuse, low-density communities in which residents would be able to use their cars not just for long distance travel but short distance errands... they needed suburbs" (Lazare 2001, p. 162). Realizing that roadways were a necessity in a nascent automobile culture, special interest groups such as tire manufacturers, oil companies, road builders and land developers were clamoring for an improved intra-urban transportation system as well (Jackson 1985, p. 164). The calls for better roads by engineers and land developers are most significant, as better roads wouldn't only bring good business for both groups, but would also result in greater incentives for car ownership and settlement further from the urban center, as well as involvement from Congress.

The Role of Government

The Federal government was just as interested in road construction and improvement as local and state governments were, passing the Federal Road Act in 1916 and establishing the Bureau of Public Roads. The former offered funds to states that created highway departments, while the Bureau was created to plan a national highway network that would connect all cities of 50,000 or more persons (Jackson 1985, p. 167). There are two primary examples of how investment by the Federal government encouraged states to improve or all together create new highway systems, those being the Bronx River Parkway and the George Washington Bridge. The Bronx River Parkway, a 16-mile stretch of highway completed in 1923, was designed to improve traffic flow from New York City into the rapidly developing surrounding area. Running through a valley, "the beautifully landscaped road stimulated automobile commuting from Scarsdale, Mt. Vernon, Bronxville, and New Rochelle" and provides an early scenario in which the union between car, suburb, and concrete is visible. Just as reflective of New York's growing metro area is the opening of the George Washington Bridge in 1933, which connected the city to northern New Jersey and spurred not only the growth of suburbanization in the area but also the need for feeder highways (Jackson 1985, p. 166). Major highway infrastructure projects like the Bronx



New York's George Washington Bridge, left, opened in 1931. Library of Congress, Prints and Photographs Division, Gottscho-Schleisner Collection Image LC-G612-40053. The Bronx River Parkway, right, runs from the Bronx to Westchester County. It was the first limited-access highway to begin construction, in 1907. This 1922 photo was taken before a center median was installed. Courtesy of the Westchester County Archives.

River Parkway and the George Washington Bridge, in conjunction with Federal assistance and increased automobile ownership levels, resulted in an early road-building frenzy that excited the middle class and urban elites into a mass exodus to the suburbs. Growing up along these new highways, automobile suburbs reflected not only the desire for independence from the city but also the ability to commute into it quickly. Even so, these early auto-suburban highway networks could not keep up with the rapidity of automobile ownership and as a result, the post- World War II years witnessed an expansion of this auto-suburban infrastructure at mind-boggling speed across the American urban landscape.

The Great Depression was an additional factor that contributed to rising auto-suburbanization just before the war, and even throughout a decade of economic hardship, car ownership levels grew in all but three of the worst years to such an extent that there were 4.5 million more cars in 1940 than in 1929 (Jackson 1985, p. 187). A testament to the unswerving desire for the freedom automobility offered, giving up the family car was a last resort even as more and more families plunged into debt. Franklin Roosevelt's New Deal-era investments in highways and road systems laid the literal groundwork for post-war suburbanization that would bond, as if some natural chemical reaction had taken place, with America's emerging car culture. Also firmly in place were the foundations of the eventual interstate highway system that would contribute—unlike any before it—to population dispersal away from the city center. Lazare sums up government efforts during this time: "Rather than putting a halt to de-urbanization, the Roosevelt administration's goal—indeed the goal of virtually every liberal intelligentsia—was to use every available resource to speed it up" (Lazare 2001, pp. 177-8). The path had been cleared for large-scale metropolitan fringe development in the decades before World War II. Everything was now in the right place, and all that was required were the right moves.

Government, since the early 20th Century, has consistently shown great interest in public roads, highways, and the automobile. This intense concern for private transportation culminated in the passage of one of the century's most significant pieces of legislation—the 1956 Highway Aid Act, whereby the Eisenhower administration, with encouragement from the highway lobby, officially authorized the construction of the interstate highway network that now exemplifies the American landscape. By the 1950s, the roads and highways built a mere three decades earlier could no longer handle increasing volumes of traffic, leading the federal commissioner of the Bureau of Public Roads, Thomas MacDonald, to boldly proclaim that the expressway was the only means available to saving American cities from "stagnation and decay" (Davies 1975, p. 11). New York City's master builder, Robert Moses, agreed. Never elected to public office, Moses nevertheless headed a number of public authorities responsible for building and maintaining most of the city's bridges and parkways from the 1930s into the 1960s. He believed the new interstate highways should go through the city center as well as connecting them, and were concrete panaceas for urban blight (Davies 1975, p. 18). The positions of these men provide compelling insight into the highway lobby-government alliance: the Highway Aid Act had authorized the largest public works project of all time. The magnitude of this undertaking benefited not only engineering firms and oil companies but also the automobile manufacturers, who reveled at the sight of countless ribbons of concrete slashing through the landscape ready to accept their supercharged V-8 four-wheeled behemoths. New highways brought more cars and people into contact with previously untouched land, a perfect recipe for suburbanization.

Interstate Highways

Interstate highway construction benefited further from the Highway Trust Fund, a separate pool into which oil and gasoline taxes were collected for the express purpose of building new highways. As more motorists used the interstate to commute from homes in the suburbs to work in the city, the fund perpetuated itself through increased tax revenue. Reflecting the automobile commuter's dependence on this new interstate highway network, Federal Highway Administrator Francis Turner posited that "people have chosen to live in suburbia… and whether this is a good thing or bad thing is not a matter for highway and traffic engineers to decide. However, we do have an obligation to fashion a transportation system that will accommodate the choice which the peo-

ple have made" (Davies 1975, p. 21). In Turner's statement, we see no concern for the ever-more apparent urban blight to the benefit of the automobile, and he overlooks one case in particular where new suburban development directly influenced the decay of downtown: Newark, New Jersey. Once a thriving urban center of the New York metropolitan area, the middle classes headed for the suburbs in such numbers over time that by 1965, a mere nine years after the passage of the Highway Aid Act, the city had lost 78 percent of its tax base. Once Newark had been all but wiped out of its wealthier residents— a process dubbed "urban manslaughter" by Lazare— it was forced to provide for left-behind minorities (Lazare 2001, p. 156). While Turner and others in the highway lobby favored everything about the interstate system and the new freedoms it provided auto-centered American suburban culture, they fundamentally glanced over the detriments it presented to central cities.

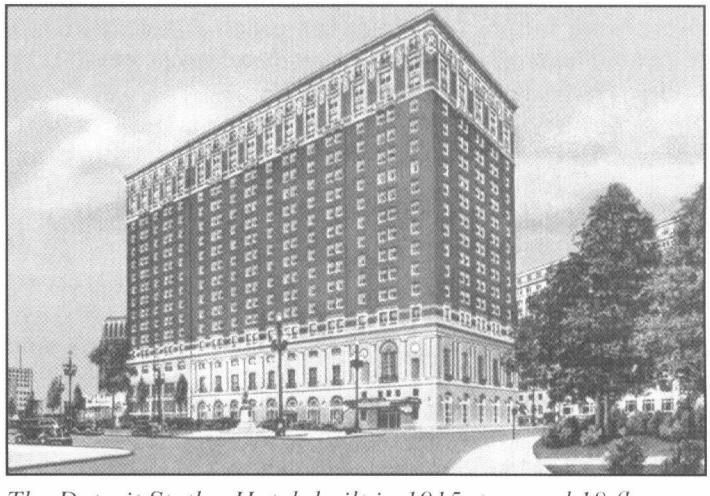
Even as urban problems became apparent within the first decade of the Highway Aid Act, real estate developers jumped on board the highway craze seeing the potential in constructing subdivisions within close proximity of interstate exits. By the mid to late 1950s, low-density subdivisions accounted for more than 75 percent of new housing in metropolitan areas that incorporated the assumption that new residents would own cars, with the garage being the most prominent feature of the new homes (Jackson 1985, p. 239). The Federal government again reached its hand into suburban development during this time through support of housing construction, which became another major cause of downtown population loss (Jackson 1985, p. 239). As new shopping centers, office parks, and chain restaurants seemingly sprouted out of the earth in this wave of federally-supported construction, auto-mobile suburbanites could now travel to work and play while at the same time "entirely avoid the congestion and unpleasantness of the central city" (Davies 1975, p. 29). The auto-suburbanization of America was in full swing by the 1960s, as "the metropolitan frontier beckoned to millions of Americans" (Teaford 2008, p. 41). But, as quickly as Americans had embraced the suburban lifestyle, car ownership and the interstate system, they grew tired of concrete and asphalt, traffic and smog, hours-long commutes to and from work. The fact of the matter was American downtowns were rapidly losing business and people as the interstates destroyed Main Street and old ethnic neighborhoods, despite the rosy depiction of middle class suburbs.

Fourteen years after the Highway Aid Act, the average American city had devoted roughly one third of its downtown space to automobile parking and parking garages, with an additional 20 percent consumed by "streets, alleys, freeways, and cloverleaf interchanges" (Davies 1975, p. 30). The steady encroachment of asphalt in the late 1950s and '60s ate up most main street businesses and eliminated downtown's traditional pedestrian dynamic. In a 1966 address to the Young Men's Business Club of New Orleans, Henry Ford II even acknowledged the distressful situation of urban America that automobility had placed it in: "The growth of auto-oriented suburbs has created serious problems for the central city" which "will thrive in the future only to the extent that they strengthen their links with the expanding suburbs" (Ford 1966, p. 692). To the auto manufacturers, suburbanization was the way forward; either the city would have to open up its land to automobile space or face a deepening crisis. After manufacturing and residents vacated the city centers, the next feature of this urban disaster was the significant loss of retail business.

Hotels and Shopping Malls

The hotel industry provides a prime example of the destructive effects auto-suburbanization placed on downtown America. Highway and automobile-friendly motels developed at interstate exits and other retail districts that dot the American exurban landscape, sucking tourists and other travelers out of the city center. By 1960, there were 60,000 motels, a clear indication of the massive degree of dispersion taking hold. By the end of the decade, this number would double. In 1972, an old downtown hotel was closing every 30 hours somewhere in the nation as the hospitality business vacated the city in favor of cheap roadside motels— "plastic and glass Shangri-La's"— across suburban and exurban America. The closing of Detroit's famed Statler Hotel demonstrates the increasing disillusionment citizens encountered highway construction and suburbanization with, as well as the loss of urban business stemming from the two. As the hotel closed its doors in 1975, having been rebranded as "Heritage," one employee exemplified the sense of despair faced not only by employees but also downtowns across the nation: "It's dying; the whole place is dying." Famous hotels like the Mayflower in Washington and the Peabody in Memphis faced similar challenges as retail sought the wide open spaces of the metropolitan fringe, although some survived as anchors of inner city revitalization efforts. (Jackson 1985, pp. 254-5).

Shopping malls and large-scale retailing are other features common to the mass exodus of business from the city center from the 1960s to the present, and perhaps the most striking. While the department store and other retailers began moving out of the city during the inter-war years,



The Detroit Statler Hotel, built in 1915, towered 18 floors above West Washington Boulevard. Abandoned in 1975, after 20 years as the Statler Hilton and a year as the Detroit Heritage, it sat vacant until demolition in 2005.

Vintage postcard view.

their moves were expedited by the ever-ubiquitous automobile and post-war prosperity (Jackson 1985, p. 257). Shopping districts had largely geared themselves toward pedestrian traffic, but once cars invaded downtown roadways, they were forced to abruptly adapt. In response, these downtown retailers transformed their operations into huge strip malls once they completed their moves out to the suburbs. Anchored by one large store (usually a grocery chain) and then a variety of smaller shops, "the multiple-store shopping center with free, off-street parking represented the ultimate retail adaptation to the automobile" (Jackson 1985, p. 258). As chain corporations took advantage of this opportunity quickly, seeing the potential growth in business with the benefits of free parking and highway access, the natural environment was converted into a sea of asphalt surrounding continents of automobiles. The concept of the strip mall became further solidified in the American auto-suburban conscious as new features of sprawl appeared— the super-regional mall. Its very designation as "super-regional" is a testament to the increasingly auto-fueled business diaspora in full swing by the 1970s. While the likes of Tyson's Corner in Virginia or the Mall of America in Minnesota sought to provide a clean, savory shopping experience, their target really proved to be the downtown department store which could not provide the parking space now necessary for business. As the auto-mobile public took to the suburbs, so too went their traditional pedestrian-centered places of retail. The J.L. Hudson Department Store in Detroit demonstrates the victory the automobile had now won over urban business. A defining feature of the city, J.L. Hudson was housed in a 25-story skyscraper that rivaled Macy's in New York and Marshall Field in Chicago. However, the very product Detroit became famous for—the automobile—was wreaking havoc on the city's central business district. In 1981, J.L. Hudson had closed its doors (Jackson 1985, pp. 260-1), another downtown victim alongside the hotel and industrial manufacturing to America's rapid suburban growth.

The J.L. Hudson Co. department store, as seen from Detroit's Grand River Avenue. Its end was ironic, hastened by the car that bore his name. Joseph L. Hudson supplied the capital to launch the Hudson Motor Car Company, which was named in his honor. His niece was married to Roscoe Jackson, one of the four founders of the firm.

Vintage postcard view.

Revolt Against Excess

With the loss of manufacturing, people, and businesses in huge numbers by the 1960s and especially the 1970s, the American public finally began protesting against the perceived excesses of their suburban lifestyles, the interstate system, and automobility itself. In his message to Congress in 1956, President Eisenhower stated that "our unity as a nation is sustained by… easy transportation of people and goods" (Eisenhower 1955, pp. 275-80), acknowledging however subtly the importance of the automobile in American culture. The ease of transportation and trade was indeed in everyone's best interest, but it was the manner in which these services were conducted that became a lightning rod for public criticism. The first to voice their rejection of Eisenhower's message were the residents of Northwest Nashville, a primarily black neighborhood where a stretch of I-40 was planned to cut through. Although engineers consistently plotted highways going through low-income and minority areas (Davies 1975, p. 32), they did not take into account that a sense of community and local culture would be so negatively affected. In Northwest Nashville, I-40's arrival would result in numerous dead end streets, forever destroying a once-unified neighborhood and opening up the door to urban blight— all in the name of suburban motorists. So much for Ford's belief that "expressways can help to solve, not only traffic problems, but the broader problems of our major cities" (Ford 1966, p. 692); in pragmatic terms, however, highways like I-40 seemed to tear apart the very cohesion of the urban center.

San Francisco, a city with one of the highest concentrations of automobiles in America, provides another look into public reaction against suburban sprawl that was encouraged by the one-two punch of the automobile and the highway. In what would become one of the greatest controversies of the past 40 years, the Embarcadero Freeway began construction in 1959. Public protest erupted from the start as the path of the highway would obstruct the view of the scenic San Francisco Bay, and accordingly, local government didn't plan any ground-breaking festivities; it is here evident that by the 1960s, Highway Trust Fund-enabled construction had resulted in too many highways that consequently encouraged too much sprawl. Citizens of San Francisco exemplified this displeasure with the excesses of the interstate system: their protests were eventually heeded, and construction had ceased by 1964. The Embarcadero Freeway,

for 24 years, stood 62 feet in the air never having carried a single vehicle; indeed, it acted as a sort of "mute testimony to the power mobilized by anti-freeway sentiment." In 1969, Mayor Joe Allioto reassured citizens still angry over the whole affair that San Francisco would not be "turned into a wasteland of freeways and garages" (Davies 1975, p. 33), a predicament for urban centers that had become all too common. Though originally touted as exponentially beneficial to suburban life and a car culture that had firmly hypnotized the American public, runaway and irresponsible interstate highway construction resulted in mounting discontent at all levels. Nashville and San Francisco reflected a new perspective of the American city that had just 50 years before regarded automobility and suburban development as tangible evidence of progress. By the 1970s, no longer would they tolerate a mass exodus of people, business, and industry from their downtowns without a serious fight.

Pittsburgh – A Case Study

Having focused so far on the history of suburbia, how the automobile and highway affected it and the growing disillusionment of Americans towards such developments, a thorough case study will look into the situation of Pittsburgh, Pennsylvania, an old industrial city that took a particularly hard hit from auto-suburbanization. Through an examination into the city itself and the industrial-residential first tier suburbs that developed when the steel industry dominated the region, the effects the automobile and highway had on the city will be brought to light. While still a large metropolitan area of some 2.3 million in the 21st Century, Pittsburgh's downtown and surrounding environs struggled to adapt to this demographic shift.

No discussion of Pittsburgh at the beginning of the 20th Century is possible without mentioning the steel industry in some way, extending even into the study of the city's earliest suburban trends. Andrew Carnegie's massive steel mills required large tracts of land which could not be acquired in the city's dense urban core. Additionally, a small army of factory workers were in need of housing within close proximity to the mills, as the automobile was a new technological phenomenon few could afford; photographs from 1906 in Arthur Smith's *Pittsburgh: Then and Now* demonstrate this proximity and compactness of industrial suburbs centered on the Schoenberger steel works in the city's Strip District (Smith 1990). The need for residential and industrial space, therefore, gave birth in Pittsburgh to "an extensive transportation network comprised of [sic] the railroad, electric street car, and even interurban electric railways" that enabled industry to disperse away from downtown and bring with it thousands of workers who settled into new industrial suburbs "well before automobiles and trucks affected the metropolitan geography" (Muller 2001, p. 64). Though it was too early to discern completely, Pittsburgh was well on its way to falling into the typical pattern of suburbanization that had affected New York and Chicago, the first part being the dispersal of manufacturing via rail transportation. With iron, glass, and steel moving out to the fringe, over half of the city's production workforce was employed in suburbs by 1900 (Teaford 2008, p. 6).

The Point, or Golden Triangle, Pittsburgh, 1925. The railroad yards that dominated the area can be seen at lower right. Aerial Photographs of Pittsburgh Collection, ca. 1923-1937, AIS.1988.06, Archives Service Center, University of Pittsburgh.

As automobile ownership rates skyrocketed throughout the 1920s and 1930s, downtown Pittsburgh was beginning to exhibit signs of urban blight as manufacturing, people, and commerce moved outward. However, Pittsburghers at this time, keeping with the national trend, were infatuated with their vehicles and wanted nothing to do with anything that would inhibit their freedom of mobility. Naturally, the region's government and philanthropists alike reflected this

sentiment. In 1938, the city's Regional Planning Association (RPA) launched the first major effort to revitalize downtown as recommended by Robert Moses, the aforementioned pro-automobile advocate from New York who often consulted for other cities. He "recommended a $38 million ten-year plan for correcting downtown traffic conditions... that would facilitate traffic flow across two existing bridges" and promoted a parkway which would serve in "connecting the Point with the new Pennsylvania Turnpike to the east" (Crowley 2005, p. 54). ("The Point," sometimes called the "Golden Triangle," is the triangular section of downtown Pittsburgh where the Allegheny and Monongahela Rivers converge into the Ohio.) In the process of transforming downtown in order to accommodate the automobile, the old Pennsylvania Railroad Terminal at the Point would be demolished, an indication that preferred modes of transportation in the city had changed. The 1925 photograph of the Point shows the extent to which the railyard in question dominated the downtown industrial scene. Little more than a decade later, an entirely new form of transportation would render it all obsolete. Richard K. Mellon, of the famed Mellon banking family, also toed the public line in founding the Golden Triangle Division of the Chamber of Commerce the following year in 1939, aiming to "stop depreciation of real estate values within the Golden Triangle by improving the mass transportation and automobile flow in and out of the central business district" (Crowley 2005, p. 36). At the same time Pittsburgh sought various avenues and

Above, aerial view of East Liberty, 1955. Thomas and Katherine Detre Library and Archives, Senator John Heinz History Center. Below, the same area seen from the opposite direction, circa 1968, the tower of the First Presbyterian Church at left. The area is being cleared for parking and redevelopment. At center right a new Sears department store can be seen. Kingsley Association Records, 1894-1980, AIS.1970.05, Archives Service Center, University of Pittsburgh.

Population Dispersion in Allegheny County, Pennsylvania, 1900-1990

(rounded to nearest thousand)

Year	Total Allegheny County Population (K)	Pittsburgh City Population (K)	Suburban County %	City %
1900	775	450*	32	58
1910	1018	533	38	52
1920	1186	588	51	49
1930	1374	669	51	49
1940	1412	671	53	47
1950	1515	676	55	45
1960	1629	604	63	37
1970	1605	520	68	32
1980	1450	423	71	29
1990	1336	369	75	25

* Includes Pittsburgh city (321K) plus adjacent Allegheny City (129K). Pittsburgh annexed Allegheny City in 1907, so subsequent Pittsburgh figures include that area.

Source:
http://www.census.gov/population/www/documentation/twps0027/twps0027.html#urban (accessed Dec. 5, 2012)

approaches to urban redevelopment, the city wanted to make land available for new roads and the automobile. Providing private means of travel, vehicle-owning city dwellers caught on to the lure of the suburban lifestyle and moved out. Thus, through auto-centered attempts at revitalization, downtown attrition began. Although Pittsburgh's population did not peak until 1950, the exodus had begun a decade earlier. The city's proportion of the total Allegheny County population, which had been fairly constant at around 50 percent in the 1920s and 1930s, began its steady slide, to 47 percent in 1940. After the war, this accelerated, as postwar prosperity and new suburban housing lured the baby boomers' parents away from the city center. The South Hills and other suburbs thrived (U.S. Census).

East Liberty was one area of the city that suffered exceptionally, due to poorly-directed efforts at inner-city redevelopment and subsequent population loss to the suburbs. In the early 1960s, Pittsburgh's Urban Redevelopment Authority (URA) allocated a $68 million investment into a project that demolished 1,500 old homes and built a suburban shopping mall in the center of the 500-acre community; additionally, the city relocated some 3,000 people and in their place 2,000 parking spaces opened up. East Liberty, with a strong ethnic background akin to that of Northwest Nashville, suffered as a neighborhood and began a period of decline as redevelopers continued believing that giving the automobile precedence over all else was essential to urban prosperity. Historic Pittsburgh Image Collections, an online database of Pittsburgh's history through photographs, depicts the loss of cohesion and community in East Liberty through construction of new public housing developments, a significantly smaller business district, and numerous parking spaces.

Farther south, Rankin provides a particularly striking example of a first tier Pittsburgh suburb that suffered heavily from both industrial and auto-driven population loss, beginning in the late 1950s and continuing up to the present day. A photograph of Rankin Crossing, in the town's business district, attests to the urban decay already affecting the area in the late 1950s: buildings are boarded up, not a soul stirs on the streets, and weeds grow through cracks in crumbling cement. Rankin's population in 1990 stood at 2,503, composed primarily of "aging retirees and welfare recipients in public housing who pay little or no taxes," and with non-existent business activity, the town remains in a perpetual state of decline. In a testament to the surrounding once-prosperous first-tier industrial suburbs that have also fallen on hard times, one once "lived in Swissvale, worked in Rankin, and shopped in Braddock." Construction of Edgewood Center in Swissvale, however, with several chain stores and an expansive parking lot, has eliminated any possibility of a revitalized commercial sector while for entertainment purposes, "one must go elsewhere to see a movie, roller-skate, bowl, or even go out to eat" (Karaczun 2010). Private means of transportation, the departure of industry and the suburbanization of retail have conspired to hollow out Rankin in a fashion typical of the blight experienced by first-tier suburbs. Too close to the central city, Rankin and other communities have absorbed the heaviest blows as droves of urbanites headed for the southern end of the Fort Pitt Tunnels. In 2004, Rankin was placed on the Commonwealth of Pennsylvania's list of financially distressed communities alongside Braddock, having lost over 50 percent of its tax base since 1980 (Teaford 2008, p. 48). By 1990, only a quarter of Allegheny County's population remained within the Pittsburgh city limits (US Census, 1990).

Conclusion

The automobile, the highway, and suburbia: all are sociocultural norms of our metropolitan areas and no doubt a central dynamic to American society's methods of living,

A section of Rankin, circa 1950. Urban decay, typified by boarded-up buildings, weeds and junked cars, is all too evident. Thomas and Katherine Detre Library and Archives, Senator John Heinz History Center.

working, and traveling. These three phenomena have fundamentally altered both the outward and inward perception of this country, and not always for the better. This article has sought to discuss the overtly detrimental impact the automobile has had on our urban centers and Main Streets; how interstate highways have unnecessarily covered the landscape in asphalt and concrete. All the while, right under everyone's noses, this increasingly popular living space known as suburbia crept up on our metropolitan fringes and like a black hole orbiting a star, sucked all the life and vitality out of them. Though Jefferson denounced the supposed benefits of city living, one wonders how pleased he would be upon hearing of honest yeoman farmers and small businessmen being pushed out of their trade by suburban box stores surrounded by an infinite landscape of parking lots and vehicles. Conversely, Hamilton might be disheartened to see urban commerce and manufacturing vacate the city and leave it out to dry. First by rail and then by private automobile, the central city was systematically picked apart as the American public sought a better life on the greener pastures of the Levittowns. Industry and retail picked up and left as shoppers indicated a willingness to travel greater distances for essentials and luxuries. Highways tore through downtowns and neighborhoods. City after city fell to the relentless auto-suburbanizing onslaught encouraged by the Federal government. In examining the case of Pittsburgh and the city's first-tier suburbs throughout the last 50 years, the chaotic urban mess across the United States becomes apparent. Jefferson and Hamilton did indeed grow up in a very different America, but the battle between city and suburb very much remains a part of the national consciousness. It is hoped that after reading this article, the victor in this battle so far may be clearly discerned.

A Pittsburgh native, Andrew J. Mabon received a Bachelor of Arts degree in History at James Madison University in Harrisonburg, Virginia, with a public history concentration and minor in American Studies. He is currently an interpreter at the Frontier Culture Museum in Staunton, Virginia, and intends to pursue a graduate degree at American University in Washington, D.C. This article is an updated version of a paper written for Dr. Kevin Borg's *History 326 course, "The Automobile in Twentieth-Century America," during his senior year at JMU. It received the Society's Richard P. Scharchburg Student Paper Award in 2011.*

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Green Power

Henry Ford's Village Industry in Upstate New York

By Daniel Strohl

In August 1918, Henry Ford bought the entire northern half of Green Island, New York. His friend Thomas Edison had introduced Ford to the area; Edison founded GE in nearby Schenectady and reportedly loved to fish and hunt on that half of the island hugging the west bank of the Hudson River, just a dozen or so miles north of Albany. Ford, however, did not see the purchase as the continuance of any recreational pursuits. Sure, he, Edison and the rest of the Vagabonds camped on Green Island almost exactly a year later, but by then Ford had already announced his intention of developing the 180 acres.

A few months after Ford bought the site, he resigned from Ford Motor Company during a dispute with the Dodge brothers and other FoMoCo shareholders. It turned out that resigning from the company was part of a plan to surreptitiously buy back every last share of the company at a reduced price, according to David L. Lewis's book, *The Public Image of Henry Ford*, but while away from the company that bore his name, Henry Ford told reporters that he planned to start a new automotive venture and build a car newer, better and less expensive than the Model T. "The new car is well advanced, for I have been working on it while resting in California," Ford said. "For our new project we are already looking about for waterpower sites."

Lewis wrote that, once his plan to buy back the company succeeded in July 1919, "Ford immediately abandoned plans (assuming he ever really had any) for the rival to the Model T." However, he didn't abandon his plans for waterpower sites. In 1917, the federal government had built a dam stretching from Green Island across to Troy, leaving a provision in it for a hydroelectric plant. Ford intended to oblige them by building a plant that would not only supply electricity to the Green Island factory, but also likely to the housing he planned to build for the factory's workers.

As Ford wrote of the Green Island factory and hydroelectric plant, they were to be the prototypes for a larger initiative to disperse manufacturing across the countryside rather than centralize it in industrial cities.

> It is my intention to try to make this plant a demonstration center for the rebuilding of the abandoned farms of New England and Northern New York. I motored through that country recently from Oswego east, and I was amazed at the amount of valuable farm land lying idle.
>
> It is this sort of productive industry that I am going to link up closely to the farm, to demonstrate the final stage of what I believe to be the solution of the problem of living. Manufacturing, instead of being concentrated in a few centers, should be and can be widely distributed. We have proved that we do not have to turn out a completed product in our central plant. We used to assemble all our cars here in Detroit; we found it more economical to build great assembling plants in many other parts of the country and of the world, and ship the finished parts. Now we know that we can make different parts in different plants and ship them to the assembling plants.
>
> What I am going to do is to establish plants for manufacturing parts of Ford cars and Fordson tractors in places where they will be within easy reach of farming districts, and provide employment for farmers and their families in winter. And these plants will be operated by water power.
>
> There is enough water power running to waste to turn every wheel in the world and provide all the light and heat the whole world needs. We are going to operate our Mexican tractor plant with water power, and we shall build water power plants in several places in the United States. I have been demonstrating what can be done with water power right here at my own home. The River Rouge, which runs through my farm, close to my house, is not a very large stream and has but an eight-foot fall, but I am obtaining 200 horsepower the year around, which lights my house and operated all sorts of electrical conveniences and which is coupled up with the steam plant at the tractor plant, so that we are really making tractors now partly by water power.
>
> We must develop water power because it is not only more economical than steam power, but we ought to save the rest of the world's coal supply for chemical use. There is nothing we now do with coal, aside from its chemical products, that we cannot do with water power, electrically transmitted; most things we can do better with water power.

The offices of Ford's Green Island factory.
Courtesy Ford Motor Company.

Construction of both the factory and the powerplant began in 1921. The former would stretch for a quarter mile about parallel to the river, while the latter (built not by Ford Motor Company, but by Henry Ford & Son) would use four Allis-Chalmers turbines mounted in a vertical fashion. Where Albert Kahn was contracted to design the factory, his only official contribution to the powerplant was the lighted Ford sign atop it; the actual contract for designing the powerplant was awarded to Stone & Webster. Though Ford and Ford officials said the factory would produce tractor parts through to 1921, Ford switched gears in 1922, as he related to *Automotive Industries*:

> The boys came in to me the other day with the sign for the Green Island plant which read "Ford Motor Company – Ball and Roller Bearings." I told them to take off the "Ball and Roller Bearings" because we didn't know what we might make there.

Indeed, by 1923, *Automotive Industries* was reporting that the factory at Green Island would produce radiators and ring gears and would soon add springs. Radiators and heater cores became the plant's principal products for the next 65 years, until Ford shut the plant down in 1988, citing the distance of the plant from Detroit as a liability – Ford could rely on a plant in Plymouth, Michigan, to make radiators and save $3 million a year versus having radiators made in Green Island. The factory fell into disrepair as Green Island's industrial development group tried to find ways to make use of it, but they finally tore the factory down in 2004.

The hydroelectric plant, however, remained standing. Ford stopped running it in 1961 and passed it on to a local utility until the Green Island Power Authority took it over in 2000. The hydroelectric plant had fallen into disrepair as well, so the power authority hired Jim Besha's company, Albany Engineering Corporation, to revitalize it.

As the president of Albany Engineering, Jim is used to working with new technology, new ideas, new construction. As a classic car enthusiast with half a dozen restoration projects in his garage, Jim is acquainted with the preservation of older technologies and outdated engineering concepts. Thus, Jim was the ideal man for the job. "It's the same idea with old cars," he said. "You try to keep it vintage if you can."

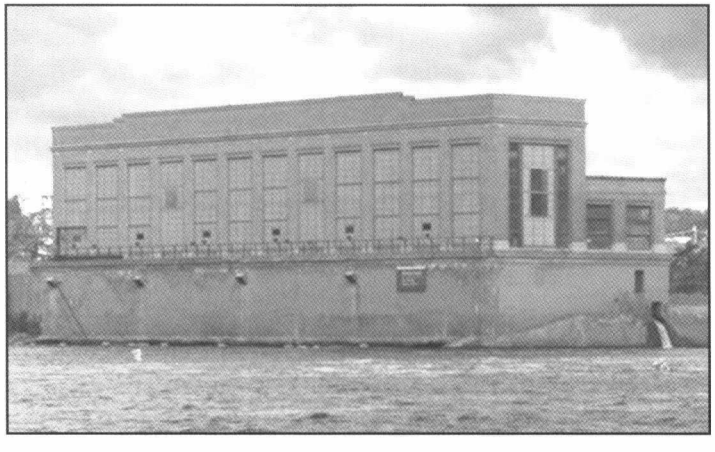
In three years, AEC completed much of the work on the hydroelectric plant. They computerized and automated all of the controls, but left the four original turbines. In his research into the hydroelectric plant's history, which included a review of the original blueprints for the building and for the turbines, Jim noted something odd: the generators, which were designed to produce 9,000 hp – about 6,000 kilowatts – were wound to produce both AC and DC power, even though DC had fallen out of favor some 25 years prior. "These generators were substantially DC – 1,000 kilowatts DC versus 800 kilowatts AC," he said. "By 1920, I doubt that factories were using DC power." (The generators were rewired in 1971 to produce only AC power.)

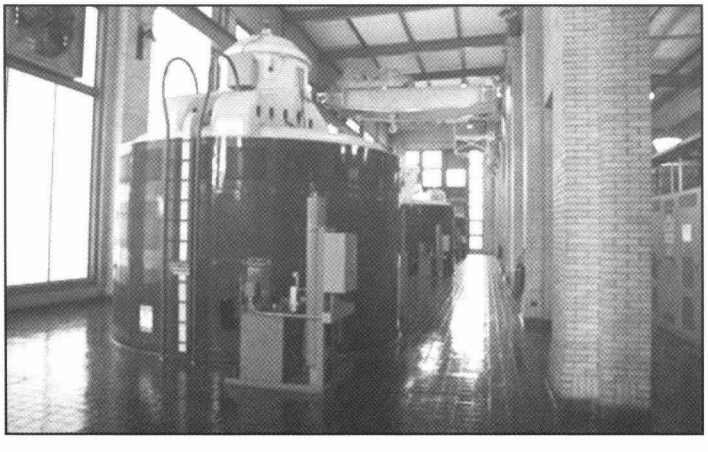
Jim also believes that the Ford factory itself would not have used all 9,000 hp to build radiators and springs (the housing Ford had planned for the factory workers never materialized). One possible explanation pops up in a brief article in the April 5, 1921, edition of the *New York Times*, in which both Ford and Edison are quoted as saying that Edison was planning a factory of some sort adjacent to Ford's on Green Island. Neither would say what Edison planned to build at that factory, and apparently nothing more was ever said about it.

Another theory that Jim has suggested centers around the electric car that Edison and Ford planned to build several years earlier: It's best to charge batteries with DC power; perhaps Edison and Ford seriously thought about one more crack at producing an electric car and charging the batteries for the cars – if not building the cars entirely – on Green Island? Ford's statements in the 1921 New York Times article even hint at that possibility: "Mr. Ford said he did not know what he would manufacture at his plant. He refused to say he would build farm tractors there – the purpose for which is had been generally believed the plant was to be erected – but did say "I may make automobiles there – in fact, it is more than likely that I will."

Whatever the purpose of both the plant and the factory, they have long since rushed past, just as the waters of the Hudson continue to rush past Henry Ford's hydroelectric plant, its original Allis-Chalmers turbines still spinning, its generators still producing electricity.

Daniel Strohl *is web editor at* Hemmings Motor News. *First appearing on the* Hemmings Daily *(hemmings.com/newsletter) July 6, 2010, this article is reprinted here with their permission.*





Above, the Green Island hydroelectric plant as it stands today. Right, the four generators in operation. Photos by the author.

Mass Confusion

The Beginnings of the Volume-Production of Motorcars

By Malcolm Jeal

Introduction

The reason for the following discourse originally arose from a casual conversation among a group of motoring historians during which the term "mass-production" was mentioned. The writer then unintentionally brought the conversation to a halt by asking the question: "In this context, what constitutes a mass?" Subsequent attempts to find a figure led to the examination of various dictionary definitions, and the consultation of numerous learned works on the subject, but a numerical total remains elusive. Not wishing to turn this into a semantic exercise, and ignoring the scientific and religious practice meanings; in simple language, when allied to the word "production," "mass" appears to mean a large quantity, or a "lot of" and I am content to settle for the latter.

The *Oxford English Dictionary* defines mass-production as "The production of manufactured articles in large quantities by a standardised process." Other definitions add to this with expressions such as "production involving an organised workforce," "division of labour," and when applied to the making of mechanical objects reference is made to the use of machine tools to provide an interchangeability of components. In some cases other words, such as "volume" or "large scale" are used as a substitute for "mass."

This unresolved quest did, however, bring to the writer's attention two other features: first, that in relation to the motorcar the process of mass-production is often viewed as the invention of Henry Ford; second, that in the case of motorcars made in Europe prior to the 1914-18 War, they are frequently described as all being hand-made, with volume-production being absent.

Concerning Mr. Ford, under whose name the entry on the subject in the 1926 *Encyclopaedia Britannica* appeared, the long-term editor of *The American Machinist*, Fred H. Colvin, observed in his 1947 autobiography:

> Henry had by this time [1913] evolved his revolutionary system of mass- production, and whether the idea was original to him or not, the fact remains that his contribution to mass-production methods changed the whole pattern of the industry ... It is true that Ford builded (sic) on the foundations of others, and that he failed notably to credit the earlier work of men like Eli Whitney, Samuel Colt, Cyrus McCormick, and others who achieved remarkable results with pioneer methods of mass-production.[1]

Colvin is not alone in commenting on Ford's arrogance in not giving due credit to those who went before him in this area. For instance, Charles Sorensen, in *My Forty Years with Ford*, noted:

> Henry Ford had no ideas on mass-production. He wanted to build lots of autos. He was determined but, like everyone else at that time, he didn't know how. In later years he was glorified as the originator of the mass production idea. Far from it: he just grew into it, like the rest of us.[2]

Given comments like these it is therefore somewhat surprising that one of the standard texts on the subject, *From the American System to Mass Production 1800-1932*,[3] should, after the first five chapters dealing with the development of large scale production in various industries during the 19th Century, then go in its sixth chapter straight to dealing exclusively with the Ford Motor Company. There is no acknowledgement of the pioneering work in this area that occurred within the American automobile industry almost from its beginnings, and not even a glance is cast across the Atlantic to Europe. At least in an earlier text, *100-Million Motor Vehicles*, published in 1948, while not naming the company concerned but making reference to Lansing, Michigan, it is noted that:

> The first big step towards mass production began in 1901... here was born the world's first gasoline engine automobile to be made by mass production methods...Each car was built of standardized parts, produced by machinery to an accuracy previously unknown...production reached 425 the first year..[4]

So at least the significant activities of Ransom E. Olds in this context receive some acknowledgement, even if his Oldsmobile was not the "world's first" in the context that the publication claims, nor does "accuracy previously unknown" stand up to scrutiny.

What follows is an attempt to address these latter points by looking at the earliest days of the automobile industry, which in essence means only in North America and Europe, to see where and by whom "lots of" autos were built prior to Mr Ford then picking up the baton and running with it.

Volume-Production

The making of articles in substantial quantities is an activity almost as old as human civilization, although use of the term "mass-production" does not seem to have become commonplace until the early part of the 20th Century – about five millennia after the process could arguably be considered to have commenced. The inhabitants of Mesopotamia as they established their towns and cities made bricks in large quantities, using two basic raw materials: clay and water.

They placed the resulting mud in wooden molds and dried the bricks in the sun. Even if one brick was not precisely identical to another, it would have taken careful measuring to demonstrate that this was so. Whether such activity constitutes "manufacture by a standardised process" is a debatable issue – but this process certainly called for the organization of a workforce and resulted in a lot of bricks. The same was true in China from the second millennium BC onwards, where a wide variety of identical bronze objects were made on a production-line basis by workers who had well-honed specialist skills.[5]

By the middle of the 18th Century needles were being produced in various countries in substantial quantities using water-powered machinery, and by the latter part of the century weekly output of wood screws from a single Derbyshire factory employing 59 workers was reported as 1,200 gross[6] – that is, 172,800 individual screws per week – a huge total to cogitate upon. At the beginning of the 19th Century Marc Brunel conceived and designed machines for making the wooden blocks needed in the rigging of the British navy's sailing ships. The necessary 44 machines (or 45 depending on the source) for semi-automated production were constructed in London by Henry Maudslay over a six- or seven-year period from 1802 and when the project was completed a mere 10 men, as against the 110 previously employed, working at the factory in Portsmouth dockyard could oversee the output of 160,000 blocks per year.[7] Celebrated though this latter achievement has become, like the needles and screws before it, only individual items were produced, although in the case of the ship's blocks detailed shape and specific function varied.

The mechanized production of more complex items seems to have originated in the late 18th Century when Frédérick Japy began manufacture of watch movements at his factory in Beaucourt, near Montbéliard in eastern France, close to the Swiss border. It is reported that by 1780 his factory's annual output had reached 2,400 units.[8] However, in view of the turmoil that was soon to embrace first France and then most of Europe, it is perhaps not surprising that this pioneering achievement was not more widely noticed.

It seems almost inevitable that a form of mass-production would arise in the armaments industry – a rifle that does not fire is probably of even less practical use than a cave man's club – the surprise is that the development of firearms with interchangeable parts, thus rendering them readily repairable, came about in America, rather than Europe, although there had been isolated attempts at this, again in France, in the late 18th Century.[9] The inception and development of this process over a period of around fifty years from the early part of the 19th Century, led initially but separately by Eli Whitney and Simeon North, is well covered in *Fire Arms Manufacture 1880*,[10] which details both the processes and the development of the machine tools necessary to make interchangeable parts, the latter being an essential requirement for the large-scale manufacture of complex mechanical objects.

Among the exhibitors at the 1851 Great Exhibition in London was the firearms manufacturing firm of Robbins & Lawrence of Windsor, Vermont, whose rifles were made using the interchangeable system. Interest in these guns led to a group of British engineers visiting America and resulted in the importation of 157 American machine tools in 1855 to equip the government arsenal at Enfield, where rifles were duly produced in substantial numbers using what became known as the "American System."[11] However, while this system was also adopted by other European makers of firearms, it was very slow to spread to other areas of manufacture. In contrast, the process rapidly permeated American manufacturing industry. Clocks and watches, sewing machines, typewriters, agricultural machinery and cycles were made in substantial numbers, so that, for example, as early as 1870 American sewing machine manufacturers were producing around 127,000 machines per year and the annual output of the American cycle industry reached its zenith at one million units in 1897,[12] although this number rapidly declined soon after that. Some more recent writings have questioned whether these 19th Century large-scale outputs resulted from "*genuine* mass-production," citing among other criticisms that a fair amount of hand assembly was still utilized, but to this writer that seems be a case of applying later criteria to an earlier process in a manner not greatly dissimilar from judging past events by today's standards of ethics or rationality — or simply the splitting of hairs for the want of something better to do.

With the cycle industry being a relative newcomer, only developing to a significant degree after the introduction of the "safety bicycle" by James Starley in 1885 and sold under the Rover name, it was one of the few British manufacturing activities, centered in Coventry, that adopted the broad concepts of the American System. This led to the cycling "boom" of the 1890s, a decade which began with Britain as the world's largest producer of bicycles and tricycles. However, as competition grew from France, Germany and America (where non-reciprocal protectionist import tariffs boosted the native industry and its exports) cycle production in Coventry fell from 63,000 machines in the year 1896 to just under 30,700 in 1900.[13]

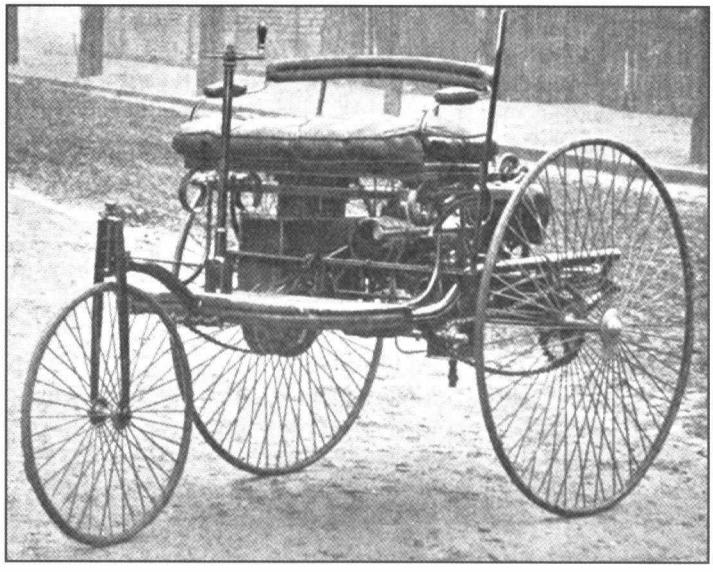
All the products considered so far have either been individual items such as the brick, or, where of a more complex nature, were "mechanical" only inasmuch as they used mechanisms within them. Where they moved about, they were animal- or human-powered, not mechanically-propelled. There were, however, a couple of exceptions to this situation that originated in the first part of the 19th Century: the railway locomotive and the traction engine or "road locomotive." Output of railway locomotives from their practical inception soon after 1800 in Britain and their rapid development from the 1830s onwards was always constrained, both because of their substantial nature and their limited market. Some sixty years later the largest producer of railway locomotives in America, the Baldwin Locomotive Works of Philadelphia, produced 2,700 locomotives in the six-year period between 1895 and 1900. Interestingly, the firm had "begun production of interchangeable repair parts by 1865 and may have employed gauges and templates ten years earlier."[14] Traction engines were similarly large vehicles, made in relatively small numbers, and they, too, found customers only within a restricted market.

The Coming of the Motorcar

Despite various interesting experimental road vehicles being made from the early part of the 19th Century onwards, the auto-mobile-personal-transport vehicle, or motorcar, as a vehicle that we could recognize today did not become a reality until the middle of the 1880s. To make this writer's view clear to those who would maintain that the motorcar was "invented" in eighteen-something-or-other by – insert your favorite name – I subscribe to the view neatly expressed by Joseph Wickham Roe in his 1916 book on the history of the machine tool industry. Roe, at that time a professor of machine design at Sheffield Scientific School, Yale University, wrote that:

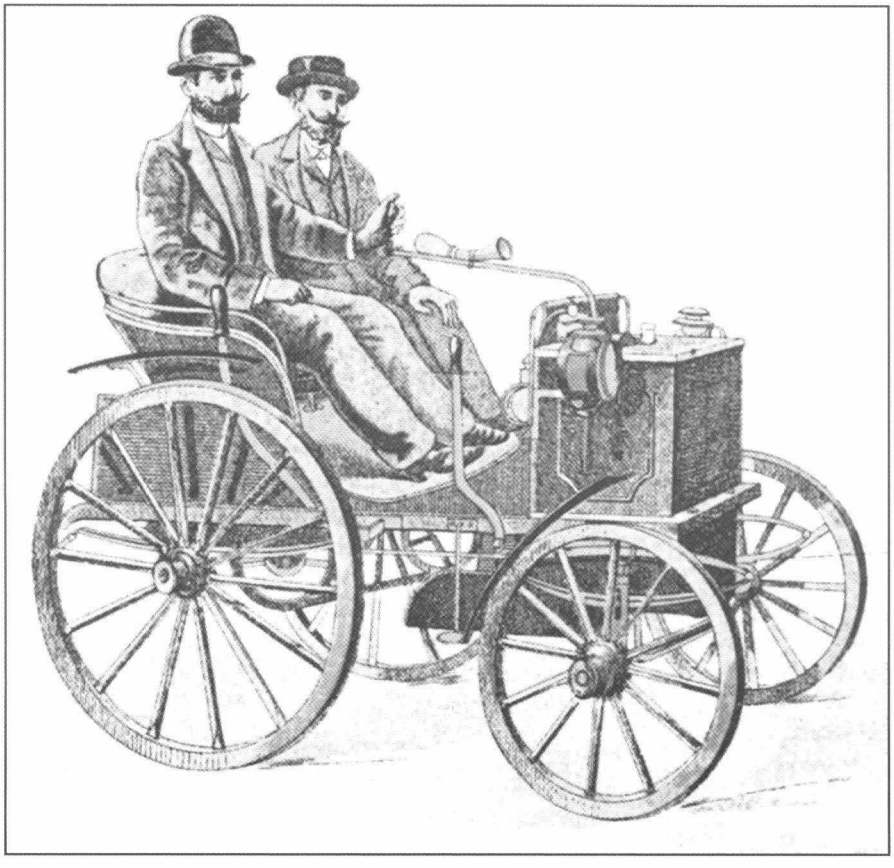
> It is not easy to assign the credit of an invention. Mere priority of suggestion or even of experiment seems hardly sufficient. Nearly every great improvement has been invented separately by a number of men, sometimes almost simultaneously, but often in widely separated times and places. Of these, the man who made it a success is usually found to have united to the element of invention a superior mechanical skill. He is the one who first embodied the invention in such proportions and mechanical design as to make it commercially available, and from him its permanent influence spreads. The chief credit is due to him because he impressed it on the world.[15]

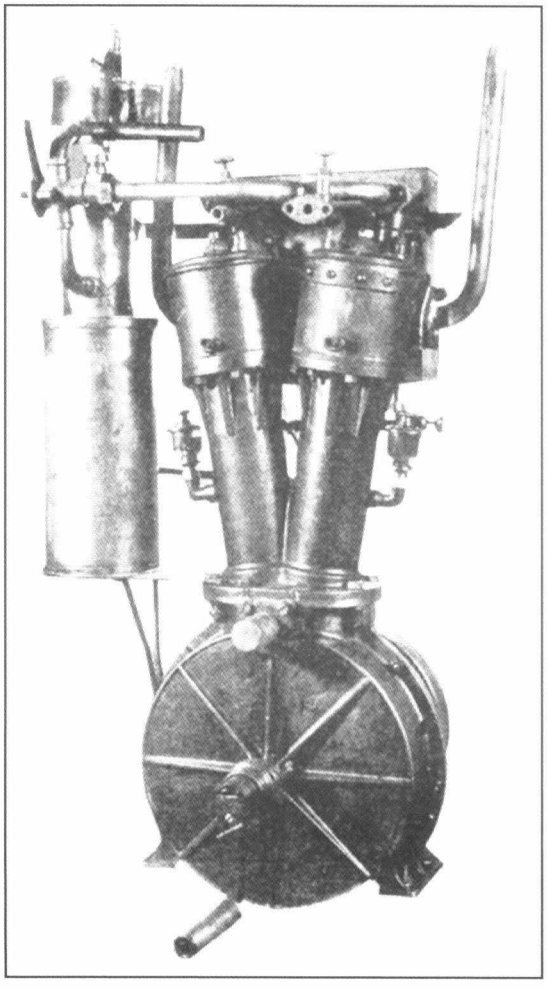
So, adopting Roe's rationale, while we may well find the work of men like Trevithick, Hancock, Lenoir, Amédée Bollée *père*, Roper and many other 19th Century experimenters fascinating, and with no intention here to diminish their achievements, it is reasonable to ascribe the "invention" of the motorcar to Carl Benz in Germany in 1885-86. While his



first car owed much to cycle practice with its "wire" wheels and tubular chassis, allied to a horizontal stationary-type engine and a transmission system derived from factory line-shafting, it nevertheless not only worked but provided a pattern for a series of similar machines that saw the total output of Benz vehicles reach 69 by 1893 and set to rise rapidly. The overall design was also much copied by others, as well as stimulating many more to make motorcars.

Coming to fruition at the same time as the first Benz motorcar was the Daimler-Maybach internal combustion engine, although the initial vehicles to which such engines were fitted were simply used to demonstrate its





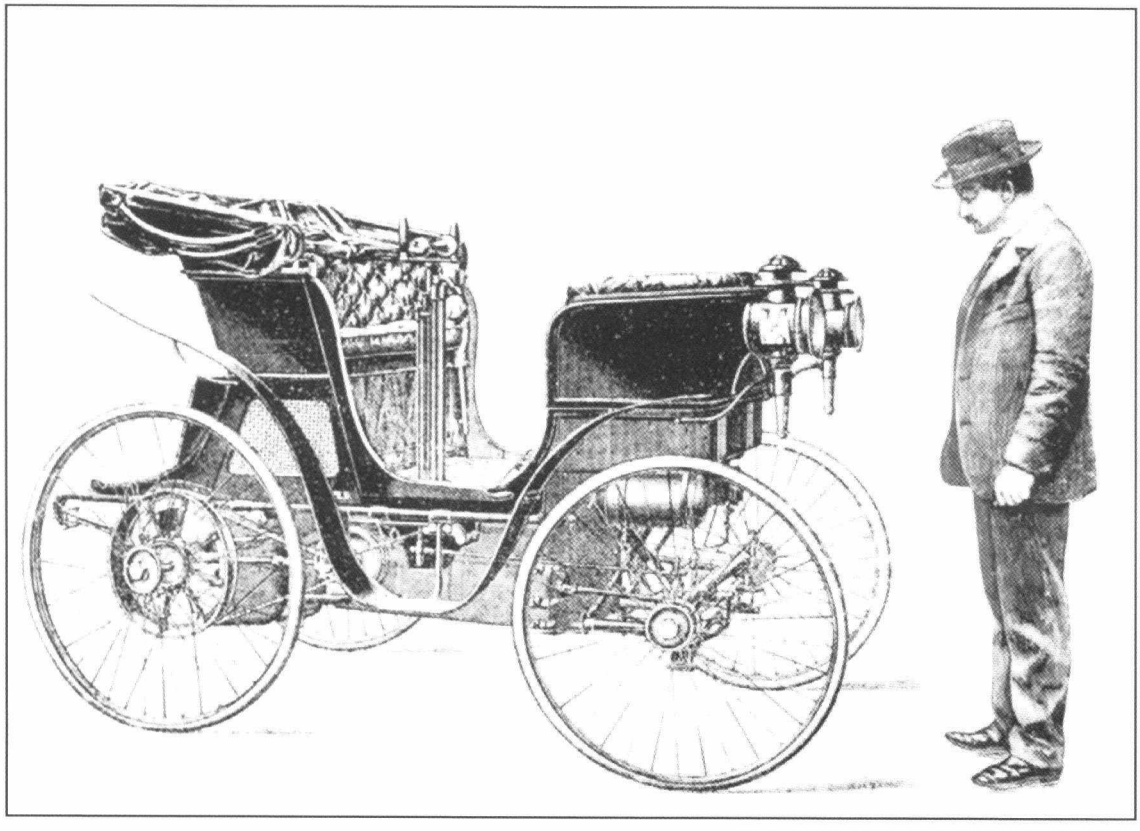
practicality as a power unit suitable for a variety of applications. It was not until Panhard-Levassor in France took up licensed manufacture of Daimler engines and sold numbers of them to Peugeot to defray some of the costs involved in their manufacture that the French motor industry began its rapid development from 1890-91 onwards.

By the close of 1900 Panhard-Levassor had produced a total of 1,958 vehicles with that year's output being 639. The Peugeot total was 1,298, with 500 made in 1900 (the factory records of both firms survive), while Benz's total figure had reached 2,317 vehicles, 603 having been made in the final year of the 19th Century (which at the time was regarded as including 1900 and is used as such herein). These Benz figures have largely been overlooked when levels of the earliest automobile production have been discoursed upon, in itself not exactly a frequent activity, and we will return to them later.

It may have been the comparatively low level of output by the relatively high-profile French manufacturers that prompted the aforementioned Professor Roe, in a 1937 lecture titled "Interchangeable Manufacture," to observe that: "All the early cars in Europe and this country [Great Britain] were *built* (Roe's italic). It was not until 1902 or 1903 that real manufacture began."[16]

Reluctant as I am to take issue with the Professor's views, in this particular instance he erred, as will be explained. Unfortunately, others who have written about this period have also expressed similar erroneous opinions, and taken matters even further by stating that something as basic as interchangeability of parts was alien to the early motor industry in Europe, which as a blanket statement it most definitely was not. For example, the 2007 edition of *The Machine that Changed the World*[17] begins its second chapter with an exposition on the building of 19th Century Panhard-Levassor motorcars, citing them as being hand-built by skilled craftsmen, which essentially they were, but then goes on to describe their perceived shortcomings, which include the firm's suppliers not using standard gauging systems thus preventing Panhard-Levassor from making any two identical cars, which just does not stand up to either dispassionate scrutiny or evidence from this writer's practical experience of surviving cars. After all, engines and transmissions were constructed in-house from parts made using machine tools, and items such as front and back axles were bought in, these coming from Lemoine and are quite clearly standardized products. Les Forges Lemoine supplied these instantly-recognizable items to the majority of the French manufacturers of larger cars, and some outside the country as well.

The information on Panhard-Levassor cars is cited by the writers of *The Machine that Changed the World* as being from *In First Gear*, the seminal book on the French automobile industry by James Laux.[18] If they ever studied the whole of this book they then either suffered from amnesic reading or resorted to selective writing to endorse a preconceived stance. Had this not been the case, while there may be a degree of truth in the contention that one of the two initial leaders in the French industry did make many individual vehicles, they might have discovered that the other, Peugeot, being familiar with bicycle making, produced series of identical motorcars, albeit in fairly small quantities. Furthermore, if they had pursued the matter more assiduously they would have found that, in chronological order from the mid-1890s onwards, Léon Bollée had set the ball rolling and then firms such as De Dion Bouton, followed by Darracq, produced motor vehicles constructed from interchangeable parts, and in substantial quantities, as enumerated by Laux.



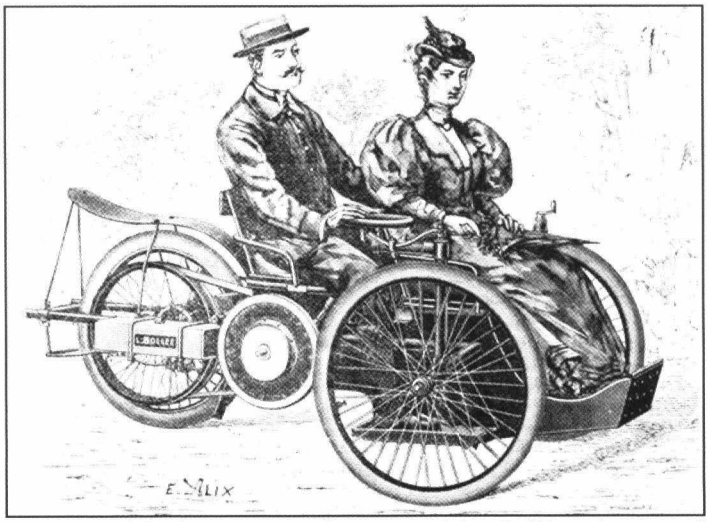
Opposite page: Top, the first Benz motorcar of 1885-86. Far left, an engraving of a Panhard-Levassor with front-mounted V-twin engine, as used on the cover of their first automobile sales brochure of 1892. Near left, Panhard-Levassor in France made more than 650 of these German Daimler engines from 1890 and into 1896, around 250 of which were used in their own cars, with 200 sold to Peugeot. This page: Rear-engine 1894 Peugeot with tubular chassis and wire wheels shows this company's familiarity with cycle making.

Léon Bollée and Volume-Production

On December 4, 1895, Léon Bollée of Le Mans received French patent number 252326 for an "automobile cycle," a compact three-wheeled motor vehicle for two people that he had designed, and to which he subsequently gave the descriptive name of voiturette – a small automobile. This word quickly became the generic term for all motor vehicles of this size regardless of their configuration. *The Autocar*, in its references to the vehicle from May 1896 onwards, called the machine either a "petroleum" or "tandem-tricycle." While it did indeed seat its passenger and driver one behind the other, the term "tricycle" creates a somewhat misleading impression, even though the vehicle had a tubular chassis and wire wheels, since it had two of these wheels at the front, which were steered, with the single driven wheel at the back. That Léon Bollée had designed his vehicle as a motor-powered entity, not using the relatively simple expedient of adding an engine to a pedal cycle, is evident from both its layout and detail. It did not have any pedals for propulsion, but it did have a horizontal single-cylinder air-cooled petrol engine, a three-speed gearbox, flat belt final drive and Ackermann steering, and while it lacked suspension it was designed from the outset to run on pneumatic tires – supplied by the Michelin brothers. Had the vehicle appeared ten years later it would have been referred to as a "tri-car." Weighing in at around 200 kg. (440 lb. or 4 cwt.) the Léon Bollée *voiturette* was lightweight, fairly simple, and fit for its purpose.

After making a number of prototypes at his father Amédée's bell foundry and engineering works in Le Mans, Léon Bollée initially contracted with the Hurtu sewing machine and cycle manufacturers Diligeon et Cie to build the vehicles in one of its factories at Albert in northeastern France. In August 1896 *The Autocar* reported that:

> MM Michelin...have purchased the whole of the production of Bollée vehicles and De Dion [motor] tricycles for the months of August and September, and have ordered two-hundred of the former from MM Diligeon et Cie and one hundred tricycles from MM De Dion Bouton et Cie.[19]



An automobile, but not as we know it—a Léon Bollée voiturette of 1896. In this view the horizontal engine lies on the far side of the back wheel.

While this was probably an attempt by Michelin to stimulate sales of its tires, its particular significance here is the quantities that are quoted.

Throughout 1898 The Autocar ran a series of articles under the title "Prospects of the Motor Industry in France," written by H. O. Duncan, a former champion cyclist and friend and later business associate of Count De Dion, among others. Early in 1897 production of Bollée voiturettes had been contracted to the *Société des Voiturettes Automobile – Système Léon Bollée* (abbreviated to SVB) with manufacture being undertaken by the *Forges et Chantiers de la Méditerranée*, which, despite the name, had an extensive factory at Le Havre. When Duncan visited the works there he reported that:

> No less than 200 machines are in the course of construction at any one time and about fifty are completed each month, but even this quantity is not sufficient to keep pace with orders and the company are nearly 200 machines in arrears.[20]

Photographs show the vehicles arranged in lines during manufacture and when ready for dispatch. Production continued during 1899, but probably at a lower level as the design was becoming obsolescent and was not really capable of further development, although some twin-engined examples were built and front suspension had been added. The SVB went into voluntary liquidation early in 1900. According to Duncan, Diligeon et Cie produced "some two to three-hundred frames" and with the production at the Le Havre factory in 1898 running at 50 per month – 600 in the year – total output was probably around 1,500-1,800 vehicles in the three to three-and-a-half year period of manufacture. SVB numbers on surviving Léon Bollée *voiturettes* lend credence to this assessment.

The Size of a Mass

Having described this example it is appropriate to pause and consider whether the output of the Léon Bollée *voiturettes* constituted mass-production. The making of 600 identical vehicles with interchangeable parts in one year can be said to meet the *OED*'s definition of a "large quantity by a standardised process," but is this large quantity of sufficient magnitude to be considered a mass? When set against the production of 172,800 individual wood screws per week, 600 objects per annum is a pathetically small figure. However, even though the Léon Bollée was a relatively simple motor vehicle, it was still intrinsically a much more complicated object than a single wood screw. Furthermore, its production process was also far more complicated. It had to perform the function for which it was designed in a constantly changing environment; and be driven and maintained by those who became skilled in so doing and also by the maladroit.

Taking these factors into account, it seems to me that the threshold for what constitutes mass-production can be considerably lower the more complex the end-product becomes, a view apparently held by those who wrote about the Oldsmobile in the previously quoted extract. However, even applying this criterion, I cannot convince myself that 600 vehicles in one year (or less than 2,000 in a 3-3½ year

period), constitutes a "mass" – but it is quite a "lot of," and deserves to be regarded as a significant step towards sustained volume-production.

Having been unable to find an actual figure for what does constitute a mass of any type of objects, let alone motor vehicles, the question needs to be addressed: is it possible to posit a total that can be considered reasonable? To enable the pattern of the early development of volume-produced automobiles to be further explored I have opted to consider only those makers that made in excess of 1,000 motorcars basically to the same specification per year, and used this as a working proposition.

Taking into consideration the complexity of the product, the thinking of the day unendowed with the benefit of hindsight, resources both in terms of finance and labor, and the perceived potential market, this will adequately serve to demonstrate that volume-production arose very early in the manufacture of motor vehicles. In view of what was to happen with motorcar production within the first decade of the 20th Century, 1,000 will seem an absurdly low figure, but there is an additional element that can be factored in. We are dealing here with the very beginnings of what was to become a major industrial development, not the situation a decade into this scenario, and the development period that is inevitable with any new manufacturing activity inevitably is not the same as that which comes later. One thousand per annum also, incidentally, serves the purpose of eliminating from discussion a large number of the early makers of motorcars that never succeeded in crossing this threshold, whether from inability or choice.

De Dion Bouton and Darracq

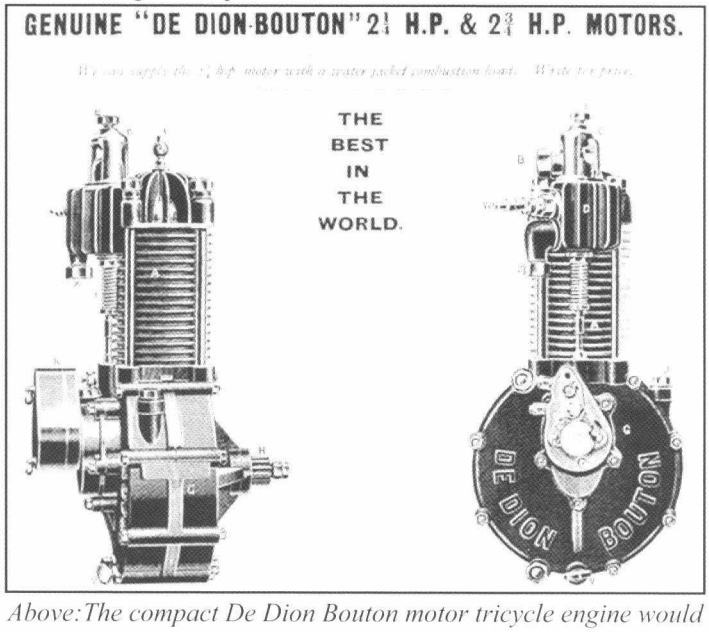
In France, there was one other automobile business apart from Léon Bollée that also produced vehicles in substantial numbers in the final decade of the 19th Century: De Dion Bouton. This business, led and financed initially by Count Albert De Dion with the technical side overseen by the brilliant but unassuming engineer Georges Bouton, originally in co-operation with his brother-in-law Charles Trépardoux, had been making a variety of steam-powered road vehicles since 1882. The comparatively complicated nature of these steamers was a source of frustration to the Count, who wished to produce motor vehicles that were, relatively speaking, simple to drive and maintain, and inexpensive to buy. Towards this end, during 1895 Bouton developed an eminently practical small high-speed petrol engine.

Right: Count De Dion astride one of his own motor tricycles in 1898.

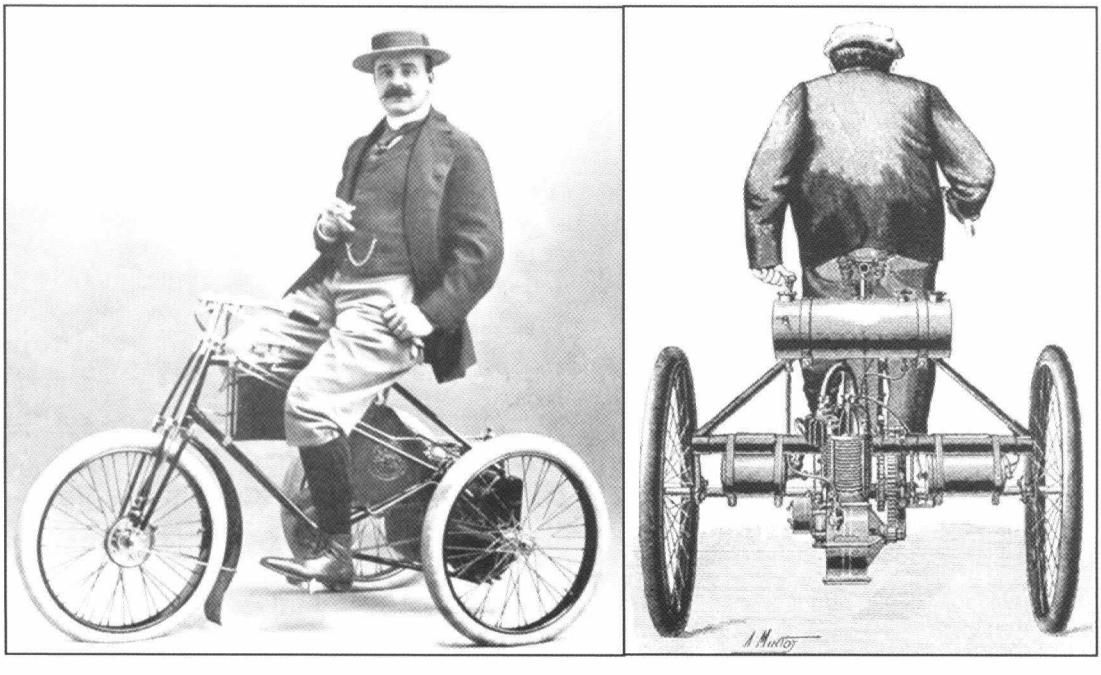
In December 1898 *The Autocar* reported:

> Count De Dion informed us that he has at the present time orders for no less than 12,000 motors in hand…To deal with thousands, where hitherto they have dealt in hundreds, is a big jump, and it is questionable if the markets will be large enough to immediately absorb them.[21]

We need to be clear that the figure in this quote refers to engines alone, not complete motor vehicles, but nevertheless it was for use in a form of auto-mobile-personal-transport vehicle that these "motors" were being made – principally for powered pedal-tricycles, although quadricycles, with a single passenger seat between the two front wheels, also began to appear at this period. We also need to be clear that these vehicles were not motorcars, nor did or does any right-thinking person claim that they were. However they were an important prelude to that which followed: establish-



Above: The compact De Dion Bouton motor tricycle engine would run up to 1,500 rpm. Below: These views show the mechanical elements of the De Dion Bouton trikes.



ing the methods by which a substantial output of powered motor vehicles could be achieved.

The engines designed by Bouton that powered these motor tricycles had first appeared in public in December of 1895, in the form of single-cylinder, ½-hp, air-cooled units with electric ignition, and these grew progressively in size, in ¼-hp increments, so that by June 1899 when the 2¼-hp engine was introduced there was to be only one further successor, of 2¾-hp, that continued to be made into 1901. Although there are no known surviving works records, press reports and two other sources[22] indicate that around 20,000 engines of this pattern were produced between 1895 and 1901, and used in De Dion Bouton's own vehicles and by numerous other makers on both sides of the Atlantic. Towards the end of 1901 *The Automotor Journal* reported that:

> Messrs De Dion Bouton & Co advise us that they have now made over 25,000 of their petrol motors, and are well forward in the 26th thousand. By these figures they may well claim that they have made more light motorcars than all the other manufacturers combined.[23]

The Autocar reported in similar vein, and gave the horsepower ratings "from ¾hp to 8hp," this in an article about the newly introduced 8-hp model. This and the 6-hp marketed from May 1901 were both front-engined motorcars. They were to become the successors to the rear-engined cars with Vis-à-vis bodywork (Face to face – a pair of two-seater seats facing each other) that had first appeared in April 1899, although there was about a 12-month period of overlap when both front and rear-engined cars were made. The Vis-à-vis model had a water-cooled engine of 3½-hp and the vehicles into which they were fitted were in every respect motorcars, made in their entirety in the newly built De Dion Bouton factory at Puteaux. The factory was equipped with the "most up to date French, English, and American machine tools, including automatic machines for the series-production of components"[24] and at that time employed around 1,000 workers. The car engines were numbered in a different series from the "trike" engines and the many surviving examples of the former provide good evidence that the figure of 1,250 motorcars claimed by De Dion Bouton[25] made in the approximately 18-month period between their introduction and October 1900, when a 4½-hp engine became the standard power unit, is justified. Motorcar production for the next 12 months was probably closer to 1,800 vehicles, but, as indicated, by this stage there was more than one model being made.

The cover of the 1900 Sales Brochure & Parts List of De Dion Bouton's British agents, showing one of the first examples of the firm's small cars of 1899 – without the vis-à-vis front seat fitted.

At least until the end of 1905, and probably later, the annual output of De Dion Bouton motorcars was well above the 1,000 threshold that I have posited, but by this stage the single-cylinder cars had been joined by a range of twins and four-cylinder models, as well as commercial vehicles. These were made by a workforce of around 3,000 employees, so it seems that there was quite a degree of hand-assembly, which to some rules it out as being any form of mass-production, but it still resulted in a "lot of" motor vehicles.

That these motor tricycles, then motorcars, and their engines from the very start were precision-made with fully interchangeable parts is a matter of fact, not one for debate. Apart from the above comment about "series-production" this is clear from two other quite different sources. First, from at least as early as 1898 De Dion Bouton published spare parts lists that included all the engine components and those for the tricycles themselves. This would have been a pointless exercise if the parts bought would not then readily fit where they were needed. Second, having personally rebuilt a number of the trike engines, I know that components from one readily interchange with those from others and that they are of "Swiss watch" quality. When the motorcars appeared on the scene in 1899 this same pattern was repeated. Indeed, I venture to suggest that if in 1900-1901 three De Dion Bouton motorcars had been submitted to a similar test to that undertaken by Cadillac's British agent in 1908, with the vehicles dismantled down to the last nut and bolt, the parts mixed, and then re-assembled as motorcars in running order, the outcome would have been exactly the same – but nobody thought of doing so, then or later.

In terms of volume-production, in the last months of 1900 De Dion Bouton was joined in this system of making motorcars by the firm led by Alexandre Darracq, also Paris-based. Darracq, together with one Jean Aucoc, had established the "Gladiator" bicycle manufacturing firm on the northeastern edge of the city in 1891. The business prospered, and in 1896 it was sold to an English financial group. An element of the sale was an undertaking that in future the

partners would not continue with the making of bicycles. Darracq abided by this constraint but went on to have a new factory built, the Perfecta Works, to the southwest of the capital in Suresnes, for the manufacturing of – cycle components! As this business also prospered, he soon began dabbling with various forms of motor vehicles, but his efforts in this field up to 1900 were all less than satisfactory.

Design of the small Darracq motorcar that went into production in the latter part of 1900 is generally attributed to a qualified engineer Paul Ribeyrolles, Darracq's "right-hand man" on technical matters. It featured a front-mounted vertical single-cylinder 6½-hp "Perfecta" engine and a three-speed gearbox with shaft final-drive, all mounted in a tubular-steel chassis and running on wire wheels. These last two features reflected Darracq's cycle-manufacturing background. Output of these vehicles was projected as 1,200 standard motorcars in the first full year of production,[26] and was reported in the *Motor-Car Journal* in December 1902:

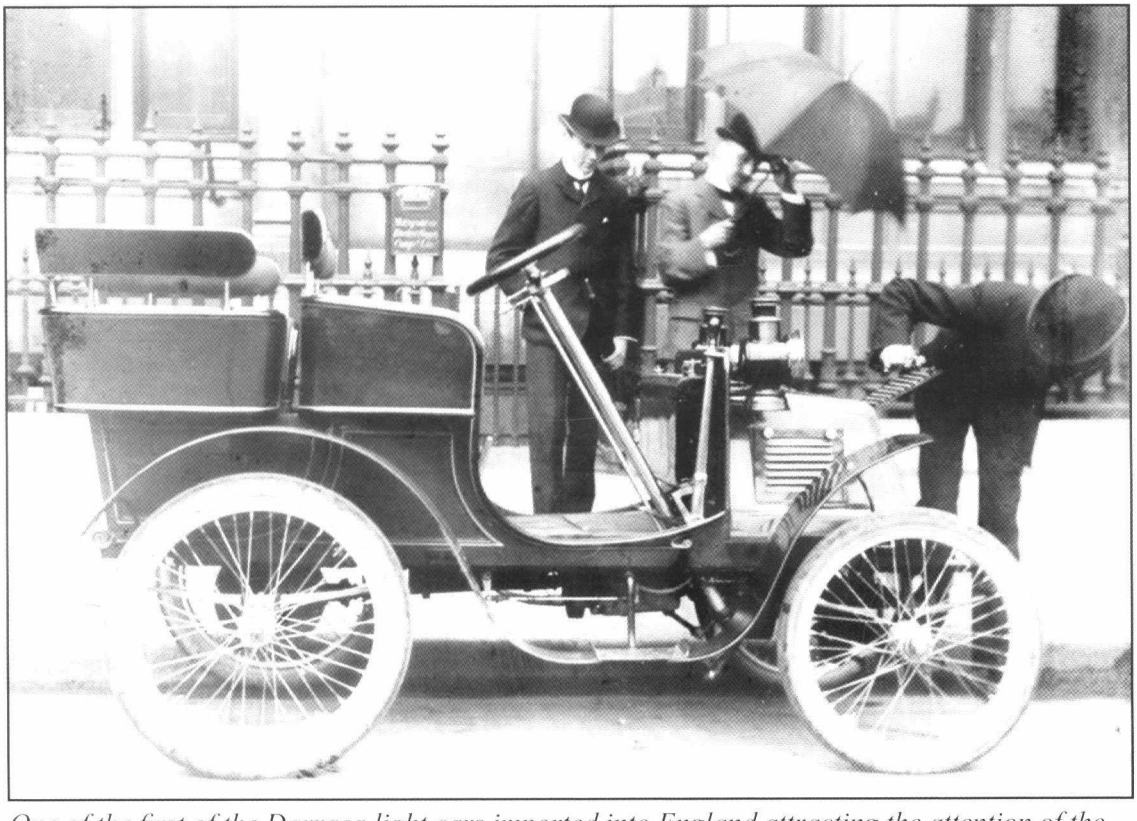
> M. Darracq explained in person…that no less than 1,050 Darracqs have been turned out at Suresnes in 1902, and that actually there are a series of 1,200 cars passing through the shops for next year.[27]

Also mentioned was a move away from a single-model policy, as the 1903 production was to be divided among one single-cylinder car, two twins, one of which was already in production, and a four-cylinder model also to be introduced. This 1,200 figure seems to indicate the limit of the capacity of the factory up to the end of 1904.[28] However, following acquisition of the business in April 1903 by a British financial group (Alexandre must have experienced *déjà vu*, although in this case he remained as Managing Director) the factory was in due course extended. Output rose steadily, but not dramatically, reaching 2,200 vehicles for the year 1906, the same year in which the shareholders' received a 25 percent dividend on their investment, otherwise for the years 1904 to 1908 inclusive they had had to be content with only a 20 percent return.[29]

For the French automobile industry in the last half decade of the 19th Century and the first few years of the Twentieth, volume-production, utilizing interchangeable parts, was a completely normal phenomenon, at least as far as De Dion Bouton and Darracq were concerned. It should be noted though that other manufacturers whose output was much smaller were also quite conversant with the concept of interchangeability. To take but one example, in December 1906 Automobiles Mors, makers of expensive motorcars with production that probably never exceeded 300 cars per year, published a fully-illustrated 80-page catalog of *Pièces de Rechange,* a spare-parts book that covered all its vehicles back to 1901. Looking through the pages one finds that it was possible to buy an extensive range of replacement parts from something as mundane as a castellated lock-nut, to camshafts, gears of all sorts, complete crankcases, cylinder blocks, and all the other elements that make up a motorcar, for any of the Mors vehicles produced in that six year period. This situation was by no means unique to Automobiles Mors.

Elsewhere in Europe

While the automobile may be said to have been born in Germany, thanks largely to the efforts of Carl Benz, it was slow to develop there and was fostered in France. Prominent German firms such as Adler and Opel, who were experienced in the cycle industry, did not begin making motorcars until around 1900. Adler drew inspiration from Renault, initially using de Dion Bouton engines, while Opel, after a hesitant start having bought the Lutzmann business – itself makers of essentially Benz copies – switched to importing Darracqs. These eventually metamorphosed into being Opels around 1904-05. Max Cudell in Aachen obtained the license to make De Dion Bouton tricycles in 1898 and cars from 1900, but production was comparatively limited. Daimler eventually found its feet



One of the first of the Darracq light cars imported into England attracting the attention of the curious in Whitehall Place, London, early in October 1900.

after the intervention of Emil Jellinek saw the emergence of its Mercédès marque at the end of 1900, but while these upmarket cars achieved considerable recognition and sporting success, volume-production was scarcely in their sights.

As previously indicated, in Germany only Benz produced automobiles in significant numbers at end of the 19th Century. During an eight-year period from 1893 onwards the firm made around 2,250 motorcars largely to the same pattern, at least mechanically, and exported them widely across the globe. This level of production was undoubtedly assisted by the introduction of the Velocipede model (soon abbreviated to Velo) in 1894. Smaller in all respects than the models that had preceded it and which continued to be built, the Velo was a neat two-seater with a single-cylinder engine of just over one liter in size. These Velos came to be much favored by country doctors and others who appreciated their simplicity and reliability, if not their performance—a maximum speed of a shade over 25 kph (15 mph). From the limited surviving Benz factory records (which are, however, complete for 1895-1897),[30] output of the Velo can be calculated as being about 1,400 vehicles, or around 60 percent of Benz total production. Over the seven years in which they were made, and with only 14 built in the first year, output thereafter averaged in excess of 200 per annum. Even at this comparatively low level of production the cars were built using interchangeable parts. Post-1900 the activities of the Benz business faltered as the search began for models of an up-to-date design, and no other German maker of automobiles opted to build on the foundation that Benz had established, and strive for anything approaching volume-production until many years later.

Above: With only minor changes the Benz Velo was produced in respectable numbers over a six year period. Below: The only volume-produced car that was manufactured in Britain in the early days was the neat little Humberette, announced in June 1903.

In the period 1895 to 1905, motor industries were gradually established in other European countries, principally the then Austro-Hungarian Empire, Belgium, Holland, Italy, and Switzerland, and, across the Channel from France, in Great Britain. Almost without exception, regardless of what was to happen in later years, there were no discernible attempts to follow the De Dion Bouton lead and attempt volume-production of automobiles in these countries at this time. That there was an exception, and that it occurred in Britain is, given the prevailing attitudes of those days, remarkable. Why a country that had pioneered and prospered on the back of what, for convenience, is called the Industrial Revolution, led in many scientific and technological developments and had initiated a mechanized transport system, the railways, that was second to none, was so hostile to the coming of the motorcar is a matter that has created much learned discussion and debate that will not be explored further here—but hostile it was. Following the repeal of the draconian legislation in late 1896 that had restricted the speed of all types of mechanically-propelled road vehicles,

including those which we now call motorcars, to four miles per hour maximum, the increase to 12 mph permitted in the countryside meant that a British motor industry of sorts did gradually come into existence in the final years of the 19th Century.

Among those who entered the fray was the well-established cycle firm of Humber, Ltd. After a period of making some fairly unremarkable motor vehicles, in the summer of 1903 Humber placed on the market a small car named the Humberette (a clever conflation of Humber and voiturette), powered by a vertical single-cylinder, water-cooled engine of 5-hp, with a conventional two-speed gearbox and shaft drive. The car's engine clearly drew its inspiration from the De Dion Bouton units and operated at a similar working speed of 1,500 rpm, although in the case of the Humberette the internals rotated counter-clockwise. The rest of the car could be said to have been copied from Darracq – the tubular chassis being an obvious similarity and given Humber's cycle making background one with which the firm was entirely familiar.

From the outset, Humberette production was from the two Humber factories, one at Beeston near Nottingham and the other in Coventry. The Beeston models had a superior finish and wooden wheels and accordingly were more expensive. Sales of these cars are said to have reached 500 by year's end, although engine numbers on surviving examples suggest that the actual figure may have been somewhat less. For 1904 an additional 6½-hp-engined version with a three-speed gearbox was introduced and indications are that around 1,000 Humberettes were made in the calendar year. These small cars, which were well constructed, entirely practical and of lively performance, continued in production until the end of 1905, at which stage the day of the single-cylinder car was deemed to be passé and Humber stopped making them. Thus the only serious attempt to volume-produce motorcars in Britain in the period prior to the 1914-18 War, despite its apparent success, ceased with the demise of the 1903-5 Humberette.

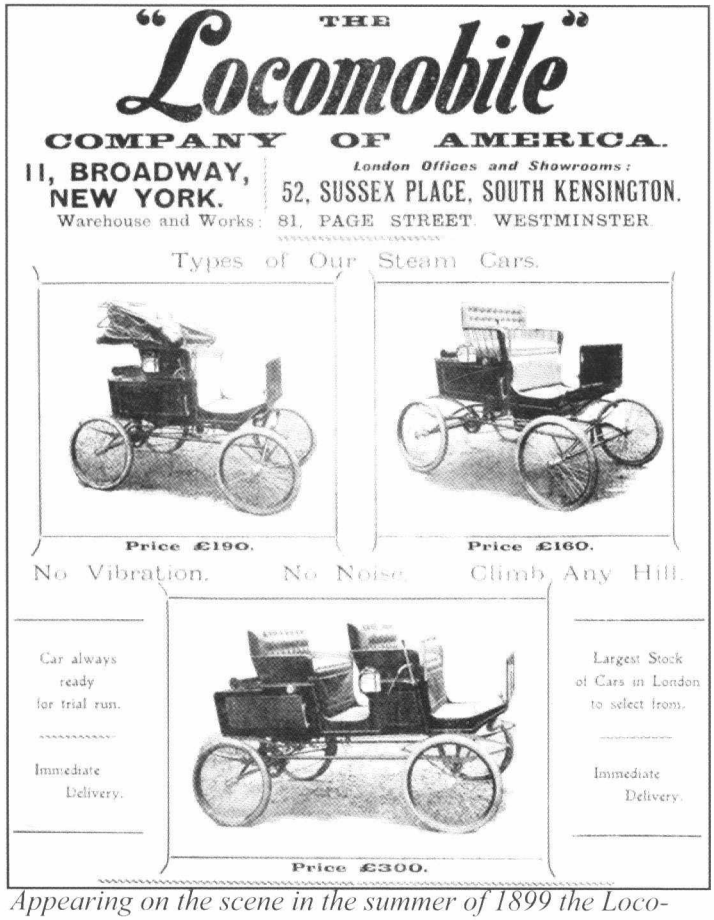
The American Scene

As far as American automobile development was concerned the closing years of the 19th Century had been essentially a period of experiment. In the year 1900 Haynes-Apperson produced 193 automobiles,[31] Winton 200,[32] and total output for the whole auto industry was 4,192 "units."[33] This latter figure is interesting to compare with all French production for 1900: 4,800 automobiles,[34] although we should perhaps note that the population of the USA in that year was 76 million, precisely double that of France.

It is appropriate at this point to expand on my objection to the quote early in this discourse concerning the Oldsmobile being the world's first gasoline-engine automobile to be made by mass-production methods. I trust that the outline of De Dion Bouton's activities in this area has dealt with why I consider this statement to be incorrect, but in fact the anonymous author of *100-Million Motor Vehicles* actually missed a trick which, it could be argued, genuinely put an American product as the first in this field, or at least jointly in first place along with the French firm in the volume-production of automobiles. It does though require the dropping of the words "gasoline engine." Quite why the Locomobile steam car has received such scant attention when this subject has been explored by others is something of a mystery.

We do well to remind ourselves that in the closing years of the 19th Century it was a completely open question as to which power source would in the future propel automobiles: electricity, steam, or the internal combustion engine. It could be all three, or maybe one would eclipse the others. In 1900 many backed something with a steam engine to achieve the desired result. After all, steam was a familiar power source with over 100 years of history behind it and it worked well enough on the railroads and in ships. Electricity was new-fangled and difficult to comprehend, while the gas engine was complicated and perceived as unreliable, particularly regarding its ignition systems. The answer seemed to lie with steam, and the Stanley twins certainly believed this to be so.

When they sold the rights to the steam runabout that they had developed to two New York businessmen, John Brisben Walker and Amzi Lorenzo Barber, in June 1899 and the Locomobile Company of America was established, the twins must have felt that the future was assured. The fact that Walker and Barber very quickly fell out with one another and went their separate ways was but a hiccup in the proceedings. Barber retained Locomobile, and several hundred lightweight steam-powered automobiles were produced before the year was out. Exact production figures do not exist, but it seems to have been around 1,800 in 1900, and over



Appearing on the scene in the summer of 1899 the Locomobile steamers were arguably the first volume-produced automobiles built in America.

2,000 the following year,[35] these embracing a variety of models although there was little variation in the mechanical details. The firm's sales brochure for the coming year of 1903 contains the statement that "Since 1899 we have placed 5,000 Locomobiles in the hands of customers" and this does not seem to be a particularly extravagant claim to have made.

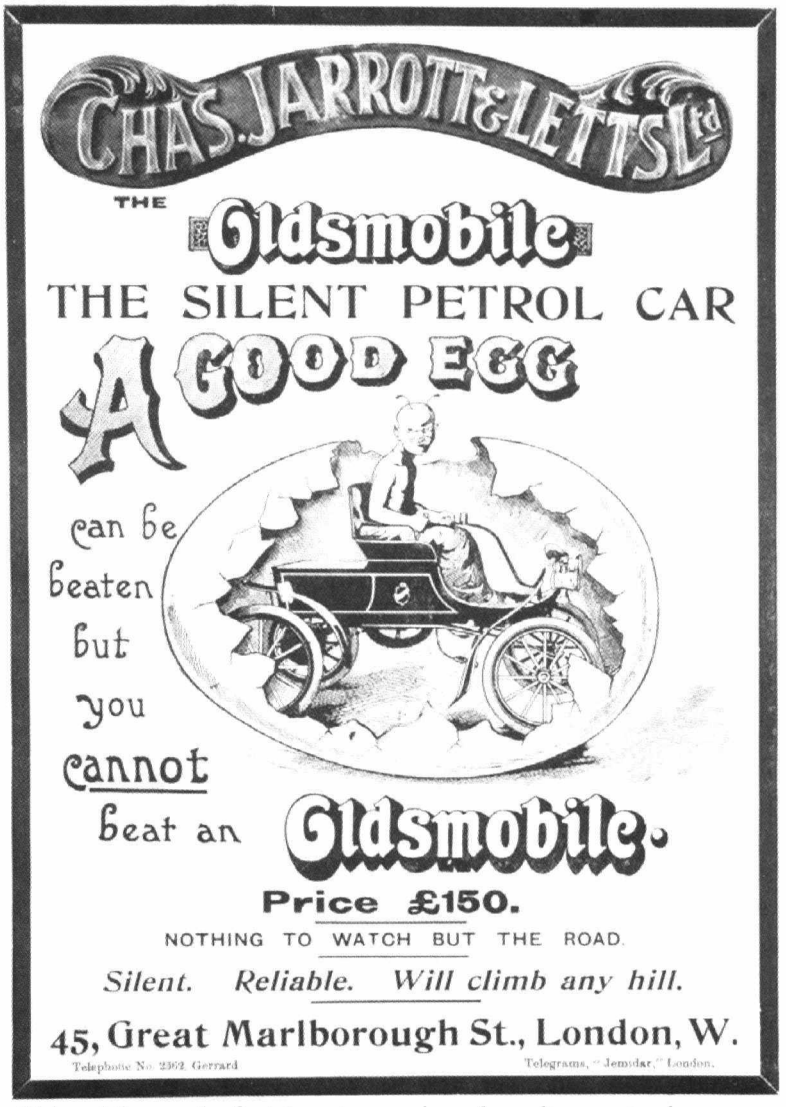
The question as to a Locomobile's "fitness for purpose" was raised at the time, and inevitably in retrospect, but although they were perhaps rather delicate, and demanded care and a fair degree of skill in their usage, many people in America, and in Britain, were introduced to the joys of motoring by ownership of or travelling upon a Locomobile, or one of the many similar steamers that drew inspiration from them. Inadvertently, they also brought to people's attention a serious deficiency with steam-powered automobiles, this being the length of time it took to fire them into action, the more so when set against the same process for a petrol-engined motorcar. It was a problem that has never been completely resolved and goes a long way to explaining the ultimate demise of the steam car. But, in the period in question, the Locomobile has a perfectly fair justification to the claim of being the first volume-produced automobile built in America.

It is possible though that the electric-powered vehicles made by the Columbia company should get a look in here as well, but I must confess to not knowing enough to comment adequately on this particular matter. However, in his delightful book of reminiscence published in 1937 Hiram Percy Maxim observes: "Few of the present generation remember these [Columbia] electric cabs, although there were hundreds of them on the streets of New York and many other cities..."[36]; and the *Standard Catalog of American Cars 1805-1942*[37] in its "Columbia" entry refers to an order for 12,000 electric taxicabs in 1899 and says that about 2,000 were built, but does not give a timescale. No doubt this topic has been properly explored elsewhere and if these figures are anything like accurate then they are worthy of note in this context.

This takes us on then to internal combustion engined vehicles that were produced in substantial numbers and inevitably Oldsmobile is the first in the queue. The basics of the 'Curved-Dash' with its distinctive splash-board, tiller steering and rear-mounted horizontal single-cylinder engine are hopefully well enough known so as to need no re-iteration here. By early 1903 the firm was claiming in its advertisements in the American motoring journals that on city streets every third car was an Oldsmobile. There was also a thriving export trade with the cars doing particularly well in Britain, sales initially being handled by the Anglo-American Motor Car Company and the Oldsmobile Company of Great Britain, both businesses being at the same address in Regent Street, London.

In September 1903 this dual-titled British business announced that it was ceasing selling Oldsmobiles, Charles Jarrott and William Letts taking on this role, and Anglo-American acquired the sole British agency for Cadillac cars. One brief quote from within the wording of their lengthy statement as to why they had acted in this way is particularly interesting: "It [the Cadillac] has been designed with a special view to making each part substantial, strong and durable, and of the best material throughout."[38] By implication, these features were not necessarily to be found in the Oldsmobile. That Ransom Olds was aware that the materials used in Oldsmobiles were not always beyond reproach and his production methods were not necessarily of the highest standard is examined in detail and largely substantiated by George May in his biography of Olds.[39] Despite these deficiencies, the Curved Dash cars readily found customers, output rising rapidly from the production of 425 vehicles in 1901 to the 5,000 or so made in 1904. The four-year output for this model alone totaled around 12,000, an additional model having been introduced in 1904, of which some 5,000 were also built. These figures may look comparatively small to us because we know what lay ahead, but at the time the scale of them seemed so enormous that some found them hard to comprehend, let alone accept.

In January 1905 there was a robust exchange of views on the matter in the pages of *The Car - Illustrated.*



Oldsmobile was the first American maker of gasoline-engined automobiles to produce them in substantial numbers and in addition to home sales a wide export market was rapidly established.

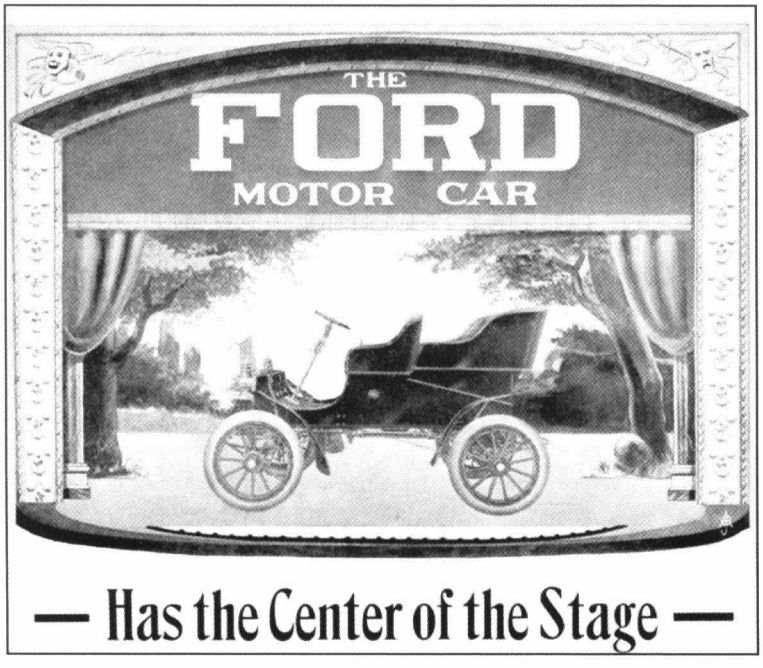
William Letts, who had been the head of the London side of the Locomobile operation and then moved on to selling Oldsmobiles together with Jarrott, wrote to the magazine following one of his regular America trips. In part he noted:

> I think the Olds Motor Works are right in claiming that they turn out more cars than any other factory in the world, for the simple reason that they keep improving their cars year by year, and keep the price practically at the same figure. They can only do this by the enormous quantities that they sell. Last year [1904] it is estimated that 10,000 Oldsmobiles were sent out of the works to different parts of the world...[40]

Elsewhere in the magazine there are photographs that show "One thousand Cars" (Curved Dash Oldsmobiles) in a huge stockroom and another in which large numbers of frames with engines in place are stacked ready for assembly into motorcars. The following week there was a stout rejoinder to Letts' comments from Charles Sangster who was Director of the Ariel Motor Company in Birmingham. He was unable to count more than 100 cars in the photograph and referred to the production figure of 10,000 cars per annum as "obviously absurd."

By this stage Oldsmobile was no longer the sole American producer turning out motorcars in substantial quantities. The Cadillac Automobile Company had entered the field at the beginning of 1903 with, for its day, a fairly conventional 6½-hp single-cylinder car with wheel steering and sold almost exactly 2,500 cars in the calendar year. Despite a serious factory fire, a similar number went to customers in 1904. As the Anglo-American business had indicated, it was indeed a product of the highest engineering quality and many others quickly recognized this to be so. Not for nothing did the man who brought Cadillac cars into existence, Henry Leland, earn the soubriquet "The Master of Precision" and the standards he set became the benchmark for many in the American automobile industry to aspire to, whether they were volume-producing their products or making them in smaller quantities generally for the top-end of the market.

Above: When the Cadillac first appeared in 1903 it looked little different from many of its American contemporaries, but in terms of quality it was second to none. Below: Even in Ford's earliest days of automobile production, facts were malleable, as this January 1904 advertisement shows.



Conclusion

I trust that I have been able to show that when Henry Ford after a number of false starts began production of his automobiles in the summer of 1903, he did so within a manufacturing climate where volume-production was already well-established in a significant number of industrial activities, as well as in the burgeoning automobile industry. That he subsequently took his "mass-production" to volume levels that nobody could envisage in 1903 is now well-known, but is not the point of issue that has been examined here.

As to why the European motor industry did not go down the path of ever-expanding volume-production until after World War I, despite the pioneering activities particularly of De Dion Bouton and Darracq described herein – plus the evidence of what was happening across the Atlantic – that, as they say, is another story.

A teacher for 20 years, Malcolm Jeal *has subsequently served as editor of several British magazines, including* The Automobile. *From 1984 until 2008 he was a member of the Dating Committee of the Veteran Car Club of Great Britain, serving eight years as Chairman, and was club librarian for more than a decade. He was awarded the Prince Henry Trophy by Lord Montagu of Beaulieu in 2000, on behalf of the National Motor Museum Trust "for services to the Veteran Car movement – worldwide." A member of SAH since 1989, he was Chairman of the Society of Automotive Historians in Britain, our United Kingdom chapter, from 2006 to 2010, and has edited the SAHB's annual* Aspects of Motoring History *since 2004. He was elected a Friend of Automotive History in 2007. The illustrations are from his collection.*

Endnotes

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3. Hounshell, David A. *From the American System to Mass Production 1800-1932*; John Hopkins University Press, 1984.

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6. Rolt, L.T.C. *Tools for the Job*; HMSO, 1986. p. 65, quoting "Shaw, the Staffordshire historian."

7. Books on the subject of Marc Brunel, Henry Maudslay, and the "Portsmouth block-making machines," dating from the mid-19th Century onwards, are far too numerous to note here.

8. www.montbéliard.com/JAPY/f, and similar Frédérick Japy-related websites.

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18. Laux, James. *In First Gear – The French Automobile Industry to 1914*; Liverpool University Press, 1976.

19. *The Autocar;* Aug 1, 1896. p. 474.

20. *The Autocar;* July 9, 1898. p. 441.

21. *The Autocar*; Dec. 24, 1898. p. 817.

22. Sources for the number of engines produced are: surviving engines, of which there are many, all of which are sequentially numbered on their crankcases; the Records of the *Service des Mines*, the French government department that administered the legally required "Type Approval" introduced in March 1899; and press reports, notably in this case *The Automotor Journal*, April 1900, p. 372. The latter notes that the last 1¾-hp engine made in June 1899 was number 9,600.

23. *The Automotor Journal;* Nov. 1901, p. 80.

24. This is a translation into English of but one sentence in a detailed article "Les Ateliers De Dion Bouton" in *La France Automobile*, July 9, 1899. pp. 334-6.

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26. Nickols, Ian and Kent Karlslake. *Motoring Entente – The Story of Sunbeam, Talbot, Darracq & Sunbeam-Talbot Cars*; Cassell & Co., 1956. p. 122.

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28. At the annual shareholders' meeting "the Chairman said it had been arranged to construct about 1,200 for the 1904 season." *The Motor-Car Journal;* Nov. 28, 1903. p. 758.

29. Laux, op. cit. p. 212.

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39. May, George S. *R E Olds: Auto Industry Pioneer*; William B Eerdmans Publishing, 1977. pp. 225-237.

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Letter

Learning From MG

In the interests of historical accuracy may I be permitted to point out that the abstract on page 44 of *Automotive History Review* No.53 ("Can GM Learn...") is incorrect. Cecil Kimber joined Morris Garages in 1921 as General Manager. Morris Garages, or its successors in title, did not become part of Morris Motors until 1935 when William Morris (later Lord Nuffield) sold his interest to Morris Motors (part of the Nuffield group). (Source: *The Kimber Centenary Book*.)

Keith Munro, Guernsey, Channel Islands.

The editor replies:

Indeed, it was Morris Garages for whom Kimber went to work in 1921. However, both Nick Georgano (*Beaulieu Encyclopaedia of the Automobile*, The Stationery Office, 2000) and the late Jan Norbye (*An Historical Who's Who of the Automotive Industry in Europe*, McFarland & Company, 2006) call him "sales manager," the title given by author Richard Knudson in *AHR* 53.

SUBMISSION GUIDELINES FOR AUTOMOTIVE HISTORY REVIEW

Authors wishing to submit articles for publication in the *Automotive History Review* are requested to follow these guidelines:

1. Manuscripts should preferably be in Microsoft Word. Spacing and type face are irrelevant, as they will be changed during the editing process. Inquire about the acceptability of other word processing programs. Text may be submitted by email or on compact disk media. Clean, typescript copy can be scanned if need be.

2. Illustrations may be submitted digitally or in hardcopy or photo print form. Digital images should be 300 dpi or better, in a size no smaller than the intended reproduction. TIFF format is preferred, but JPEGs can be used as long as the resolution is sufficient. In general, photos downloaded from the internet do not have sufficient resolution. In any case, authors submitting photos should obtain the necessary authorizations for publication from the person or entity holding the copyright or ownership of the image. Illustrations are an important part of automotive history. Very rarely do we consider an article without illustration.

3. Articles should begin with a paragraph headed ***Introduction***, or some other introductory heading. As the theme of the article is developed, there should be additional breaks in the text identified by similar headings, e.g. ***The Early Years***.

4. Punctuation and spelling follow United States conventions. These will be brought into conformity during the editing process, but authors are encouraged to take these measures on their own. *The Chicago Manual of Style* is the preferred reference.

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