

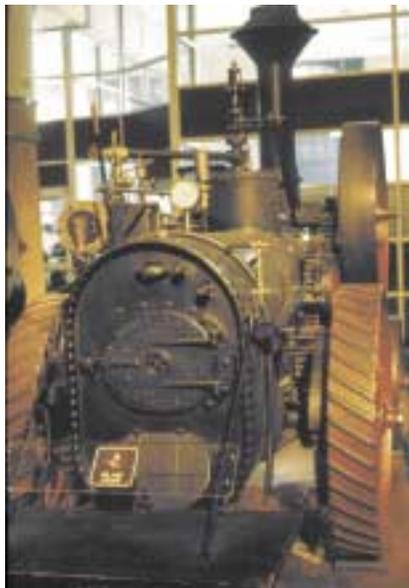
Part I: The Automobile From Horseless Carriage to Everyday Technology

by Arthur D. Delagrange, *Massachusetts Beta '64*

IF ONE PIECE OF TECHNOLOGY had to be chosen to represent twentieth-century America, a likely candidate would be the automobile or, more precisely, the presence of a car in every household, on the average. (There are more cars than licensed drivers.) The microcomputer is certainly impressive, but every new car has at least one of these *plus* a host of other highly-developed parts. The machines that produce these cars, nearly automatically, are marvels in themselves. If engineering is science in quantity, then the automobile is an engineering masterpiece. Not only is auto-making the biggest industry in the U.S., it supports a number of other major industries, e.g., steel.

Sociologically, few things define the American culture better. One of my earliest memories from childhood was our car. I was impressed that you just got in, turned the key, *pumped* the accelerator, pulled out the *choke*, pushed a button, and it started—if the weather were not too cold—and it went nearly anywhere you wanted to go. I was told our car would go clear across the country, and when I was 10 we went! I was told a car was a precious thing (it was World War II), and I should be thankful we had one, which I was.

Today's young people see the car pretty much as a given. You turn the key and it goes; if it doesn't, you pick up the cell phone and call for another. Of course, we engineers realize there is really much more to it. There was a lot of development to get to this point, and a lot of things have to work correctly to drive down the road safely and reliably. Tales of traveling by horse and buggy seem further removed from today's life than Star Trek is in the future. Actually, this is probably correct, because it took not just one century, but more than two, to reach this point.



Steam-powered "traction engines" (tractors) such as this were available in the 1770s. (Henry Ford Museum)

The development of the modern automobile is a microcosm of the development of modern engineering. The story is recounted here, both for those young people who would like to know how we went about achieving personal land rockets that sit in massive traffic jams, and for the old-timers who long for the good-old days when cars wouldn't start in cold weather, boiled over in hot weather, and wouldn't stop in wet weather.

Origins: The 1700s

The history of the automobile can be conveniently divided into three periods: the 19th century (and earlier!) and the first and last halves of the 20th century. That break may be taken at WWII as civilian car production ceased during the war and resumed immediately afterward—pre-war models.

The first section is short. Steam-powered vehicles were demonstrated in the latter half of the 18th century, the first practical application being *traction engines* (tractors) available in the 1770s. Some steam-powered *horseless carriages* were used in the 1800s. They were large, and there were few roads adequate for them. Instead, steam was mostly applied to boats and locomotives where large size and heavy weight were partly an advantage.

Beginnings: Cars & Traffic

A major, if not overriding, factor in the advent of the automobile (literally, moving by itself) was the invention of the internal-combustion (IC) engine (as opposed to steam, where combustion takes place outside the cylinder). Electric was also a competitor, but the required batteries were expensive, short-lived, heavy, and of limited capacity. In this application, nothing could match the performance of the IC engine.



1896 Duryea: one of 13 similar cars from the first real auto factory. (Henry Ford Museum)

FORD FLATHEAD V-8

In 1932 Ford advanced from a four-cylinder engine directly to a V-8. The result established the Ford name for performance, but it was almost a disaster. Being frugal, Ford did not want to add an oil pump but wanted to stay with splash lubrication. His engineers finally persuaded him that the power achieved destroyed the engine without it. Ford was also overly optimistic as to making an integral V-8 block with the casting techniques of the day, and many defective blocks had holes welded in order to get enough engines built.

The engine clearly reflected its lineage; the two sides were nearly independent: twin water pumps had twin hoses from the radiator, which had twin return hoses from the heads. The distributor had twin caps for the two sides. The carburetor had two barrels, each pretty much feeding its side. Oddly, it had but a single exhaust, a tortuous design where the two manifolds were connected together and only one was connected to the exhaust pipe.

The Chevrolet *straight-6* was a nicer design, theoretically, being inherently balanced, whereas the V-8 was not. But this was of little consolation when one was literally *left in the dust*. Performance was especially exciting because Ford resisted changing from mechanical brakes to hydraulic. The Ford flathead V-8 was the choice of hot rodders for decades, and performance parts are still made for it today!

There is some argument, but the first car is generally credited to Benz in Germany. In 1885, he designed, as an integral unit, a 3/4 hp, 8 mph three-wheeler (it still exists) with a surprising number of features still used, including a four-stroke gasoline engine with electric ignition and a differential. The first automobile factory likely belonged to the Duryea Brothers in Massachusetts, who produced 13 similar cars in 1896.

By 1900 there were more than 100 brands. Early vehicles were mostly built one-at-a-time, sometimes entirely by the builder, and were often to a customer's specifications. This made them very expensive, but it was understood they were for the rich. As quantities increased, sections were farmed out, particularly the coachwork, which was often of parlor quality. When Ransom E. Olds suffered a fire in his factory, he contracted out nearly everything and became basically a designer/assembler. Some of Ford's early cars used almost entirely parts made by the Dodge brothers, who did not sell a car of their own—yet.

The early twentieth century was dotted with the names of pioneers, some becoming rich from cars that bore their names, some winding up broke, and several doing both: Chevrolet, Ransom E. Olds (Oldsmobile and REO), Ford, Dodge, Chrysler, Cord, Duesenberg, Firestone, Benz, Bugatti, Buick, Daimler, Renault, Packard, Studebaker, Dunlop, Michelin, Mitsubishi, Bentley, Citroen, Peugeot, Rolls, and Royce. Some attempts were made to produce an inexpensive car, notably by Olds, but it was Henry Ford who succeeded beyond anyone's imagination. He made some decisions that revolutionized the industry (although some of these were apparently accidental), and he made some bad decisions, too. He felt it wrong to charge *too much* for a car, and hit a more favorable spot on the supply/demand curve.

The product of many buyers times a low price turned out to be much more than a few buyers times a high price. Ford was also persuaded by his partner that workers should be treated and paid better.

They reduced the workday from nine hours to eight and nearly doubling the prevailing wage rate. This gave Ford the pick of the work force and worker loyalty, at least for a while. He set a speed record, 91 or 100 mph, depending on the account, personally driving a car of his own design at considerable risk. He was also responsible for the first recorded auto accident, running his first car over a pedestrian, who went on his way once the spindly car was lifted off him.

Ford's crowning achievement was the *Model T* in 1908. To achieve his goals, he had to cut costs and improve efficiency. The key was an assembly line producing identical cars in huge quantities. Ford didn't invent assembly line mass production, but he mastered it. He may have invented the moving assembly line, which produced a "steady stream of cars flowing forth" from the factory. Everything was carefully engineered to support the process. Parts suppliers, eager to be chosen for the huge quantities used, were required to ship the parts in boxes made with certain-size boards with certain-size holes drilled in specific places. These re-appeared in the cars as floorboards (hence the name). The *T* was a front-engine, rear-drive layout. It used a water-cooled four-cycle engine and would exceed 40 mph. The transmission used epicyclic (plan



1908 Model T Ford: the start of major mass production. (Henry Ford Museum)

etary) gears, which would be replaced later, only to re-appear in automatic transmissions.

But the production line had its downside. Workers, installing the same part hour after hour as the line moved faster and faster, began to envy the freedom and individuality of the farmer, even at more work for less pay. It was called *dehumanizing*, certainly true in the sense that Ford sought to eliminate human error. Ironically, the first big labor demonstration in the industry was directed at Ford, who had originally improved the worker's lot. He responded with force against the union, which quickly learned the tactic. He was ready to close his plant rather than admit a union, until his wife persuaded him otherwise.

Ford reduced the price of the Model T several times, finally down to \$260. The ubiquitous *T* sold 15,000,000 cars in 20 years, more than any other model until the Volkswagen *Beetle* broke the record in the 1990s, but only after a production run of more than half a century. In some countries, and indeed parts of the U.S.A., *Ford* became synonymous for *car*. Ford tried to enjoy the success too long. He believed that if the car did the job, there was no reason to change it. Meanwhile, other makers were offering improved models. Sloan of General Motors (GM) created the concept of regularly introducing new models, *planned obsolescence*. But Ford came up with a trick of his own. He terminated production of the Model T before the new Model A was ready! All the details of the *A* were kept secret: no specifications, no pictures, no price, nothing. (Apparently, industrial espionage was not in vogue yet.) The suspense and speculation created a new type of market. When the *A* finally appeared, it was not outstanding. Nevertheless, dealers took 400,000 orders in the first two weeks!



Willys-Overland Jeep: THE vehicle of WWII.
(Walter P. Chrysler Museum)

On the other end of the scale, many others tried their hands at making automobiles, typically after working for an established company. In engineering terms, some of these were masterpieces. There is little on today's cars

that wasn't at least tried before WWII. But economically, most firms were failures in the sense that they didn't produce a large number of cars or stay in business for a long time. In fact, a surprising number of companies never got as far as actually selling a car. The Depression eliminated many of them. The number of brands available today may be bewildering, but it is small compared to the number that no longer exist. *The Complete Encyclopedia of Motorcars* lists more than 300 makes under the letter *A* alone!

Cars quickly changed the American landscape, filling in the spaces between the towns. *Motor hotels*, later shortened to *motels* were built along the highway. Ford himself, with his friends Harvey Firestone and Thomas Edison (for whom he had worked), pioneered the motoring vacation. In 1913 the Gulf Refining Company opened the first *filling station*; previously motorists had to drive to a railroad station and fill from a tank car.

Government, rather than supporting the wonderful invention, considered it a nuisance and discouraged it with high taxes and low speed limits. Bad technical design was purposely used to avoid repressive regulations, but the concept was too powerful to kill.



CHRYSLER HEMI

To improve the breathing of the flathead design with the valves beside the cylinder, they were put above the piston, the *Over-Head Valve* (OHV), most resembling the design adopted by Cadillac in 1952. The line of valves was still parallel to the camshaft but not directly above it, actuated by pushrods and rocker arms. Better yet was to put the intake valve at the top (on a V-8) next to the intake manifold and the exhaust valve at the bottom, next to the exhaust manifold. The valve train is yet more complicated, but Chrysler used this design in its '51 V-8, dubbed the *hemi*, as the combustion chambers were nearly hemispherical. *Hemi* became synonymous for raw power. It was later discontinued and reintroduced in the '60s and discontinued again. But it is once again available for about \$17,500 (engine only).

FWD, 4WD, & AWD

Nomenclature is not completely standard, but generally FWD means Front-Wheel-Drive. Four-Wheel-Drive is best denoted 4WD and is used for a vehicle which normally runs in 2WD but is shifted to 4WD for emergency conditions. All-Wheel-Drive (AWD) is full-time 4WD. Since in a tight turn all four wheels follow a different arc, each wheel added past a unicycle requires another differential: 2WD requires one, 4WD two, and AWD three.

FORD'S SAFETY PROGRAM

In 1956 Ford made a big pitch for safety, offering seat belts (lap only) and a deep-dish steering wheel (the unyielding steering posts of the day were noted for impaling the driver in a front-end collision). Oddly, the doors on mine would fly open on a sharp corner; safety latches were introduced later. But the saying was that Ford sold safety while Chevy sold cars. It was suspected that Ford had no other choice, being unable to match Chevy's performance. It was a bad year for Ford, but the lesson was learned. Later, Ford was the most overt in support of stock-car racing with the philosophy, *Win on Sunday; Sell on Monday.*

CHEVROLET V-8

In 1952 Ford introduced its first six-cylinder since '07, creating zero excitement. Indeed, it was aimed at the slower drivers. Conversely in late '54, Chevy put its first V-8 into the Corvette and created a veritable national monument. Virtually overnight it became the hot rodder's choice. It was similar to the earlier Cadillac, but was less expensive than that or the Chrysler "hemi." When fitted with fuel injection in '57, it produced more than one horsepower-per cubic-inch and was America's best all-around performance engine.

WWII

Production of civilian cars ceased shortly after the country's entry into WWII. All industry turned to manufacturing war materiel. Even replacement parts to keep the existing cars going were sometimes unavailable. Gasoline was rationed, but if you needed extra, you just bought tickets from someone else, and the free market continued as the black market. Tires, the fastest wearing parts on the car, were nearly unavailable, but they used inner tubes, which were. If the tire were torn too badly to contain the tube, "boots" (essentially pieces of ultra-heavy tube) were available to cover the hole. The main problem was that the supply of natural rubber from the Orient had been intercepted by the Japanese. This led to the development of synthetic rubber, which turned out to be better anyway.

The best-known vehicle of WWII was the Army's *general-purpose* vehicle, abbreviated *GP*, which came to be pronounced *Jeep*, now a registered trademark. In 1939 the Army sought a lightweight, but tough, utility vehicle. The first successful models were built by Bantam, but the contract was awarded to Willys-Overland Company. With Ford also producing the vehicle under forced license, 660,000 were produced for WWII. It had four-wheel-drive (4WD), unusual back then, and was known for chewing through muck while everything else was getting stuck. Aside from the complexity of 4WD, it was simple and rugged. If the defrosters couldn't keep up with the snow, which was most of the time, you disassembled the top, folded down the windshield, and soldiered on. At one time *Jeep* was used to signify any 4WD vehicle. A notable anomaly was the ubiquitous U.S. postal jeep (neither rain, wind, nor snow, etc.), which was 2WD.

After WWII, Willys redesigned the Jeep slightly for civilian use and designated it the *CJ* for *civilian Jeep*. Willys-Overland was taken over by Kaiser in 1953 and then by American Motors Corporation (AMC) in 1970. After a model run of 33 years with minimal changes, the CJ was replaced by the *YJ*, allegedly for *yuppie Jeep*, although never officially acknowledged. AMC became dominated by Renault and then was bought entirely in 1988 by Chrysler, now part of Daimler-Chrysler. The Jeep survived all of this and is now a complete line, all 4WD.

Post WWII

At the end of WWII, the mighty wartime industry returned to manufacturing cars for the public in record numbers as fast as factories could be reconverted and scarce supplies replenished. These were bought hungrily by returning military personnel who had not been home to spend their pay and by civilians, who had not spent theirs because there were few goods to buy. Initially, the cars were the same as before the war, but the industry was already preparing for explosive growth. If the economy could produce millions of vehicles to be destroyed, why not millions for good use? In 1946 the miles of surfaced roads exceeded the unsurfaced total for the first time.

American manufacturers began making their cars look different with sheet metal, chrome, and ornaments, but underneath they were pretty much the same: water-cooled flathead V-8 or straight-6 engine, front-mounted, rear drive. Automatic transmissions were just beginning, and some were not fully automatic. Independent front suspension was beginning to replace beam axle. Rear was *solid* or live-axle with leaf springs. Although far from optimum, the combination was quite adequate, serviceable, and reliable. Options consisted of: exterior color, whitewall tires, radio (AM only), heater/defroster, and cigarette lighter. Generally not available were: power steering, power brakes, power windows/door locks, air conditioning, any safety equipment, or any sort of sound reproduction.



Old and new high-performance: famed Duesenberg "J" (origin of the expression, "It's a Doozy!") and Dodge Viper (William Pettit)

1950s: The Modern Automobile

All that changed in the 1950s. If one decade were selected out of the century as that of the automobile, it would be the fifties. By now most families again had a car; the industry set out to convince them they needed a *new* one, perhaps more than one! Each model year was *improved*, mostly restyled. Options proliferated even for the less expensive brands: a range of models within each brand, a variety of engines, standard or overdrive or automatic transmission, anti-spin differential, power accessories, air conditioning, two-tone paint, seat belts, full-wheel covers (very important), fender skirts, and *continental kits* for the spare tire. Low-profile tubeless tires were introduced, and wheel diameter was reduced to 15 inches, and then 14, to lower vehicle height. It was assumed that each year's models would be slightly bigger, heavier, better, and, of course, more expensive than the previous year's. The luxury marque would, over a few years' span, be downgraded and replaced with a new name and eventually be relegated as the economy model. Competition was fierce, but it consisted more of copying than innovating. Industrial spying was becoming big business. Although model changes had to be planned years in advance, features in one make were invariably reflected in the others. Grilles in Fords and Chevys had an uncanny resemblance. One year it was noted that the prices of the base models from the *big three* were within \$20 of each other.

I might be slightly biased, because it was the year I got my license, but 1955 seemed to be *the* outstanding year of *the* outstanding decade. Chevrolet put the first V-8 in its passenger cars, and it was overhead valve (OHV) and a potent engine. Plymouth had a V-8 for the first time. Ford had gone OHV the year before, but horsepower was up for 1955. Chrysler upped the horsepower of its hemi engine to 300 for a special new model. The *300 series* endures today. Styling completed the transition from bulbous to boxy. Chrome was an integral, or even defining, element of the styling. That great American icon, the tailfin, had spread from Cadillac to all makes, although in modest form at first. With the V-8's popularity came dual exhaust. A *beltline* chrome strip separated the body into halves for two-tone paint (or three!). The buyers loved it all; by the end of 1955 there were twice as many cars in the country as in 1945.

Another notable year was 1958, but in this case it was a bit negative. It was the year of the chrome plague: chrome bumpers were massive to the point of being blinding in bright sun, and trim strips were added anywhere there was room. It was the year of the Edsel, a word that has become a synonym for bad planning. It was the year Chevy introduced air suspension. The damping from the leafs of the leaf springs rubbing against each other was gone, the shock absorbers (dampers, really) were not stiffened accordingly (probably in deference to Americans' penchant

INTERSTATE HIGHWAY SYSTEM

In 1919 outside Washington, DC, Major Dwight D. Eisenhower joined a military convoy traveling from coast to coast to find out how long it would take to complete the trip. It took two months. But when he reached Germany in WWII, he found himself directing attacks towards Hitler's troops which were no longer there—they were miles away via the autobahn. He vowed that the U.S. would have such a system. When he was later elected president, he was able to fulfill this wish. You could then drive to most parts of the country reliably with rest stops and services available and without stoplights. The car became much more viable for long-distance travel. (See WHY I DON'T FLY, below.)

WHY I DON'T FLY

This may be a worst-case scenario. Once when I was traveling somewhere by air, I had to drive to the airport satellite parking lot, walk to a bus stop, ride to the terminal, walk to another bus stop, ride to a satellite terminal, walk to the plane, fly in a seat with less room than the smallest car, walk to the car-rental agency, walk to a car I would never buy, and drive to my destination. During this time, I carried my bags, stood in line, or just waited. Contrast: put my bags in the car of my choice and drive to my destination. Times to any place East of the Mississippi: car, one long day; air, one miserable day. (See INTERSTATE HIGHWAY SYSTEM, above.)

CHEVROLET CORVAIR

Despite protests to the contrary, the Corvair was clearly intended to be an American Volkswagen. This turned out to be a contradiction. Two cylinders were added to the engine, which meant more weight farther from the center of gravity. The fan was changed to horizontal to lower the hood profile, which meant the fan belt had to make sideways right-angle turns, giving it a good opportunity to jump off. The marginal rear suspension design (swing axle) used by VW was retained.

To reduce oversteer, the rear tires were inflated to a much higher pressure than those on the front. A major problem occurred when some shops rotated the tires from front to back without readjusting the pressure. This gave a truly unstable vehicle and was the primary cause of crashes.

Documentation revealed that GM engineers had recommended against using that axle design. Criticizing the car, Ralph Nader wrote a book entitled *Unsafe at Any Speed*. In an attempt to discredit Nader, GM responded by investigating his personal life. The ploy backfired. Nader won a lawsuit against GM and became famous, eventually becoming a candidate for U.S. president.

GM redesigned the rear suspension using Corvette parts, and the Corvair was refined to a good little car. (My aunt and uncle owned two cars, both Corvairs.) But it was more fun to yell *Unsafe!* than *Nice little car!* The brand was hounded out of existence.

for a soft, if unsafe, ride), and the rear end was noted for bobbing around. (Air was soon replaced by coil springs all around, but this had the same problem, and the uncomplimentary name *bedspring suspension* was acquired.) Chevy's body style lasted only one year. Chevy introduced a bigger optional V-8, which proved less practical and was itself replaced after seven years. (The previous *small block*, in contrast, lasted into the 90s.) Ford also introduced a new engine that was disturbingly similar to the previous trouble-prone design it replaced; it was eventually refined into Ford's legendary 427. Ford's Thunderbird became a four-passenger luxury sedan, giving up all pretense of being a sports car.



1959 Cadillac: dubbed the *Batmobile*, the fins were later declared a hazard to pedestrians. (Henry Ford Museum)

1960s: Muscles, Compacts, and Ponies

The sixties were notable for several things, not all good: Beauty may be in the eye of the beholder, but it is close to scientific truth to say that some profoundly ugly cars were made. Cadillac produced the *batmobile* series whose tailfins were so big and sharp that they were declared a hazard to pedestrians. Some Chrysler products had a fake spare tire cover on the trunk lid that was promptly named the *toilet seat*.

Enthusiasts cared less about looks—performance had become breathtaking! Performance meant engines—speed in a straight line only, please. In the decade after 1955, available horsepower doubled. To be eligible under NASCAR (National Association of Stock Car Racing) rules, a maker had to sell a certain number of cars or engines through a dealer, allegedly for use on the street. The companies quickly learned the advertising value of winning races. Ratings shot from 200 hp to 400 hp and then mysteriously stopped while development continued. What had happened was that the insurance companies were declining to insure these rockets, and they weren't selling, even at cost. At the peak, all of the big three makers had engines actually producing in excess of 600 hp on the test stand!

This was for full-sized cars, as all had been in the 50s. Within each brand in the 60s came sub-lines of different sizes. Known as *compacts*, they seemed relatively small, spartan, and underpowered. Except for their styling, compacts weren't much different from the cars of a decade or two earlier.

In between came a line imaginatively termed *intermediates*. However, some came to be fitted with engines only slightly smaller and tamer than the NASCAR-oriented engines. These came to be known as *muscle* cars and are highly prized by collectors today.

In 1962 Ford exhibited a two-passenger, mid-engine, V-6, independent-rear-suspension, sporty show car named the Mustang. It generated much interest, and Ford announced it would produce the Mustang. In 1964 the company did, but it was a four-passenger, front-engine, solid-axle car which used components from Ford's regular compact, the Falcon. However, the Mustang was cute and sold well; in fact, the Mustang gave a name to a class known as *pony cars*. The line was downgraded, but it survived, and *pony cars* became Ford's current performance line.



1964 Mustang: resemblance to show car, nearly zero, was close enough.
(Henry Ford Museum)

1970s: Backsliding

The euphoria was shattered by a series of events: First, the government imposed emission standards. High performance had been achieved partly by feeding the cylinders excess fuel to use 100% of the oxygen, considerably more than theoretically necessary. This improved horsepower, response, and cold operation at the expense of seriously increasing hydrocarbons and carbon monoxide. These had to go, so mixtures were leaned, and the old bugaboos returned. Unleaded gasoline was mandated—lead fouled the necessary catalytic converters. Octane ratings dropped, necessitating lower compression ratios. The method of rating octane was changed, making the numbers look even worse than they were. The converters contained platinum and hence were expensive, so dual exhaust disappeared.

Second, a more realistic method of rating horsepower was adopted. Originally engines were tested with everything possible removed—no water pump, generator, air cleaner, or exhaust system. The new system required the engine to be in *street* configuration. Net output was measured rather than gross; ratings suddenly dropped by about a third.

Lastly, the Organization of Petroleum Exporting Countries (OPEC) oil embargo hit in 1973. Gasoline was scarce, and many companies stopped producing *high-test* altogether. Also, the government mandated the posting of fuel-economy figures on new cars, and buyers paid attention.

All of these factors conspired against the engine, and the seventies were known for poor-performance cars. The suddenness of the change, combined with the de-ratings, made the decade seem worse than it was. There was a general consensus (fortunately incorrect) that high-performance was gone for good.

WHEEL TUCK

When a vehicle with swing axles flies upward from a bump, the wheels drop with high positive camber. If this happens on a curve, the side force can keep the outside wheel down in the *tucked* position, riding on the sidewall. There is little traction, and the vehicle goes out of control.

CHEVROLET SEMI-HEMI ENGINE

When Chrysler revived its famed *hemi* design to dominate the Ford and Chevy *wedge-head* designs, Chevy responded with a compromise design. Rather than being side-by-side, as was standard, or at top and bottom, as with the *hemi*, valves were roughly at 45 degrees, which was dubbed the *semi-hemi*. The engine produced high horsepower. The current engines are 454 or 501 cu. in. I have one in my boat, 395 hp.

A few 427s were cast in aluminum for race cars, and these were highly prized. A local race shop reportedly secured its engine with a chain through one cylinder and an eye bolt cast into a concrete floor.



MADE IN JAPAN

Two men were responsible for the success of Japanese cars in America.

Soichiro Honda ignored the government of Japan when it advised automakers not to try to sell cars in the U.S. Honda had risen from the factory floor to head his own company, and he was a competent and demanding individual.

W. Edwards Deming, an American, became known as the “prophet of quality.” He insisted that quality would cut cost, not increase it. His warnings fell on deaf ears among U.S. automakers, but the Japanese listened.

At a time when American manufacturers considered 10 defects in a car acceptable, Japan was demanding less than one on the average, i.e., some cars were perfect. The implication of “Made in Japan” quickly went from junk to quality.

Notes:

This article was written principally from the author’s memory with the information checked and filled in from the references listed. The author thanks William Pettit, owner of the former Museum of Motoring Memories, Natural Bridge, VA, for proofreading.

A future article will detail some of the high (and, unfortunately, low) points of the modern automobile, as drawn from the author’s personal experience.

1980s: Fight for Survival

By the eighties all American automakers were in trouble, losing billions of dollars per year. The dinosaurs (as George Romney, AMC president, had referred to them) were having trouble adapting to cosmic changes. They believed (correctly) that by-and-large Americans preferred American cars, but they mis-guessed how much the buyers would put up with before they switched. Japan became the world’s No. 1 automaker in 1980, eventually capturing 28% of the U.S. market. Chrysler convinced the government to guarantee a billion-dollar loan to modernize in order to survive.



427 Shelby-Ford-AC Cobra: a living legend. There are many more clones than originals. (Auburn-Cord-Duesenberg Museum)

Throughout the seventies American manufacturers begrudgingly introduced subcompacts. (Smaller cars returned smaller profits.) They also made alliances with foreign manufacturers, sometimes selling a purely foreign car under an American name. As the economy worsened, small cars came to account for the majority of sales.

In 1985, Ford boldly invested heavily in an all-new FWD aerodynamic model—the Taurus. It certainly looked different, eliciting such comments as “a basket of Easter eggs” and “another Edsel.” But Ford stood by it, fixed some problems, and maintained quality. Taurus/Sable became its mainstay.

GM gradually undertook to beat the Japanese at their own game—build a better car for a lower price—and with the help of tariffs, import quotas, and changing exchange rates, succeeded to a certain extent. Some parties, both labor and management, clearly would have preferred a law requiring Americans to *buy American*, but the government wasn’t willing to go that far.

1990s: The Resurgence of the Automobile

With the economy strong once again, the price of gasoline stabilized, and a number of significant technological advances coming on line, designing, selling, and driving cars once again became fun. Manufacturers stopped complaining about emission standards and bragged that they could exceed them. Computer-controlled, sequential-port electronic fuel injection (EFI) gave not only lower emissions, but also better performance. Closed-loop feedback systems measured combustion and exhaust and adjusted the engine parameters for optimal operation, even for sub-optimal components on the input side. Detroit decided that it could afford disc brakes and independent suspension for the rear, too, after seeing them on imports for decades. Virtually everything designed for home



Dodge Viper prototype: the production car was as similar as the law would allow. (Walter P. Chrysler Museum)

audio was so miniaturized and rugged that it could be readily adapted for a car. Makers could no longer afford *not* to have the automatic transmission controlled by an electronic computer, rather than remain mechanical. Performance began to match that of the old muscle cars, while meeting emission standards, getting reasonable gas mileage, and retaining all safety and comfort features. In addition, a number of specialty *supercars* became available—200 mph cars that met federal standards.

2000 and Beyond

Historically, exciting predictions of the future have mostly been wrong. The best bet is the status quo. Breakthroughs are always possible, but one should not count on them, much less schedule them. One manufacturer speaks of the air being cleaner *after* its car has passed through; imagine being urged to drive because the air was dirty! (A similar situation does occur with river water intake compared to sewage water output in some cities.) We do have some potentially limitless energy sources: the sun, if we can invent a cheap, efficient way of harnessing its radiation, preferably directly as electricity; nuclear fusion, which needs a technological breakthrough; and nuclear fission, where the problems are political, not technical. Then we can use electric cars, that is, if we can get a battery breakthrough. Or we can dissociate water into hydrogen and oxygen so we can have a more powerful IC engine whose emissions are harmless, if we can figure out a practical storage system for the gases.

As one wag puts it, "The electric car is the car of the future and has been for 100 years." The internal combustion engine will probably be around in some form for a while, continually improving. Historically, again, most predicted barriers have since been broken. We have already reached the point where replacing an existing car with a new one is negative progress because the pollution incurred in manufacturing all the necessary materials is more than the old car will emit. Furthermore, the expense could have been directed to something that actually would reduce pollution (the exclusion principle, too often ignored). It appears that the future of the IC automobile may be decided not by engineering, nor even economics, but by politics. Often in the past, lawmakers have tried to set aside the laws of nature, with disastrous results, and it will no doubt happen again.

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