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UNSAFE AT ANY SPEED?

The truth about Chevrolet's controversial Corvai

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American revolution A proud Ed Cole, Chevrolet's general manager, shows off the rear-mounted air-cooled engine of the groundbreaking Corvair. Turn to page 44 for the full story of Cole's controversial creation

CORVAIR

Class & Controversy

Although 1.7 million were produced in its 10-year lifetime, the Chevrolet Corvair is sometimes labelled a loser. Few of its enthusiastic owners would support that assessment of the most radical model ever made by General Motors, says **Karl Ludvigsen**
Photographs by **Stefan Marjoram**


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Introduced in 1959 as a 1960 model, the Corvair was referred to as the 'Chevy-VW' by Chevrolet insiders during its development. The association with the Volkswagen was often made in a critical way by industry observers, who were quick to draw the conclusion that the Corvair was rear-engined and air-cooled because that was the combination that had helped VW sales to soar over the 100,000 mark in 1958 and 1959.

Some industry watchers, especially in Europe, even spread the story that the Corvair had actually been designed by the Porsche organisation under contract to Chevrolet. Ferdinand Porsche, of course, had designed the original Volkswagen, but the Porsche firm did not consult or advise on any aspect of the Corvair's design. At the time Chevrolet had more than 2000 engineers and was quite capable of handling the job. Ferry Porsche himself was interested in the Corvair, of course, and through Huschke von Hanstein arranged to buy one of the first off the line.

It can also be shown that the VW could have had very little effect on Chevrolet's manner of engineering the Corvair, even though, as we shall see, Porsche chassis platforms were used as mules during development. In 1956, when a running prototype had been built and styling work had already begun, VW registrations in the US were still at the relatively low level of 55,690. They had risen spectacularly from only 8895 in 1954, to be sure, but this served more to confirm Chevrolet chief engineer Ed Cole's conviction that there was a growing market for smaller cars than it did to tell him how to design his dream. When the Corvair finally appeared, VWs were registered at a rate of 150,601 in 1959, which was what made the American newcomer look to many like a copycat.

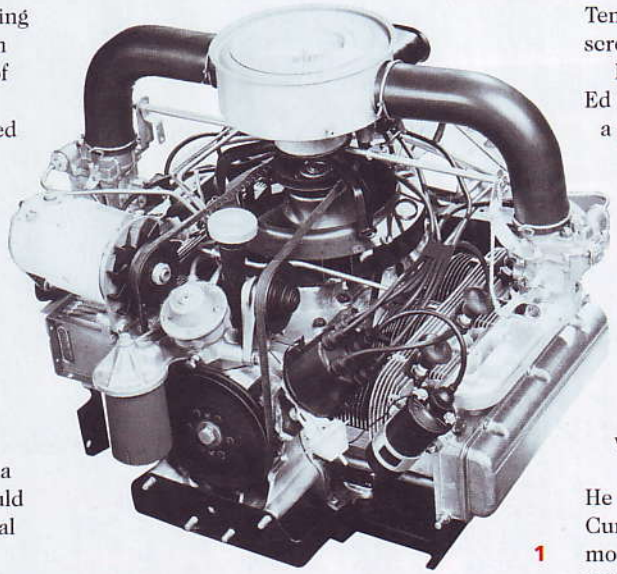
Ed Cole also saw from Volkswagen's example that the people who were buying imported cars were interested in unusual engineering as well as small size. If he built a car that was different, Cole reasoned, it would appeal to them while being less likely to steal sales away from GM's big cars – the main concern of many top executives. And Cole's Corvair was certainly different.

Before Corvair, Edward Nicholas Cole was general manager of Cadillac's tank plant in Cleveland. After Corvair, he was no less than president of the mighty General Motors Corporation. Others invested more detail engineering in the Corvair than Ed Cole did, but he is on record as the car's creator. Cole conceived this small car in its main outline and successfully sold it to General Motors management. The conception took place while he was Chevy's chief engineer and the go-ahead was given after he had moved to general managership of the Chevrolet Division.

A Michigan boy, Cole had attracted Cadillac's attention while still a student at the General Motors Institute in Flint. In 1933 he was working full time as a Cadillac engineer, mainly on engine design. When in charge of Cadillac's Cleveland tank plant in 1950, he arranged for a room at the Lakeshore Hotel to be equipped for engineering work. There, with associates Harry Barr and Kai Hansen, who were later to join him at Chevrolet, Cole spent many of his off-duty hours at the drawing board, sketching ideas for the first real postwar automobiles, as opposed to the warmed-up 1930s models that had filled the gap.

Engines of these cars kept moving to the rear. Early in his career Cole had driven the rear-engined British Burney that had been demonstrated in Detroit. He had also seen Bill Stout's work on the Scarab. In the 1940s the existence of the Tucker was a powerful demonstration that a large car with a flat-six engine in the rear could work. More significant was the experience Cole himself had had with an experimental car built in 1946 at Cadillac, a fastback Pontiac coupé with a Cadillac V8 where the back seat was, driving a de Dion rear axle through a bus-like vee-drive. Cole drove this car, with dual rear tyres at each side to handle its weight, through most of a blustery, snowy Detroit winter.

Air-cooling also kept showing up on Cole's drawing board. The tank he worked on at Cleveland had a Continental flat-six engine. It was air-cooled, like the smaller Continental flat-six that powered the Bonanza light plane he was flying privately at that time. These



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experiences convinced Cole and his associates that air-cooling could be right for a car engine that had to be simple, dependable and light in weight while doing a heavy-duty job.

In May of 1952 Ed Cole was picked to go to Chevy as chief engineer to enliven its stodgy product line. One of his first moves was the establishment of a research and development department in the hands of Englishman Maurice Olley, an inquisitive engineer who had worked with Earle MacPherson on GM's postwar Cadet small-car project. Olley brought with him one of the industry's most complete portfolios on the possibilities of small-car design.

Cole focussed his R&D team on integral structures and special tyre design at first. Weight was going to be crucial, he could see; in 1954 he was already negotiating for a quantity supply of the aluminium he was sure to need. By 1955 a proposed design for the small car was well advanced. In the spring of 1957, at Chevy's freshly-minted Engineering Centre, the first complete drive train was installed in a reworked Porsche Type 356 body/chassis. Eager as a kid, Ed Cole hopped in and belted away. After a high-speed session on the local roads he returned and said with a grin, "This is it!"

Made general manager of Chevrolet in July, 1956, Cole could move faster. In two Porsches and several Vauxhalls the experimental engine/drive assemblies were already being road-tested. At his request, GM chief stylist Harley Earl set aside a corner of Bob McLean's semi-secret Research Studio for the first trials of styles in scale-model form in August, 1956. After an interior package was worked out on a 102-inch wheelbase, the project moved to full-scale in the Advanced Studio in charge of Ned Nickels.

Chevy engineers had already made a complete prototype with a body of their own creation. Early in 1957 casts were taken at different times of different parts of the fast-changing shape of the clay model, to be used for the first Fisher-built car. The outcome was a mongrel in looks but the engineers cared little as long as they could drive it. This and other early cars had fake grilles. To heighten the illusion, a car for testing in the Kentucky-Tennessee area was even equipped with a bug screen in front of the fake grille...

By the first week of September, 1957, Ed Cole had an advanced styling model and a prototype that ran pretty well. He now had a selling job to do. His target was Harlow Curtice, president of GM, an ace salesman himself and the last of the one-man rulers of General Motors. Curtice had certain ideas about cars. One was that they should be as large as possible. Another was that the engine should be in front and there should be a high, pointed bulge in the bonnet line that would clearly show it was underneath. Curtice would be no pushover for Cole's Corvair.

Ed Cole had, as usual, done his homework. He was able to field most of the questions Curtice posed while they walked round a clay model of the Corvair-to-be. He already had firm cost data that showed the car could be low in price. Then Cole asked Curtice to take a spin with him in the prototype. After that the chief executive was grudgingly approving: "I think you've got something there, Ed."

With Curtice's tentative okay, Cole wrote a memo to top GM officials on 9th September, 1957, confirming that Chevrolet would handle the design, development, styling, testing and manufacturing process planning for the 'Holden 25'. It didn't indicate that Chevy would also manufacture the car, nor could it at this stage. Holden, GM's compact Australian marque, gave cover to the Corvair project. To enhance the deception, GM's Overseas Operations Division issued orders to Chevrolet for the new car. In November, 1957, it even wired Chevy

1 The Corvair's revolutionary air-cooled aluminium flat-six was unlike anything seen in contemporary mainstream American cars

"It was among the most influential and original styling statements of the postwar era"

about it from Australia, urging that it be given 'top priority'.

Once Harlow 'Red' Curtice decided he wanted something, he wanted it right away. In October two more 'Holden' prototypes were approved. In December and then in January two final hurdles were vaulted as the new car was approved by GM's powerful Engineering Policy Group and then by the board of directors, which unlocked the coffers of cash for production and assigned the job to Chevrolet. Ground was broken in July of 1958 for a completely new plant at Willow Run, Michigan, to produce the small Chevy.

The Corvair's shape was well-defined by early 1958, when it got the green light. As completed, the Corvair's styling was acknowledged the world over as masterful. It is among the most influential and original styling statements of the postwar era. Some of the first attempts, carrying the La Salle code name, were awful – contorted big-car shapes compressed onto the Corvair's smaller armature. Gradually, out of a welter of bulbosities, a clear, slim shape emerged.

The idea of a sharp, raised 'bone line' encircling the body was controversial, defended by the designers as an enhancement of the light look they sought. The line was gradually raised as the shape was developed and given a downward dip at the front of the car to solve one of the Corvair's most frustrating styling problems: its lack of a 'face'. The Nickels/Earl/Mitchell shape of the first production Corvair inspired many manufacturers abroad to emulation and outright copying. Among the most blatant examples were the Simca 1000, Hillman Imp, Fiat 1300/1500 and NSU Prinz.

Cole's compact was going to be complicated. An air-cooled engine and independent rear suspension were not going to be cheap to build. This made it imperative to get as much cost out of the body as possible. Cost, to the body designer, is weight. Drawing on GM's experience with designs for its overseas affiliates, Chevy and Fisher Body planned an integral structure with major sub-frames at the front and rear to carry the suspension. They came very close to their weight targets, paring 610 pounds from the chassis/body weight of the full-sized Chevrolet.

A stiffness target of 6000 pounds feet per degree in torsion was established for the body structure, met easily by the first test vehicle on a 102-inch wheelbase and also by its 108-inch successor, stretched to gain more front-seat leg room. Stiffness in torsion of the final production prototype was 6682 pounds feet per degree.

Cradled within the rear sub-frame was Ed Cole's creation, the Corvair's flat-six engine. Inevitably, it was complex, with two heads, six separate cylinder barrels and two crankcase halves. In its final form it was heavier, more complicated and more expensive than Cole had intended, perhaps more so than he had assured Curtice it would be.

The choice of a flat-six engine was unusual in those days, long before Porsche's 911. Few had been designed specifically for cars. One was an experimental Mercedes engine of the mid-'30s. Another was the original Tucker six. The flat-six was much more typically an aircraft engine. Franklins, Continentals and Lycomings in this format were common, like the one in Cole's Bonanza. Examination of these shows that the crankshaft can be very light and simple, with four main bearings and no counterweights, and also that the camshaft can get by with nine lobes instead of 12, with the exhaust lobes doing double duty.

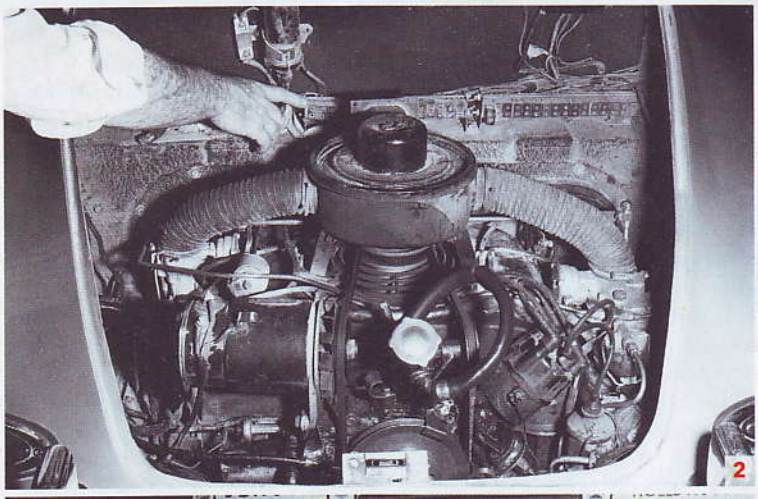
With decades of experience behind it, Chevrolet was expert at estimating the likely weight of a new car or engine. Yet it was well off the mark with the Corvair six. The target weight had been 288 pounds but the actual weight of a 1960 Corvair engine was 366 pounds. No other part of the car was overweight by so great a percentage of error. This gap between hope and reality was widened by cost considerations, adding 78 pounds or 3.5 per cent to the total weight of the car where it could do the most harm – well behind the rear axle.

Cole had bet his weight estimate on a production *tour de force*, an engine formed of two main symmetrical aluminium die castings, each comprising half a crankcase, finned cylinder barrels and integral heads. When this proved too advanced for the state of the manufacturing art, the next option was a layout like that on the aircraft engines: individual cylinders with integral heads of aluminium, bolted to the crankcase. This too was a step too far for GM in the late 1950s. Each step of design evolution led farther away from the unique engine Cole hoped to build, adding a few more pounds.

The design by Adelbert 'Al' Kolbe that remained could hardly avoid looking like a cross-section of a Volkswagen engine. The rectilinear split crankcase with its flared bottom had more of an aircraft flavour, however. And it was cast in aluminium rather than the much lighter magnesium preferred by the German firm. Instrumented tests of Porsche and other air-cooled engines provided useful data. Single-cylinder test engines yielded information on chamber shapes and air-cooling effects. Finally, complete six-cylinder test engines were made for durability tests.

Novel air-cooling problems were posed by the Corvair engine's configuration. Abnormally large spacing between the valves was needed to provide enough cooling airflow past the seats. The valves themselves couldn't be large, but they were big enough for the performance Cole asked of his flat-six. At the back of the engine Kolbe added a casting carrying oil pump, distributor and fuel pump, driven from a conical cam on the crankshaft.

A pulley powered one of the Corvair's most controversial features, its fan belt bent over two pulleys, one driving the dynamo. This twisted the belt four times and bent it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through 540 degrees instead of the normal 360. Chevy engineers were certain it was sound, however, and chose it over bevel gears, chains or belts in series. Five years later the same belt system was adopted by one of the world's most fastidious car makers, Peugeot, for its 204 – driving a radiator fan, to be sure, not a cooling blower.

For his radical new car Ed Cole had the same vision of the ideal as other rear-engine experimenters such as John Tjaarda and Preston Tucker: a completely automatic car. He hoped it could be engineered so only one transmission would be offered – fully automatic. Designs for a suitable transaxle were already available, developed by GM's engineering staff from Powerglide components for a rear transaxle to suit front-engined cars. With the addition of a driveshaft through a hollow, quill-type mainshaft, these designs were adapted to the Corvair's needs.

As other costs rose, especially that of the engine, the automatic box as standard equipment looked less and less likely. It faded even faster when GM learned that Ford and Chrysler were playing catch-up with their own small cars, which were also expected on the market for the 1960 model year. A less costly manual box was made from pieces of the standard Chevy three-speed transmission, arranged inside a special aluminium case. Again a quill-type mainshaft was used, which allowed the Corvair to have direct drive in top, unlike the VW. The adoption of a floor shift for this Chevy was, at the time, highly controversial.

The weight distribution of the 'Holden 25' was no less controversial. Its targeted kerb weight had been 2201 pounds. The actual weight came to 2382 pounds. Of the difference, an 88-pound increase was distributed throughout the body. There were minor reductions, but then came the major 105-pound increase over budget accounted for by the engine and rear suspension, This took the weight on the rear wheels from the planned 60 per cent of the total to 61.5 per cent – not a desirable direction. Later, to get more luggage room, Chevy moved the spare tyre to the engine room, which brought the rearward percentage to 63 on most Corvairs.

Chevy engineers brought up the heavy artillery when the Corvair was introduced, and later when it was challenged in court, to show that they had every reason in the world to put the weight where they did. It helped rear-wheel traction, it aided forward weight transfer on braking and it reduced the difference between the distribution empty and laden. But it did expose the engineers to some challenging handling problems.

The design of the Corvair's suspension was supervised by Robert Schilling, an extremely original and able German-born engineer. The detail work he provided was excellent. The coil-spring front end was light and simple, with an unusually compact steering box placed ahead of the front wheels. Semi-trailing rear swing axles pivoted around an axis of 37 degrees to the car centreline, the same angle as on the Fiat 600's very similar suspension. Careful design allowed Chevy to one-up Fiat by omitting an outboard universal joint for the exposed half-shaft.

Steering linkage and rear suspension geometry were laid out to give the Corvair an initial understeering feel. But the high roll centre at the rear, 13.6 inches, worked in the opposite direction, as did the high rear spring rates, 550 pounds per inch, needed to support the back of the car. These two combined to give final oversteer, the onset of which was at cornering speeds towards the lower levels of those then obtainable on production cars.

If Schilling had been asked to, he could have done better. In his superb chassis design for the original turbine-powered Firebird of 1953, he used single-leaf springs to carry a de Dion rear axle. He joined the rear ends of the springs together by a transverse balance beam pivoted at the centre of the chassis. This decoupled the rear suspension in roll and transferred more of the roll couple to the front wheels, reducing any tendency towards oversteer. Schilling provided a front anti-roll bar for the Corvair, which was deleted at the last minute to reduce cost.

That was the status at the outset. For the 1962 model year Chevy introduced RPO 696, which offered even stiffer front and rear springs, shorter rear-axle limit straps and the front anti-roll bar. This made the Corvair appreciably easier to drive near its limit. For 1964 all Corvairs were given a transverse leaf spring at the rear, which took more of the jounce loads so the main springs could be softer. This increased the car's cornering capability to 0.7g from what Chevrolet said had been 0.6g and what other tests had shown

could be as low as 0.53g. Further improvement came in the 1965 model with its Corvette-type rear suspension giving a lower rear roll centre.

Back in 1959, however, faced with severe cost restraints, Chevy had to make some hard decisions. On 21st January of that year it established the front/rear tyre pressures of 15/26 psi which, Chevy later said, 'promote vehicle stability by introducing proper steer characteristics, under all road conditions'. It was an inelegant solution to a difficult problem, exacerbated by the American driver's congenital lack of interest in tyre pressures.

Also important was the design of special tyres for the Corvair. A low-profile section was chosen for the 6.50 by 13 tyre, which was mounted on a 5.5-inch rim, half an inch wider then than the standard Chevy rim, to give the tyre additional cornering power. Twelve-inch tyres and wheels had been part of the programme in the beginning, to the horror of the stylists. Ed Cole personally made the decision to go to 13 inches, a size for which tyres were more readily available.

One of the least happy compromises on the Corvair involved its steering. Schilling's recirculating-ball setup was good, with an 18 to one ratio, but its linkage was such that five turns were needed from lock to lock. The steering was pleasingly light and painfully slow. Chevrolet evidently felt that as long as it was slow, drivers would be less likely to turn the wheel fast enough to get themselves into trouble. But once in trouble, with the standard steering it was almost impossible to get out.

So much money had gone into the Corvair's chassis that the interiors had to be stark indeed to get the cost of the coupé, introduced in early 1960, down to $1955. Items such as arm rests and a right-hand sun visor were extra-cost options. In the early weeks they weren't even available. The base Corvair was a very plain Jane next to Ford's Falcon and the late-arriving Plymouth Valiant from Chrysler.

Teething troubles included the special fuel-distributing cluster in the Rochester single-barrel carburetter, one per bank, which was prone to icing that first winter. A valve was added to draw warm air into the inlet when needed. Fuel consumption was disappointing to some buyers, ranging from 19 to 23 miles per gallon. Then there were the fan-belt rumours, and most were exactly that, but some were based on actual breakages and thrown belts.

These faults were gradually cured. But at the time they seemed to pose such a threat to this new car's reputation that there was doubt in Motor City boardrooms that the Corvair would last out the year. Only half a year after its introduction GM began designing the Chevy II, a Falcon look-alike that was planned to take over the compact market after Cole's car failed.

The good news was that the deluxe Monza version of the Corvair coupé caught on, after the display of an experimental version at the Chicago show early in 1960. The bucket-seated Monza played a big part in inspiring later specialist cars from GM and other makers, including the Ford Mustang that was to contribute so much to the Corvair's sales decline after 1965.

Chevy tried two approaches to a station wagon version of the Corvair. One, Volkswagen Type 2-like, was the Greenbrier, which came on the market in 1961. Even more than the Corvair car, however, it took a licking on price from Ford's Econoline version of the Falcon. Another effort was the Lakewood station wagon, which lived for only a year and a half, 1961 and the first part of the 1962 model year, when it was dropped to make room for more Chevy IIs on the assembly line at Willow Run, a sad fate for a sound and useful little car.

The Lakewood's loss was more than counterbalanced for most Corvair fans by the addition of a convertible to the line in

2 Prototype running gear was tested using a modified Porsche 356

3 Early prototypes were fitted with fake front grilles and badged as Holdens

4 A Corvair on display at the 1959 London Motor Show. UK sales were negligible

5 The author with a Corvair Monza in 1962 whilst working at General Motors

6 Cost-cutting meant early Corvairs were relatively Spartan, but passenger space and comfort were class-leading and the styling clean, if stark

7 The 2296cc flat-six is a neat fit in the tail

8 Only early cars, like this 1960 model year example, had the spare wheel in the boot

9 The instrumentation is basic but user-friendly, and the dashboard is understated by 1959 standards

10 On the road, the Corvair is sure-footed and easy to drive. The belt-line chrome signifies a top specification 700 model

April, 1962. Along with it came the Spyder option, deriving its name and style from several experimental cars by GM Styling. The highlight of the Spyder's specification was its turbocharged engine, producing 150bhp at 4400rpm. Peak torque of 210lb ft came at relatively high speed, 3200 to 3400rpm.

In 1961 a bore increase from 3⅜ to 3⅞₁₆ inches brought the engine's displacement up from 2296 to 2375cc. A lengthened stroke came along in 1964, producing 2683cc with an increase from 2.60 to 2.94 inches. A most welcome option in 1965 was a new cylinder head with larger valves and ports, fed by redesigned manifolds carrying four downdraught carburetters, joined by a progressive-action linkage. This was the best all-round Corvair engine, producing a usable 140 horsepower. The option was dropped for the 1967 model year, then brought back by popular demand.

Both Bertone and Pininfarina failed to outdo the men of Styling Staff with their versions of the Corvair. How, then, were the GM stylists to top their own achievement? What would the restyled 1965 Corvair look like? Attempting to outdate a classic took a lot of nerve. Many approaches were tried; for a while a leading candidate was a look of prominent wheelhouse bulges, as on Oldsmobile's first Toronado. Finally, the stylists led by Ron Hill swayed towards a 'pretty' look better integrated into the Chevrolet car family.

The new 1965 Corvair was the best ever, in handling, performance and looks that were pleasant if not memorable. But it was already doomed, infected by its makers with a terminal disease. New men were now at Chevy's controls, men to whom the Corvair was just another car and not a very profitable one at that, with its costly engine and those liability actions that were starting up over the earlier models. The Mustang showed the way to go, so work was begun on the Camaro.

Word came down in April of 1965, before that fellow Nader even finished writing his book: 'No more development on the Corvair. Do just enough to keep it up with the safety standards.'

The last Corvair, an Olympic Gold coupé, was completed at 1:30pm on 14th May, 1969. Like its 1969 sisters it was sold complete with a certificate good for $150 against the purchase of a new 1973 Chevrolet. The surviving cars remain in demand among collectors well supported by CORSA, the Corvair Society of America.

Total Corvair production came to 1,710,018 units, a volume which many car builders in Europe would consider a good 10 years' work. It was a brave car, a unique individual in a world of lookalikes. Far from dull, the Corvair was that rare achievement, a unique automobile. There had never been one quite like it before. And there probably never will be again. ■

UNSAFE AT ANY SPEED?

Through the distorted lens of history it is easy to see why so many people conflate the publication of *Unsafe at any Speed* with the death of the Corvair, but the truth is not quite so simple.

When the 31-year-old Ralph Nader published his incendiary polemic on safety standards in American automobiles in 1965, the Corvair's handling characteristics had already been questioned in several American courts after a slew of single-car accidents, the most famous being the case of Rose Pierini of California, who lost an arm after her Corvair overturned. General Motors settled the case for a five-figure sum – an admission, claimed Nader in his book, of the company's liability. Nevertheless, there was no general feeling with either the public or the road testers that the Corvair was anything other than perfectly safe, albeit with handling more akin to European cars than American ones.

It is likely that this would have remained the case even after Nader's book was published, except that GM, in a misguided attempt to learn more about the young Connecticut attorney, hired a team of private investigators to delve into his personal life, follow and, ultimately, harass him. When the subterfuge was discovered, Nader sued and GM settled the case with a $425,000 payout. Suddenly, everybody knew his name and sales of his book soared. GM's dirty tricks had backfired, catapulting *Unsafe* into the bestseller lists and tarnishing the Corvair's reputation forever.

Unsafe at any Speed, although now synonymous with the Corvair, has not one but many targets, the Chevrolet only bearing the brunt of a particularly damning first chapter, before Nader turns his attention to the far more widespread low standards of consumer safety throughout American industry. Far from killing the Corvair, the book's success actually prolonged its lifespan: GM management were desperate to save face, and rather than quietly dropping the model in the wake of the controversy, it deliberately kept production going longer than had been planned, lest anyone think the mighty corporation could be coerced by an upstart attorney.

Investigations both in and out of court into the Corvair's supposed stability issues culminated in 1972, when a government-backed committee essentially discredited much of what Nader had written as biased and fanciful, and declared that the Corvair's handling 'does not result in abnormal potential for loss of control'.