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CHEVY'S 2020 C8 SETS NEW STANDARDS ON THE STREET AND RACETRACK

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CONSIDERING THE ALTERNATIVES

Prototypes featuring a variety of engine types and placements helped lay the groundwork for the bold, new C8 Corvette

| BY **GARY WITZENBURG** | PHOTOS **COURTESY GM** |

For nearly seven decades, Chevrolet's iconic two-seat sports car carried its engine up front and its drive wheels out back for several very good reasons—namely, component packaging, cost, complexity, cooling, and cargo capacity. The configuration served the car's legions of dedicated fans, owners, and drivers well during that span, but by its sixth generation, the Corvette was pushing the limits of its conventional powertrain layout.

Both former Corvette Chief Engineer Tom Wallace and his eventual replacement, Tadge Juechter, wanted to build the seventh-generation on a mid-engine (ME) platform. But then GM went bankrupt. Wallace took early retirement, and Juechter barely saved both the car and its Bowling Green, Kentucky, plant as a government task force dictated which brands, models, and facilities were worth preserving. When the all-new C7 bowed to widespread acclaim 2014, an engine located behind the driver was not part of the package.

But the mid-engine fire still burned, and the tools to build such a car were readily at hand. ME drawings made prior to the bankruptcy and a hot-looking full-size model or two had been carefully preserved at GM Design, and the corporation's new leadership—primarily CEO Mary Barra and product executive VP (now Global President) Mark Reuss—jumped onboard. Propelled by the full backing of the GM brass, Juechter and company got to work.

The culmination of their efforts should be hitting the streets around the time you read this, in the form of the 2020 C8. But the long path to the first ME Corvette is littered with interesting alternative powertrains that never saw the light of day—not just mid-mounted engines, but also six-cylinders, Wankel rotaries, and a rear-engine design a la the Porsche 911—dating back to the early Duntov era in Corvette's first decade.

"Downsizing Mania"

As we know, Chevy's old 150-hp, 235-cubic-inch six was Corvette's only engine for its first two years, and was then carried on (with five more horses) for one more year after the 195-hp, 265-ci V-8 became a coveted option for 1955. But from '66 on, all production Corvettes have been powered by V-8s, most direct descendants of that first remarkable Chevy small-block, the rest more muscular 396-, 427- and 454-cid "big-blocks."

Yet there were times when Corvair-based flat sixes and (later) corporate V-6s were seriously proposed as standard Corvette power. Way back in 1959-60, when Corvette was still selling fewer than 10,000 units a year, a series of Larry Shinoda–designed rear- and mid-engine renderings and full-size Corvair-based models were explored as potential future Corvettes. Some were designed around the Corvair's flat six, while others had "blisters" on their rear decks to accommodate a taller V-8. These sketches and clay explorations didn't look bad, but they were no competition for then-Design VP Bill Mitchell's stunning 1960 Sting Ray racer, which would evolve into the '63 C2 Stingray.

(Clockwise from top left) CERV I, CERV II, XP-897, and Stingray III illustrate the evolution of mid-engine Corvette prototypes over a nearly 30-year period. Though the cars would gradually become less radical and more driver-friendly during that span, none were deemed suitable for mass production.

Suddenly, no one at GM wanted to build a six-cylinder Corvette.

Years later, when 1973 and 1979 fuel shortages shocked America into temporarily downsizing into small cars and smaller engines, V-6s were seriously proposed for future Corvettes. "For a time, even Corvette was pulled into this downsizing mania," wrote Dave McLellan, Corvette's second chief engineer, in his 2002 book, *Corvette from the Inside*. "Jerry Palmer had his designers and studio engineers resize the Four-Rotor Corvette [more on that later] around the corporation's new 2.8-liter, 60-degree V-6…Up to this point, we had avoided studying a V-6 front-engine Corvette, even though influential members of top management considered the V-8 socially irresponsible…Corvette engineering rejected the mid-engine V-6 proposal on performance grounds. Chevrolet management rejected the mid-engine V-6 because there was still no clamor for a mid-engine Corvette among the owner group. Absolutely nobody was asking for a V-6 Corvette."

Then, in 1985, a Buick-based, turbocharged, 90-degree V-6 was proposed and tested. "But we rejected [it], and so did the car," McLellan wrote. "The engine caused problems in the driveline and rear suspension, and made the car buzz and the mirrors shake. This unbalanced V-6…was totally unacceptable when mounted in the Corvette, which had never been designed for such an engine."

Still, one of the two Corvette GTP prototype race cars built for 1985 IMSA (International Motor Sports Association) competition was motivated by a high-power turbocharged V-6 (the other used a racing small-block V-8). And a dozen years later, the svelte 1997 Stingray III concept car designed by GM's Newbury Park, California, Advanced Concept Center was V-6–powered.

A Hard Look at Rotaries

While then-Chevrolet GM John DeLorean liked Zora Duntov's great-looking 1969-70 ME Corvette proposals, he couldn't sell them to corporate financial types, who foresaw higher prices leading to fewer sales. And at about that same time, GM President (and former Chevrolet Chief Engineer and GM) Ed Cole fell in love with the Wankel rotary engine. It was small, light, smooth, high-revving, and powerful for its size. Maybe it could eventually replace bigger, heavier, much more complex piston engines, including the now-legendary small-block V-8 that Cole himself was credited with designing.

But the Wankel rotary had one critical flaw: The seals at the tips of its rotors were so unreliable and short-lived that they allowed unburned gasoline, lubricating oil, and exhaust gas to slip by, which killed both fuel economy and emissions while quickly depleting the engine's oil supply. Even assuming that those seals would be frequently replaced (which required an engine tear-down), the Wankel was far from ready for volume production. Yet ace engineer Cole believed that if anyone could solve that rotor-seal problem, it would be General Motors. And so, in late 1971, he told

(Clockwise from top left) Appellation notwithstanding, GS-II(b) was not a Duntov creation. XP-819 actually used a rear-engine layout, and its handling suffered as a result. The original Astro was far more radical than its successor. Astro II, meanwhile, was developed with an eye towards production.

Duntov that he would approve an ME Corvette, but only if it was rotary powered.

But while the compact Wankel would perhaps eventually be perfect for mid-chassis placement in a small, lightweight sports car, it was too weak in both low-end torque and peak power for Chevy's flagship Corvette. According to McLellan, the two-rotor GM Wankel under development at the time was good for roughly 200 hp, while Corvettes of the era could pack 400-plus galloping ponies.

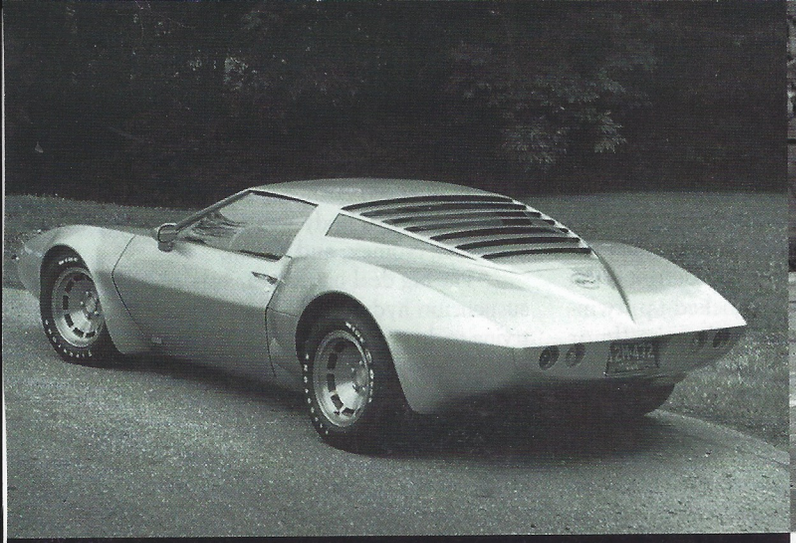
Partly to prove that point, Duntov built a rotary-powered ME concept car designated XP-987 (aka the "Chevrolet GT," and often misidentified as XP-892 or XP-897), wearing a handsome, compact, two-seat sports-car body on a Porsche 914 chassis. When the car debuted at the September, 1973 Frankfurt Auto Show as the Corvette Two Rotor, most thought it looked great and maybe should be the next Opel GT. But it was far too slow to be the next Corvette.

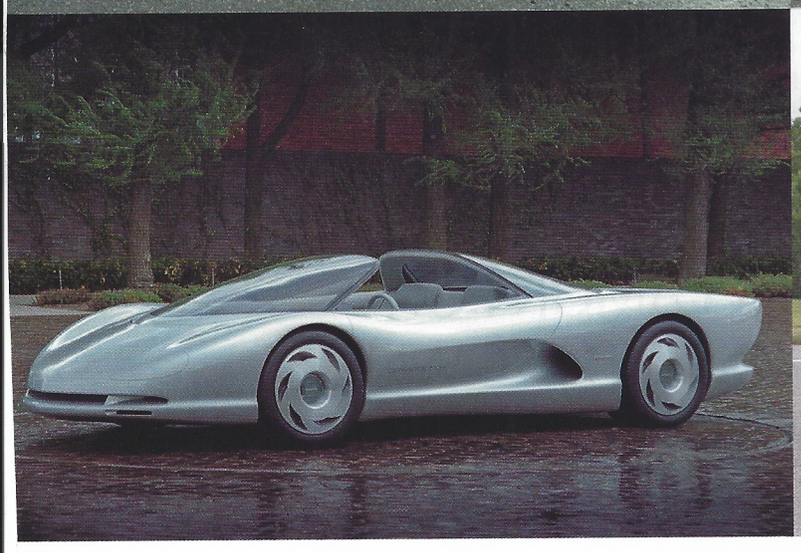
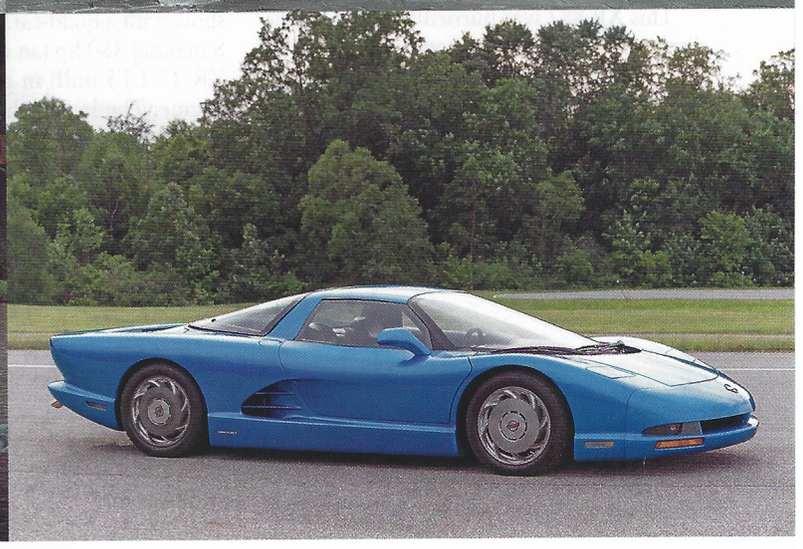
So Cole authorized Duntov to design a four-rotor Wankel, and Corvette engine guru Gib Hufstader cleverly cobbled together a pair of two-rotor development engines that together were reportedly good for some 500 hp. The oversize rotary was packaged behind the cockpit of maybe the sexiest Corvette concept yet: a sleek, two-pointed missile designed by Henry "Hank" Haga and Jerry Palmer on the earlier XP-882 mid-engine chassis. Unveiled at the 1973 Paris Salon as the Corvette Four Rotor, it was never performance-tested, its fuel economy was dismal, and its output quickly fell off as its rotor seals wore. Undeterred, Cole told Duntov to pursue that sexy design and its mid-mounted rotary engine as the next-generation Corvette.

But then the 1973-74 Arab oil embargo and the resulting fuel crisis shocked the country into a fuel-efficiency panic that would lead to strict federal corporate average fuel economy (CAFE) standards and ever-increasing emissions requirements, both tough challenges for the Wankel. Additionally, the engine's rotor-seal and oil-consumption issues were beginning to look insurmountable, and its projected cost also was much higher compared with equivalent piston designs. GM's Wankel engine program was canceled soon after Cole retired in early 1975, and out the door with it went Duntov's dream of a production mid-engine Corvette. In 1976, the Four-Rotor Corvette concept was refitted with a 400-ci V-8 and renamed Aerovette.

CERV Shows the Way

Duntov's first mid-engine car—which he personally demonstrated at the U.S. Formula One Grand Prix at Riverside, California, in November, 1960—was not a Corvette concept but a radical tube-frame, open-wheel, Indy-type car called CERV (Chevrolet Experimental Racing Vehicle), designed by senior engineers Harold Krieger and Walt Zetye. While "Formula" cars with rear-mounted engines had become common in international racing, this was a year before the first rear- (actually mid-) engine Indycar (a Cooper Climax driven by Jack Brabham) finished Ninth at the 1961 Indy 500, and



(Top row, L to R) XP-882 was first shown at the 1970 New York Auto Show, as a riposte to the Pantera. It was followed by the so-called Reynolds Aluminum Car, which swapped V-8 power for a rotary. (Above, L to R) The wild '86 Indy inspired CERV III, which appeared in 1990 with a twin-turbo LT5 and AWD.

five years ahead of the first rear-engine Indy 500 win by Jim Clark's Lotus-Ford.

Designed to Indy-car dimensions but powered (initially) by an all-aluminum, 353-hp, 283-ci V-8, this first CERV was used extensively for handling development and demonstrations of both ME and its independent rear suspension. Duntov tested it at Pikes Peak, Daytona, and Sebring, and in 1964 (with a more powerful Hilborn-injected 377) reportedly drove it to an astounding average-speed record of 206.1 mph on GM's Milford Proving Grounds five-mile circular track.

Then Duntov and his team designed the 1964 CERV II, a four-wheel-drive, mid-engine, Le Mans-style "Prototype" racer intended to take on Ford's GT40, Ferrari, and the rest at the Le Mans 24-Hour and other endurance races. According to author and historian Karl Ludvigsen, then-Chevrolet GM Bunkie Knudsen approved this project in 1962, then was ordered to drop it by GM management due to the 1957 AMA (Automobile Manufacturers Association) ban on high-performance cars and factory-backed racing. Just one CERV II, an open roadster powered by an aluminum OHC 377 generating 490-hp, was built with all the technologies that Duntov and his team believed would make a great racecar.

CERV II reportedly reached 200 mph at the Milford Proving Ground in 1964, and while its racing ambitions were stifled, it proved a very useful R&D and demonstration tool for the proposed mid-'60s production ME "Super-Corvette" that Duntov wanted to build. Tested at times by Jim Hall and Roger Penske, and powered (in 1970) by a 550-hp, 427-ci ZL-1 big-block, it could rocket from rest to 60 mph in a stunning 2.8 seconds. The car pioneered the basic configuration (less its four-wheel drive) of the legendary Jim Hall Chaparral racers that Chevrolet Engineering supported out of its back door—and essentially every ME sports-racing car since.

A Boost from DeLorean

Convinced that ME was the only way to go for Corvette to compete effectively in styling, image, and performance with top European sports cars, Duntov and his fellow engineers designed and built several ME prototypes during the 1960s and early '70s. They also relentlessly fought Chevrolet and GM management for approval to bring an ME Corvette to production. Frank Winchell's team built a GS-II, then an improved GS-IIb racecar chassis with a low-slung Shinoda-designed body. Used primarily to test ME frame and suspension components, it evolved into the GS-III and eventually the 1966 Jim Hall Chaparral racecar. In addition, a potential production ME chassis and powertrain were designed by Winchell's R&D group in 1965, and a series of bold-looking bodies for it were explored by GM Styling. One that evolved into a running prototype was the XP-880, a Shinoda design derived from his earlier XP-819 rear-engine concept. The XP-880 later became the Astro II concept sports car (following a much more radical ME Astro I) that was publicly displayed at the April 1968 New York Auto Show.

Duntov gained a powerful ally when GM eminence John DeLorean was promoted to GM of Chevrolet in February 1969. DeLorean was instantly impressed by Duntov's XP-882 concept prototype, a sleek, silver bullet powered by a 400-ci V-8. The engine was mounted transversely behind the seats and channeled power through an Oldsmobile/Cadillac three-speed automatic transaxle. Its torque converter drove the rear wheels through a prop shaft passing through the sump. A newly designed four-speed manual was planned for later, and 4WD was likely part of the plan as well.

This XP-882 was hurriedly spiffed up for display as a "Corvette Prototype" at the 1970 New York Auto Show, to counter the DeTomaso Pantera. (The Pantera, an Italian exotic powered by a mid-mounted Ford V-8, would go on sale through U.S. Ford dealers in 1971.) Because it was enthusiastically received by both the public and the media, this fine-looking car was seriously considered for production. In what would become a trend, the motoring press excitedly touted it as the next-generation Corvette.

But given that Chevrolet was selling every Corvette it could build at the time, would investing substantial dollars to go ME increase sales and profits? Probably not, management reasoned, especially since the price would almost certainly have to be raised. So while showing mid-engine concept Corvettes proved useful for raising interest in the marque, actually building them for public consumption was deemed too risky.

Still, to help keep the ME program alive, DeLorean authorized design and construction (along with Reynolds Aluminum) of the XP-885, a restyled, aluminum-bodied version of the XP-882. But while it was both pretty and provocative, the concept never gained traction.

ME Goes Modern

Although Duntov's dream of an ME production Corvette didn't come to pass during his tenure, the idea of such a car continued to tantalize those at GM Design. In 1985, not long after the all-new C4 hit the road, Design VP Chuck Jordan commissioned the swoopy ME Corvette Indy concept. The car debuted at the January 1986 Detroit Auto Show, complete with a (mocked-up) twin-turbo, 2.65-liter, 600-hp Penske/Ilmor Chevy Indy racing engine wedged transversely behind its seats.

Strongly positive media and public reaction led to two more Corvette Indys, a slightly toned-down show car and a running prototype. The former debuted at the 1988 Detroit show with a quad-cam, 32-valve, 5.7-liter V-8 making 380 hp (an early version of the C4 ZR-1's LT5 mill) in place of the Indy race engine. The latter—largely engineered and built by Lotus, which GM owned from 1986-93—served as a rolling test lab for engine and suspension hardware.

Meanwhile, the C5 program slipped from a 1993-model launch to 1994, and with GM struggling financially under then-CEO Roger Smith, engineers were told not to pursue any ME proposals. But Jordan wouldn't give up. "When GM shut down for its traditional Christmas holiday, five scale-model Corvettes were sitting on display stands in Tom Peters' Advanced 4 studio," wrote James Schefter in his 1996 book, *All Corvettes Are Red*, "Two of them were mid-engine machines."

Those Corvette Indy concepts were followed at the 1990 North American International Auto Show by the somewhat more production-feasible CERV III, which previewed the roof shape and some other styling elements of what would eventually become the C5. Built by GM Corporate Engineering with Lotus consultation, its long tail accommodated a 650-hp, twin-turbocharged, quad-cam, 5.7-liter V-8 that drove all four wheels through a six-speed automatic transaxle (actually a three-speed Hydra-Matic driving a custom two-speed gearbox) and advanced viscous-coupled AWD. Active suspension and rear steering tightened the car's turning circle and stabilized high-speed cornering, while the low-drag (0.277 Cd) body was made from carbon fiber, Nomex, and Kevlar.

"The big deal on that car was an active-suspension hydraulic bladder that we were trying to do on the Corvette at the time," GM Global President Mark Reuss relates. "It even had things like yaw control. We spent a lot of money trying to get it donw, but it was too unwieldy, too heavy, too expensive, and not quick enough. It was a great test bed, but we could never quite get there on the dynamics."

Even as GM's financial condition continued to worsen through 1991, Jordan refused to give up on ME. By early 1992, the C5 program (now pushed back to 1996) was, according to Schefter, down to three options: 1. a *momentum architecture* (front engine, rear transmission, evolutionary body style); 2. a *mid-engine architecture* that offered dramatic new styling avenues; or 3) a stiffer and lighter conventional Corvette. And because the momentum option would be the most profitable and highest quality of the three, it finally won out.

"THERE WAS NO CLAMOR FOR A MID-ENGINE...AMONG THE OWNER GROUP. [AND] ABSOLUTELY NOBODY WAS ASKING FOR A V-6 CORVETTE."

The CERV III concept car was tested at GM's Milford, Michigan, and Mesa, Arizona, Proving Grounds, as well as at Lotus' test track in Hethel, England. But once the decision was made that the next-gen Corvette would be front-engine, the car was removed from service. (It now resides in GM's Heritage Collection.)

Except for Italian design house Bertone's interesting 1990 LT5-powered Nivola Corvette proposal, and the '97 V-6 Stingray III concept from GM's Advanced Concept Center in California, that was about it for ME Corvette explorations until Wallace and Juechter restarted them in the mid-2000s. And now, following a decade-plus delay for GM's bankruptcy and recovery, here we are at the long-awaited arrival of the very real, very mid-engine C8. ○