Geneva Motor Show technical highlights

In the world of automotive design and engineering, the compact, annual Geneva Motor Show has long been a showcase of original thought. With the addition of a new hall, the event was bigger this year, but it still just managed to retain its special atmosphere that no other motor show in the world can match. It is also a gathering place for top-level executives, designers, and engineers from across the global industry. There they can gain firsthand knowledge of the emerging technologies, as well as the thinking and policies of a wide spread of OEMs, design houses, and consultancies.

Franco Sbarro can usually be relied upon to take the wraps off something weird and wonderful at Geneva, and this year he surpassed himself with a sort of semi-encapsulated motorcycle, squeezing a 160-hp (119-kW) **Yamaha** motorcycle engine and five-speed gearbox, plus systems including a radiator, exhaust, suspension, brake, battery, and a gasoline tank, into its 22-in wheel. Sbarro calls the concept independent wheel-drive or an autonomous motor unit, which also involves two small stabilizing wheels dropping down at low speeds. He said that car wheels have been steadily increasing in size and he sought to make use of the hollow interior of the wheel—and decided it could contain a powertrain. The result is a motorcycle with the power unit in its rear wheel.

Sbarro also showed a three-wheeler that looked very sci-fi and a four-wheeler

Sbarro showed a motorcycle concept with an engine inside its rear wheel and a sci-fi three-wheel concept.

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with the powertrain "divided between the two back wheels." In one rear wheel was a V6 power unit and differential, two prop shafts linking to the opposite wheel, which had another differential and also contained the gearbox, plus systems including the air-conditioning compressor. Between the wheels were the radiator and exhaust system. Sbarro is indisputably a free thinker and certainly not hide-bound by evolutionary engineering.

The Lamborghini Gallardo uses aluminum spaceframe construction.

Dubbed the "baby Lambo," the mid-engined **Lamborghini** Gallardo was very much a Geneva Show star. Power is provided by a 5.0-L V10 all-alloy, quad-cam engine producing 493 hp (368 kW) at 7800 rpm and driving all wheels with front/rear power split 30/70. Weight distribution is 42/58 front/rear. The engine is placed longitudinally with the six-speed manual gearbox mounted behind it. An e.gear sequential shifting system will be an option. Lamborghini and Audi developed the power unit jointly. An aluminum spaceframe helps to keep mass at 1430 kg (3153 lb). Suspension comprises double wishbones, coil springs front and rear, and there are adaptive **Koni** dampers and **Brembo** brakes. Length is 4300 mm (169.3 in), width 1900 mm (74.8 in), and height 1165 mm (45.9 in). Top speed is about 192 mph (309 km/h).

Making its debut at the Geneva Motor Show was the production version of **Porsche**'s Carrera GT. First seen two years ago as a concept, the production car has carbon fiber bodywork, which the company says could be "deployed in the future" on other models. A 5.7-L V10 engine based on Porsche's 5.5-L racing unit powers the GT, the slight increase in capacity for the road car deemed necessary to better suit a series production car. Output is 450 kW (603 hp) at 8000 rpm, maximum torque 590 N•m (435 lb•ft). Maximum speed is claimed to be 330 km/h (205 mph), with 0-100 km/h (0-62 mph) acceleration in 3.9 s and 0-200 km/h (0-124 mph) in 9.9 s. The V10 engine drives through a six-speed gearbox.

Porsche says that for the car's new construction concept, both the monocoque and entire subframe are made of carbon fiber reinforced plastic (CFRP). Porsche has applied for a patent for the technology. It says carbon is the only material that, after "complex

processing," can meet "the prerequisites needed to combine top-class driving performance and driving dynamics with minimum weight at maximum rigidity." The Carrera GT has advanced underbody aerodynamics including rear diffuser and flow channels. Ceramic composite brakes are fitted, and the GT has a ceramic composite clutch. Wheels are magnesium produced in a special forging process deployed for the first time in a mass-produced vehicle, according to Porsche. Tires are 265/35 ZR19 at the front, 335/30 ZR20 at the rear.

The Carrera has detachable roof panels comprising two individual carbon fiber shells, each having a mass of 2.4 kg (5.3 lb), which can be stowed in the car's front trunk. The GT is 4.61 m (181.5 in) long, 1.92 m (75.6 in) wide, and 1.16 m (45.7 in) tall, with a wheelbase of 2.73 m (107.5 in). Dry mass is 1380 kg (3042 lb).

Calling a car Enjoy may sound more Japanese than Italian, but that was the name **Pininfarina** chose for its roadster concept based on the **Lotus** Elise's tub structure. As the chassis is the load-bearing structure of the central body, the body panels are not an essential part of its structural integrity, said Lotus. This allowed the introduction of the car's removable front and rear wings, which house headlights and taillights. Upon detaching the four removable wing panels, Enjoy is transformed into an open-wheeled racer for the track. The body panels are employed only for driver comfort and protection as well as aerodynamic considerations, similar to motorbikes and single-seat racing cars—two of the primary inspirations for Enjoy. The roadster is 3740 mm (147.2 in) long, 1070 mm (42.1 in) tall, and its front and rear suspension uses "overlaid wishbones" with pushrods at the front.

The name of **Bertone**'s Birusa GT concept is derived from "biross," which in Piedmontese dialect is said to describe

Porsche's Carrera GT has a 450-kW (603-hp) V10 and twin detachable carbon fiber roof shells.

Bertone's Birusa concept has a Segway in the trunk.

a brilliant, extremely resourceful purpose. Describing one aspect of the car's styling, the company said "the side window is sculpted like a diamond and protrudes from the side like a dihedral of light cut through by an aluminum blade." Such hyperbole is part of the Geneva Show. The GT concept, developed in concert with several suppliers, features voice controls (**Loquendo**) to open the carbon fiber gull-wing doors and the double sunroof (developed with **Inalfa**) and made of heat-resistant glass (**Socar** ICS) laminated with PVB film (**Solutia**); a stereo system with Dolby Surround effect (**Bose**); semi-adaptive headlights with an infrared night vision system (**Valeo**); and a Segway (**HT**) stored in the trunk. The car is based on the **BMW** Z8 two-seater with a 400-hp (298-kW) V8 power unit driving through a six-speed gearbox.

The Audi Nuvolari quattro is described as a "design study" rather than a concept, which indicates production plans possibly as an A8 coupe.

Audi also showed a GT concept, the Nuvolari quattro, named for the last driver (Tazio Nuvolari) to win a Grand Prix race in an **Auto Union** at Belgrade on September 3, 1939. "The concept outlines the direction that Audi's exterior and interior design will take," said Walter de'Silva, Head of Design, Audi Group. The 2+2 coupe is 4.80 m (189.0 in) long, 1.92 m (75.6 in) wide, and 1.41 m (55.5 in) tall on a 2.89-m (113.8-in) wheelbase. Like the TT coupe, the car has a high waistline and relatively small glass area. It has very short overhangs and uses an Audi Space Frame for its aluminum body. The Nuvolari's engine is the most powerful Audi has developed for a road car: a 5.0-L V10 twin-turbo with direct gasoline injection producing 441 kW (591 hp) and 750 N•m (553 lb•ft) at 2000 rpm. Performance claims include a 0-100 km/h (0-62 mph) time of 4.1 s. Its six-speed auto gearbox has shift-by-wire technology and paddle operation for manual shifting. The suspension uses an adaptive air system and four aluminum links at the front and a trapezoidal link at the back. Rear lights are LED and adaptive to ambient light conditions.

Audi's second-generation A3 was also unveiled at the Geneva Motor Show with a 3.2-L V6 engine option and twin-clutch Dynamic Shift Gearbox (DSG), both of which are available on Audi's latest TT. Quattro four-wheel drive is available either as an option or standard on all A3 variants. The new hatchback A3 has sportier, crisper styling compared to its predecessor, and it is 65 mm (2.6 in) longer, 30 mm (1.2 in) wider, but 10 mm (0.4 in) lower. Audi says it has given it proportions similar to a coupe, with short body overhangs and a marked C-pillar slope together with shallower side windows. Initially available in three-door form, a five-door will follow. Interior dimensions have been increased front and rear and the seating positions lowered. Detail points include aluminum-look circular ventilation outlets and a high center console for improved ergonomics.

Powertrain choice is exceptionally wide, starting with a 75-kW (101-hp) 1.6-L gasoline engine and extending to a 3.2-L V6 with 177 kW (237 hp) and 320 N•m (236 lb•ft). A new 2.0-L TDI turbodiesel produces 103 kW (138 hp) and has 320 N•m (236 lb•ft); a 1.9-L turbodiesel is available with 77 kW (103 hp) and 250 N•m (184 lb•ft). Manual gearboxes are five- or six-speed depending on engine size, and there is a six-speed Tiptronic automatic. The most powerful gasoline and TDI engines can be specified with the direct-shift DSG transmission, which has twin automated clutches that facilitate gearshifts with no break in engine power. Steering-wheel shift paddles are used, or gears can be shifted automatically. Suspension includes a refined version of the MacPherson strut layout at the front and a new four-link system at the rear. The car has speed-sensitive electromechanical steering.

As with other Audis, great attention to detail has been paid to the design and fit of the new A3's interior.

Another concept that points to likely future design cues is **Volvo**'s

Volvo's Versatility Concept Car has no B-pillar and an aft-hinged rear door that reveals a simple but high-tech interior.

BMW's oil-burning 330Cd Coupe produces 410 N•m (302 lb•ft) of torque.

mild-hybrid Versatility Concept Car (VCC). A bold station wagon design, its rear doors are hinged from their trailing edges, although Volvo says that "for safety reasons" they are unlikely to be seen on production cars. (**Rolls-Royce** emphasized the safety elements built into its similar production Phantom.) Some aspects of the car, though, are likely to appear on future models. It also has a panoramic roof and continues Volvo's established styling tradition of "shoulders." The futuristic design "uses inspiration" from the glass tailgate of the P1800 ES of the early 1970s and the prominent front grill first seen on the 1968 164 sedan. High-strength steel facilitates narrower A-pillars, and the concept's backward-opening rear doors obviate the need for B-pillars.

BMW's M3 CSL is 110 kg (243 lb) lighter than the regular M3.

But the VCC is not just a styling exercise; it has a raft of new technologies. It has no conventional audio unit but instead uses wireless-LAN (W-LAN), third-generation 3G wireless telecommunication, or general packet radio service (GPRS) technology. The car's interior is minimalist and uses concealed air outlets instead of vents, touch-sensitive controls

The Subaru B11S Concept Coupe has a new horizontally opposed six-cylinder engine.

for the powered windows, and LED HVAC controls. Some controls are positioned on the steering wheel's fixed center, and each passenger has an independent "webpad" to access main controls, including navigation, and to surf the Internet. The load-area floor slides out electrically, and the car has separate heated and chilled compartments.

The VCC's high-compression 2.6-L six-cylinder gasoline engine produces 250 hp (186 kW) and has "Direct Stop&Start," which stops the engine while the car is stationary. Its Compression Auto Ignition (CAI) system creates a lean fuel/air mixture that is compression-ignited when the engine is at low to medium revs. An electric drive unit with an independent 42-V battery gives extra power to minimize turbo lag and improve response at low revs.

The car also has a newly developed Ambient Air Cleaner said to neutralize the hydrocarbon emissions produced by up to three other cars; a solar panel powers the system when the engine is not running. The VCC has a removable V-pulse unit instead of a key to start the car. Away from the vehicle it "pulses" at different rates to indicate if the car is secure or if the alarm has been triggered.

The Crossfire grows another two doors and becomes Chrysler's Airflite concept at Geneva.

In keeping with some other companies, BMW is now using diesel power for its sporty models, adding the 330Cd turbodiesel coupe to its range. Its engine is an uprated version of the six cylinder previously fitted to other

A high level of torsional rigidity and good aerodynamics mark out the new Mercedes-Benz CLK Cabriolet.

BMW models, but now with 204 vs. 184 hp (152 vs. 137 kW) and 410 vs. 390 N•m (302 vs. 288 lb•ft). With a six-speed manual gearbox (a five-speed auto is optional), the 0-100 km/h (0-62 mph) time is 7.2 s and top speed 149 mph (240 km/h).

The ultimate version of the Coupe, the M3, is the lightened and uprated M3 CSL. Its 1385-kg (3053-lb) mass is 110 kg (243 lb) less than the regular M3. Carbon fiber reinforced plastic (CFRP) is used for the roof, saving 6 kg (13 lb) and lowering the center of gravity. Further mass saving is achieved via long-glass-fiber thermoplastics as the structural material for the car's through-loading system and on the rear bumper supports. A paper honeycomb panel is used on the floor of the luggage compartment. As with the regular M3, the car has an aluminum hood and a rear windshield of thinner-than-normal glass. The CSL's 3.2-L engine produces 265 kW (355 hp) at 7900 rpm and a 0-100 km/h (0-62 mph) of 4.9 s.

Subaru unveiled the four-door B11S Concept Coupe with what is described as a symmetrical all-wheel-drive system with variable torque distribution. The Barcelona-based design studio **Fuore Design International** contributed to it. The B11S was developed to pursue the "Gran Utility Turismo" concept, says Subaru. The front fascia is said to "conjure up the turbine of a small jet plane and the freedom of flying wings"—an association with **Fuji Heavy Industries**' corporate roots as an aircraft company. The car has a new horizontally opposed six-cylinder engine, which is being developed as a twin-turbo to produce 294 kW (394 hp) at 6400 rpm and 550 N•m (406 lb•ft) from 3600 rpm.

Although it does not call it one, **Chrysler**'s Airflite concept shown at Geneva is also a four-door coupe. Based on the production Crossfire two-seat sports car, Chrysler says it has the styling of a coupe and is described as a "sedan coupe hybrid." It has a steeply tapered roofline and a center spine that connects the interior from front to rear. The floor is stepped up behind the rear seats to create a raised cargo area. Length is 4838 mm (190.5 in), wheelbase 2946 mm (116.0 in), and height 1488 mm (58.6 in). It is powered by a 3.5-L V6.

DaimlerChrysler (DCX) took the lid off the latest version of the **Mercedes-Benz** CLK at the Geneva Motor Show. Extensive work in the wind tunnel gives the CLK Cabriolet a Cd figure of 0.30. DCX says the car's body is very rigid for a convertible, helped by 40% of its bodyshell panels using high-strength steel alloys. At 12,378 N•m/° (9130 lb•ft/°), torsional rigidity is some 12% better than the previous CLK Cabriolet. The car has a newly developed roof design with multi-layer fabric to damp noise. It opens completely to disappear beneath a cover that has rear-headrest fairings. Opening and closing the roof requires no manual input, and roof folding provides less trunk intrusion in the new car compared to its predecessor. **VDA** trunk volume is now 390 L (13.8 ft^3), an increase of 40 L (1.4 ft^3).

The car has a sensor-controlled rollover bar, large head/thorax sidebags in the front-seat backrests, and belt tensioners with belt-force limiters for all seats. Automatic belt feeders for driver and front passenger are fitted, together with adaptive front airbags. Sidebags for the rear seats are available. The interior is roomier than the previous car with 23 mm (0.9 in) extra headroom for those at the front, while rear passengers get about 44 mm (1.7 in) added knee room. Engine choice is wide, spanning four-, six-, and eight-cylinder units from 120 to 270 kW (161 to 362 hp). Fuel consumption has been reduced by between 2 and 7%, depending on engine, compared to the outgoing car. Four-cylinder engines include Mercedes' Twinpulse technology incorporating supercharger, balancer shafts, and variable camshaft adjustment.

Peugeot unveiled its twin-engine Hoggar concept (top), 807 Grand Tourisme luxury minivan concept (middle), and a Coupe Cabriolet with folding hardtop.

GME's Opel/Vauxhall showed the GT Concept (top right), which indicates the styling direction for the next-generation Astra; the Signum (bottom right), which emerged from a late 1990s concept; and the VX220 Speedster (top/bottom left), which now has a turbocharged 147-kW (197-hp) engine.

Mercedes-AMG produces the 270-kW (362-hp) engine of the CLK 55 AMG, which reaches 100 km/h (62 mph) in 5.4 s.

Peugeot's new offerings at Geneva went from one extreme to the other; there was the unlikely Hoggar concept, a sort of twin-engined dune buggy; the highly practical 807 Grand Tourisme concept; and the neatly designed production 307 Coupe Cabriolet with retractable hardtop. The Hoggar has two HDi diesel engines (front and rear), together giving about 800 N•m (590 lb•ft), in a lightweight two-seater—a combination that must concentrate the driver's mind. The 807 is a luxurious four-seat minivan with a 204-hp (152-kW) V6 engine, a panoramic sunroof,

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A good view from all seats is possible in the EDAG Cinema 7D.

and an interior that includes two TV screens for the rear-seat passengers, integrated RT3 telematics, refrigerated storage units, and electrically retractable footrests.

Making big efforts to present interesting but practical new concepts and designs, **GM** Europe's **Opel** and **Vauxhall** brands showed the GTC (Grand Turismo Compact) Genève concept. A three-door hatchback, it is likely to indicate the style of the next Astra. The concept has a length of 4349 mm (171 in), a height of 1773 mm (69.8 in), and a panoramic roof section stretching from front to rear windshields. GME also had the space-efficient Signum on its stand. Based on a stretched Epsilon (Vectra) platform, it combines hatchback and station wagon styling. Engine choice covers six units including a 2.2-L direct-injection diesel and 3.0-L V6 common-rail diesel. GME also showed the two-seat VX220 Turbo, now with 200 hp (149 kW) for a claimed 0-97 km/h (0-60 mph) time of 4.7 s.

EDAG's new concept is the Cinema 7D, so-called because its seven seats are placed in three ascending rows, offering all occupants a good view of the road. The seats are also "staggered" to further enhance the view, just as they are in a movie theater.

Saab's new 9-3 is now available as a convertible.

Passengers in **Saab**'s latest model also get a fine view—when the roof is lowered. It is the new 9-3 convertible, initially available with a 2.0-L turbocharged gasoline engine producing 129 or 155 kW (173 or 208 hp). Other engines will follow and may include a diesel. The car was designed and developed in parallel with the new 9-3 sedan as part of a family of variants. It will be built at a new production facility at **Magna Steyr** Fahrzeugtechnik near Graz, Austria. From the A-pillars back, every external panel of the convertible is different from those of the sedan.

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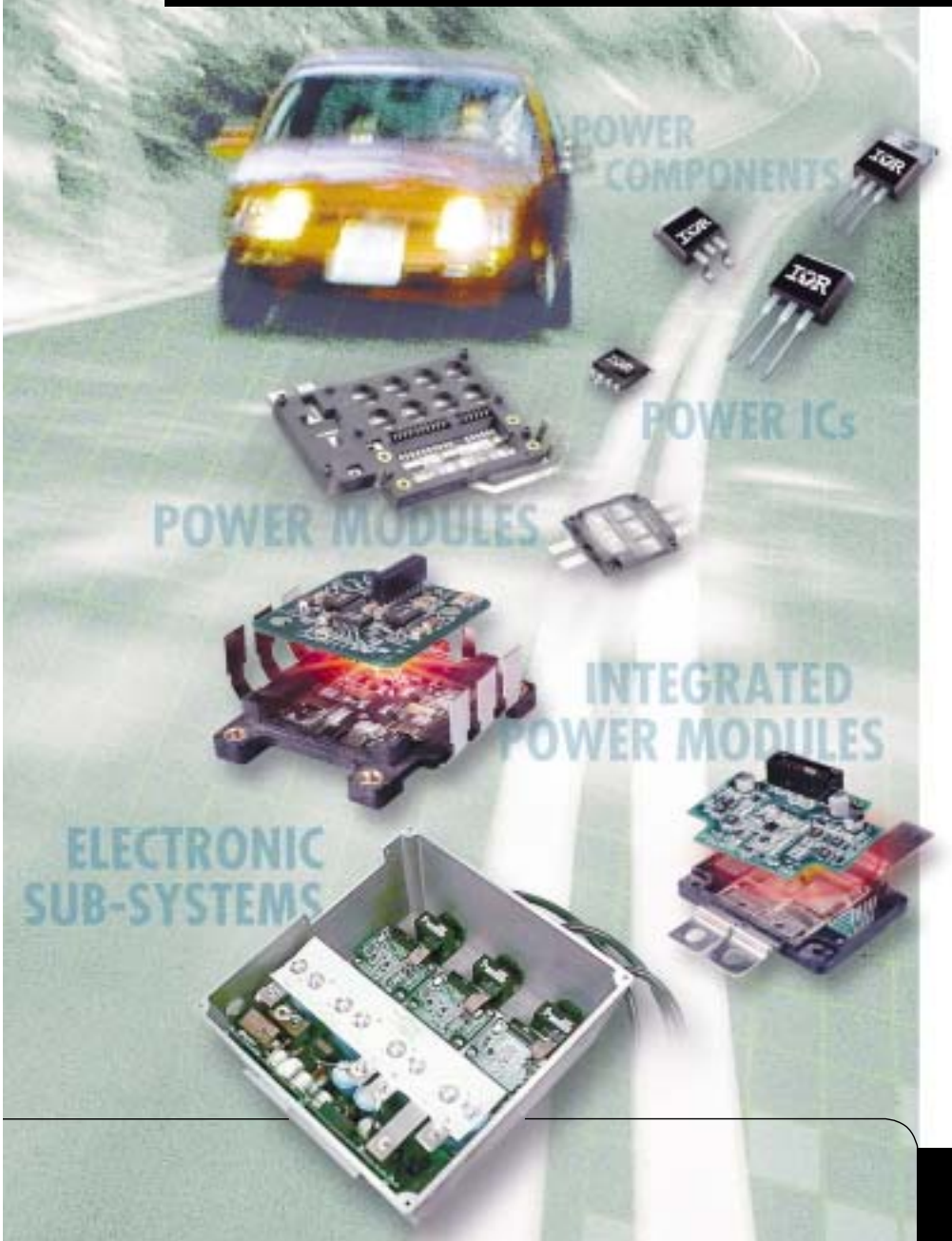

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Compared to the previous 9-3 convertible, the new car is 51 mm (2.0 in) wider with a 70 mm (2.8 in) longer wheelbase, but shorter overhangs have reduced its overall length fractionally to 4635 mm (182.5 in). It has pop-up aluminum alloy rollover hoops mounted inside the car's torsion box and released via a small pyrotechnic charge at the onset of a rollover, when all four seatbelt pretensioners are also activated. The 9-3 convertible's CargoWing rear spoiler folds out to carry skis or a snowboard. The roof is hydraulically powered, with automatic self-latching to the header rail, and deploys in 20 s.

The roof has six, instead of the previously used five, swiveling braces. It is tensioned by locking braces at the rear rather than the front, which Saab says stretches the fabric more tightly. With the roof raised, Cd is 0.34. The body structure's stiffness is put at 11,500 N•m/° (8482 lb•ft/°). Saab says the car has a "second" supplementary chassis, an additional "ring of steel" linking and reinforcing the front, rear, and side structures.

Renault is expanding its new Megane range with this folding-glass-topped Coupe-Cabriolet.

Renault also had its new convertible at Geneva, describing the Megane Coupe-Cabriolet as the first car to be equipped as standard with a folding glass roof. Options include fixed or automatically deployable rollover hoops. Only the front grille, headlamps, and hood are carried over from the new Megane hatchback. Renault says that shut lines have been the subject of special care. The glass roof was designed and developed by **Karmann**. Acoustic and thermal

Citroën's motorsport concept is the C2.

Valmet's glass roof concept has been applied to this Ford Thunderbird show car.

comfort is enhanced by the use of 4 mm (0.16 in) thick **Saint-Gobain** Venus 35 glass. Opening and closing is automatic via an electrohydraulic mechanism. The roof module is delivered to Renault's Douai factory, where it is installed on the car. The Coupe-Cabriolet is built on the same line as the new Megane hatchback and new Scenic.

The new **Ferrari** Challenge Stradale lines up alongside the 360 Modena and 360 Spider, with the precise aim of giving drivers the performance and feel of a true racing car for road use, says Ferrari of its new model. About 110 kg (243 lb) was saved, compared to the 360 Modena on which it is based, via materials construction technology and project optimization. Titanium has been used for parts of the suspension, notably for the wheel bolts (50% weight reduction) and springs (27% less). Carbon fiber has been used for door panels, shells of the racing seats and filter box covers, and for interior and exterior trim features. A particularly advanced construction technology was adopted for the car's floorpan, according to Ferrari. It involves impregnating the resin with multi-axial carbon fibers in a vacuum to obtain the necessary rigidity while simultaneously leading to a 50% reduction in floorpan weight. Carbon-ceramic brake discs are fitted, plus aluminum brake carriers. Engine changes include optimization of the compression ratio, fluid dynamics, and "mechanical performance" via a low-friction cylinder block and new positioning of the valve springs. The car has two gearshift modes: Sport and Race. Suspension changes include stiffer springs, with **Pirelli** P Zero Corsa tires on 19-in wheels. Aerodynamic changes include enhanced downforce; at 200 km/h (124 mph), the load increase is about 40 kg (88 lb) for a gain corresponding to the effect of a wing with a 15-cm (5.9-in) chord length and 1.8-m (70.1-in) span, according to Ferrari.

Citroën took along a motorsport concept to Geneva. The C2 Sport has a 1.6-L, 225-hp (168-kW) engine driving through a six-speed sequential gearbox with **ZF** limited-slip differential. Mass is 1000 kg (2205 lb) and front/rear distribution 60/40. Length is 3660 mm (144.1 in), wheelbase 2326 mm (91.6 in).

Valmet Automotive showed a two-section, retractable glass roof for the **Ford** Thunderbird developed in collaboration with **ThyssenKrupp Automotive**, which already produces doors, fenders, and hoods for the car. The roof folds into an area behind the seats and is covered by a hard tonneau. The Thunderbird glass roof is the fourth retractable roof concept car developed by Valmet.

The new Alfa GT Coupe is extensively changed from the 156 sedan on which it is based.

Alfa Romeo's Kamal concept is described by the company as a fusion of different vehicle types, combining the off-road performance of an SUV with the driving satisfaction and handling characteristics of a compact Alfa Romeo. The car was styled by Alfa's Arese Style Center and it has an MPV-style versatile seating system interior. It uses a 3.2-L V6 producing 250 hp (186 kW) in conjunction with electronically controlled all-wheel drive, three differentials, and a Torsen system. Suspension is double wishbone front and rear.

Alfa Romeo also showed the coupe version of the 156 simply called the Alfa GT Coupe. The Bertone Style Center designed it.

Stuart Birch