



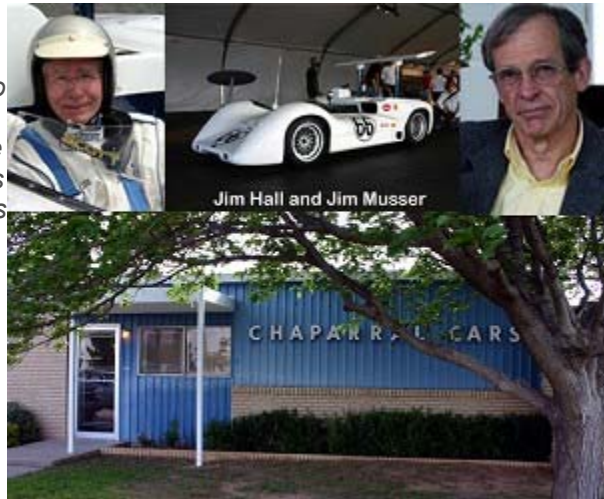
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This column originally appeared on TheRaceSite.com

### Through The Esses - The Birth And Rebirth Of The Chaparral 2E

10/3/2005 - © Andrew S. Hartwell

*"It was Hall that first recognized the importance of aero down force and balancing that force front to rear to achieve near neutral handling in high speed turns. The aerodynamics of the contemporary race car still has its origins in the Chaparral program. Even passenger cars utilize the Chaparral's front spoiler and many employ rear wings or spoilers and other ground effects."* - From the Official [Chaparral website](#)



The 'man from Midland', Jim Hall, was - as the quote above confirms - a true pioneer in the design of sports cars who took the inherent disadvantage found in the wind that fights against the forward movement of a race car, and turned it into an advantage. In the early 1960's, Hall, a successful Texas oil man and engineer, worked out of his small Chaparral Cars compound in then-rural Midland, Texas. He, and his business partner and co-driver Hap Sharp, worked alongside several talented people from Detroit who helped Hall to set new standards for aerodynamic intelligence. And, as the quote also confirms, the benefit of the engineering genius brought together in a little part of a very big state so many years ago is still being employed today.

One of the key people who were there, in Midland, and working right alongside Jim Hall during this incredible time of revelation and discovery, was a young R&D Engineer out of General Motors by the name of Jim Musser. From about 1962 into 1968, Musser and Hall shared ideas, concepts and hands-on skills that ultimately benefited both Chaparral race cars coming out of Texas, and GM production cars coming out of Detroit.

We spent some time talking with Musser about that special time in racing and automotive history. Our conversation was prompted by the recent announcement that Hall and Musser were going to produce a limited number of new Chaparral 2E model race cars, to be sold to those who wished to drive a Chaparral 2E in vintage races. Since only one original 2E exists, and is among the cars Jim Hall donated to the Chaparral Gallery, the Chaparral name is never seen in vintage racing. The exception is the Chaparral 1, but Hall didn't build that one. He bought it and then later sold it when his own creations finally came together.

For those who may have lost track of the Chaparral model numbers, the 2E featured a high mounted rear wing that was put in a flat position on the straights with a foot pedal - to reduce drag - and then tilted downward when the pedal was released to act as a 'spoiler', using the force of the wind to both slow the car down and give it tremendous grip through a corner. Hall has often called the 2E his favorite, and many Chaparral fans would probably say the same. The winged wonder certainly thrilled the fans at the

32nd Rolex Monterey Historics where Hall did parade laps in the one and only 2E in existence.

The 'new' 2E will be a 'continuation series' which is to say it will be built using the same molds and parts - and in the same manner by many of the same people - that were used in the original. There had been two cars but one was destroyed in a crash and never rebuilt. The one and only remaining 2E is on display with the other Chaparral models (the 2, 2D, 2F, 2H, 2J and Indy Car 2K) in the new Chaparral Gallery within the Petroleum Museum. The museum is located just a few short miles away from the Chaparral Cars compound.

Musser took some time to tell us about the origins of the 2E, how he came to be a part of the creation process, and why he and Hall plan to build additional cars for sale to the public. In our conversation we learned quite a bit about the history of Chaparral, the deeply involved non-involvement of Chevrolet, the connection to Ralph Nader (sort of), and a bit about the men who pooled their talents and resources to come up with some of the best loved race cars of all time.

At the start of the Chaparral era, Jim Hall had no direct or substantial links to General Motors or Chevrolet, before he finished building his Chaparral 2. But one day, while he was at Elkhart Lake (Road America) for a sports car race with his Chaparral 1, he came across a prototype that Musser and his boss, Frank Winchell had on display. The car was the Monza GT and its mid-engine design piqued Hall's interest. He struck up a conversation with the two men and a new era in automotive aerodynamics was born.

Jim Musser relates the story behind that car and the relationship that was started, appropriately enough, at a race track.

"Bill Mitchell (GM's Vice President of Styling) was a real car enthusiast. In the early 1960s the transition from front engine to mid engine sports cars was just beginning. He, along with several others, wanted to see GM build a mid-engined sports car. They looked initially at the Corvette (along with Zora Arkus-Duntov, the creator of the Corvette) but the cost of doing a mid-engined vehicle, because of the specific transaxle that you need, and other things that are different than the standard components that we used in Corvettes at the time, made it cost prohibitive for a small volume vehicle.

"Chevy R&D was working with our styling department on a front-drive car. The way we elected to do it was to use the Corvair engine and transaxle and just reverse it and put it up front. I had the project of designing a front wheel drive car, which was essentially the Corvair. When Bill Mitchell looked at that he thought we ought to do a mid-engined sports car using that package.

"He had a little secret studio downstairs in the basement of the styling area. Larry Shinoda was the head of the studio and Tony Lapine, who later went to work at Porsche, was the designer and they made a clay model of a mid-engined Corvair sports car. Mitchell didn't know how he could get a real version built so he invited Frank Winchell (my boss at the time) and me over to look at his model. This was about two months before we met Jim Hall at Elkhart Lake. Mitchell said he would really like to have a car like this to take to Road America. I said we could build a chassis in a month if he could put a body on it in a month. We agreed to try and we designed and built the car in just two months.

"Mitchell had in mind a tubular space frame, which was the popular choice in racing at the time. But as I looked at it, it became obvious that a monocoque design would be more appropriate. So we went to work on it and had the car in time to take it to Road America.

"Jim Hall and Hap Sharp were there with the Chaparral 1 (the front engine cars that were built for them by Troutman and Barnes). But they had already started working on their own mid-engined car (which would become the Chaparral 2) and it had a monocoque epoxy-fiberglass chassis. Jim's initial thought was to do a coupe and when he saw the Corvair GT he was quite intrigued.

"I had an immediately good impression of Jim. I knew he was a premier driver and, as he was an engineer too, we spoke the same language. We had a good relationship right from the beginning."

That relationship was about to broaden tremendously as events inside and outside of racing would find the two men collaborating to reach two distinctly different goals.

"We had started a vehicle dynamics project in Chevrolet R&D to study the behavior of cars at the limit of control. Since race cars and race drivers operate at the limit of control all the time, working with someone in racing was an obvious direction for us to take. We (Chevrolet and GM) were never directly involved in racing activities as the corporation's policy was not to be in racing. But we were approaching the whole project from an engineering point of view."

That project took shape in response to a consumer advocate's indictment of a Chevrolet vehicle that was being sold at dealers across North America. That car was the Corvair.

"In the early 60's, GM was confronted with a number of lawsuits about the Corvair street cars. (History buffs will recall Ralph Nader's book, "Unsafe at any speed" which essentially sought to have the cars taken off the roads outright for the good of the nation and motorists everywhere.) The lawsuits alleged there were problems with the cars design. Chevy R&D was given the responsibility to prepare the technical defense for the Corvair. We ran numerous experiments and we built a number of exhibits for use in the courtroom. We also created a bunch of devices that could demonstrate to the jurors what understeer and oversteer and so on were. It was this effort that started the vehicle dynamics project.

"The goal was to study the behavior of cars in general at the limit of control. The issue with the Corvair was that you would lose control of the car because it had oversteer at the limit whereas other domestic cars had understeer at the limit of control. We hadn't been testing cars at the limit of control because we had always been more concerned about how cars were being driven normally. So we knew that if we wanted to test at the limit of control that race cars and race drivers were the way to go.

"We had started to talk to certain racing people. In fact we had Stirling Moss and Juan Manuel Fangio as witnesses at the first trial. They had come to Detroit and performed certain tests and so on so they could testify as expert witnesses to the handling of the Corvair. We actually got just about every car available, both domestic and foreign, for the purpose of testing and collecting data on the skid pad and how the cars performed and so forth.

"Coming back to our relationship with Jim Hall, initially the conversation we had with him and Hap Sharp told us we could communicate very well with them about these issues and the science of vehicle dynamics. Since we wanted to expand our project and build some vehicles to test with to increase our knowledge, we needed a facility to support us. The proving grounds in Detroit were not suitable for this kind of research as the weather was only favorable for half the year. As we got into discussions with Jim and Hap, we learned of Rattlesnake Raceway, their private race track that was set up right behind their compound.

"Their track was just what we needed except it did not have a skid pad. At that time, race car builders didn't utilize skid pads. We wanted to rent a facility to do our testing work and as part of our rental agreement with Jim he agreed to build a skid pad."

With the agreement set, Musser found he began spending more and more time in Midland. Some of that time was in the seat of a car doing laps around Rattlesnake Raceway but most of it was in the garage where ideas and notions were bounced back and forth between the men who wanted to learn about every aspect of aerodynamics and at-the-limit performance. And both Musser and Hall wanted to apply what they were learning to their respective automotive projects. Among other innovations, the famous Chaparral "automatic transmission" was born of this historic collaboration.

"In the vehicle dynamics program, we still had an interest in building a mid-engined Corvette. It was right around that time that Zora built the Grand Sport Corvette. There were about a half a dozen of them built. They were eventually sold into private hands and did some racing. But they were essentially lightweight but still front-engined Corvettes. In R&D we did a mid-engined car that we called the Grand Sport II. So you had a front engined GSI and a mid-engined GSII. The GSII was initially a prototype for what could have been a production Corvette. It had a steel spot welded monocoque chassis with a specifically designed transaxle.

"That transaxle is an interesting story. Even today about half of the Corvettes sold have manual transmissions and half have an automatic. The thing that really held up doing a mid-engined Corvette was the cost of designing a transaxle that would be unique to the Corvette. The Corvette would have to absorb the total cost of the tooling expense. Compare that to something like an automatic transmission where the same one was used in all the cars (Pontiac, Buick, Oldsmobile, Chevrolet and even the Corvette) so the tooling cost was spread out over all the cars. Millions of cars.

"Compounding the problem was that, to maintain the Corvette volume, we would have had to do two transaxles, one for manual and one for automatic. That kind of cost was prohibitive. If we only did the automatic the purists would not want the car. And if we only did the manual there were a lot of people who only wanted to drive around town and look sporty and not have the nuisance of having to shift gears.

"At about the time we were doing this and working with Jim, Hap Sharp was the guy who said the car is so light and the engine is so powerful we can spin the rear tires in any gear so why do we even need a transmission? Why not just have a torque converter? That got us thinking that, if we could do what I will call an "automatic" transaxle for a mid-engined Corvette, and more importantly take that to the preeminent road racing series - the United States Road Racing Championship (USRRC) - and win races, that would go a long way in getting the purists to accept it. I mean why would you need a manual transmission when you can go out there and beat the best cars in the world with an automatic?

"The GSII had this transaxle with a torque converter with one forward and one reverse speed. It performed quite well and one of the really neat features of it was that you only had two pedals, the brake and the throttle. So you kept your left foot on the brake and your right foot on the throttle.

"I think it was around this time that driving techniques were changing, with the bigger tires and better handling cars and so on. It used to be back then that they talked about a four wheel drift when going around turns. But, it may have even been Stirling Moss who first perfected the technique of braking hard as you approach a turn then easing off the brake as you approach the apex before accelerating out. That was a little tricky to do with a clutch pedal, a brake pedal and a throttle pedal but with left foot braking you could really develop that technique. Jim was really quite good at it.

"We wanted to explore that further. We decided to build a second prototype that was much lighter than our first GSII so it would make the single speed transaxle more acceptable. I went back to Detroit and designed another car with an aluminum monocoque that weighed only 57 lbs. We called this one the GSIIIB.

"We took that vehicle to Midland and did a lot of development work on it. We wanted to have the transaxle further developed by having it engaged in racing so we made transaxles available to Jim. The Chaparral 2 that he had built originally had a Colloti gearbox so he just converted it to be able to use our transaxle. He did that on his race cars and took it racing but, in keeping with corporate policy, we never actually went to the races representing GM. But we did supply that component because we wanted to see how well it was going to work. And we did want to establish the fact that a car with an automatic transmission could win races against the best that was out there.

"Eventually the plan for the mid-engined Corvette just fell away. There were two camps within Chevrolet and styling. One felt that a front engined sports car for the street was the most appropriate way to go and the other camp felt the rear engine approach was most appropriate. In the end the front engined camp

won out.

"The aluminum GSIIIB car was strictly a development car. It was never raced. But because it was easy to build, lightweight, and structurally rigid, Chaparral decided to essentially adopt my chassis design for Chaparral 2C, which was raced for about a half a season. It was the one with the adjustable spoiler on the back.

"I was deeply involved in the Chaparral 2E. The aluminum chassis was essentially based on my original design. The rest of the car, the aerodynamics, the body design, the wiring, the plumbing and the race preparations were all done by Jim.

"One of the things that emerged in our vehicle dynamics project was the observation that aerodynamic down force was a very powerful part of how vehicles handled at high speeds. Up until that time there was really not much attention paid to aerodynamics except from a drag point of view. All the European guys particularly worked on body shapes to reduce drag to increase speeds. But the light bulb had not turned on relative to down force. Jim was the guy that recognized the importance of that and first began to experiment on ways to develop aerodynamic down force.

"Many different things were tried and what happened was the car developed so much down force that it began to bottom out at high speed. The down force would push down on the body and then when you went into a high speed turn and got the roll of the vehicle you would bottom out the suspension on the outside and that would drastically change the handling of the vehicle.

"I don't know which of us was the first to come up with the idea but it became obvious that what we needed to do was to put the down force right into the suspension upright - right into the tires - and not into the suspension. The first wing we built was mounted just slightly above the body. What we discovered was that, even though the wing was developing down force, under the wing we were developing a low pressure area on the body which was creating lift so one thing was offsetting the other. So we just kept incrementally raising the wing until we didn't get that low pressure area. We ended up finding the right height to get the full benefit of having the wing there.

"Everything that gives you down force also gives you drag. Airfoil shapes balance lift and drag. When we had the wing in a position to maximize down force we also were generating maximum drag. The drag was really not a problem in a cornering situation where you are normally not going full speed. But when you got onto a straightaway and wanted to accelerate up to maximum speed, drag was a problem. It was therefore pretty obvious that you would want to trim out the wing when going in a straight line.

"Jim has to be the one who gets the credit here because he was the first one to recognize the issue and then take the steps to find a way to make drag and down force work in his favor."

The 2E Continuation Series was introduced at the recent 32nd Rolex Monterey Historics at Laguna Seca. A car was on display right outside the Chaparral exhibit and Jim Musser was on hand to answer questions about the rebirth of the winged wonder. He told us the interest is there for people to own a 2E for vintage racing, but he was more surprised at the number of Jim Hall and Chaparral fans who shared so many memories with him over the Historics weekend.

"There are quite a number of people who are excited about having Chaparrals available for vintage racing. Jim never sold any of the Chaparrals he built and they are all in the Chaparral Gallery. There have never been any Chaparrals available for sale, with the exception of the Chaparral Ones which were not built by Jim. Private owners simply never had the chance to own a Hall-built Chaparral to drive in vintage racing and that seemed a real shame to us. The Can Am cars, the Lola's, McLaren's and everything else are on the track but no Chaparrals. Back in the 60's, the Chaparrals were prominent competitors in the USRRC and the Can Am Championship. So it seemed we ought to be able to build a small quantity of Chaparrals and make them available to private owners. The cars in the museum will never be raced.

"I was frankly surprised at the number of Chaparral fans at Monterey. There were so many people there who were wearing Chaparral T-Shirts and buying the Chaparral books and standing in line for a long time to get Jim's autograph. I had a number of conversations with these fans and they knew more about the Chaparrals than I did! There were some fans that went to every race the Chaparrals ran in! Guys traveled all over the country! I knew a lot of people were interested in the Chaparrals but the number of real hard core fans was a surprise to me."

While there was a car on display at Laguna Seca, it was nowhere near ready to go on the track and be driven head to head against the rest of the vintage racers. But the day is getting closer when the first new Chaparral 2E will be out running alongside of - correction, in front of - the Lola's, McLaren's and Porsche's of old. Musser gave us a status check on the program.

"We don't have a car ready yet to make it available for sale. We rushed to get the display car ready for Monterey. It had a dummy engine in it and it didn't have all the parts on it. The car is back here now and the engine is on the dyno. Sometime in the next few weeks we will have the car up and running. I will be getting parts from the Chaparral compound but the cars will be constructed in Detroit. While the original Chaparrals are in the museum, there were lots of spare parts still in the Midland shop. We had the parts sent up to our shop here outside Detroit.

"The 2E is the only Chaparral for which the original molds still exist. We used those molds to make a master plug and sent it up to Detroit to make the body parts. And Jim had all the original engineering drawings of the chassis and the suspension and other parts so we either got those pieces from the spares at the shop or we fabricated parts from the drawings. The car is pretty much an exact duplicate of the original.

"We think the car meets the criteria for a continuation series because it is a car being produced by the original company, and by the original people who were involved with the creation of the original car, and it is being built using the original molds and drawings.

"We haven't resolved the issues of cost and lead time yet. It is expensive to build a race car when you have to make all the parts specific for the car. If we could have used off the shelf components it would have been less costly. But we are essentially building a prototype so it will be expensive. But we don't think it will be too far out of the ballpark for what others are paying for vintage cars like the McLaren or Lola or even the Chaparral Ones. We don't have all the costs together yet so we don't know what it will eventually cost and we don't know just how many should be built. I think it kind of depends on what happens when we have the first one finished. The workmanship, the finish and the function of the car has to be up to Chaparral standards and once we have that we should be able to get a sense of how many of them we might want to build. Some museums have even inquired about buying one just to display, while others want to go vintage racing in a 'real' Chaparral 2E."

Regular readers of this column are well aware that we are Chaparral fans. And the crowd at the Rolex Historics confirmed that there are literally thousands of race fans who share our passion for what Jim Hall created. After talking with Jim Musser, and learning about the birth of the Chaparral 2E from someone who was there, we feel confident we can think of him as being at least as big a fan as are we.

"I went to work with Chevrolet back in 1957. My direct involvement with Jim started around 1962 and ended in 1968, when I was promoted to the production side of things. I was still responsible for all the research that tied to racing and we were making parts available to people in racing, but I was not as closely associated with racing as I had been when working with Jim. Working with him was the highlight of my whole professional career."

And we have to put our conversation with Jim Musser right up there on our personal list of career highlights.

For more information on the 2E continuation series visit the [official Chaparral website](#)

