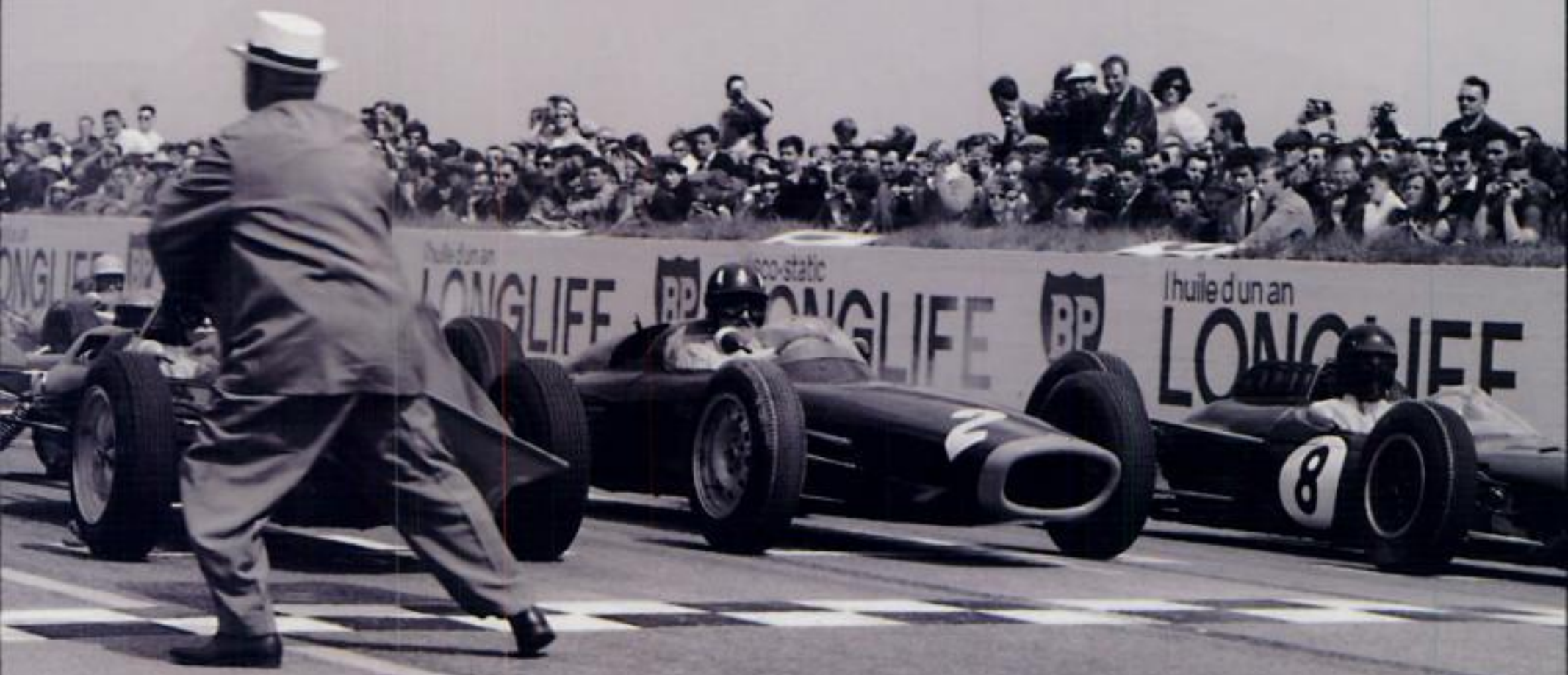
1½-litre Grand Prix Racing 1961-65

– Low Power, High Tech



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Dedication

To Anne – with love and thanks for your support and encouragement

and

in memory of my dad, James Whitelock, MBE, who took me to Goodwood on Easter Monday 1957 and started the ball rolling.

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Foreword

by Raymond Baxter, OBE, former BBC TV Grand Prix commentator

This book is not written for your average petrolhead devotee of *Top Gear*, nor for the flag-waving mob at current F1 Grands Prix who are interested only in the nationality of drivers or, in the case of Ferrari, the cars. Both groups would, however, profit from a study of Mark Whitelock's work.

I use the word 'study' deliberately, for this is not an easy read, although it makes an excellent bedtime book in comfortable bits at a time. It is a scholarly history of an exciting, fascinating and technically important period in international motor racing – it is a classic of its kind.

My only regret is that, although it sets out the achievements and failures of its characters, it does little to bring them alive as human beings. This is not surprising as the author was too young to enjoy their company. Thus, although Leonard Lee's remarkable achievements as the guiding hand of Coventry Climax are reported event by event, the equally remarkable persona of Leonard Lee as a major collector of art is un-noted. Equally, the contrasting natures of Walter Hassan, Colin Chapman and Harry Mundy are left to the imagination of readers not of that generation.

Nevertheless, Mark portrays accurately the days when the characteristics of each circuit differed profoundly, and straw bales or stone walls were, to coin a phrase, par for the courses. To this he attributes the huge difference in attitude between the drivers of those days and today, not least in their relationships and behaviour towards one another.

To me, as both a close observer and participant in that particularly madcap period, this book is a warm stimulant of happy memories as well as tragic ones, of a time when cars were painted in their national colours and advertising logos were forbidden (until Colin Chapman broke the mould with 'Gold Leaf Team Lotus'); when rival competition managers of BP and Shell, Dennis Druitt and Gerry Woollard, were close drinking mates; when Dunlop enjoyed a virtual monopoly of racing tyres; when spectator protection was as sparse as the money; and the paddock and its bar were open to the public.

Very few contemporary photographs were taken of Raymond Baxter as he was generally on the other side of the camera. However, here he is engrossed in conversation with Graham Hill in about 1972 (judging by Graham's overalls and the length of his hair).

One does not have to have been over the age of ten during the 1½-litre era to enjoy this book, however. On the contrary, it is a mine of information and pleasure for every true motor racing enthusiast.

Raymond Baxter

Introduction & acknowledgements

Introduction

This is the story of a Grand Prix formula that no British race car constructor wanted and yet which became one they would almost totally dominate. It is a period of Grand Prix racing that has remained largely overlooked due to the perception that the cars, at 1½-litre engine capacity, were underpowered and, hence, unspectacular. While it is true that this was the smallest engine capacity in the history of the World Championship, such a perception ignores a number of factors that mark out this period for closer attention:

- despite the low power, there was no less spectacle than under any other regulations, either before or since;
- the period saw a number of significant technological developments (most originated by British manufacturers) that are now taken for granted, including the introduction of monocoque chassis construction, huge advances in tyre technology, and the recognition of the benefits of fuel-injection and four-valve-per-cylinder technology;
- Stirling Moss was at the pinnacle of his career as the period opened in 1961, a career shortened by his untimely accident a few months later. In his absence, a new breed of British driver rose to prominence and won World Championship titles. Men such as Jim Clark, Graham Hill and John Surtees remain household names to this day.

At the time of writing, anyone seeking information on the period would need access to a wide range of sources from contemporary magazines and annuals to a variety of books. Unfortunately, few of the sources are easily available – many of the books are out of print and the contemporary magazines are not easily available. To the best of my knowledge no one has brought all the various strands together to paint a complete picture of the 1½-litre F1; this is what I have attempted to contribute to the bookshelves. In so doing, I have largely restricted detailed coverage to World Championship qualifying Grands Prix only, primarily due to reasons of space. A characteristic of the early part of the period was the profusion of non-Championship F1 events organised throughout Europe, and these are covered in a results summary at the end of each seasonal survey and, where significant, are referred to in the main body of the text.

While there is little new to add to the histories of BRM, Cooper, Lotus, Porsche and Ferrari, there were a further 16 marques that contributed to the excitement. Similarly, there were some 91 drivers outside the 'top ten' who took part in one or more of the 46 GPs over the period. Many of the marques, and the majority of the drivers, made little or no impact and tend to be forgotten, yet all gave of their best. All who contributed deserve to be remembered. Not to set down their contributions would be a disservice both to them and the enthusiast seeking a fuller knowledge of the period.

Readers wanting further information on the period are urged to find copies of the volumes listed in the bibliography, particularly the works of Doug Nye.

During my research I have consulted a great number of books and magazines, and have carefully cross-checked information from one to the other, nevertheless, any errors are my responsibility.

Acknowledgements

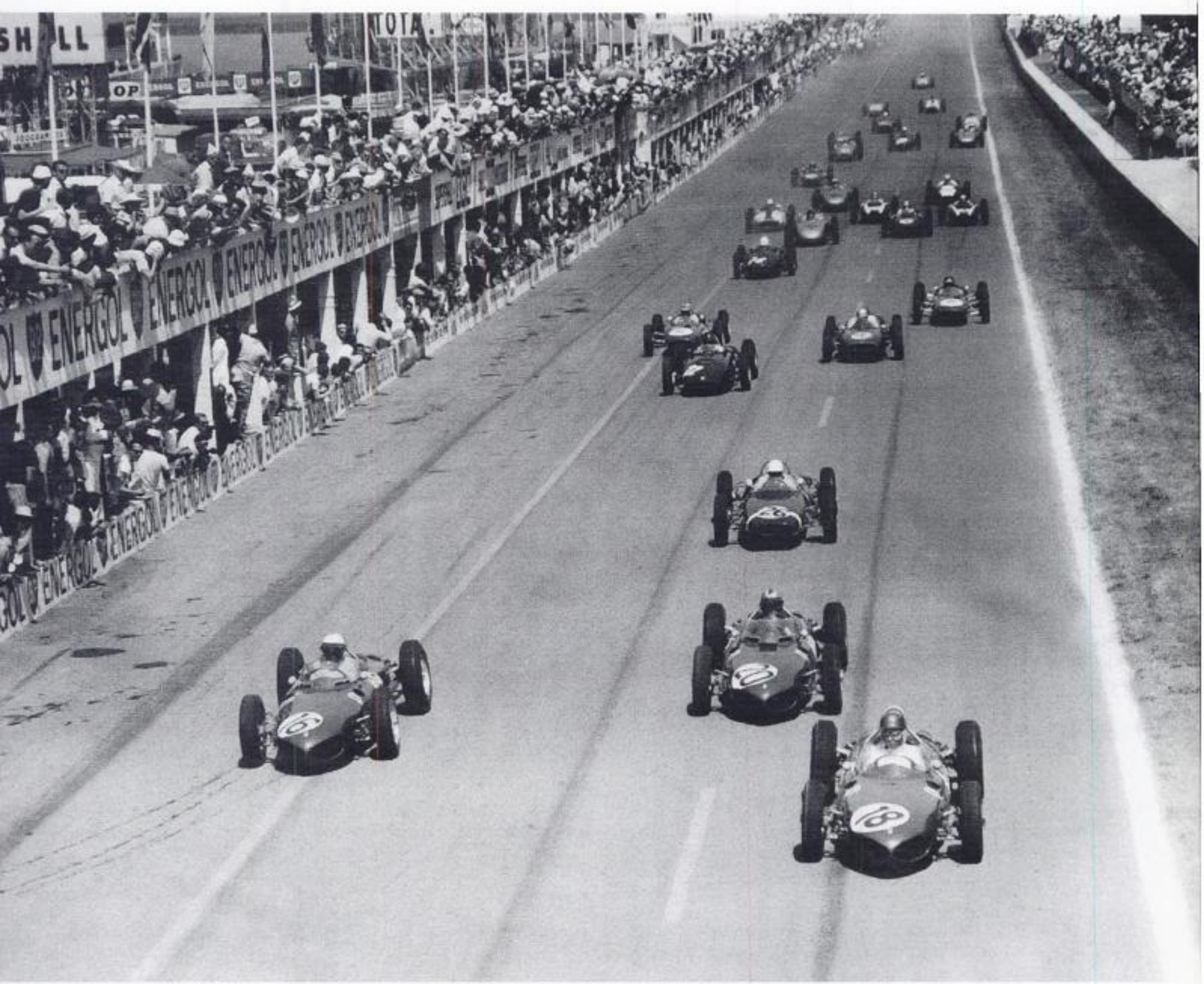
This is the first book that I have had published and I would like to thank Rod Grainger of Veloce Publishing for taking the gamble that other publishers were unwilling to risk.

All the photographs come from the archive of LAT Photographic, and I am indebted to Tim Wright and his team for their help and cooperation. LAT maintains the photographic archives of *MotorSport*, *Autocar*, *Motor* and *Autosport* magazines.

Paul Sheldon was kind enough to allow me to use data from *A Record of Grand Prix and Voiturette Racing* compiled by himself with Duncan Rabagliati. The 1½-litre formula is covered in volumes 7 and 8, and is the source of GP results and the data used to compile the chassis histories (updated where applicable to reflect new information) included in the Chassis Directory section.

The editor of *Autosport* has kindly allowed me to quote from contemporary editorials and race reports written by Gregor Grant.

I make no apology for being a keen fan of cutaway drawings. The drawings used to illustrate the profusion of contemporary technical articles published in *Autocar* magazine written by the



For many the 1½-litre formula was a new beginning, not least for Ferrari which was on the ball from day one with a new rear-engined chassis. Typifying the 1961 season, the Ferrari boys storm ahead from the start of the 1961 French GP at Reims. Ritchie Ginther leads Phil Hill and Wolfgang von Trips, with Stirling Moss (Lotus 18/21) clinging on a couple of lengths ahead of Graham Hill (BRM P57), Innes Ireland (Lotus 21), John Surtees (Cooper T53), Jim Clark (Lotus 21) and the rest.

late Harry Mundy and Edward Eves allowed a real insight into the F1 technology of the time and have no equal today. The 1½-litre F1 was well served by *Autocar* staff artists John Marsden, Dick Ellis, John Fisher, Vic Berris and John Ferguson, and their work is included in the book, providing a clearer illustration than a simple photograph. LAT sourced a number of these from the *Autocar* archive, others are from my own collection. The cutaway of the 1960 F2 Porsche by C O LaTourette is reproduced with the permission of Hachette Filipacchi Magazines Inc/*Car & Driver* archive.

James Allington was probably the most distinguished cutaway artist of the 1960s, and his drawings set the standard against which all others were judged. Despite every effort, it had not proved possible to contact him at the time of publication. Nevertheless, five of his drawings have been reproduced in this book, four with the permission of the *Car & Driver* archive, the fifth from the *Autosport* archive.

Finally, I should like to express my thanks to Raymond Baxter for writing the foreword. To describe Raymond as the Murray Walker of the 1950s and 1960s would serve to illustrate to those unfamiliar with him his standing in motor sport broadcasting of the time. It would, however, be a complete misnomer. To be accurate, Murray Walker was the Raymond Baxter of the 1980s and 1990s. In the days before global TV rights, the televising of a GP was an exception rather than the rule, it being completely at the behest of a combination of the organisers of the event, the broadcasting authority, Eurovision and the BBC TV schedulers. Nevertheless, when we were treated to a live broadcast, his was the distinctive, warm, polite yet informative and authoritative voice that welcomed us viewers to continental locations such as Monte Carlo, Monza or Reims on a Sunday afternoon.

Mark Whitelock
Flimwell, East Sussex

1 Setting the scene

A new Formula 1 is announced

On 29 October 1958, the motor racing community gathered at the Royal Automobile Club's Pall Mall headquarters in London for the presentation of the 1958 World Championship awards. For the first time this was to be an all-British affair, with Vanwall and Mike Hawthorn having won the Constructors' and Drivers' Championships respectively. Britain had at last established itself as a force in GP racing. At the end of the presentations, the RAC's Press Officer, Pat Gregory, read out the English text of a communiqué from M Auguste Perouse, the President of the Commission Sportive Internationale (CSI) of the Fédération Internationale de l'Automobile (FIA), the governing body of motor sport. The stunned audience heard that new F1 regulations would come into force on 1 January 1961, limiting engine capacity to 1½-litres. Furthermore, the CSI was determined to contain speeds and to prevent the construction of lightweight, potentially fragile racing cars by imposing a minimum weight limit of 500kg (1102lb).

The announcement was greeted with uproar from the British constructors. M Perouse, who was present that evening, was jeered and bombarded with questions and comments. It is difficult to comprehend this reaction nearly 50 years later as British interests would have been well served by the new F1. It was to be identical to the then current F2 that had been dominated by British constructors since inception. The general feeling seemed to be that the 'continentals' were ganging up on the British. More realistic was a concern that lower power cars would reduce the spectacle of GP races. It was said that British manufacturers would neither contemplate building the prohibitively expensive multi-cylinder power units that such a formula would require, nor the six speed gearboxes necessary to match their narrow power bands, as they had no practical applications commercially. Events, however, would prove otherwise.

France, a country with no representation in F1 at the time, had instigated the new formula. When the CSI committee met to consider the proposal, delegates from Monaco, Holland, France, Germany and Belgium had voted in favour. Britain and Italy, the only countries actively involved in F1 at the time, had voted for retention of the existing 2½-litre F1. The USA favoured a 3-litre limit and had abstained, while representatives from Sweden, Switzerland and Mexico had not attended. Consequently, the proposal had been carried by 5 votes to 2.

Quite why the CSI wished to change the formula is difficult to reason. The 2½-litre F1 had flourished since inception in 1954 and appeared able to continue to do so. Speeds had not approached unacceptable levels and yet they were to be contained. In later years, the FIA would be criticised for acting too late; in 1958 it appeared to be acting too soon.

The RAC Competitions Committee met two weeks later, on 12 November, and reported that the decision taken by the CSI was contrary to British interests. *Autosport* magazine reported that it was now "virtually certain that the new F1 would not be supported by Britain, Italy and the USA, but that it was not too late for the FIA to reverse its decision. If the plan proceeds, France, Holland and Germany may be without full scale F1 racing in 1961." The only redeeming factor was that the CSI had authorised Britain, Italy and the USA to propose another formula to suit their mutual interests. As a result, a proposal was put forward for an 'Inter-Continental' formula with a 3-litre limit that would also admit the existing 2½-litre machinery. British interests supported this in the hope that the 1½-litre F1 would fail due to lack of support. In the event, it was the Inter-Continental formula that lacked support, demonstrating that the British were out of step with their continental rivals and the CSI.

In February 1960, however, with less than eleven months to run before the new F1 came into force, British interests continued to speak out against it. On 10 March, the Society of Motor Manufacturers and Traders (SMMT), representing the British constructors, drivers, fuel and oil companies, and accessory and tyre manufacturers met in London. A statement was issued to the effect that its members would not support the FIA proposals for the new F1. It recommended that the new regulations should be rescinded and that the current F1 and F2 regulations should continue unchanged. *Autosport* informed readers that "the CSI ... has been called to account and either will have to reverse their original resolution or permit GP racing to deteriorate into an unimportant contest carrying no prestige whatsoever". The CSI did not respond to the SMMT statement.

Over the following months, the realisation gradually dawned on the British motor racing industry that the new F1 would be

implemented despite its protests. Constructors Cooper and Lotus relied heavily on Coventry Climax for power units but the meetings, strong words and general self-imposed uncertainty had served only to distract both Climax and BRM from designing suitable 1½-litre engines. Neither company started detailed design work until September 1960, and a raceworthy engine would not be seen until late 1961, well into the first year of the formula. Meanwhile Ferrari, despite its initial objections to the new formula, was noticeably silent. It was working away quietly on its experimental rear-engined chassis in 1½-litre form with encouraging results. Porsche was also readying itself for the step up from F2 to F1.

On 3 September 1960, British delegates met with the CSI to make a last ditch request for a twelve-month postponement of the new regulations. An alternative suggestion was made, asking that the 450kg minimum weight limit be reduced (in May the CSI had given in to British pressure and reduced it by 50kg). There was even a proposal that the World Championship should be made up of six GPs for 1½-litre and six for 2½-litre cars. There was a feeling, however, that it was most unlikely that there would be any change made, and this proved to be the case. M Perouse and his colleagues had not responded to the previous British protestations (apart from the 50kg weight reduction) and had been resentful of the attitude adopted by the SMMT. In addition, Britain was now totally isolated in its opposition, having lost any lingering support from Italy following the British teams' boycott of the Italian GP as they objected to the use of the combined road and banked circuit.

As anticipated, the CSI confirmed that the 1½-litre F1 would take effect from 1 January 1961, on schedule, since sufficient notice of change had been given. Suffice to say, the resolution made by the SMMT back in March was quietly forgotten and the new formula was fully supported by British constructors, drivers, fuel companies and tyre manufacturers alike. With all constructors now committed to running rear-engined chassis, it was perhaps fitting that a new formula should be introduced, almost tailor-made for the latest concept in race car design.

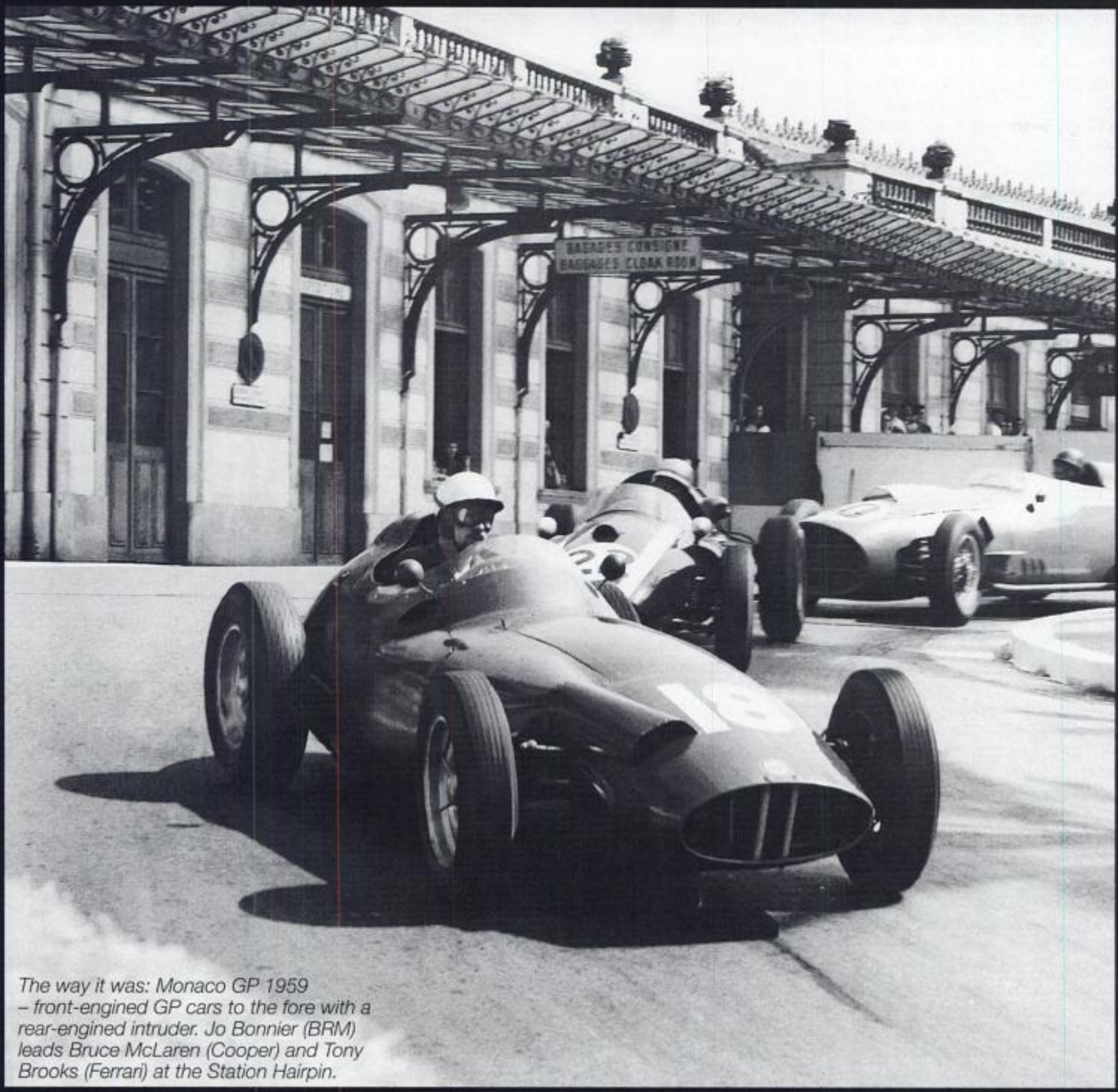
Grand Prix racing in the late 1950s

In the seven years from 1954 to 1960, Grand Prix racing had been run to regulations limiting engine capacity to 2½-litres. For the majority of that period, typical front-runners had been front-engined single-seaters from Ferrari, Maserati, Mercedes and Vanwall, battling for national prestige and running in their national colours. In 1958, however, revisions made to the regulations changed the shape of GP cars fundamentally. These revisions banned the use of alcohol-based fuels in favour of AvGas aviation spirit, reduced the minimum GP distance from 500 to 300km and the minimum duration from 3 to 2 hours. The switch to AvGas reduced power outputs but improved fuel consumption and, allied to the reduction in race distance, GP cars now needed to carry much less fuel than previously. This opened up the real possibility of a smaller and lighter car running a full GP without a stop for fuel or tyres. Such a car arrived in the shape of the British-built Cooper.

The Cooper Car Co was producing successful rear-engined single-seaters, powered by proprietary four-cylinder Coventry Climax engines, for the 1½-litre F2 category introduced in 1957. The Cooper had better weight distribution, a lower frontal area and better handling than the then conventional front-engined equivalents. If the Climax engine could be enlarged nearer to 2-litres, it was a logical step to progress into F1 where the Cooper's lighter weight would compensate for the shortfall in power, especially on tighter circuits. Stirling Moss proved the point by winning the 1958 Argentine GP in a 1960cc F2-based Cooper, outwitting his front-engined rivals by running non-stop while they stopped for fresh tyres. This was followed up by victory in the Monaco GP for Maurice Trintignant in a similar Cooper. Thereafter, front-engined cars regained their momentum, the Vanwalls of Stirling Moss and Tony Brooks fighting a season long duel with Mike Hawthorn's Ferrari, Hawthorn winning the 1958 World Drivers' Championship, and Vanwall the Constructors' title.

Vanwall retired from racing at the end of the season and the balance of power in GP racing swung away from the established manufacturers towards the smaller, British specialist constructors that Enzo Ferrari would disparagingly refer to as the 'garagistes'. Participation in GP racing by major motor manufacturers was no longer considered viable, principally on the grounds of cost. Ferrari and BRM alone survived as manufacturers, while Cooper and Lotus represented the specialist constructors that built their own chassis but purchased engines, transmissions and other components from proprietary suppliers. In fact, it was only the availability of competitive, off-the-shelf engines from Coventry Climax that made their participation possible. Under pressure from these customers, Coventry Climax enlarged the FPF engine to a full 2½-litres for the 1959 season. In this form it produced only 'adequate' power – 243bhp against the claimed 280bhp of its major rival, the Ferrari Dino 246. It did possess advantages, however, in its ability to produce far higher torque over the middle speed range than its rivals, enabling greater acceleration away from corners and making it less demanding in terms of the number of gear changes required. The Cooper chassis was lower, lighter and more responsive than its rivals, particularly those with front-engines. Separately, the FPF and Cooper were ineffective, but when combined into a single package they became such a dominant force that they quickly brought about the 'rear-engined revolution' in F1.

There was nothing new about installing the engine behind the driver. Benz had done it in 1923 with the Tropfenwagen GP



The way it was: Monaco GP 1959 – front-engined GP cars to the fore with a rear-engined intruder. Jo Bonnier (BRM) leads Bruce McLaren (Cooper) and Tony Brooks (Ferrari) at the Station Hairpin.

car and Auto Union from 1934. Unfortunately, the spectacular Dr Ferdinand Porsche-designed V16 A, B and C type Auto Unions were flawed by the use of swing axle type rear suspension, the handling characteristics of which were mastered by only a few talented drivers. The popular misconception was that placing the driver so far forward in the chassis delayed his awareness of, and reaction to, incipient tail slide. The subsequent V12 D type Auto Union, designed after Dr Porsche had moved on, was a vast improvement. De Dion rear suspension had replaced the swing axles and the cars were significantly more controllable but, because of the earlier problems, the rear-engine concept had been discredited. This held sway for another 20 years until Cooper showed that the concept was vastly superior by winning five GPs in both the 1959 and 1960 seasons, and taking consecutive Constructors' Championships.

The new 1½-litre F1 regulations came into effect from 1 January 1961 but Cooper's advantage would not persist, as now all F1 constructors had adopted the rear-engined layout and enjoyed, to a greater or lesser extent, the advantages that the Cooper chassis had demonstrated; that is to say they were lighter, softer sprung and more responsive than anything previously and could be cornered with precision rather than in dramatic four-wheel drifts.

Race car technology in 1961

Engine development

The situation that had allowed Cooper and the 4-cylinder Coventry Climax engine to prosper in the latter years of the 2½-litre F1 had a side effect in that engine development had, to some extent, stagnated. The only multi-cylinder engine remaining in use was the Ferrari Dino 246, the performance of which was hindered by an inadequate, front-engined chassis. The reduction in engine capacity from 2½ to 1½-litres imposed a theoretical loss of 40 per cent in power with a commensurate reduction in torque. With so much less performance, a far greater proportion of the engine's outright power output became useable because so many corners on the majority of circuits could now be taken at full throttle in top gear. Henceforth, outright engine power would be more important than torque and a 4-cylinder engine would no longer be sufficient to win a GP under the new regulations, except under exceptional circumstances. The route to higher power was via increased crankshaft speeds but, in the case of the Climax 4-cylinder engine, this was restricted by the valve gear's speed limitations and stress considerations in connecting rods and pistons. To obtain an adequate increase in power with reliability, it would be necessary to reduce the inertia of the reciprocating parts by a reduction in their dimensions, i.e. a greater number of smaller cylinders. Eight cylinders was initially the logical choice, a conclusion reached by all the major engine designers.

By 1961, far more sophisticated tyres with improved levels of grip were coming on stream from Dunlop and it became clear that lesser power outputs placed more emphasis on realising performance advantages from matching these tyres to equally sophisticated suspension systems and rigid chassis. Significantly, it was British specialist chassis constructors, rather than the established F1 manufacturers, that pioneered the developments in suspension and chassis technologies.

Tyre developments

The new formula opened with the British Dunlop tyre manufacturer as the sole supplier of race tyres to the competing teams, a position it had assumed since the end of 1959. In such a situation development might well have stagnated but, rather to the contrary, Dunlop made dramatic advances in race tyre technology over the course of the new formula.

In the late 1950s, Dunlop had introduced a tyre with a nylon ply carcass in place of the then normal cotton carcass. This tyre had greater flexibility to match the road surface and its lighter construction not only saved about 12lb per tyre but also gave cooler running. These factors contributed to better grip and the potential to reduce tyre pressures down from a typical 50psi to as low as 32psi to suit car and driver preferences. Development continued on carcass technology, and, in 1959, Dunlop introduced the lower profile R5 tyre. This had an aspect ratio of around 70 per cent (i.e. the section height was 70 per cent of the section width, giving a tyre that was wider than it was high), previous tyres having had a typical ratio of 100 per cent. Rear tread width was just over 4 inches.

For the 1961 season, Dunlop had the nylon carcass R5 tyre available in a number of compounds: D9 – for normal use, D10 – harder compound for abrasive surfaces and D11 – harder again, for extreme conditions. Softer compounds provided better grip but at the expense of faster wear. In April, prior to the start of the GP season, Dunlop introduced the D12 compound, designed specifically for really bad weather conditions.

Dunlop had spent some considerable time in developing the softer D12 compound, the first race tyre to feature a synthetic rubber tread in a high hysteresis (i.e. its capacity to absorb energy) compound. It offered startling degrees of grip in the wet, with a 20 per cent increase in braking efficiency and considerable improvements in reducing rear-end breakaway in corners. While the synthetic rubber could be run to higher temperatures, it needed the cooling effect of a wet track to keep the temperature and wear rate under control. All the R5 tyres, including the D12, featured identical construction and tread pattern. Normal usage for 1961 would be the D9 for dry and D12 for wet conditions, all mounted on 15in diameter wheels. The D12, identifiable by a green 'spot' on the sidewall, was intended only for races starting on a wet track.

The developments in tyre technology had increased cornering forces from about 0.75g in the mid-1950s to approaching 1.0g by 1961, and it was important to realise the performance advantage these improved levels of grip offered.

Suspension technology

The availability of improved grip would have little significance without adopting a scientific approach to suspension design. The main purpose of the suspension is to maintain maximum tyre contact between all four wheels and the road surface. Put simply, the wheels must be kept upright at all times, failure to do so would result in loss of traction or grip. During cornering, a large proportion of the weight of the car is transferred on to its outside wheels and the car tends to roll, promoting 'positive' camber (i.e. the outward inclination of the wheels from the vertical) and loss of cornering power. Control of chassis roll and camber occupied the minds of suspension designers in the late 1950s, the ideal being to achieve a situation in which camber change was independent of chassis roll. This was pursued through the progressive development of wishbone suspension linkages, firstly by way of equal length parallel wishbones, then unequal length wishbones. By 1961, the adoption of unequal length, non-parallel wishbones had made it possible to exercise almost total control over the wheels and for them to be kept virtually upright under all conditions of body roll.

With this level of control, camber could be used to achieve maximum tyre contact with the road surface during suspension movement and chassis roll. An element of 'negative' camber (inward inclination of the wheel) could be built into the suspension geometry when static that would reduce to zero under cornering loads. Dunlop called for strict control over camber with its tyres, however, as anything more than 1.5° negative camber when static would cause the outside edge of the tyre to overheat and have the car leaning on its tyres in a corner rather than generating true cornering force.

Springs help ensure that the tyres remain firmly in contact with the road surface throughout cornering and maintain chassis ride height. In the front-engined era, stiff suspension was considered essential to restrict body roll and pitching, and compensate for the flexing chassis of the period but at the expense of the wheels losing contact with the road on uneven surfaces. By 1961, improvements in suspension design and chassis rigidity had seen the adoption of soft springs that, in conjunction with efficient shock absorbers, allowed considerable wheel movement on uneven surfaces while maintaining tyre contact with the road surface.

The maintenance of stability of the chassis under all conditions was essential and the design of the suspension had to take account of a number of requirements, including roll centre heights, roll stiffness, camber settings, weight transfer, spring rates and shock absorber settings together with basic chassis concepts of weight, weight distribution and centre of gravity. All these factors worked together but did not necessarily function in harmony and the suspension design would inevitably be a compromise. An added complication was the different character of each GP circuit and the desire to match the car to each one to realise the full potential offered from tyre, engine and chassis performance. Clearly this level of control could only be achieved by including provision for adjustment to the suspension by way of alternative pick up points, threaded linkages, alternative spring rates and anti-roll bars, etc. Within the early minutes of a practice session, suspension settings could be adjusted to match the conditions of any given circuit.

If the suspension settings dialled into the chassis were to maintain their geometrical accuracy under conditions of acceleration, braking and cornering, the suspension linkages needed to be firmly attached to a rigid chassis. Only a fractional movement of a suspension pick up point due to a flexing chassis was sufficient to rubbish the settings, and a torsionally stiff chassis was crucial, a factor not necessarily fully appreciated by all constructors.

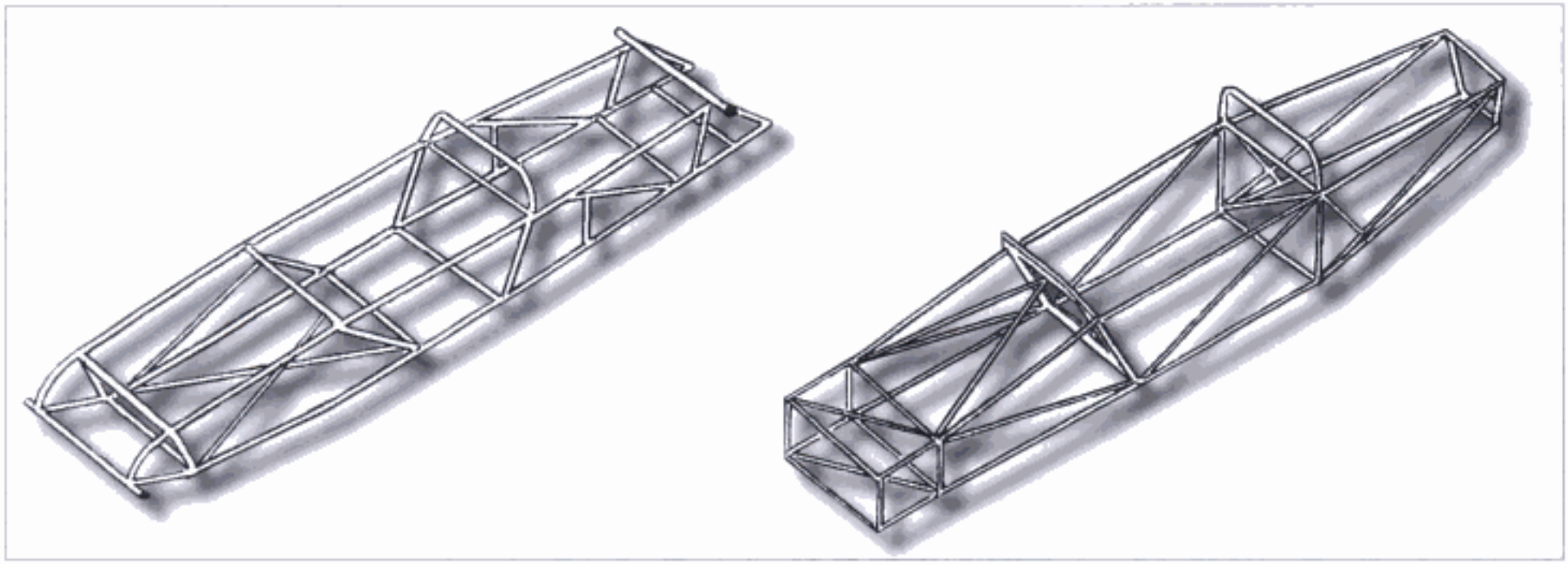
Chassis technology

The purpose of the chassis is to provide suitable mounting points in a structure that is rigid in both bending and torsion for all the component parts of the car, including the engine and transmission, front and rear suspension, radiator in the nose, fuel tanks, seat, and controls, and it was the disposition of these components that decided the design of the chassis. The new F1 opened with all the major constructors utilising tubular chassis of two basic types:

a) Multi-tubular

This term describes a chassis utilising four main longitudinal steel tubes as the basis of the structure, but cannot be classified as a space frame. Relatively large section tubes, typically 1½in 18-gauge mild steel tube, were necessary to achieve stiffness from welded joints and torsional rigidity in individual members. Load capacity in bending was generally adequate provided there was sufficient diagonal bracing to prevent lozenging. Even so, the multi-tubular frame was significantly lower in efficiency than a true space frame and, of necessity, considerably heavier. It also tended to be difficult to maintain dimensional accuracy during manufacture. The frame was more liable to structural failure than a space frame and could be difficult to repair, even after only minor impacts, as loads were transmitted through the frame rather than restricted to a single area. Despite these disadvantages, Cooper and Ferrari utilised multi-tubular chassis at the outset of the new formula.

Cooper had won back-to-back Championships in 1959 and 1960, although this owed more to a lower weight, smaller frontal



Chassis technology in the early 1960s.
Simplistic drawings illustrating the general principles of (left) the multi-tubular chassis, deriving its strength from large section steel tubing with only minimal diagonal bracing. By comparison, the space frame (right) is constructed from relatively small diameter tubing but is fully triangulated and supplemented by a stressed undertray (not shown) to provide the necessary rigidity.

area and higher cornering power than to chassis excellence. The Cooper chassis defied many structural laws including the location of suspension and engine mounting brackets part way along tubes, thus taking loads directly into those members. There was a shortage of cross-bracing; most of what there was being located towards the front of the chassis. Nevertheless, the chassis was thoroughly practical, accommodating all the components in a simple package.

b) Space frame

The most efficient type of tubular frame was the space frame, in which relatively small diameter steel tubing was utilised in a fully triangulated structure to provide both adequate torsional rigidity and rigidity in bending. For practical purposes, the structure was split into three bays, each fully triangulated with the exception of the cockpit opening (to allow driver access). To overcome this, the corners of the cockpit might be braced with additional secondary tubing. The engine bay would be braced with a detachable member to permit engine installation and removal. Bays were separated from each other by bulkheads for the front suspension, scuttle, seat back and rear suspension. Where it was not possible to fully triangulate a bulkhead, as for example at the scuttle where the driver's legs needed to pass through it, a 'perforated hoop' type bulkhead might be employed. This would be fabricated from two smaller diameter tubular hoops, one within the other, joined by perforated sheet steel.

Normal material usage would be 1in diameter mild steel tubing of 16- or 18-gauge with lighter stressed members in 3/4in 18-gauge tube. The well-made space frame was durable and able to absorb impacts progressively, as damage would be limited to the bay sustaining impact. The frame was more expensive to manufacture because of the number of tubes used and the amount of welding involved, but the very best use was made of materials and it was somewhat lighter than a multi-tubular frame.

The space frame chassis was used by BRM, Porsche and, in particular, Lotus where Colin Chapman had been instrumental in its wider use in race car construction, being one of the few designers to appreciate the importance of chassis design.

Fuel tanks

The majority of multi-tubular or space frame chassis cars carried their fuel in fabricated aluminium tanks mounted pannier fashion on either side of the chassis. Many of these tanks were a complex example of the panel beater's art, shaped to fit around and between frame tubes. The outer skins doubled as bodywork so as to provide maximum capacity within a minimum overall width. Supplementary tanks could be located behind the driver's seat and above his legs to give a capacity of around 30 gallons, sufficient to run a GP non-stop.

The regulations

Formula 1 World Championship races were to be run, for the first

Formula 1 regulations

1. The engine capacity is fixed at a minimum of 1300cc and a maximum of 1500cc. No supercharging is allowed and commercial pump fuel is to be used. This grade of fuel is to be defined by the Fédération Internationale de l'Automobile which means, in practice, that it is equivalent to Super Premium grades with an octane rating of 100 (research).
2. Minimum weight of car to be 450kg (991lb or 8.9cwt). This weight includes the car in full running order, complete with all oils and coolants, but with empty fuel tanks.
3. An 'automatic' starter is compulsory and must be used for starting the engine on the grid and after any subsequent pit stop. This starter must be operated by the driver when seated at the steering wheel and its source of energy – electric or otherwise – must be carried on the car.
4. An electrical master switch must be fitted working either automatically or operated by the driver.
5. The driver's seat position must be so arranged that it can be occupied or left without the necessity for opening a door or removing a panel.
6. There must be attachment points for a safety belt, but the wearing of this is optional.
7. A safety roll-protection bar must be fitted, complying with the following conditions: (a) not overhanging the driver's head; (b) exceeding in height the driver's head when he is seated at the steering wheel; (c) exceeding in width the driver's shoulders when he is seated at the steering wheel.
8. All wheels must be exposed and the bodywork must not cover them in any plane, even when the front wheels are on full lock.
9. A dual-braking system must be fitted, operated by the same pedal and arranged so that, should a pipe fracture or a brake fail, there will always be braking on the front wheels at least.
10. Fuel tank fillers must not protrude beyond the body panels. The diameter of these fillers must be large enough to allow air to escape when being filled by a pressure hose. Any tank breathers must be arranged to make it impossible for fuel to escape with the air.
11. No oil may be added to the car at any time during the race; oil fillers and water fillers must be fitted with attachment points for seals. Breakages of these seals on the oil tank will lead to disqualification, but those on the radiator may be removed at any pit stop.

time, to a set of rather rigid rules. These rules, as published in *Autocar* on 14 April 1961, are reproduced alongside.

Races counting towards the World Championships for both drivers and constructors were to be of a maximum distance of 500km (310.7 miles) and a minimum of 300km (186.4 miles), subject to a minimum duration of two hours.

For the Drivers' Championship, points were awarded to the first six finishers on a 9-6-4-3-2-1 basis in order. To qualify, a driver had to finish the race in the car in which he started.

The Constructors' Championship awarded points to a constructor's highest finisher in the first six, with points awarded on an 8-6-4-3-2-1 basis in 1961. This increased to 9 points for a win, in line with the Drivers' Championship, from 1962 onwards. In situations where the chassis constructor employed an engine from another manufacturer, championship points were awarded to the chassis constructor. Where chassis constructors employed more than one manufacture of engine, each chassis/engine combination was counted as a different contestant for the Constructors' Championship.

Each year a driver or constructor could only score in a specified number of points finishes. In the period covered by the 1½-litre F1 this proved to be:

- the best 5 results out of 9 or less qualifying races;
- the best 6 results out of 10 qualifying races.

2 1961 – Ferrari sets the pace

It was not uncommon in the 1950s for new engines to be slow in appearing following the introduction of new F1 regulations, despite adequate notice of the change having been given. This was particularly true in 1961 of the British engines for the new 1½-litre F1, delayed while the British racing industry had wasted much of 1959 and 1960 attempting to persuade the CSI to reverse its decision. These wasted months had left the British teams without competitive engines, neither BRM nor Coventry Climax having started design work on new 1½-litre power units until autumn 1960. Their new V8 engines would not be ready until late in 1961 at best, more probably early 1962. 1961 would, therefore, be a somewhat interim season for the British contenders and uniquely, each one – including BRM – would be using the four-cylinder Coventry Climax FPF engine. This engine, originally designed in 1957 for the then new F2, would be available in an extensively modified Mk II form.

Nevertheless, Britain was set to be well represented in the new formula with entries from BRM, Cooper and Lotus, supported by a number of private teams such as those of Rob Walker, Yeoman Credit and UDT-Laystall. There was an optimistic feeling that Britain would be in a strong position to take top honours for a third year in succession, although foreign competition was likely to be more significant. Indeed, in its technical appraisal of cars for the new formula, *Autocar* wrote that Cooper must have "every confidence for a hat-trick of Constructors' and Drivers' Championships" although it would "undoubtedly experience sterner opposition from Ferrari and Porsche than previously".

In Germany, Porsche was preparing to make its F1 debut. Having made its name in up-to-2-litre endurance and sports car racing, it was a relatively easy and logical step to move into the F2 category in 1957 with a converted sports car. The first single-seater Porsche appeared in 1959, and a spasmodic F2 programme undertaken in that year, and a fuller one in 1960, indicated that, with its unique air-cooled, horizontally-opposed power unit, it was the equal of the British Coventry Climax-powered rivals. The transition from F2 to F1 was expected to be relatively painless and, in early 1961, details had been announced of a new 8-cylinder engine, once again with air-cooled, horizontally-opposed cylinders. The engine would not be ready until later in the year, in the meantime the 4-cylinder F2 engine would be run in a new chassis.

Although initially against it, Ferrari was the only constructor fully prepared for the new F1 and was confident of being in a strong position. The Italian constructor had been quietly working away on its prototype rear-engined chassis which had first raced at Monaco in 1960. Testing and development of the chassis in 1½-litre F2 form continued throughout the year with some success, notably with a win in the 1960 Solitude GP against a strong Porsche entry. The definitive 1961 car, with dramatic

They're off: first lap of the first Grand Prix under 1½-litre regulations. Jim Clark (Lotus 21) leads Stirling Moss (Lotus 18), Dan Gurney (Porsche 718) and the rest up the hill from Ste Dévote to Casino Square.

'Sharknose' styling and (virtually) new wide angle 120° V6 engine, was shown to astounded journalists attending the Ferrari press conference at Maranello in February 1961. Ferrari would enter a three-car team in 1961, supplemented by additional entries for occasional guest drivers. Regular drivers would be Phil Hill, Ritchie Ginther and Graf Berghe Wolfgang von Trips. Hill and Ginther were Californians with successful careers behind them in US West Coast sports car racing. Hill had established himself as an extremely proficient endurance race driver for Ferrari and had been on the F1 team since late-1958. Ginther had arrived in Europe at the beginning of 1960, joining his friend Hill at Ferrari. With a talent for test and development work, he had put in a lot of work on the 1961 Ferrari. By contrast, German aristocrat 'Taffy' von Trips had an almost legendary lack of interest in technical matters. His F1 career had begun in 1958 but had been punctuated by several heavy accidents, earning him a reputation as a car wrecker. During 1960, however, he had shown a new maturity and, having chosen to stay with Ferrari rather than switch to Porsche, looked forward to a competitive season.

The early season non-Championship F1 races in Britain lacked any foreign representation and had not, therefore, given any indication of the prospects for the GP season ahead. The first race with a representative grid was the Syracuse GP in Sicily. This had demonstrated that the new 'Sharknose' Ferrari was a force to be reckoned with, even in the hands of the relatively unknown Italian Giancarlo Baghetti. Driving the 1960 development chassis with a 65° V6 engine, Baghetti had beaten the factory Porsches into second and third places. It appeared that the British teams, following breathlessly in the remaining places, could look forward to a long, hard season.

The 1½-litre F1 era opened in earnest at Monaco on 14 May 1961, and would provide Stirling Moss with the opportunity to demonstrate his acknowledged skills, as he took on the Ferrari team in a thrilling contest around the streets of the principality. Moss was universally acknowledged as the man to beat, a title he had inherited from Juan Fangio following the latter's retirement in 1958. He had been a regular GP driver since 1954 and had been runner-up in the World Championship from 1955-58. Any of the factory teams would have welcomed him onto their books and yet he preferred to drive for his friend, the private entrant, RRC (Rob) Walker.

Walker, the great-great-grandson of Johnny Walker of whisky fame, had raced both before and after World War II until

1961 World Championship – Round 1

Monte Carlo 14 May 1961 100 laps
Starters 16 **Finishers** 10

	Driver	Entrant	Car	Laps	Result
1	S Moss	RRC Walker Racing Team	Lotus 18 Climax 4	100	2h 45m 50.1s
2	R Ginther	Ferrari SpA SEFAC	Ferrari 156/61 120° V6	100	2h 45m 53.7s
3	P Hill	Ferrari SpA SEFAC	Ferrari 156/61 65° V6	100	2h 46m 31.4s
4	W von Trips	Ferrari SpA SEFAC	Ferrari 156/61 65° V6	98	DNF – ignition
5	D Gurney	Dr Ing hc F Porsche KG	Porsche 718 F4	98	
6	B McLaren	Cooper Car Co	Cooper T55 Climax 4	95	
7	M Trintignant	Scuderia Serenissma	Cooper T51 Maserati 4	95	
8	C Allison	UDT-Laystall Racing Team	Lotus 18 Climax 4	93	
9	H Herrmann	Dr Ing hc F Porsche KG	Porsche 718 F4	91	
10	J Clark	Team Lotus	Lotus 21 Climax 4	89	
	J Surtees	Yeoman Credit Racing Team	Cooper T53 Climax 4	68	Engine
	J Bonnier	Dr Ing hc F Porsche KG	Porsche 787 F4	59	Fuel injection
	C A S Brooks	Owen Racing Organisation	BRM P57 Climax 4	54	Engine
	M May	Scuderia Colonia	Lotus 18 Climax 4	42	Oil leak
	J Brabham	Cooper Car Co	Cooper T55 Climax 4	38	Ignition
	G Hill	Owen Racing Organisation	BRM P57 Climax 4	11	Fuel pump

Winner's speed 70.70mph (113.787km/h)
Fastest lap Moss & Ginther 1m 36.3s, 73.13mph (117.570km/h)

Championship placings

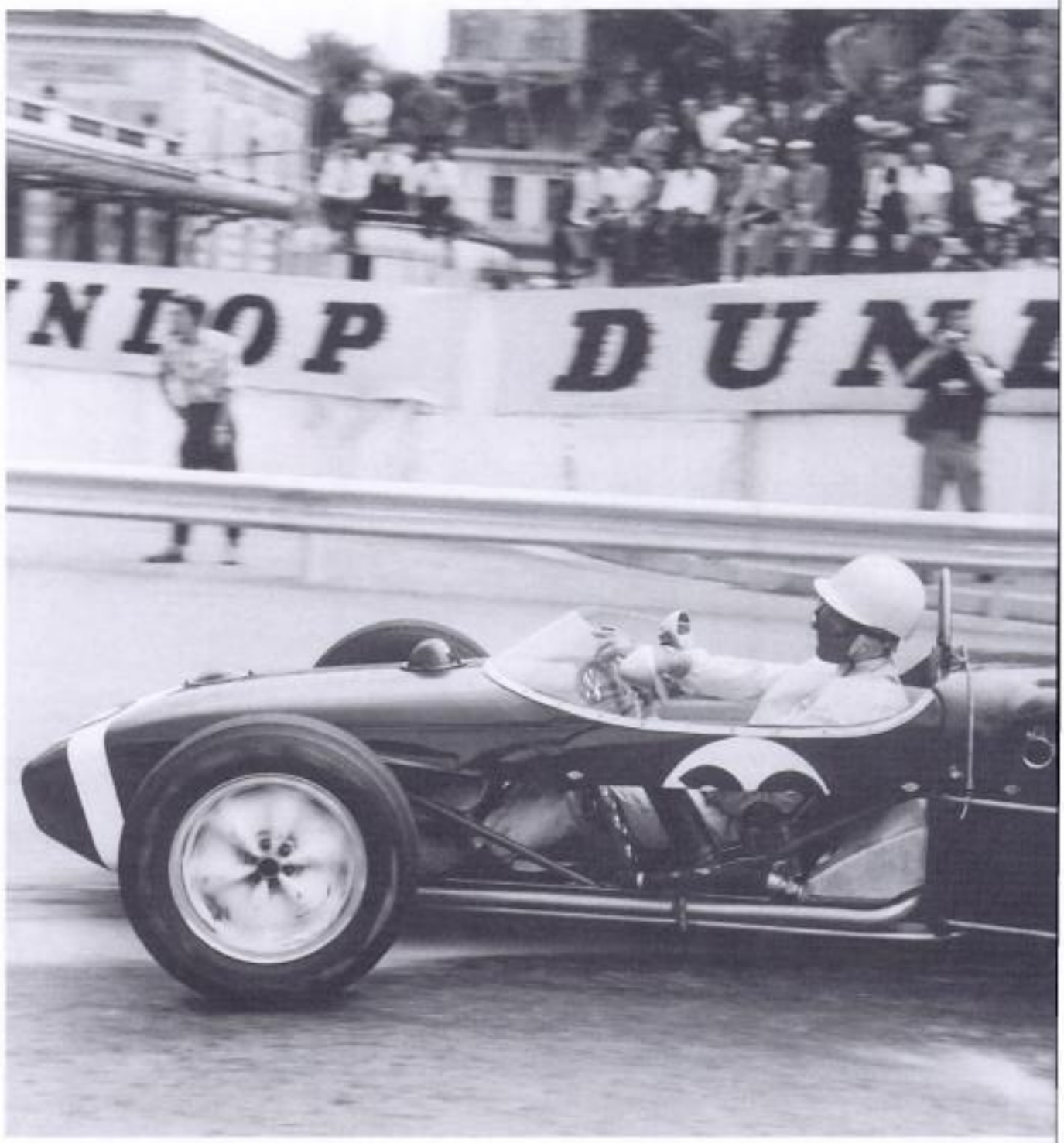
Drivers		Constructors	
1. Moss	9	1. Lotus	8
2. Ginther	6	2. Ferrari	6
3. P Hill	4	3. Porsche	2
4. von Trips	3	4. Cooper Climax	1
5. Gurney	2		
6. McLaren	1		

Grand Prix de Monaco

195.42 miles (314.50km)
Weather Warm and hazy

Grid

Clark 1-39.6	Ginther 1-39.3	**Moss 1-39.1**
P Hill 1-39.8		G Hill 1-39.6
Brooks 1-40.1	McLaren 1-39.8	von Trips 1-39.8
Gurney 1-40.6		Bonnier 1-40.3
May 1-42.0	Herrmann 1-41.1	Surtees 1-41.1
Trintignant 1-42.4		Allison 1-42.3
		Brabham 1-44.0



Monaco GP, Monte Carlo, 14 May 1961. Master and commander: Stirling Moss (Walker Lotus 18), at the peak of his powers, rounds the Station Hairpin in his epic defeat of the Ferrari team. Note that the side panels have been removed to keep him cool during the long, hot race.

retiring from driving as a promise to his wife on their marriage. He began entering cars for other drivers from his Pippbrook garage base in Dorking, Surrey; the cars were immaculately turned out in dark blue with a white noseband. In 1958, Moss started to drive Walker Coopers when his commitments permitted, and, from 1959, he drove for Walker full time. Between 1958 and 1960 the Walker team won six GPs, giving both Cooper and Lotus their first GP victories. The Polish-born Alphons Kovaleski ('Alf Francis'), a gifted engineer who had maintained Moss' cars between 1953 and 1957, headed the Walker mechanics in whom Moss had complete confidence. Moss would be driving a Lotus 18 in 1961, a year old chassis as the 1961 Lotus 21 was not available to him due to conflicting fuel contracts – Moss was contracted to BP while Team Lotus was with Esso. The Climax-powered Lotus faced the Ferraris with a 30bhp power deficit.

At the fall of the starters flag, Ginther, in the sole Ferrari with the 120° V6 engine, took the initiative from the middle of the front row to lead the opening laps through the Monte Carlo streets. Moss moved ahead on lap 13, followed by Jo Bonnier's Porsche, Ginther being ordered to allow the slower starting Phil Hill to lead the challenge. Hill was in second by quarter distance and Ginther got ahead of Bonnier again so that, by half distance, the two Ferraris were running nose-to-tail 8sec behind Moss. Hill and Ginther piled on the pressure to reduce the gap to 3.8sec by lap 60, but after another 10 laps Moss, appreciably quicker through traffic, was drawing away again. On lap 75, Ginther, able to lap faster than Hill, was signalled to pass him and go for Moss. On lap 84 he set an inspired new lap record, nearly 3sec faster than pole position and a tenth quicker than the old 2½-litre record. Moss responded immediately and equalled Ginther's time, driving superbly and as hard as he could to keep his lead. The crowd was enthralled by the duel as Ginther closed on Moss but could finish no closer than 3.6sec to him. Like Moss, Ginther would describe this as the race of his life, knowing that to do well against Moss the maestro was to do well indeed. Baghetti's win at Syracuse had indicated the potential of the new Ferraris, but the superior skill of Moss, allied to the more nimble, better handling Lotus, had more than compensated for the additional 30bhp developed by the V6 engines. It had been one of the greatest GPs of all time.

How much better would Ferrari perform on the sweeping curves of Zandvoort, scene of the Dutch GP, on Whit Monday,

Monaco GP, Monte Carlo, 14 May 1961. Pursuit: Ritchie Ginther (Ferrari 156 120° V6) is released to go after Moss but finished 3.6sec behind.

damaged his chassis trying a little too hard having already set third fastest time. The Lotus was the state-of-the-art Climax-engined car of the year, being ultra slim and, with the driver reclining in his seat, the lowest as well. 1961 was to be Clark's first full GP season, and Zandvoort gave a hint of the considerable talent that would take the 25 year old Scot to a dominant position in F1 from 1962. Clark's performance netted him third place, with Moss taking fourth from Ginther in the final laps when the Ferrari's throttle return spring broke.

While there might have been some lingering doubt as to the outcome of the Dutch GP, few would have doubted that the extra power of the Ferraris would be a decisive factor in the Belgian GP on the super-fast Spa-Francorchamps circuit. This proved to be the case, as the scarlet cars were never challenged, either in practice or the race. On this occasion, a fourth Ferrari, with 65° V6, was entered, nominally by Equipe National Belge in Belgian racing yellow but tended by factory mechanics. The driver was the Belgian Olivier Gendebien, a Ferrari endurance racing specialist who had won his third Le Mans 24 Hours on the previous weekend, partnered by Phil Hill. He had only run in F1 only eight days away? This event would earn a special place in history as the only GP with a 100 per cent finishing record – all 15 starters finishing with not a single pit stop or incident. All the teams managed to prepare their cars in time, although Ferrari arrived late and missed the Saturday morning training session. This did not prevent it dominating the front row of the grid, with Phil Hill on pole on a circuit never ideally suited to Ferrari handling characteristics. Von Trips had had a quiet run into fourth place at Monaco despite ignition failure in the closing laps. At Zandvoort he converted his centre spot on the front of the grid into an immediate lead and was never headed. Hill had a problem with his clutch pedal on the warm-up lap and, despite a quick repair, pedal movement was erratic. This enabled Jim Clark in the new Lotus 21 to scrap with him for second for the major part of the race. Clark was noticeably quicker around the back of the circuit but lost out on the straight. Eventually, Hill pulled clear to close to within 1sec of von Trips at the finish, the Lotus' handling deteriorating as its fuel load reduced.

Lotus had introduced its sleek new type 21 at Monaco, although not without incident. In practice, Innes Ireland wrote-off one chassis in an accident in which he broke a leg, while Clark

Dutch GP, Zandvoort, 22 May 1961. Jim Clark (Lotus 21) makes a nuisance of himself by disputing second place with Phil Hill (Ferrari 156 120° V6) during the early stages.

1961 World Championship – Round 2

Zandvoort 22 May 1961 75 laps
Starters 15 **Finishers** 15

	Driver	Entrant
1	W von Trips	Ferrari SpA SEFAC
2	P Hill	Ferrari SpA SEFAC
3	J Clark	Team Lotus
4	S Moss	RRC Walker Racing Team
5	R Ginther	Ferrari SpA SEFAC
6	J Brabham	Cooper Car Co
7	J Surtees	Yeoman Credit Racing Team
8	G Hill	Owen Racing Organisation
9	CAS Brooks	Owen Racing Organisation
10	D Gurney	Dr Ing hc F Porsche KG
11	J Bonnier	Dr Ing hc F Porsche KG
12	B McLaren	Cooper Car Co
13	T Taylor	Team Lotus
14	G de Beaufort	Ecurie Maarsbergen
15	H Herrmann	Ecurie Maarsbergen

Winner's speed 96.23mph (154.828kp/h)
Fastest lap J Clark 1m 35.5s, 98.23mph (158.060km/h)

Championship placings

Drivers		Constructors	
1. Moss	12	1. Ferrari	14
von Trips	12	2. Lotus	12
3. P Hill	10	3. Porsche	2
4. Ginther	8	4. Cooper	2
5. Clark	4		
6. Gurney	2		
7. McLaren	1		
Brabham	1		

Grote Prijs van Nederland

195.41 miles (314.47km
Weather Sunny but windy

Car	Laps	Result
Ferrari 156/61 120° V6	75	2h 01m 52.1s
Ferrari 156/61 120° V6	75	2h 01m 53.0s
Lotus 21 Climax 4	75	2h 02m 05.2s
Lotus 18 Climax 4	75	2h 02m 14.3s
Ferrari 156/61 120° V6	75	2h 02m 14.4s
Cooper T55 Climax 4	75	2h 03m 12.2s
Cooper T53 Climax 4	75	2h 03m 18.8s
BRM P57 Climax 4	75	2h 03m 21.9s
BRM P57 Climax 4	74	
Porsche 787 F4	74	
Porsche 787 F4	73	
Cooper T55 Climax 4	73	
Lotus 18 Climax 4	73	
Porsche 718 F4	72	
Porsche 718 F4	72	

Grid

Ginther 1-35.9 | von Trips 1-35.7 | **P Hill 1-35.7**
G Hill 1-36.3 | Moss 1-36.2
Brooks 1-36.8 | Brabham 1-36.6 | Gurney 1-36.4
Clark 1-36.9 | Surtees 1-36.8
McLaren 1-38.2 | Herrmann 1-38.0 | Bonnier 1-37.1
de Beaufort 1-39.8 | Taylor 1-39.5

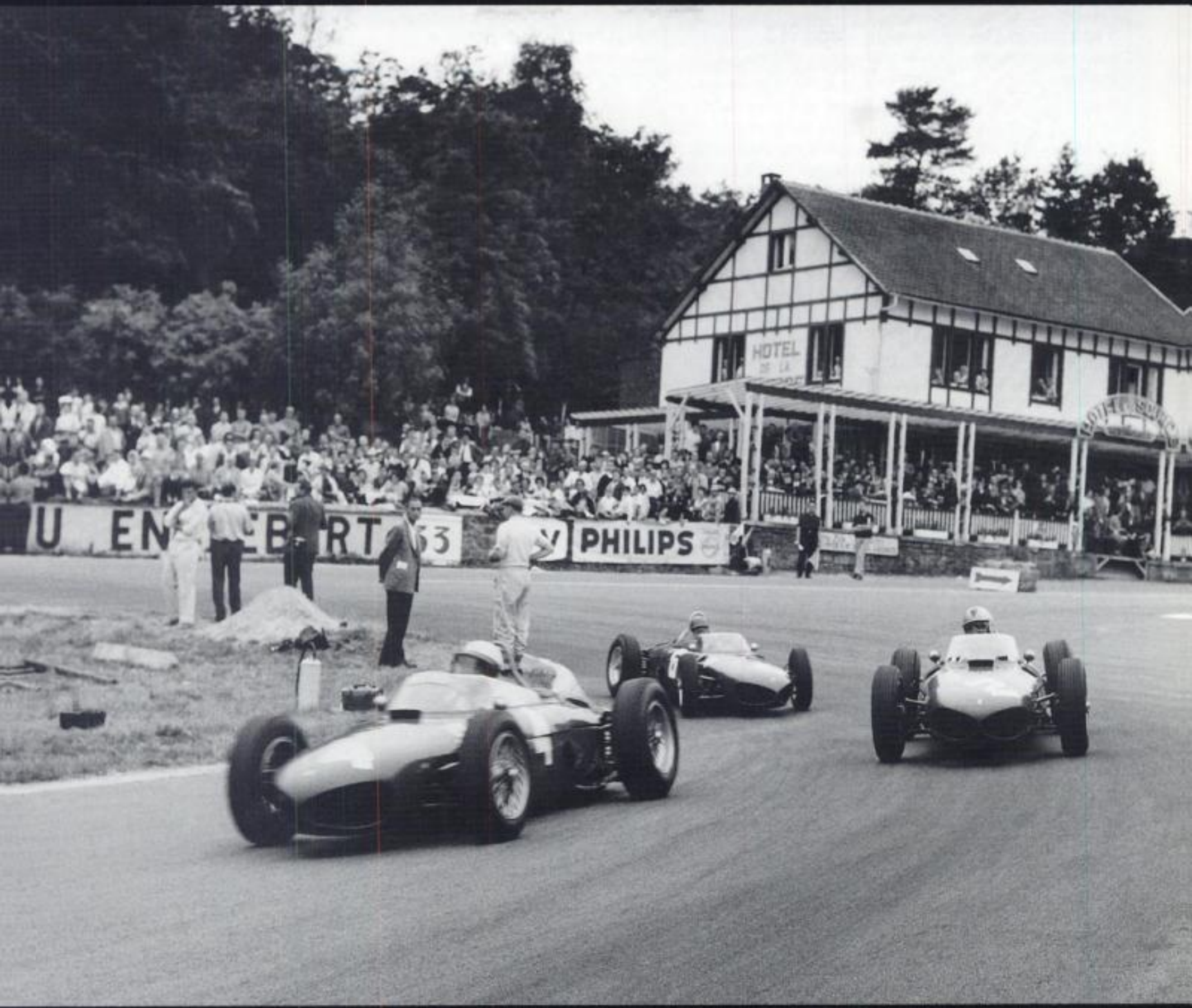
on an intermittent basis, most recently driving a Yeoman Credit Cooper in 1960.

Graham Hill made a brilliant start from the third row in his BRM to lead the field into Eau Rouge but was soon overwhelmed, leaving the Ferraris to run as they pleased, finishing 1-2-3-4 in the order Hill, von Trips, Ginther and Gendebien. Such an achievement would not be repeated as Ferrari restricted entries in most cases to two per race after 1962, in line with the British teams. Three and four car entries stretched preparation resources too far and only on rare occasions such as this would any benefit be realised. This all put *Autosport* into a rather downbeat mood, the editorial declaring that "the domination begun by Vanwall and carried on by Cooper Climax is at an end. Until British drivers receive new equipment, particularly engines, they will continue to tail along behind the red cars from Maranello."

Best of the British drivers, and best of the rest, was John Surtees in a Yeoman Credit run Cooper. The former motorcycle champion, like Jim Clark, was taking part in his first full F1 season and had chosen the Yeoman Credit team in which to make a low-key entry to gain experience. Run by respected former driver and Aston Martin team manager Reg Parnell from a base in Hounslow, West London, the team benefited from financial support provided by the Yeoman Credit finance house – one of the first instances of commercial sponsorship in motor sport. Parnell had chosen to run Cooper chassis in the belief that they would be identical to the factory entries and was disappointed to find that this was not the case. Nevertheless, Surtees was easily faster than the 'slimline' factory Coopers at Spa, finishing fifth ahead of Dan Gurney's Porsche. Stirling Moss had an uncharacteristically low finish in eighth, his Lotus now updated to '18/21' specification.

Barring unforeseen circumstances, the Drivers' Championship looked to be heading for a straight contest between Ferrari team-mates Phil Hill and 'Taffy' von Trips. This situation highlighted the traditional Ferrari reluctance to nominate a team leader, a decision that was continually postponed and, in the event, never made. This could easily have been counterproductive had Ferrari not been in a dominant position. As it was, it introduced an unwanted element of tension within the team.

Having entered F1 with great optimism, Porsche was now in trouble. The new air-cooled flat-8 engine was running behind schedule and a fuel injection version of the familiar flat-4 had been run in the new type 787 chassis. This combination proved to be off the pace, however, and, following the Dutch GP, this line of



Belgian GP, Spa-Francorchamps, 18 June 1961. The Ferrari boys come to town: Phil Hill rounds La Source ahead of Wolfgang von Trips, Ritchie Ginther and Olivier Gendebien (out of picture) to score an overwhelming 1-2-3-4 finish.

1961 World Championship – Round 3

Spa-Francorchamps 18 June 1961 30 laps
Starters 21 **Finishers** 11

	Driver	Entrant	Car	Laps	Result
1	P Hill	Ferrari SpA SEFAC	Ferrari 156/61 120° V6	30	2h 03m 03.8s
2	W von Trips	Ferrari SpA SEFAC	Ferrari 156/61 120° V6	30	2h 03m 04.5s
3	R Ginther	Ferrari SpA SEFAC	Ferrari 156/61 120° V6	30	2h 03m 23.3s
4	O Gendebien	Equipe National Belge	Ferrari 156/61 65° V6	30	2h 03m 49.4s
5	J Surtees	Yeoman Credit Racing Team	Cooper T53 Climax 4	30	2h 04m 30.6s
6	D Gurney	Dr Ing hc F Porsche KG	Porsche 718 F4	30	2h 04m 34.8s
7	J Bonnier	Dr Ing hc F Porsche KG	Porsche 718 F4	30	2h 05m 50.9s
8	S Moss	RRC Walker Racing Team	Lotus 18/21 Climax 4	30	2h 05m 59.4s
9	J Lewis	H&L Motors	Cooper T53 Climax 4	29	
10	M Gregory	Camoradi International	Cooper T53 Climax 4	29	
11	G de Beaufort	Ecurie Maarsbergen	Porsche 718 F4	28	
	J Clark	Team Lotus	Lotus 21 Climax 4	24	N/C
	CAS Brooks	Owen Racing Organisation	BRM P57 Climax 4	24	N/C
	G Hill	Owen Racing Organisation	BRM P57 Climax 4	23	Ignition
	M Trintignant	Scuderia Serenissima	Cooper T51 Maserati 4	22	Gearbox
	L Bandini	Scuderia Centro Sud	Cooper T53 Maserati 4	20	Engine
	J Brabham	Cooper Car Co	Cooper T55 Climax 4	12	Engine
	L Bianchi	Equipe National Belge	Lotus 18 Climax 4	9	Oil pipe
	I Ireland	Team Lotus	Lotus 21 Climax 4	9	Engine
	B McLaren	Cooper Car Co	Cooper T55 Climax 4	8	Ignition
	W Mairesse	Equipe National Belge	Lotus 18 Climax 4	7	Engine

Winner's speed 128.16mph (206.235km/h)
Fastest lap R Ginther 3m 59.8s, 131.56mph (211.676km/h)

Championship placings

Drivers		Constructors	
1. P Hill	19	1. Ferrari	22
2. von Trips	18	2. Lotus	12
3. Moss	12	3. Cooper	4
Ginther	12	4. Porsche	3
5. Clark	4		
6. Gurney	3		
Gendebien	3		
8. Surtees	2		
9. McLaren	1		
Brabham	1		

Grand Prix de Belgique

262.84 miles (423.00km)
Weather Overcast

Grid

P Hill 3-59.3		von Trips 4-00.1	Gendebien 4-03.0
	Surtees 4-06.0		Ginther 4-06.1
G Hill 4-07.6		Brooks 4-07.9	Moss 4-08.2
	Bonnier 4-08.3		Gurney 4-08.4
Brabham 4-08.6		Gregory 4-10.2	Lewis 4-11.1
	de Beaufort 4-16.7		McLaren 4-17.4
Clark 4-17.7		Bandini 4-19.0	Ireland 4-20.0
	Trintignant 4-21.4		Mairesse -
Bianchi -			

the tall Californian had joined Bonnier at BRM and continued to demonstrate his talent despite running unreliable equipment.

The French GP took place on the long, slipstreaming straights of the Reims circuit. After its total dominance at Spa, Reims was regarded as another certain walkover for Ferrari, which once again fielded a four-car entry. The fourth car was the 1960 chassis with 65° V6 engine for Giancarlo Baghetti entered in the name of 'Federazione Italiana Scuderia Automobilsche' (FISA). This federation had been formed over the winter of 1960/61 by a group of Italian racing teams with the object of promoting new Italian talent for F1. An arrangement was made with Ferrari to enter a new 'Sharknose' 156 in selected F1 events. Baghetti had beaten Lorenzo Bandini to the drive, although the latter would feature as a Ferrari F1 driver long after Baghetti had faded away. Nevertheless, Baghetti had proved his worth already by taking the 'Sharknose' to a debut win in Syracuse and also a win in the non-Championship Naples GP on the same day as Monaco.

development was not pursued. The 1960 type 718 F2 chassis with carburettor engine would have to be relied on for the remainder of the season. This was something of a disappointment for team drivers Jo Bonnier and Dan Gurney. Bonnier had driven for Porsche regularly in sports cars and F2, and given BRM its maiden GP victory back in 1959. Gurney had impressed with a short season of GP drives for Ferrari on his arrival in Europe in 1959. In 1960,

The three regular Ferrari drivers dominated practice in the order Hill, von Trips and Ginther, with Baghetti no better than twelfth. Moss managed to pick up a tow from von Trips, much to the annoyance of the Ferrari team, and took fourth on the grid some 1.4sec quicker than the rest. From the start, the three Ferraris led as predicted until Ginther spun at Muizon on lap 4,

dropping to fourth behind Moss. Hill let von Trips into the lead on lap 13 but, after only five more laps, von Trips was into the pits with water pouring from his exhaust pipes. Hill regained a comfortable lead for a further 20 laps until spinning at Thillois on melting tar in the extremely hot conditions. Nudged by Moss, he stalled and lost 2 laps when the starter refused to operate. Ginther, having recovered from his spin, inherited the lead only to lose his oil pressure a further 4 laps into the race. With only 12 laps to run, the Ferrari team had been decimated. Unable to recover his lost laps, Hill continued to finish ninth with the consolation of fastest lap to his name. Moss had fallen back at quarter distance with brake problems that eventually saw him retire.

Attention switched to what had been a fierce slipstreaming scrap for fourth but had now become a battle for the lead. This had originally featured the Ferrari of Baghetti, the Porsches of Gurney and Bonnier, the Lotuses of Ireland and Clark, McLaren's Cooper and Graham Hill's BRM. The hot pace had split the group so that, on Ginther's retirement, the lead was down to a straight fight between Baghetti, Bonnier and Gurney. Porsche had moved at a stroke from an also-ran to a potential race winner, and team manager Huschke von Hanstein urged his drivers on from the pits. For the remaining 12 laps the Ferrari and the two Porsches chopped and changed places all around the circuit. Three laps from the end, Bonnier's engine went off song and he dropped away, eventually finishing seventh. Gurney and Baghetti continued at unabated pace bringing the crowd to its feet on every lap. On the final lap, Gurney was first out of Thillois corner for the run-up to the finish and could have blocked Baghetti but in 1961 that was not the done thing. Baghetti, displaying the coolness of a veteran in only his first GP, ducked out of the Porsche's slipstream on the run down to the flag, snatching victory by 0.1sec. It was a sensational victory. Ferrari was jubilant and the quiet man from Milan had written a place for himself in motor racing history. He had won his debut GP and his first three F1 races, feats that are now unlikely to be repeated. For Porsche there was some encouragement as it now appeared to be the equal of the British teams.

From the hot, Champagne region of France, the GP scene moved to the bleak and wet suburbs of Liverpool for the British GP at Aintree. Adding interest to this event was what would be the sole GP appearance of the new four-wheel-drive Ferguson. Entered by Rob Walker alongside the Lotus of Moss, it was never likely to set the track alight in the hands of Jack Fairman, a reliable second division F1 driver past his best. Moss tried the car in the wet Friday practice session and was soon able to demonstrate its potential, lapping 4sec faster than anyone else.

Once again there were four Ferraris, the addition being Baghetti in the FISA car, entered this weekend in the name of Scuderia Sant Ambroeus, no doubt as a reward for his win in France. The Ferraris of Hill and Ginther occupied the first two places on the grid with Bonnier's Porsche on the outside. Von Trips was relegated to the second row alongside Moss, the timekeepers having adjudged that the first four drivers had recorded the same time, mainly because times were calculated only to the nearest one-fifth of a second. Baghetti could only manage 19th alongside Fairman in the Ferguson.

It was raining heavily as Phil Hill led von Trips, Ginther and Moss away from the start in a vast plume of spray. The huge crowd was hoping that the conditions would act as an equaliser and offer Moss an opportunity to mix it with the Ferraris. They cheered loudly when Moss moved up to third as Ginther had a big slide on lap 6. On the following lap, von Trips nipped by into the lead as Hill slowed momentarily at the scene of an accident. On lap 10, Hill, now being threatened by Moss, had a hairy moment on a puddle at the Melling Crossing. Moss was through into second and moved up onto von Trips' tail in the hope that a problem might befall the Ferrari. He maintained his position for 30 laps despite a spin on Hill's puddle at the Melling Crossing. Ginther

French GP, Reims, 2 July 1961. New boy makes good: Giancarlo Baghetti (Ferrari 156 65° V6) shows the way through the corn fields to Dan Gurney (Porsche 718), Jo Bonnier (Porsche 718 just entering picture) and Jim Clark (Lotus 21), unaware that their duel will eventually be for the lead.

1961 World Championship – Round 4

Grand Prix de l'ACF

Reims 2 July 1961 52 laps
268.25 miles (431.70km)
Starters 26 **Finishers** 14 **Weather** Very hot

	Driver	Entrant	Car	Laps	Result
1	G Baghetti	Fed Italiana Scuderia Automobilsche	Ferrari 156/61 65° V6	52	2h 14m 17.5s
2	D Gurney	Dr Ing hc F Porsche KG	Porsche 718 F4	52	2h 14m 17.6s
3	J Clark	Team Lotus	Lotus 21 Climax 4	52	2h 15m 18.6s
4	I Ireland	Team Lotus	Lotus 21 Climax 4	52	2h 15m 27.6s
5	B McLaren	Cooper Car Co	Cooper T55 Climax 4	52	2h 15m 59.3s
6	G Hill	Owen Racing Organisation	BRM P57 Climax 4	52	2h 15m 59.4s
7	J Bonnier	Dr Ing hc F Porsche KG	Porsche 718 F4	52	2h 17m 32.9s
8	R Salvadori	Yeoman Credit Racing Team	Cooper T53 Climax 4	51	
9	P Hill	Ferrari SpA SEFAC	Ferrari 156/61 120° V6	50	
10	H Taylor	UDT-Laystall Racing Team	Lotus 18/21 Climax 4	49	
11	M May	Scuderia Colonia	Lotus 18 Climax 4	48	
12	M Gregory	Camoradi International	Cooper T53 Climax 4	43	
13	M Trintignant	Scuderia Serenissima	Cooper T51 Maserati 4	42	
14	I Burgess	Camoradi International	Lotus 18 Climax 4	42	
	R Ginther	Ferrari SpA SEFAC	Ferrari 156/61 120° V6	40	Oil pressure
	S Moss	RRC Walker Racing Team	Lotus 18/21 Climax 4	31	Brake pipe
	W Mairesse	Equipe National Belge	Lotus 21 Climax 4	27	Fuel system
	G de Beaufort	Ecurie Maarsbergen	Porsche 718 F4	23	Engine
	L Bianchi	UDT-Laystall Racing Team	Lotus 18/21 Climax 4	21	Clutch
	W von Trips	Ferrari SpA SEFAC	Ferrari 156/61 120° V6	18	Engine
	G Scarlatti	Scuderia Serenissima	de Tomaso F1 OSCA 4	15	Engine
	J Brabham	Cooper Car Co	Cooper T55 Climax 4	14	Oil pressure
	B Collomb	B Collomb	Cooper T53 Climax 4	6	Engine
	CAS Brooks	Owen Racing Organisation	BRM P57 Climax 4	4	Engine
	J Lewis	H&L Motors	Cooper T53 Climax 4	4	Engine
	J Surtees	Yeoman Credit Racing Team	Cooper T53 Climax 4	4	Accident

Winner's speed 119.84mph (192.874km/h)
Fastest lap P Hill 2m 27.1s, 126.25mph (203.176km/h)

Championship placings

Drivers		Constructors	
1. P Hill	19	1. Ferrari	30
2 von Trips	18	2. Lotus	16
3. Moss	12	3. Porsche	9
Ginther	12	4. Cooper	6
5. Baghetti	9	5. BRM	1
Gurney	9		
7. Clark	8		
8. Gendebien	3		
9. McLaren	3		
Ireland	3		

Grid

Ginther 2-26.8		von Trips 2-26.4	**P Hill 2-24.9**
	Clark 2-29.0		Moss 2-27.6
McLaren 2-29.4		Surtees 2-29.1	G Hill 2-29.1
	Ireland 2-29.8		Gurney 2-29.6
Bonnier 2-30.5		Baghetti 2-30.5	Brooks 2-29.9
	Salvadori 2-31.2		Brabham 2-31.0
Lewis 2-32.0		de Beaufort 2-31.8	Gregory 2-31.3
	Mairesse 2-35.8		Bianchi 2-33.4
Trintignant 2-38.8		May 2-37.9	Collomb 2-36.8
	Taylor 2-40.8		Burgess 2-39.7
			Scarlatti 2-47.1

1961 World Championship – Round 5

Aintree 15 July 1961 75 laps
Starters 30 **Finishers** 16

RAC British Grand Prix

225.00 miles (362.10km)
Weather Overcast and wet. Dry later

	Driver	Entrant	Car	Laps	Result
1	W von Trips	Ferrari SpA SEFAC	Ferrari 156/61 120° V6	75	2h 40m 53.6s
2	P Hill	Ferrari SpA SEFAC	Ferrari 156/61 120° V6	75	2h 41m 39.6s
3	R Ginther	Ferrari SpA SEFAC	Ferrari 156/61 120° V6	75	2h 41m 40.4s
4	J Brabham	Cooper Car Co	Cooper T55 Climax 4	75	2h 42m 02.2s
5	J Bonnier	Dr Ing hc F Porsche KG	Porsche 718 F4	75	2h 42m 09.8s
6	R Salvadori	Yeoman Credit Racing Team	Cooper T53 Climax 4	75	2h 42m 19.8s
7	D Gurney	Dr Ing hc F Porsche KG	Porsche 718 F4	74	
8	B McLaren	Cooper Car Co	Cooper T55 Climax 4	74	
9	CAS Brooks	Owen Racing Organisation	BRM P57 Climax 4	73	
10	I Ireland	Team Lotus	Lotus 21 Climax 4	72	
11	M Gregory	Camoradi International	Cooper T53 Climax 4	71	
12	L Bandini	Scuderia Centro Sud	Cooper T53 Maserati 4	71	
13	A Maggs	Mrs L Bryden-Brown	Lotus 18 Climax 4	69	
14	I Burgess	Camoradi International	Lotus 18 Climax 4	69	
15	K Greene	Gilby Engineering Ltd	Gilby Climax 4	69	
16	G de Beaufort	Ecurie Maarsbergen	Porsche 718 F4	69	
	J Clark	Team Lotus	Lotus 21 Climax 4	62	Oil pipe
	W Seidel	Scuderia Colonia	Lotus 18 Climax 4	58	N/C
	J Fairman	RRC Walker Racing Team	Ferguson P99 Climax 4	56	DSQ – push-start
	L Bianchi	UDT-Laystall Racing Team	Lotus 18/21 Climax 4	45	Gearbox
	S Moss	RRC Walker Racing Team	Lotus 18/21 Climax 4	44	Brake pipe
	G Hill	Owen Racing Organisation	BRM P57 Climax 4	43	Engine
	G Baghetti	Scuderia Sant Ambroeus	Ferrari 156/61 65° V6	27	Accident
	A Marsh	AE Marsh	Lotus 18 Climax 4	25	Ignition
	J Surtees	Yeoman Credit Racing Team	Cooper T53 Climax 4	23	Final drive
	T Parnell	RHH Parnell	Lotus 18 Climax 4	12	Clutch
	J Lewis	H&L Motors	Cooper T53 Climax 4	7	Steering
	G Ashmore	G Ashmore	Lotus 18 Climax 4	7	Ignition
	H Taylor	UDT-Laystall Racing Team	Lotus 18/21 Climax 4	5	Accident
	M Natili	Scuderia Centro Sud	Cooper T51 Maserati 4	0	Gearbox

Winner's speed 83.91mph (135.04km/h)
Fastest lap CAS Brooks 1m 57.8s, 91.68mph (147.54km/h)

Championship placings

Drivers			Constructors	
1.	von Trips	27	1. Ferrari	38
2	P Hill	25	2. Lotus	16
3.	Ginther	16	3. Porsche	11
4.	Moss	12	4. Cooper	9
5.	Baghetti	9	5. BRM	1
	Gurney	9		
7.	Clark	8		
8.	Brabham	4		
9.	Gendebien	3		
.	McLaren	3		
	Ireland	3		

Grid

P Hill 1-58.8	Ginther 1-58.8	Bonnier 1-58.8
von Trips 1-58.8		Moss 1-59.0
Brooks 1-59.0	Ireland 1-59.2	Clark 1-59.2
Brabham 1-59.4		Surtees 1-59.6
G Hill 2-00.0	Gurney 2-00.2	Salvadori 2-00.8
McLaren 2-01.0		Lewis 2-01.0
Gregory 2-01.4	Taylor 2-01.8	de Beaufort 2-02.0
Baghetti 2-02.0		Fairman 2-03.4
Bandini 2-03.6	Seidel 2-04.2	Greene 2-06.0
Maggs 2-06.4		Burgess 2-06.6
Ashmore 2-08.2	Marsh 2-09.6	Natili 2-10.2
Parnell 2-16.8		Bianchi 2-18.8

British GP, Aintree, 15 July 1961. Phil Hill (Ferrari 156 120° V6) splashes his way to second place on a wet afternoon.

moved into second on lap 40, and 4 laps later Moss retired with a broken brake pipe to a huge groan from the crowd. The race ran its course in drying conditions as another Ferrari 1-2-3, the order being von Trips, Hill and Ginther.

Of the rest, Bonnier's front row position translated into fifth behind Jack Brabham who had his best finish of the year but a far cry from the double World Championships of the preceding years. For Baghetti, his GP honeymoon ended in the barriers from tenth place while being lapped by von Trips at one-third distance. Fairman ran the Ferguson in mid-field until a pit stop for an electrical fault dropped him down the order. Having retired his Lotus, Moss relieved Fairman and proceeded to run competitive times in the Ferguson before it was disqualified for having been push-started after its pit stop.

Von Trips now led the Championship by 2 points from Hill, while *Autosport* wrote that "British drivers would have to tail along behind the Maranello cars, their only hope of success depending on whether or not their rivals fall by the wayside, as happened at Reims." A glimmer of hope was about to appear on the horizon, however.

Less than two weeks after the British GP, on Friday 28 July, the first Coventry Climax FWMV V8 engine was delivered to the Cooper factory at Surbiton. Installed in a suitably modified T55 chassis, the first 'proper' British 1½-litre F1 car ran at Silverstone on the following Tuesday. The engine was dominated by an extremely complex exhaust system in which exhaust pipes on opposing cylinder banks were interlinked so as to obtain the best extractor effect before terminating in twin outlet tailpipes above the car's tail section. Encouraged by the engine's performance, the car was readied for the German GP, practice starting only three days away.

Meanwhile, *Autosport*, in its issue of 4 August, published first photographs of the new BRM P56 V8 engine undergoing bench tests at Folkingham. The development programme was running ahead of plan and the engine was expected to be seen in a new, purpose-built chassis before the end of the season, possibly at Monza in September.

The German GP returned to the magnificent 14.5 mile Nürburgring after a gap of two years. The ultimate test of driver and car, the circuit would provide another opportunity for Stirling Moss to match his skills against the Ferrari team, especially if the weather was wet. Predictably, a Ferrari was quickest in practice: Phil Hill lapping on soft Dunlop rain tyres in an almost unbelievable time of 8m 55.2s, the first sub-9 minute lap of the circuit. This was not without some effort, however, as it left him physically and mentally drained. Brabham was next up, some 6sec slower, despite numerous problems with the new V8-engined Cooper. Moss was third fastest with Bonnier completing the front row of the grid. Of the other Ferraris, von Trips was 10sec slower than Hill in fifth, Ginther 14th and Belgian Willy Mairesse in a fourth factory entry, with a 65° V6, just ahead of him.

Race day dawned hot and sunny but experts predicted rain. This proved to be the case as it rained at midday, soaking the circuit, but as the cars formed up on the grid the sky cleared and the sun returned. The circuit remained wet enough for the teams to have to consider whether or not to run the Dunlop D12 rain tyre. Dunlop advised that the D12s would not last the distance on a drying track but Moss went against this, seeking to gain an advantage over the Ferraris should the track not dry out completely. At the start, Brabham jumped into the lead from Moss and Bonnier, with Hill getting away slowly. By the end of the first long lap, Moss appeared with a 2sec lead over Hill. Brabham's race had lasted barely 5km before he lost the new Cooper on the wet track and went off into the shrubbery, due to having had to start on a mix of wet and dry tyres. A disappointing result after all the effort put in to prepare the car.

German GP, Nürburgring, 6 August 1961. Moss again: Stirling Moss (Lotus 18/21) leads Phil Hill (Ferrari 156 120° V6) to another defeat for Ferrari at the hands of the maestro.

1961 World Championship – Round 6

Grosser Preis von Deutschland

Nürburgring 6 August 1961 15 laps
212.60 miles (342.15km)
Starters 26 **Finishers** 17
Weather Showery

	Driver	Entrant	Car	Laps	Result
1	S Moss	RRC Walker Racing Team	Lotus 18/21 Climax 4	15	2h 18m 12.4s
2	W von Trips	Ferrari SpA SEFAC	Ferrari 156/61 120° V6	15	2h 18m 33.8s
3	P Hill	Ferrari SpA SEFAC	Ferrari 156/61 120° V6	15	2h 18m 34.9s
4	J Clark	Team Lotus	Lotus 21 Climax 4	15	2h 19m 29.5s
5	J Surtees	Yeoman Credit Racing Team	Cooper T53 Climax 4	15	2h 20m 05.5s
6	B McLaren	Cooper Car Co	Cooper T55 Climax 4	15	2h 20m 53.8s
7	D Gurney	Dr Ing hc F Porsche KG	Porsche 718 F4	15	2h 21m 35.0s
8	R Ginther	Ferrari SpA SEFAC	Ferrari 156/61 120° V6	15	2h 23m 35.5s
9	J Lewis	H&L Motors	Cooper T53 Climax 4	15	2h 23m 36.1s
10	R Salvadori	Yeoman Credit Racing Team	Cooper T53 Climax 4	15	2h 30m 23.9s
11	A Maggs	Mrs L Bryden-Brown	Lotus 18 Climax 4	14	
12	I Burgess	Camoradi International	Cooper T53 Climax 4	14	
13	H Herrmann	Dr Ing hc F Porsche KG	Porsche 718 F4	14	
14	G de Beaufort	Ecurie Maarsbergen	Porsche 718 F4	14	
15	W Mairesse	Ferrari SpA SEFAC	Ferrari 156/61 65° V6	13	Accident
16	A Marsh	AE Marsh	Lotus 18 Climax 4	13	
17	G Ashmore	G Ashmore	Lotus 18 Climax 4	13	
	M Trintignant	Scuderia Serenissima	Cooper T51 Maserati 4	12	Engine
	B Collomb	B Collomb	Cooper T53 Climax 4	11	DSQ – pushed car
	L Bandini	Scuderia Centro Sud	Cooper T53 Maserati 4	10	Engine
	CAS Brooks	Owen Racing Organisation	BRM P57 Climax 4	6	Engine
	J Bonnier	Dr Ing hc F Porsche KG	Porsche 718 F4	5	Engine
	W Seidel	Scuderia Colonia	Lotus 18 Climax 4	3	Steering
	I Ireland	Team Lotus	Lotus 21 Climax 4	1	Fire
	G Hill	Owen Racing Organisation	BRM P57 Climax 4	1	Accident
	J Brabham	Cooper Car Co	Cooper T58 Climax V8	0	Accident

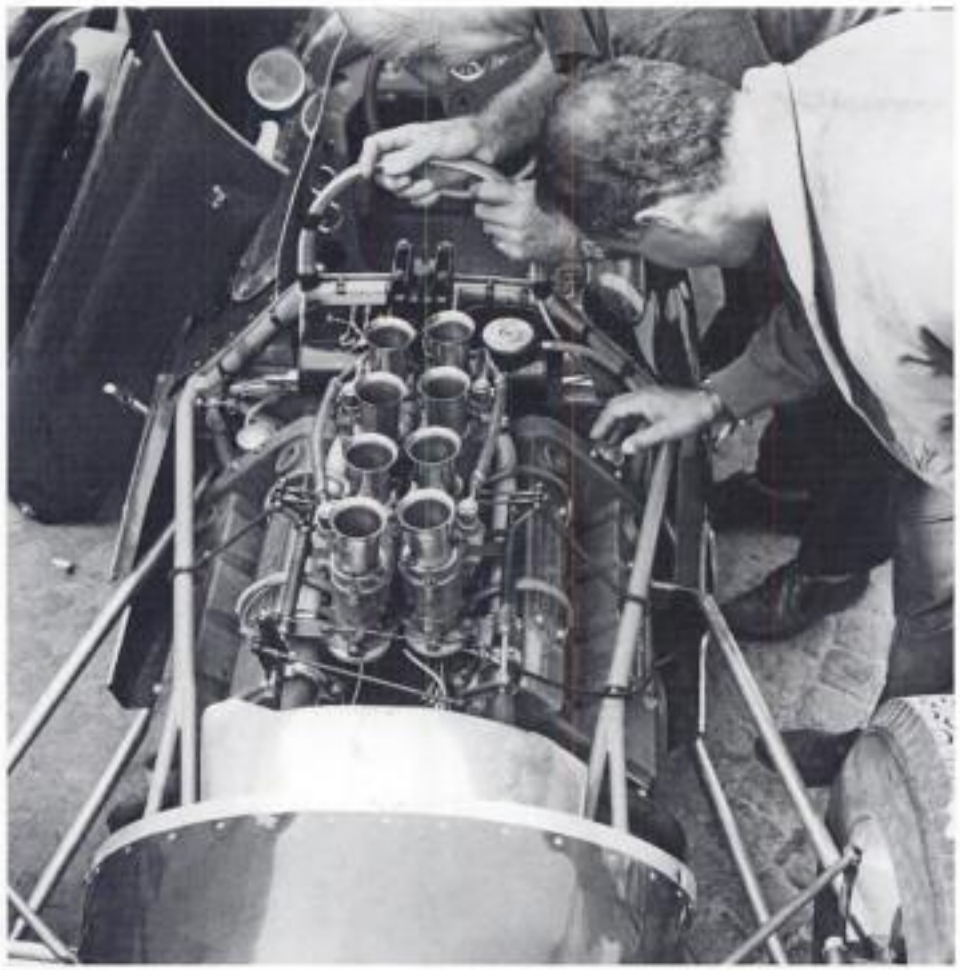
Winner's speed 92.34mph (148.538km/h)
Fastest lap P Hill 8m 57.8s, 94.88mph (152.689km/h)

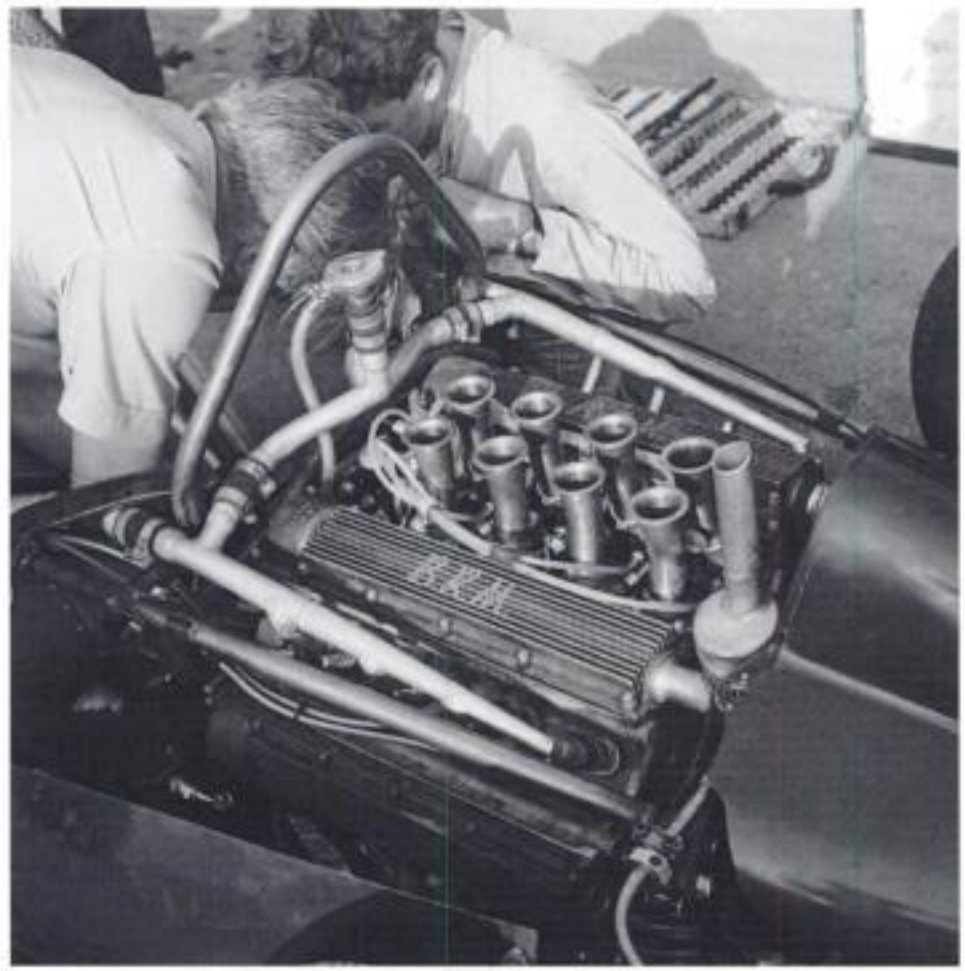
Championship placings (*5 best performances)

Drivers			Constructors	
1.	von Trips	33	1. Ferrari	*38
2	P Hill	29	2. Lotus	24
3.	Moss	21	3. Porsche	11
4.	Ginther	16	4. Cooper	*10
5.	Clark	11	5. BRM	1
6.	Baghetti	9		
	Gurney	9		
8.	Brabham	4		
	McLaren	4		
	Surtees	4		

Grid

Bonnier	Moss	Brabham	**P Hill**
9-04.8	9-01.7	9-01.4	**8-55.2**
Gurney	G Hill	von Trips	
9-06.6	9-06.4	9-05.5	
Herrmann	Surtees	Brooks	Clark
9-12.7	9-11.2	9-09.3	9-08.1
Ginther	Mairesse	McLaren	
9-16.6	9-15.9	9-13.0	
Lewis	de Beaufort	Ireland	Salvadori
9-31.4	9-28.4	9-22.9	9-22.0
Trintignant	Marsh	Bandini	
9-38.5	9-37.7	9-35.4	
Ashmore	Burgess	Seidel	Maggs
10-06.0	10-01.4	9-59.9	9-45.5
		Collomb	
		10.23.0	





New British V8s at Monza: the Coventry Climax FWMV (left) installed in the specially modified spare Walker Lotus 18/21 chassis and the BRM P56 (right) during practice. Neither ran in the race.

By lap 4, Moss had extended his lead to 11sec over Hill who had von Trips rapidly gaining on him. Moss had been making full use of his softer, wet weather tyres but the track had now dried and the Ferraris were able to put the pressure on. Moss maintained his lead, however, making up on the corners what he lost on the straighter bits. Von Trips took Hill for second and began stringing together a series of fast laps around the 9 minute mark. On lap 10 he became the first driver to break the 9 minute barrier in a race with a lap in 8 min. 59.9sec, although it would be Hill who made the fastest lap later in the race, 2sec quicker than von Trips' time. Despite this, the Ferraris were still 6.9sec in arrears but it seemed ever more likely that they would catch Moss as his tyres became more marginal every lap. He held on purely by virtue of his superior skill and then, on lap 13, it started to rain, giving his tyres the break they needed. Moss won by 21.4sec after another display of masterly driving to match that seen at Monaco. The Ferraris were left to dispute second place, von Trips just making it, slithering across the line 1.1sec ahead of Hill. Of the other Ferraris, Ginther finished a distant eighth, while fourth man Mairesse crashed heavily trying to relieve Surtees of fifth. Clark finished an impressive fourth but the Porsches disappointed on their home track – Gurney was seventh and Bonnier suffered first a puncture and then piston failure.

Autosport celebrated with its traditional green cover for a British win and enthused over the ability of Moss to match "... the superior power of the Ferraris with driving virtuosity and an uncanny appreciation of the situation that had both von Trips and Hill baffled". Little did anyone realise that this was to be Stirling's last GP victory in a long and distinguished career.

In the Drivers' Championship, von Trips had extended his lead over Hill to 4 points, whist Ferrari led the Constructors' Championship from Lotus by 38 points to 24. There were a further three rounds scheduled for the Championship, these being in Italy, Morocco and the USA. There was some doubt, however, as to whether the latter two would actually take place, in which case the Italian GP at Monza would be the season finale. In the event, the Moroccan GP was not held but the US GP would take place at the Watkins Glen circuit in October.

It was over a month before the GP circus gathered at Monza. The race was to take place on the combined road and banked circuit, as it had in 1960. On that occasion the event had been boycotted by the British teams because they considered that the

1961 World Championship – Round 7

Gran Premio d'Italia

Monza 10 September 1961 43 laps 267.19 miles (430.00km)

Starters 32 **Finishers** 12 **Weather** Very hot

	Driver	Entrant	Car	Laps	Result
1	P Hill	Ferrari SpA SEFAC	Ferrari 156/61 120° V6	43	2h 03m 13.0s
2	D Gurney	Dr Ing hc F Porsche KG	Porsche 718 F4	43	2h 03m 44.2s
3	B McLaren	Cooper Car Co	Cooper T55 Climax 4	43	2h 05m 41.4s
4	J Lewis	H&L Motors	Cooper T53 Climax 4	43	2h 05m 53.4s
5	CAS Brooks	Owen Racing Organisation	BRM P57 Climax 4	43	2h 05m 53.5s
6	R Salvadori	Yeoman Credit Racing Team	Cooper T53 Climax 4	42	
7	G de Beaufort	Ecurie Maarsbergen	Porsche 718 F4	41	
8	L Bandini	Scuderia Centro Sud	Cooper T53 Maserati 4	41	
9	M Trintignant	Scuderia Serenissima	Cooper T51 Maserati 4	41	
10	T Parnell	RHH Parnell	Lotus 18 Climax 4	40	
11	H Taylor	UDT-Laystall Racing Team	Lotus 18/21 Climax 4	39	
12	R Pirocchi	Pescara Racing Club	Cooper T51 Maserati 4	38	
	S Moss	RRC Walker Racing Team	Lotus 21 Climax 4	36	Wheel bearing
	R Ginther	Ferrari SpA SEFAC	Ferrari 156/61 120° V6	23	Engine
	G Starrabba	Prince G Starrabba	Lotus 18 Maserati 4	19	Engine
	J Bonnier	Dr Ing hc F Porsche KG	Porsche 718 F4	15	Rear suspension
	N Vaccarella	Scuderia Serenissima	de Tomaso Alfa Romeo 4	13	Engine
	R Rodriguez	Ferrari SpA SEFAC	Ferrari 156/61 65° V6	13	Fuel pump
	G Baghetti	Scuderia Sant Ambroeus	Ferrari 156/61 120° V6	13	Engine
	M Gregory	UDT-Laystall Racing Team	Lotus 18/21 Climax 4	11	Rear suspension
	G Hill	Owen Racing Organisation	BRM P57 Climax 4	10	Engine
	J Brabham	Cooper Car Co	Cooper T58 Climax V8	7	Overheating
	B Naylor	JBW Car Co	JBW Climax 4	6	Engine
	J Fairman	Fred Tuck Cars Ltd	Cooper T45 Climax 4	5	Engine
	I Ireland	Team Lotus	Lotus 18/21 Climax 4	5	Chassis
	J Surtees	Yeoman Credit Racing Team	Cooper T53 Climax 4	2	Accident
	R Bussinello	Scuderia Tomaso	de Tomaso Alfa Romeo 4	1	Engine
	R Lippi	Scuderia Settecolli	de Tomaso OSCA 4	1	Engine
	W Seidel	Scuderia Colonia	Lotus 18 Climax 4	1	Engine
	W von Trips	Ferrari SpA SEFAC	Ferrari 156/61 120° V6	1	Accident
	J Clark	Team Lotus	Lotus 21 Climax 4	1	Accident
	G Ashmore	G Ashmore	Lotus 18 Climax 4	0	Accident

Winner's speed 129.18mph (209.387km/h)
Fastest lap G Baghetti 2m 48.4s, 132.84mph (213.776km/h)

Championship placings (*5 best performances)

Drivers		Constructors	
1. P Hill	*34	1. Ferrari	*40
2. von Trips	33	2. Lotus	24
3. Moss	21	3. Porsche	17
4. Ginther	16	4 Cooper	*13
5. Gurney	15	5. BRM	3
6. Clark	11		
7. Baghetti	9		
8. McLaren	8		
9. Brabham	4		
Surtees	4		

Grid

von Trips 2-46.3	Rodriguez 2-46.4	
Ginther 2-46.8		P Hill 2-47.2
G Hill 2-48.7	Baghetti 2-49.0	
Clark 2-49.2		Bonnier 2-49.6
Ireland 2-50.3	Brabham 2-51.6	
Moss 2-51.8		Gurney 2-52.0
Brooks 2-52.2	McLaren 2-53.4	
de Beaufort 2-53.8		Lewis 2-54.0
Gregory 2-55.2	Salvadori 2-55.2	
Surtees 2-55.6		Vaccarella 2-56.0
Bandini 2-57.7	Trintignant 2-58.7	
Taylor 3-00.6		Bussinello 3-01.7
Ashmore 3-03.0	Fairman 3-04.8	
Parnell 3-05.7		Seidel 3-06.0
Pirocchi 3-06.5	Starrabba 3-07.9	
Naylor 3-08.1		Lippi 3-08.9

roughness of the banking was unsuitable for a modern GP car. The banking remained rough but the British teams only objected this time, hoping perhaps that it might cause the Ferraris to falter on their home ground. The grid formed up on a 2-by-2 basis, possibly instigated by the organisers to allow the Ferraris to pull clear from would-be slipstreamers in the lower ranks. In any event, those at the back of the 32 car grid would pass the start line some seconds after the front rows.

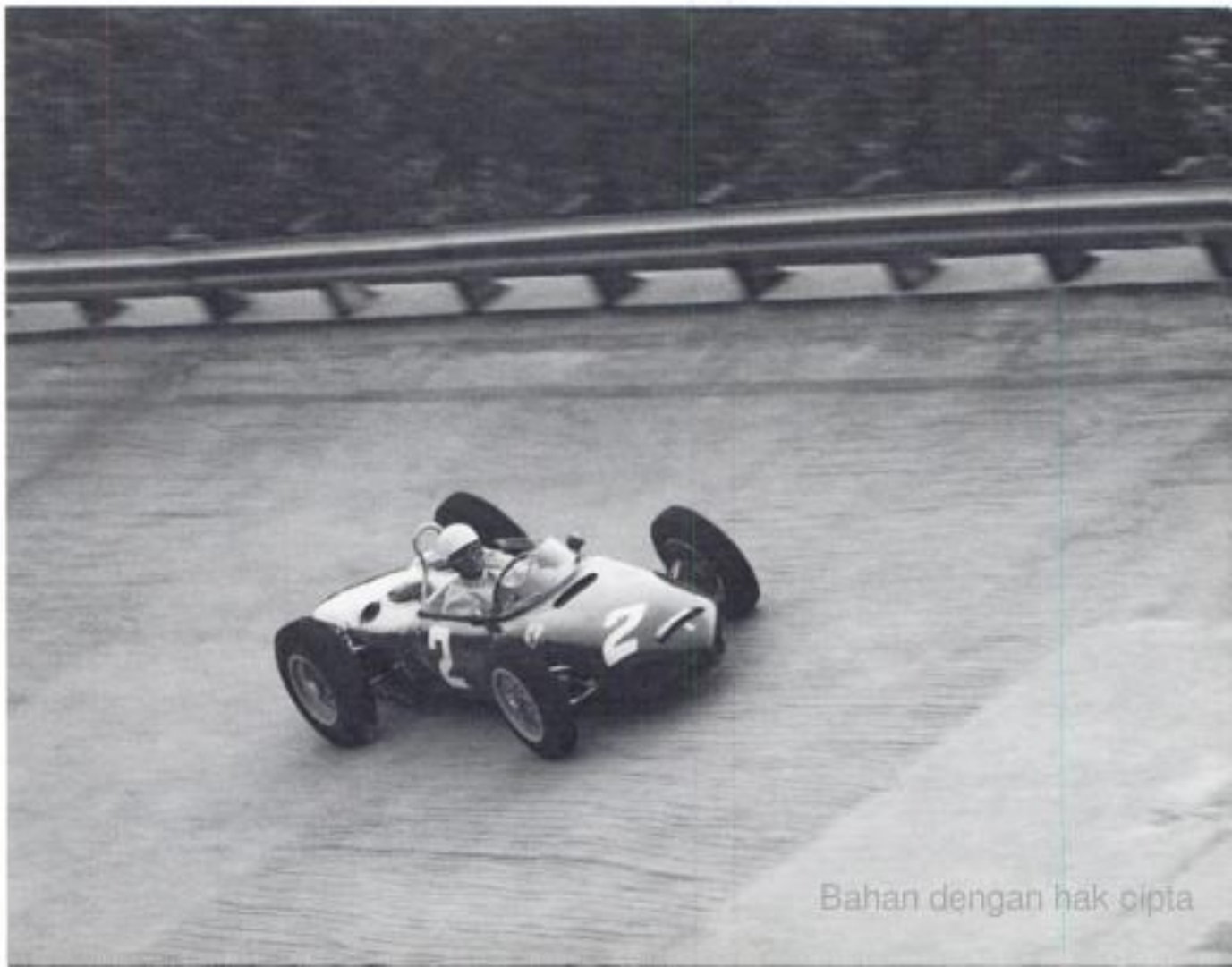
Showing how seriously it was taking this event, Ferrari arrived for practice with six 156 chassis, four with 120° V6 engines and two with 65° V6s, one of which was a spare for practice only. The 120° V6-engined chassis were to be driven by the usual team of Hill, von Trips and Ginther joined by Baghetti whose entry was in the name of Scuderia Sant Ambroeus again rather than FISA. The 65° V6 chassis was to be driven by GP debutant Ricardo Rodriguez.

The Mexican Rodriguez brothers had made a name for themselves racing in the USA, mostly in Ferrari sports cars. In 1960, they had raced at Le Mans (Ricardo finishing second), and US Ferrari dealer Luigi Chinetti had brought their names to the attention of Enzo Ferrari for F1 drives. A car was offered to Pedro, the elder, for Monza but business commitments prevented him from taking it up. Ricardo stepped into his place. At only 19 he was a confident and fearless driver.

In the intervening period since the German GP, Coventry Climax had produced a second FWMV V8, this for Stirling Moss. Rob Walker's team, assisted by Ferguson engineers, had rebuilt the engine bay of the team's spare Lotus 18/21 chassis to take it. Making its first public appearance was the new V8-engined BRM P578, a beautifully executed and prepared F1 car. The engine looked more compact than the Climax equivalent, having an orthodox exhaust system and lower air inlets to the Lucas fuel injection rather than the comparatively bulky Weber carburettors of the latter. Little running had been undertaken and the car was unlikely to be raced, the team intending to stay on after the GP to begin some serious testing. Ferrari dominated practice, as anticipated, taking the top four places with von Trips on pole and, sensationally, Rodriguez alongside him just 0.1sec slower. The Climax V8s had suffered chronic overheating, consuming gallons of water. While Brabham persevered with his, Moss decided to fall back on his familiar 4-cylinder engine. Graham Hill took the new BRM round to clock fifth fastest time but no decision was taken to race it. Overnight, with the blessing of Colin Chapman, Innes Ireland offered his Team Lotus 21 to Moss to aid his Championship chances and those of Lotus in the Constructors' Championship. The car appeared at the start liveried in a combination of Team Lotus and Rob Walker colour schemes.

The Ferraris were fitted with higher final drive ratios for this circuit and were slow getting away at the start. This allowed Clark and Brabham to get amongst them so that Hill led the first lap followed by Ginther and Rodriguez, Clark, Brabham and von Trips. On lap 2 tragedy struck entering the Parabolica. It seems likely that Rodriguez pulled across in front of von Trips who, having nowhere to go, moved outwards in front of Clark, little suspecting that the Lotus would still be with him. In the ensuing collision, the Ferrari spun and overturned, throwing von Trips out and killing him instantly. The car careered along the spectator enclosure before bouncing back onto the road, leaving fourteen spectators dead or dying. Clark's Lotus came to a halt further down the road but he was able to step out unhurt.

The race continued with Hill leading the three remaining Ferraris in a tight bunch, Brabham hanging on until lap 9 when



Italian GP, Monza, 10 September 1961. Phil Hill rides the banking alone on his way to victory in the GP and the World Championship unaware that his teammate and rival, 'Taffy' von Trips, is dead.

he went out with the inevitable overheating. On lap 13 problems hit the Ferrari team when both Rodriguez and Baghetti coasted in with engine problems. Hill and Ginther were signalled to reduce the pace to conserve their engines. Behind them Moss and Gurney were evenly matched in disputing third place all around the circuit. To compound Ferrari's problems, Ginther's engine went off-song and on lap 23 he pulled out. Hill, who had insisted on an overnight engine change, now led the dicing Gurney and Moss by 29sec and maintained his lead to the end. Moss retired on lap 36 with a broken wheel bearing, leaving Gurney an untroubled second. Bruce McLaren drove steadily to finish third and privateer Jack Lewis took his Cooper into fourth, holding off Tony Brooks' BRM at the line. This, together with fastest lap at Aintree and third in the US GP, would be the only high points in Brooks' season with BRM. A highly skilled driver from the front-engined era, during which he had driven for both Vanwall and Ferrari, he was not finding the new, smaller capacity F1 to his liking and he would retire from the sport at the end of the season.

Phil Hill's victory had given him the Drivers' World Championship, the first American ever to hold the title. His only serious rival, however, now lay dead, and Phil's feeling of elation was soon tempered by that knowledge. He had feared the worst for von Trips but was not told of his fate until after the champagne and congratulations. Von Trips had been the best German driver since World War II; he was popular but had seen more success in sports cars than single-seaters, notably with Porsche. He would be sadly missed.

Enzo Ferrari now faced a backlash from a hostile Italian press in the aftermath of the death of so many spectators killed in an incident involving one of his cars. A similar situation had arisen following the 1957 Mille Miglia when a burst tyre sent the Marquis de Portago off the road, killing him, his co-driver and several spectators. Ferrari issued a statement to the effect that he was withdrawing from all forms of racing and the factory Ferrari team would not be seen again in 1961.

Unfortunately for Phil Hill, Ferrari's withdrawal prevented him from racing and celebrating his title in front of his home crowd at the US GP, the final round of the Championship. The introduction of F1 to the USA in 1959 had not exactly been a roaring success, the GP being held at Sebring that year and Riverside on the West Coast in 1960. Cameron Argetsinger and his team decided to take a chance on holding the event in the East at Watkins Glen for 1961. This proved to be a success and the GP would be held at the Glen throughout the 1½-litre F1, attracting increasingly larger crowds each year, including a great number from Canada, boosted in 1963 by the US F1 debut of Ferrari.

In the absence of Ferrari, the US GP had the feeling of a British non-Championship race about it, with the Porsche team adding a little international flavour. A number of local drivers were entered in privately run Coopers or Lotus, many of whom would achieve fame later in their careers: Hap Sharp and Jim Hall as constructors of the technically advanced Chaparral sports cars, Roger Penske as a successful Indy car constructor and team owner, Ken Miles as a founder driver for the Shelby Cobra team and Walt Hansgen who was already a successful sports car driver and would race for Ford at Le Mans. Ferrari's absence also gave Jack Brabham the opportunity to take pole position in the V8 Climax-engined Cooper T58. Stirling Moss was only marginally slower in his V8-engined Lotus but elected to drive his regular 4-cylinder example. BRM had not brought its new, untried V8-engined cars to North America.

The start of the race was signalled by a leap in the air and wave of the flag from the lavender-suited, cigar-chewing Tex Hopkins, whose antics would become a regular feature at Watkins Glen. Moss took an initial lead but was taken by Brabham after 5 laps, the improved Climax V8 running well. These two swapped the lead over the next 40 laps at which point overheating problems manifested themselves again in the Climax engine and Brabham was out. This was the last GP in a Cooper for the former world champion who harboured ambitions to become a constructor in his own right. Moss inherited a lead that would last only a further

US GP, Watkins Glen, 8 October 1961. Innes Ireland (Lotus 21) scores the first GP win for Team Lotus and, ultimately, dismissal from the team.

1961 World Championship – Round 8

Watkins Glen 8 October 1961 100 laps
Starters 19 **Finishers** 11

United States Grand Prix

230.00 miles (370.10km)
Weather Warm and dry

	Driver	Entrant	Car	Laps	Result
1	I Ireland	Team Lotus	Lotus 21 Climax 4	100	2h 13m 45.8s
2	D Gurney	Dr Ing hc F Porsche KG	Porsche 718 F4	100	2h 13m 50.1s
3	CAS Brooks	Owen Racing Organisation	BRM P57 Climax 4	100	2h 14m 33.6s
4	B McLaren	Cooper Car Co	Cooper T55 Climax 4	100	2h 14m 43.8s
5	G Hill	Owen Racing Organisation	BRM P57 Climax 4	99	
6	J Bonnier	Dr Ing hc F Porsche KG	Porsche 718 F4	98	
7	J Clark	Team Lotus	Lotus 21 Climax 4	96	
8	R Penske	John M Wyatt III	Cooper T53 Climax 4	96	
9	P Ryan	J Wheeler Autosport	Lotus 18 Climax 4	96	
10	H Sharp	H Sharp	Cooper T53 Climax 4	93	
11	O Gendebien	UDT-Laystall Racing Team	Lotus 18/21 Climax 4	92	
	R Salvadori	Yeoman Credit Racing Team	Cooper T53 Climax 4	96	Engine
	L Ruby	J Frank Harrison	Lotus 18 Climax 4	76	Magneto
	J Hall	J Hall	Lotus 18 Climax 4	76	Fuel pipe
	S Moss	RRC Walker Racing Team	Lotus 18/21 Climax 4	58	Engine
	J Brabham	Cooper Car Co	Cooper T58 Climax V8	57	Overheating
	M Gregory	UDT-Laystall Racing Team	Lotus 18/21 Climax 4	23	Gear selector
	W Hansgen	Momo Corporation	Cooper T53 Climax 4	14	Accident
	J Surtees	Yeoman Credit Racing Team	Cooper T53 Climax 4	0	Engine

Winner's speed 103.22mph (166.03km/h)
Fastest lap J Brabham 1m 18.2s, 106.14mph (170.40km/h)

Grid

	G Hill 1-18.1	**Brabham 1-17.0**
McLaren 1-18.2	Moss 1-18.2	
	Brooks 1-18.3	Clark 1-18.3
Ireland 1-18.8	Gurney 1-18.6	
	Bonnier 1-18.9	Surtees 1-18.9
Salvadori 1-19.2	Gregory 1-19.1	
	Hansgen 1-20.4	Ryan 1-20.0
Penske 1-20.6	Gendebien 1-20.5	
	Hall 1-21.8	Sharp 1-21.0
	Ruby 1-21.8	

Championship placings (* 5 best performances)

Drivers		Constructors	
1. P Hill	*34	1. Ferrari	*40
2. von Trips	33	2. Lotus	32
3. Moss	21	3. Porsche	*22
Gurney	21	4. Cooper	*14
5. Ginther	16	5. BRM	7
6. Ireland	12		
7. Clark	11		
McLaren	11		
9. Baghetti	9		
10. Brooks	6		

14 laps before his race was over with main bearing failure in the 4-cylinder Climax engine. The lead now passed to Innes Ireland who was nursing his Lotus along due to falling fuel pressure. Having his best race of the season, Roy Salvadori had worked his Yeoman Credit Cooper up from ninth and was closing rapidly on Ireland when his engine failed a mere three laps short of the finish. So it was that Ireland, a long time Lotus driver, scored the first GP victory for Team Lotus and for himself with Dan Gurney just over 4sec behind in his third runner-up position in a largely disappointing season for Porsche. The highest placed local driver was Roger Penske in eighth, four laps down.

Ireland's reward for his victory was to be told by Colin Chapman that his services would not be required for 1962. In Jim Clark, Chapman saw a great talent in the making, a driver with whom he could work and who could bring Lotus success. Nevertheless, Ireland's achievement was the high point of Team Lotus' season. The 21 was the state-of-the-art 4-cylinder Climax-engined GP car of the year but it had failed to produce the results. Runner-up position in the Constructors' Championship was due mainly to the effort of Stirling Moss in his year old chassis.

Despite predictions to the contrary, the new F1 had proved a success and had featured some close racing, even though Ferrari had dominated the majority of GPs. Ferrari had enjoyed its best season since 1958, taking both the Drivers' and Constructors' Championships. The V6 engine had enjoyed a 30bhp advantage over its rivals, but, to counter this, it was installed in a less

effective chassis than its British rivals. Only Moss had been able to challenge the 'Sharknosed' cars on circuits where handling and driver skill were at a premium, and the weather intervened as an equalising factor.

Summary of results of non-Championship F1 races

1961 Points Table

	Drivers	Monaco	Holland	Belgium	France	Britain	Germany	Italy	USA	Total	Best 5 scores
1.	Phil Hill	4	6	9	-	6	4	9		38	34
2.	Wolfgang von Trips	3	9	6	-	9	6	-		33	33
3.	Stirling Moss	9	3	-	-	-	9	-	-	21	21
	Dan Gurney	2	-	1	6	-	-	6	6	21	21
5.	Ritchie Ginther	6	2	4	-	4	-	-		16	16
6.	Innes Ireland			-	3	-	-	-	9	12	12
7.	Jim Clark	-	4	-	4	-	3	-	-	11	11
	Bruce McLaren	1	-	-	2	-	1	4	3	11	11
9.	Giancarlo Baghetti				9	-		-		9	9
10.	Tony Brooks	-	-	-	-	-	-	2	4	6	6
11.	Jack Brabham	-	1	-	-	3	-	-	-	4	4
	John Surtees	-		2	-	-	2	-	-	4	4
13.	Olivier Gendebien			3					-	3	3
	Jack Lewis			-	-	-	-	3		3	3
	Jo Bonnier	-	-	-	-	2	-	-	1	3	3
	Graham Hill	-	-	-	1	-	-	-	2	3	3
17.	Roy Salvadori				-	1	-	1	-	2	2
	Constructors										
1.	Ferrari	6	8	8	8	8	6	8		52	40
2.	Lotus Climax	8	4	-	4	-	8	-	8	32	32
3.	Porsche	2	-	1	6	2	-	6	6	23	22
4.	Cooper Climax	1	1	2	2	3	2	4	3	18	14
5.	BRM Climax	-	-	-	1	-	-	2	4	7	7

Private entrants

A feature of the early years of the new formula was the large number of private entrants with old F2 cars that could be updated to F1 specification. This ensured healthy grids at many GPs – the 1961 British GP had 30 starters and the Italian GP 32, the greatest number of starters ever recorded for a GP. In practice, the private owners tended to patronise the large number of non-Championship races organised at circuits that had previously run F2 events. Even so, never again in the history of motor racing would it be so easy or inexpensive to race in F1.

Safety

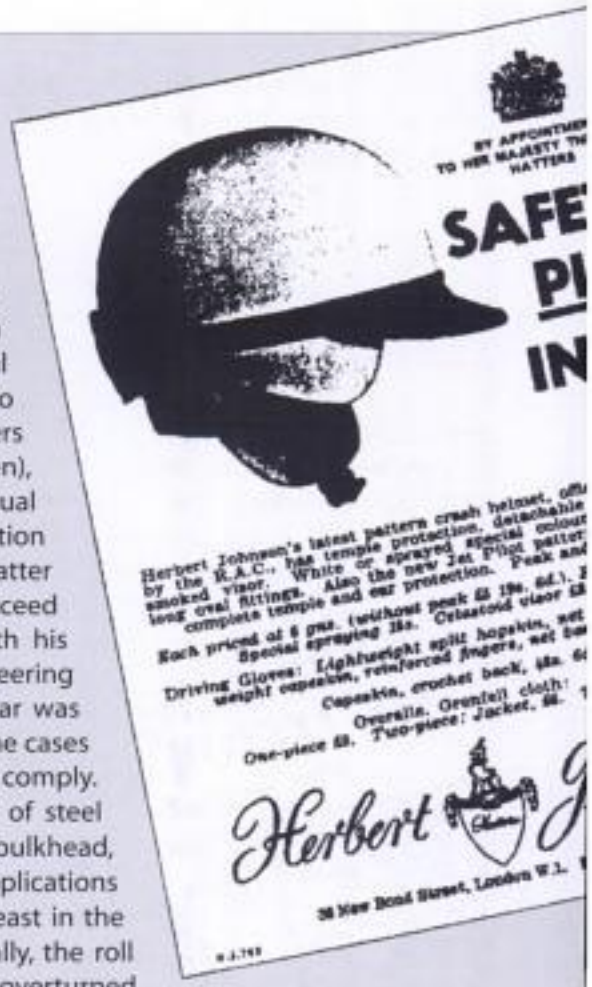
Chassis

Safety was a significant factor in the drafting of the 1½-litre F1 regulations. A minimum weight limit of 450kg was specified to counteract a widely held view that the ultra-lightweight British chassis lacked adequate structural strength. In addition, all cars had to be fitted with electric self starters (push-starts were forbidden), ignition cutout switches, dual braking systems and roll protection bars. The specification of the latter was that their height should exceed the driver's head and their width his shoulders when seated at the steering wheel. The strength of the roll bar was not specified, however, and in some cases only token efforts were made to comply. It was sufficient to weld a piece of steel tubing onto the drivers seat-back bulkhead, and even the more professional applications lacked any rearward bracing, at least in the early years of the formula. Typically, the roll bar would be flattened if a car overturned, as in the case of von Trips' fatal accident at Monza.

The standard multi-tubular space frame of the period would protect its occupant in an accident by deforming progressively but only if it struck another solid object at the right angle. The tubular frame employed by Cooper and Ferrari tended to fold-up dangerously on impact, especially around the cockpit as the impact loading was transmitted throughout the frame.

The popular misconception that prevailed into the early 1960s was that a big accident was more survivable by being thrown out of, or leaping from, the car. At Monza, von Trips suffered a broken neck as a consequence of being thrown from his car, although whether he would have survived had he not been is a matter of conjecture. Nevertheless, there was no call for seat belts. Although the regulations specified that cars should be fitted with attachment points for them, wearing them remained optional. As the size of the cars reduced, so too did the space within the cockpits to the extent that the possibility of being thrown out became very much reduced.

One of motor racing's greatest hazards was the risk of fire following fuel spillage from ruptured tanks in an accident igniting on hot engines and exhausts systems. Fuel



tanks were traditionally fabricated from aluminium sheet to fit around the driver and chassis tubes. Being secured to the chassis with bungy cords, and subject to flexing and vibration during a race, it was not uncommon for them to develop leaks. The introduction of monocoque chassis construction went some way to alleviating this risk, fuel being contained within the monocoque in fireproof rubberised bag tanks, reducing, but not eliminating, the risk of fire in an accident.

Driver kit

Despite the ever present risk of fire, drivers were not conscious of fire protection, being confident that in the event they would get out quickly and get away with it. Normal race wear comprised pale blue Dunlop racing overalls produced in lightweight cotton poplin. Originally designed by Stirling Moss, they were available in one and two-piece styles with elasticated wrists and ankles and a gusset in the back for freedom of movement.

It was not unusual, however, to see drivers racing in short sleeve T-shirts or pullovers. Following an accident in which he suffered burns, race driver and accessory shop owner Les Leston had a set of overalls flameproofed by the same method used for theatre safety curtains. He began producing 'Les Leston flameproof overalls' commercially in various colours at £5 each, available from his High Holborn shop. This was a small beginning in providing protection but a long way from the fireproof clothing introduced in the later 60s.

British racing drivers were required to wear crash helmets of a specification approved by the RAC. The British 'Herbert Johnson' was a popular choice of helmet (Stirling Moss wore one), together with the 'Les Leston Racemaster' helmet worn by Jack Brabham and Bruce McLaren. racing in Europe brought with them 500TX model as worn by Dan Gurney. The US drivers Bell helmets, notably the British drivers racing regularly in the USA soon adopted these more stylish, but safety approved, examples of headwear and they became an almost universal choice.

Driver kit of the 1960s from contemporary magazine adverts. From the top: the Herbert Johnson crash helmet; Les Leston's range of racewear; Bell helmets including the popular 500TX model available stateside for a pricey $37 ppd (£13 4s 3d in 1963).

Lombank Trophy, Snetterton (GB), 26.3.61, 100.27 miles.
1. J Surtees, Cooper T53 Climax 4, 96.58mph. 2. H Taylor, Lotus 18 Climax. 3. R Salvadori, Cooper T53 Climax 4. FL: Salvadori 99.55mph. *First 1½-litre F1 race, only 9 starters and combined with InterContinental race.*

Grand Prix de Pau (F), 3.4.61, 171.40 miles.
1. J Clark, Lotus 18 Climax 4, 63.48mph. 2. J Bonnier, Porsche 718 F4. 3. L Bandini, Cooper T51 Maserati 4. PP: J Brabham Cooper T53 Climax 4. FL: Clark 65.47mph. *Jim Clark's first F1 win.*

Glover Trophy, Goodwood (GB), 3.4.61, 100.80 miles.
1. J Surtees, Cooper T53 Climax 4, 95.76mph. 2. G Hill, BRM P57 Climax 4. 3. R Salvadori, Cooper T53 Climax 4. PP: S Moss, Lotus 18 Climax 4. FL: Surtees 98.18mph.

Grand Prix de Bruxelles, Brussels (B), 9.4.61, 186.68 miles.
1. J Brabham, Cooper T53 Climax 4, 80.37mph. 2. B McLaren, Cooper T53 Climax 4. 3. A Marsh, Lotus 18 Climax 4. FL: J Surtees, Cooper T53 Climax 4, 84.20mph. *Three heats decided on points system.*

Preis von Wien, Aspern (A), 16.4.61, 93.30 miles.
1. S Moss, Lotus 18 Climax 4, 80.15mph. 2. W Seidel, Lotus 18 Climax 4. 3. E Prinoth, Lotus 18 Climax 4. PP: Moss. FL: Moss 84.57mph. *Moss sole top line driver present.*

BARC 200, Aintree (GB), 22.4.61, 150.00 miles.
1. J Brabham, Cooper T55 Climax 4, 78.06mph. 2. B McLaren, Cooper T55 Climax 4. 3. G Hill, BRM P57 Climax 4. PP: Hill. FL: Brabham 80.00mph. *Debut of 'slimline' Cooper T55 and Dunlop D12 wet weather tyres on soaking track.*

Gran Premio di Siracusa, Syracuse (I), 25.4.61, 194.77 miles.
1. G Baghetti, Ferrari 156/61 65° V6, 104.38mph. 2. D Gurney, Porsche 718 F4. 3. J Bonnier, Porsche 718 F4. PP: Gurney. FL: Gurney 108.97mph. *Debut of 'Sharknose' Ferrari and ex-FJ new boy Baghetti who outruns Porsches. Highest placed Brit Jack Brabham in 4th.*

Gran Premio di Napoli, Posillipo (I), 14.5.61, 92.86 miles.
1. G Baghetti, Ferrari 156/61 65° V6, 67.65mph. 2. G Ashmore, Lotus 18 Climax 4. 3. L Bandini, Cooper T51 Maserati 4. PP: Ashmore. FL: Baghetti 67.60mph. *Second straight win for Baghetti after Salvadori suffers puncture. Other teams at Monaco GP.*

London Trophy, Crystal Palace (GB), 22.5.61, 51.43 miles.
1. R Salvadori, Cooper T53 Climax 4, 82.55mph. 2. H Taylor, Lotus 18 Climax 4. 3. A Marsh, Lotus 18 Climax 4. PP: Salvadori. FL: Salvadori & Taylor 83.96mph.

Silver City Trophy, Brands Hatch (GB), 3.6.61, 201.40 miles.
1. S Moss, Lotus 18/21 Climax 4, 91.78mph. 2. J Clark, Lotus 21 Climax 4. 3. CAS Brooks, BRM P57 Climax 4. PP: Moss. FL: Moss 93.52mph. *Clark and Surtees set pace but Moss wins after the latter had spun out.*

Grosser Preis der Solitude, Stuttgart (D), 23.7.61, 177.23 miles.
1. I Ireland, Lotus 21 Climax 4, 105.26mph. 2. J Bonnier, Porsche 718 F4. 3. D Gurney, Porsche 718 F4. PP: Bonnier. FL: Gurney 108.01mph. *Brilliant and close fought win for Innes on Porsche home ground. Moss never featured.*

Kanonloppet, Karlskoga (S), 20.8.61, 55.89 miles.
1. S Moss, Lotus 18/21 Climax 4, 69.26mph. 2. J Bonnier, Porsche 718 F4. 3. J Surtees, Cooper T53 Climax 4. PP: J Clark, Lotus 21 Climax 4. FL: Moss 74.23mph.

Danske Grand Prix, Roskilde (DK), 27.8.61, 59.65 miles.
1. S Moss, Lotus 18/21 Climax 4, 60.18mph. 2. I Ireland, Lotus 21 Climax 4. 3. R Salvadori, Cooper T53 Climax 4. PP: Moss. FL: Moss, 63.02mph. *Three heat race on 3/4mile circuit.*

Gran Premio di Modena, Modena (I), 3.9.61, 147.14 miles.
1. S Moss, Lotus 18/21 Climax 4, 88.10mph. 2. J Bonnier, Porsche 718 F4. 3. D Gurney, Porsche 718 F4. PP: Moss. FL: Moss 89.40mph. *Moss dominant as Ferrari's miss race in their own back yard in favour of preparation for Italian GP.*

Flugplatzrennen Zeltweg, Zeltweg (A), 17.9.61, 159.07 miles.
1. I Ireland, Lotus 21 Climax 4, 91.45mph. 2. J Brabham, Cooper T53 Climax 4. 3. J Bonnier, Porsche 718 F4. PP: Ireland. FL: Ireland 97.26mph. *Ireland masterly on rough airfield track, wins by a lap.*

International Gold Cup, Oulton Park (GB), 23.9.61, 165.66 miles.
1. S Moss, Ferguson P99 Climax 4, 88.83mph. 2. J Brabham, Cooper T53 Climax 4. 3. B McLaren, Cooper T53 Climax 4. PP: McLaren. FL: Moss 93.42mph. *Sole F1 win on suitably damp track for four-wheel-drive Ferguson suitably mastered by Moss.*

Lewis-Evans Trophy, Brands Hatch (GB), 1.10.61, 79.50 miles.
1. A Marsh, BRM P48 Climax 4, 91.15mph. 2. M Spence, Emeryson 1004 Climax 4. 3. T Parnell, Lotus 18 Climax 4. PP: Marsh. FL: Marsh 92.08mph. *Minor national race held while top teams on way to US GP.*

Coppa Italia, Vallelunga (I), 12.10.61, 66.22 miles.
1. G Baghetti, Porsche 718 F4, 66.11mph. 2. E Prinoth, Lotus 18 Climax 4. 3. N Vaccarella, Cooper T51 Maserati 4. PP: Vaccarella. FL: Vaccarella 68.27mph. *Held to decide Italian Championship.*

Rand Grand Prix, Kyalami (ZA), 9.12.61, 190.88 miles.
1. J Clark, Lotus 21 Climax 4, 90.55mph. 2. T Taylor, Lotus 21 Climax 4. 3. J Bonnier, Porsche 718 F4. PP: Clark. FL: Bonnier 92.40mph. *Taylor had now replaced Ireland at Team Lotus. Lotus demonstration run in first race of Springbok Series*

Natal Grand Prix, Westmead (ZA), 17.12.61, 200.21 miles.
1. J Clark, Lotus 21 Climax 4, 89.59mph. 2. S Moss, Lotus 18/21 Climax 4. 3. J Bonnier, Porsche 718 F4. PP: Clark. FL: Moss 93.37mph. *Clark shows superiority over Moss.*

South African Grand Prix, East London (ZA), 26.12.61, 194.80 miles.
1. J Clark, Lotus 21 Climax 4, 92.20mph. 2. S Moss, Lotus 18/21 Climax 4. 3. J Bonnier, Porsche 718 F4. PP: Clark. FL: Clark 94.20mph. *Clark beats (unwell) Moss again.*

Technical overview: 1961

Engine situation

All the major constructors relied on former F2 engines for motive power during the first season of 1½-litre GP racing. Ferrari, the only constructor to be fully prepared for the new formula, had produced a wide angle, 120° V6 but this was effectively a development of the proven 65° V6 Dino unit that had first seen light of day in late 1956. The wider angle gave better internal balance and, when installed in the chassis, a lower centre of gravity and overall height than the 'conventional' engine. By the end of the season claimed power output was 192bhp at 9500rpm, 40bhp better than the Climax FPF.

Photographs and brief descriptions of a new air-cooled flat-8 from Porsche were issued in April but problems during development prevented it from being seen in a chassis. The German constructor had not expected to use its familiar flat-4 F2 engine for the entire season but it produced 165bhp and, allied to the 1960 718 chassis, performance was generally on a par with the British teams that were relying on the Coventry Climax FPF engine. This F2 unit, first seen in 1957, underwent a considerable amount of redesign work over the winter of 1960/61, including a shortening of the stroke and adoption of the 1959/60 2½-litre unit bottom end. In this Mk II form it developed 151bhp at 7500 rpm.

Chassis progress

Ferrari's first rear-engined chassis for the 1½-litre F1 was of multi-tubular construction, a development of the prototype seen on occasion during 1960 and owing much to Cooper design principles. Although an advance on previous chassis, it was heavy, relatively crude and featured only minimal cross-bracing. Because of the width of the engine, the top side-members were kinked outwards in the engine bay to aid engine

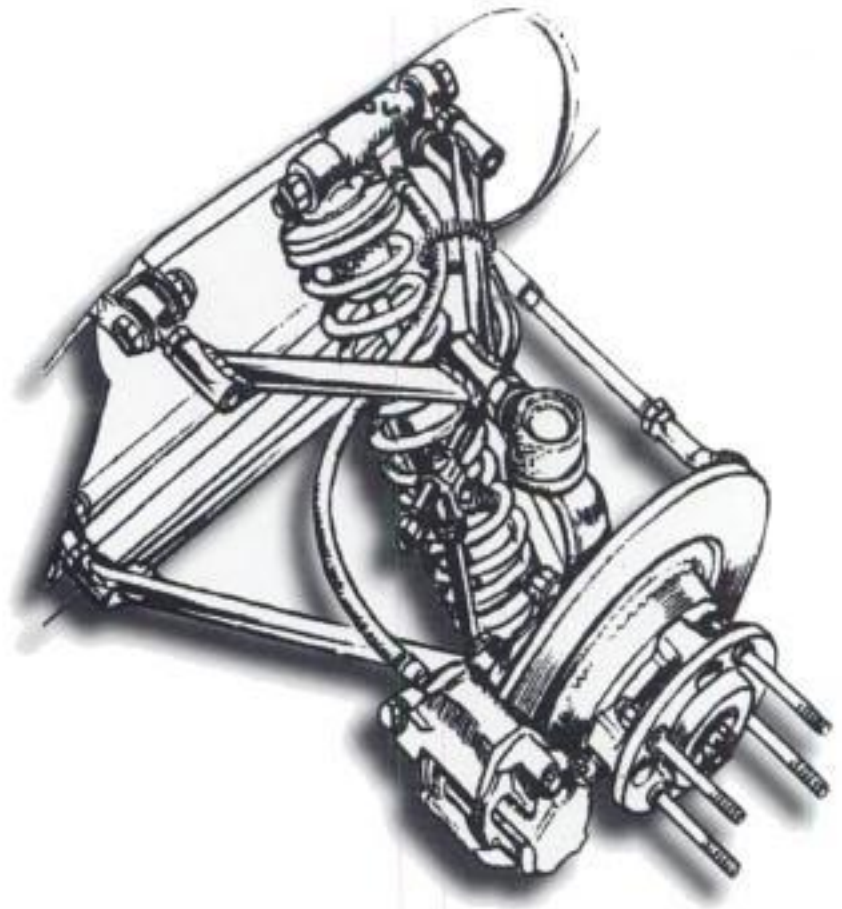
installation. Consequently, it lacked rigidity compared to the more sophisticated British chassis. Nevertheless, it formed a simple package for the powerful engine and provided the desired results on all circuits bar those on which handling was at a premium.

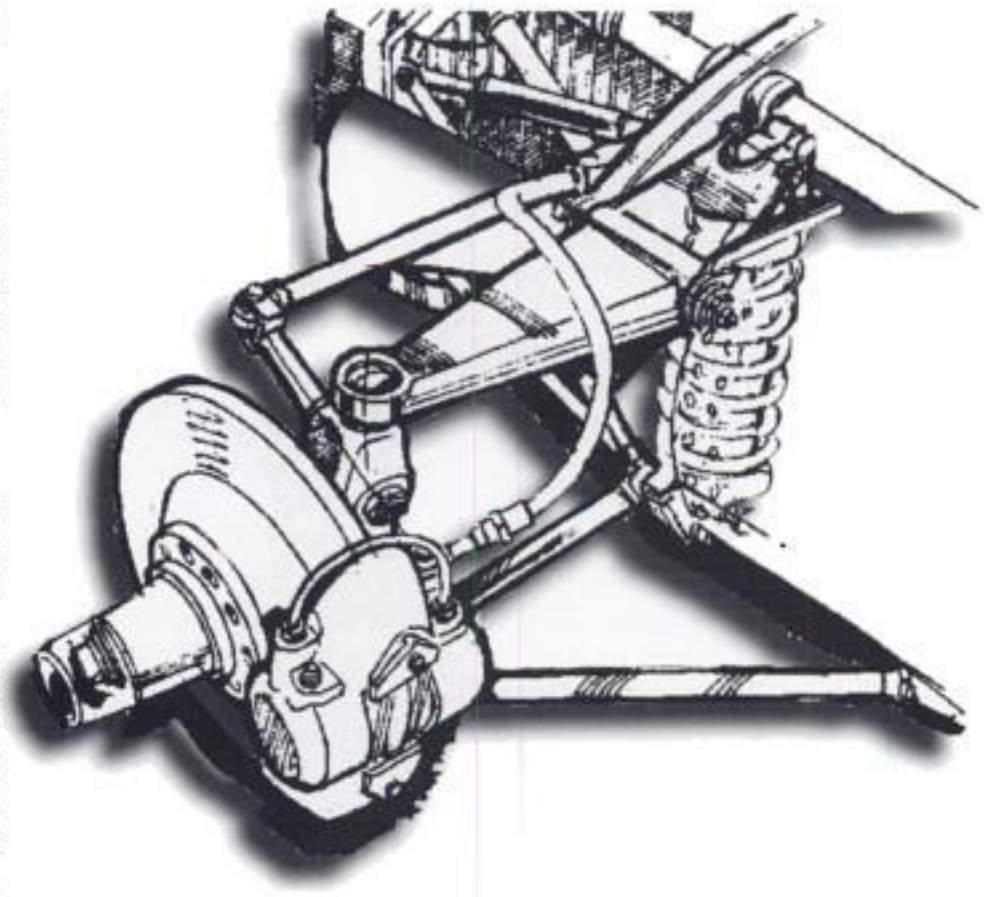
Lotus produced the type 21, the state-of-the-art space frame chassis for the 4-cylinder Climax FPF engine. It was designed to present the lowest, slimmest profile and the cleanest shape so as to make the most of the limited power that the engine provided. Needless to say, the chassis was fully triangulated and, in the interests of space saving, the main chassis tubes were used to convey oil and coolant to and from the front-mounted radiator. The engine was installed in the chassis at an 18° angle to the vertical to both lower the height of the engine cover and bring the carburettor inlets further within the chassis, as well as tuck the exhaust system inboard. More significantly, the driver was lowered into the chassis out of the airstream by reclining his seat back steeply, lowering his head by some two inches.

Suspension technology

All constructors, with the exception of Porsche, utilised double wishbone and coil spring front suspensions. The 1959/60 type 718 chassis betrayed Porsche's Volkswagen origins with its traditional trailing link front suspension with torsion bars as the springing medium. The type 787 chassis introduced at Monaco to take the new flat-8 engine, however, adopted wishbones with curved forward links and coil springs. This chassis was abandoned after two GPs due to handling problems.

Colin Chapman set a new standard for front suspension layouts on the Lotus 21. In an effort to reduce aerodynamic drag and unsprung weight, he mounted the coil spring/damper unit inboard of the chassis. The top wishbone was narrow-based, plated in for additional stiffness and acted as a rocker arm, pivoting on the chassis to compress the coil spring unit. The lower wishbone was a conventional wide-based unit. While not a new idea, Chapman was able to utilise the rocker arm principle to maximum advantage at a time when suspension technology was making rapid progress.





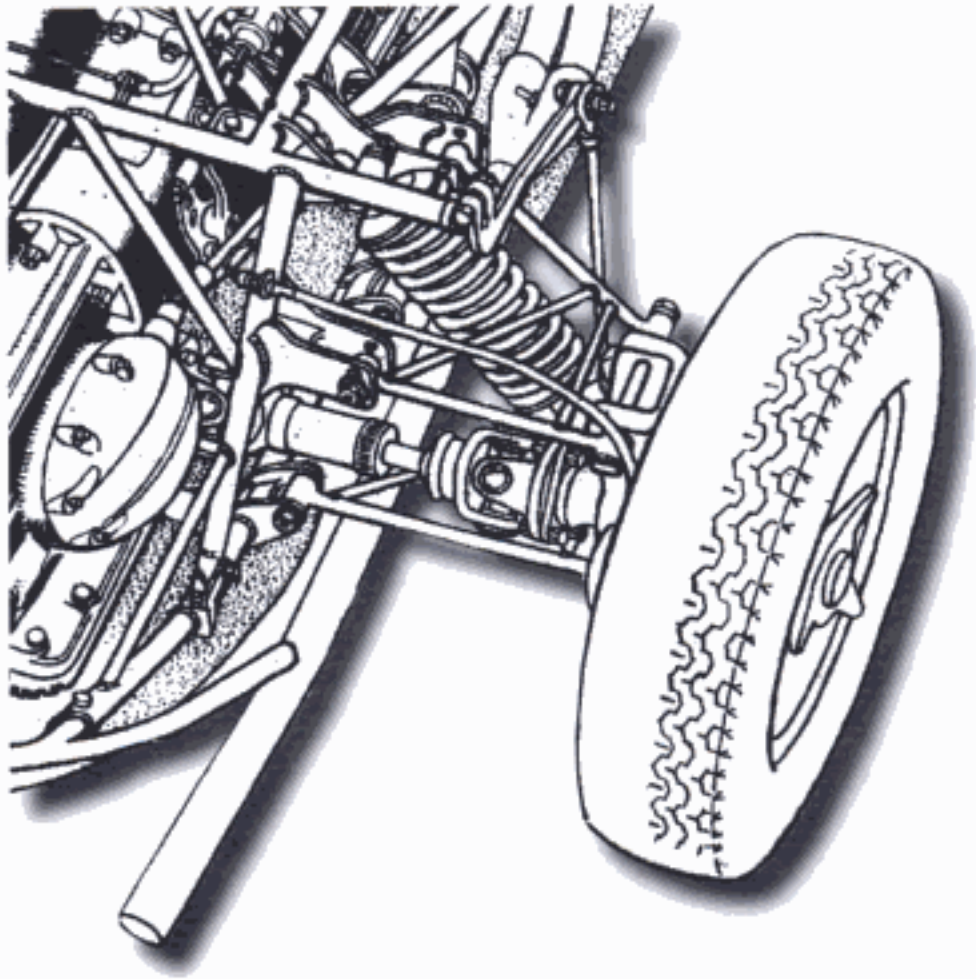
Top: Typical unequal length, double wishbone front suspension of the late '50s and early '60s that would have been fitted to many single-seater and sports racing cars. Note the combined coil spring/damper unit and Standard-Triumph front upright. ***Bottom:*** *Colin Chapman's new standard on the 1961 Lotus 21. The upper wishbone is plated for strength, and pivots on the chassis to act on the inboard-mounted coil spring/damper unit. The orthodox lower wishbone is wide-based and shares its pivot point with the lower mounting of the spring unit. By 1964, every constructor, bar Brabham, would use this front suspension layout.*

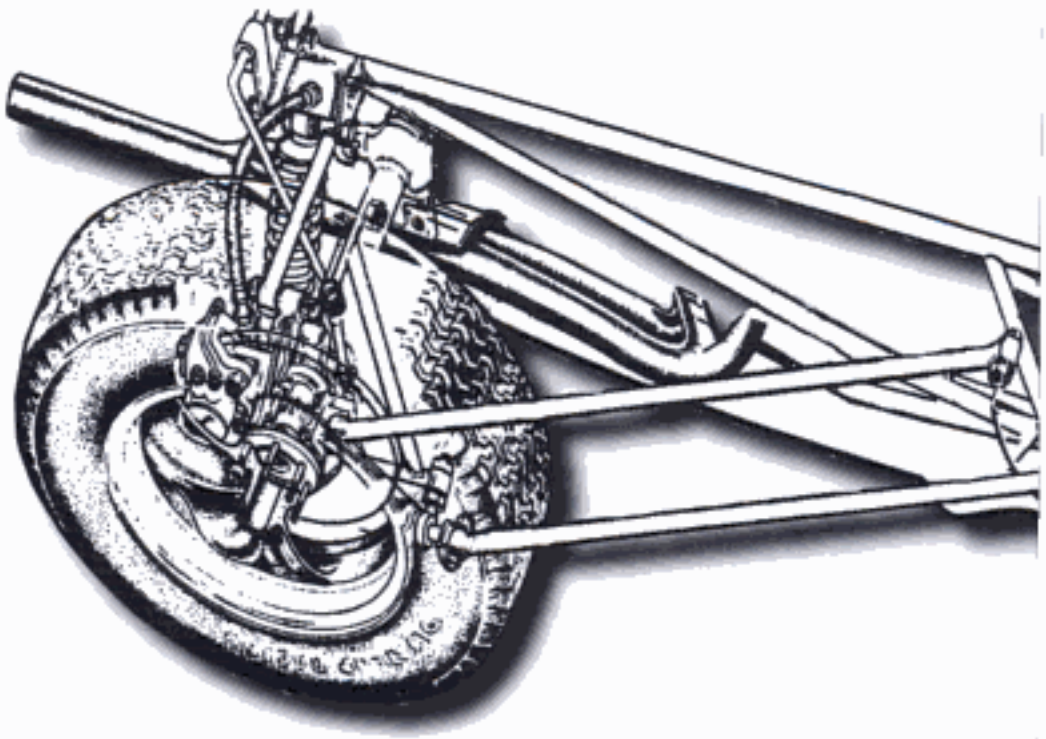
British constructors Cooper and Lotus utilised a proprietary front upright manufactured by Alford & Alder. This was a popular component with 'special' builders and low volume manufacturers of FJ single-seaters and sports racing cars, being inexpensive and easily available. It was first manufactured in 1938 and, because of its use on such cars as the Herald and Spitfire from the Standard-Triumph motor group, it came to be known as the 'Standard-Triumph front upright'. A lightweight steel forging, it was easily adaptable to changes in disc brake size or caliper type, suspension and steering layout, and geometry. It would also be used in future F1 cars from Lola and Brabham, and was only superseded by purpose-made components when there was a trend towards raising the steering arm to the same level as the top wishbone for drag reduction purposes. This was a rather expensive method of obtaining only a dubious advantage, as the upright was easily adequate for the job throughout the 1½-litre F1.

There were two types of independent rear suspension in use, both basically of a wishbone layout. BRM, Cooper, Ferrari and Porsche used double wishbones with wider-based inner pivots than on the front suspension. When designing the 1960 Lotus 18, Colin Chapman had devised what would become the trendsetting layout for rear suspensions. Long, low-mounted, reversed wishbones pivoted almost on the chassis centre line beneath the gearbox. The outer ends of the wishbones were anchored to cast alloy hub carriers that extended down to approximately three inches above the road surface. Fixed-length driveshafts doubled as the upper suspension links and twin parallel radius arms picking up from the seat-back bulkhead provided longitudinal location. This layout was similar to that seen on the 1959 Lola Mk I sports car and, in principle, the linkages formed very wide-based wishbones to achieve a higher level of wheel control than previously available. Combined coil spring/damper units and anti-roll bars were fitted front and rear, and the fully adjustable suspension geometry placed both front and rear roll centres close to the road.

Transmissions

The rear-engined revolution had simplified the layout of race





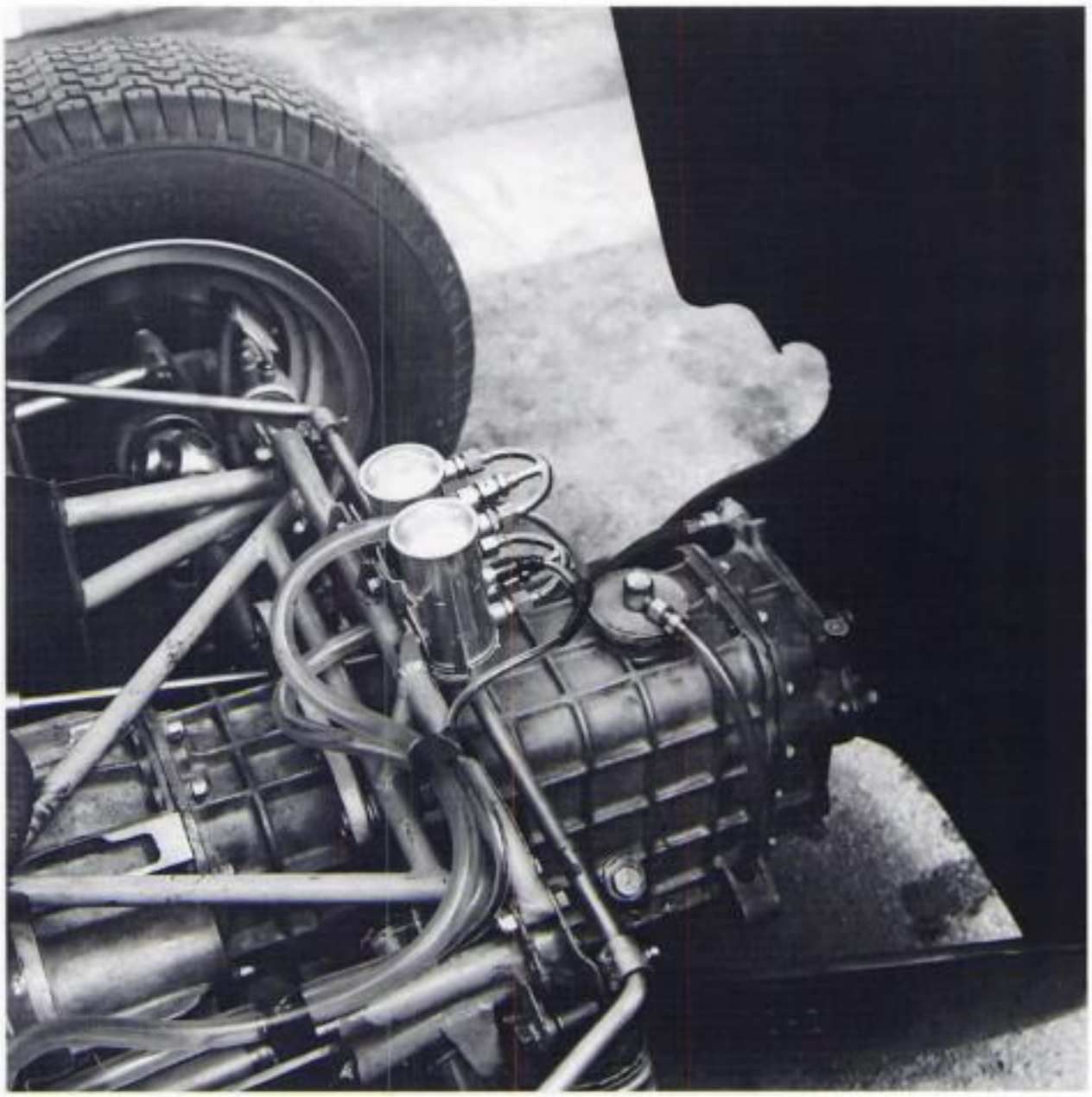
Top: A conventional double wishbone rear suspension layout demonstrated by Cooper on its T53 Championship-winning chassis, although seen here on the one-off T54 Indianapolis chassis of 1961. Note that the upper wishbone is diagonally braced and there is a reversed lower wishbone with short radius arm (not visible here). ***Bottom:*** *What would become the standard rear suspension layout of the 1960s. Colin Chapman provided the Lotus 21 with a single upper link and reversed lower wishbone located by twin radius arms picking up from the seat-back bulkhead.*

car transmissions, bringing the gearbox and final drive into a single unit attached directly to the clutch and back of the engine. Typically, drive would pass from the clutch to a quill shaft running below the axle centre line to the gearbox overhung behind it, then pass forward via an upper second motion shaft to the final drive.

While BRM, Ferrari and Porsche had the capacity and engineering backup to design and build their own transmissions, the new breed of F1 constructors had comparatively limited resources. As rear-engined trendsetter, Cooper had initially relied on modified production Citroën transmissions. By 1961, Jack Knight was manufacturing a purpose-built unit to Cooper design at his Battersea engineering shop. This 'C5S' cost £1000 per unit, a vast amount at the time and a significant proportion of the team budget.

Lotus, meanwhile, had made an exclusive arrangement with the German ZF transmission manufacturer for supply of a proprietary 5-speed transmission originally intended for light commercial use. Colin Chapman had spotted this in ZF's experimental department during a visit to its Friedrichshafen base and it would prove to be eminently suitable for F1 purposes. In this 5DS10 transaxle, the relationship between the 5 gears remained constant, only the crown wheel and pinion could be changed to provide alternative overall ratios. This necessitated carrying complete spare transmissions with alternative crown wheels and pinions to every GP.

The only transmission available 'off-the-shelf' in 1961 was the GSD type 32 5-speed unit, commonly known as the 'Colotti'. Valerio Colotti had worked at Ferrari and then Maserati where he had been chief chassis and transmission engineer from 1953 to 1958. When Maserati withdrew from racing he set up his own design studio, one of his first commissions being a new transmission for the Rob Walker Coopers driven by Stirling Moss. The link with Walker brought him into contact with chief mechanic Alf Francis and, in 1960, the two of them went into partnership to form Gears Speed Developments SpA (GSD) in Modena to market and produce Colotti's transmissions. During 1961, the GSD type 32 appeared on the Climax-engined BRMs and the Moss Walker-entered Lotus.



The GSD (Colotti) type 32 5-speed gearbox installed in a Lotus 18 chassis seen at Monaco.

3 1962 – British rule restored

In the first year of new GP regulations, driver, engine and chassis combinations inevitably go through a formulative phase, and any constructor in an advanced state of readiness has the opportunity to clean up. 1961 was no exception, and it was Ferrari that benefited, while Porsche should have been similarly placed had development of its flat-8 come up to expectations and the new chassis not been a disaster. The British constructors had shot themselves in the foot in attempting to oppose the new regulations, and had been without competitive engines. Come 1962, the new V8 engines from both BRM and Coventry Climax were race ready and prospects for the season ahead were viewed with some optimism.

Before the 1962 GP season started, a shadow was cast over it following an accident at Goodwood in which Stirling Moss was badly injured. Although never World Champion, he was acknowledged as the undisputed 'number 1'. His performances during the 1961 season, when he defeated the Ferrari team at Monte Carlo and the Nürburgring, underlined his position. In the early 1962 non-Championship F1 races he had competed in the Coventry Climax V8-engined Lotus 18/21 hybrid built-up by Rob Walker's team in the latter part of 1961. Typically, he had made this competitive despite ongoing gear selection and throttle linkage problems. At Goodwood, on Easter Monday, these problems had continued but did not prevent Moss from lapping at unabated pace following a pit stop. Why he went off the road and ploughed into the earth bank at St Mary's has never been satisfactorily explained. He was severely injured and the Lotus destroyed, but it seemed inevitable that he would be back, as he always had after injury. In the meantime, his number 1 position was vacant.

Ferrari looked set to remain competitive throughout 1962, though not repeat the domination seen in the previous year. Under the surface, however, all was not well. Following the 1961 Italian GP, a major dispute had erupted at Maranello and eight key personnel had walked out, including technical director Carlo Chiti and team manager Romolo Tavoni. Newly crowned World Champion Phil Hill had visited Enzo Ferrari at his home in Modena shortly after the tragic race at Monza and had pledged his support for Ferrari by agreeing to drive for the team in 1962. Had he been aware of the departure of Chiti and Tavoni, with whom he had a good working relationship, it is unlikely that he would have agreed to stay.

Enzo Ferrari was never one to rely too heavily on personalities, preferring a policy of strength through depth. He was quick to promote from within the ranks to fill vacancies, and one of those to benefit was a young design office engineer named Mauro Forghieri who would develop into an outstanding technical director through the 1960s and into the 1970s. For the moment, however, Ferrari would have to rely on updated 1961 cars while the new engineering team settled in. On the driver strength, Phil Hill would be partnered by a trio of Latins – Giancarlo Baghetti, Lorenzo Bandini, and Ricardo Rodriguez – with Belgian Willy Mairesse primarily as the test-driver.

Unable to secure a guaranteed F1 drive with Ferrari for 1962, Ritchie Ginther had left the team and joined BRM as number 2 to Graham Hill. Ginther's test and development skills would greatly benefit BRM as it developed its new P578 chassis and V8 engine. Hill was entering his third season with BRM, having previously driven Lotus sports cars and single-seaters in its early years in F2 and F1. The determined Londoner was looking to BRM in 1962 to provide him with the competitive drive that had so far eluded him and enable him to demonstrate his skill. In fact, BRM seemed to be in a happier and more competitive position with the new P578 car than at any time in its previous troubled 16 years of racing.

Porsche had retained the services of Dan Gurney and Jo Bonnier, and some progress had been made on the flat-8 engine over the winter. A new chassis had been designed to take this engine but it was anticipated that it would be fitted with the familiar flat-4 until the flat-8 was raceworthy.

Colin Chapman had been quick to pen the Lotus 24, an updated 21, to take the new Coventry Climax V8. Jim Clark, who was now Lotus number 1 following the dismissal of Innes Ireland

Opposite: Dutch GP, Zandvoort, 20 May 1962. A new era: Jim Clark debuts monocoque technology, putting the Lotus 25 ahead of Hill (BRM P578) and, from right to left, Gurney (Porsche 804), McLaren (Cooper T60), Phil Hill (Ferrari 156), Surtees (Lola Mk 4), Ireland (UDT-Laystall Lotus 24), Rodriguez (Ferrari 156), Taylor (Lotus 24) and Brabham (Lotus 24).

at the end of 1961, had driven this with some success in the early season non-Championship races. His team-mate was Trevor Taylor, promoted from the ranks of Formula Junior. Ireland had agreed to drive for Ken Gregory's UDT-Laystall team, running customer Lotus 24 chassis with either BRM or Climax engines. Innes was subsequently offered a drive by BRM but, having already agreed to drive for Gregory, he turned the offer down. He was to be partnered by Kansas-born Masten Gregory who had driven for the team in the latter part of 1961. Masten had not had a competitive F1 drive since a season with Cooper in 1959.

In what seemed a reversal of previous policy, Colin Chapman was producing the Lotus 24 for sale to customers and, as well as UDT-Laystall, purchasers included Jack Brabham and Rob Walker. Brabham had now set up his own organisation with fellow countryman and designer Ron Tauranac, initially to produce FJ cars for sale. The first Brabham F1 car was still a few months away, however, and, in the meantime, he would run a Lotus 24 entered by his Brabham Racing Organisation. In the absence of Stirling Moss, Walker would run his car for the veteran Frenchman Maurice Trintignant who had won the non-Championship Pau GP on the same day as Moss' accident.

While Lotus was on time with the 24, Cooper was lagging behind on development of its new T60, despite having had the experience of running the Climax V8 since August 1961. New Zealander Bruce McLaren, number 2 to Jack Brabham since 1959, was now team leader. His number 2 was the young South African Tony Maggs, another driver to be promoted from Formula Junior, who had competed in two 1961 GPs in a privately entered Lotus

18. Cooper chassis had always been a popular choice with private entrants but they had attracted no new customers for 1962, although a number of 1961 T53s would continue to be run.

The Reg Parnell-run Yeoman Credit team, newly renamed Bowmaker in deference to a change in ownership of the finance house, had been a Cooper customer in 1961. Now it would be more in control of its destiny, having contracted Eric Broadley to build and supply a Lola F1 chassis. Broadley had begun as a constructor in much the same way as Colin Chapman and his 1100cc sports racing cars had dominated their class in 1959/60. His Formula Junior chassis had not been as successful but Parnell's lead driver, John Surtees, had been sufficiently impressed to recommend Broadley to the team. In any event, the arrangement put Parnell on a par with other works teams. The new Lola was a neat and well-executed design, and was on test early in the season. Roy Salvadori would back up Surtees, as in 1961.

Once again, team principals and enthusiasts alike looked to early season non-Championship races to assess form. Willy Mairesse had won the Brussels GP for Ferrari in a 65° V6-engined car entered to gauge the potential of the new British threat. The V8s had failed on that day but, thereafter, Jim Clark won twice for Coventry Climax, as did Graham Hill for BRM. Races at Pau and at Aintree had seen the Ferraris soundly beaten. Of the new Porsche there was no sign, but, all in all, it looked as if 1962 could be anyone's.

The GP season began with the Dutch GP on 20 May rather than the traditional Monaco opener. Not all the teams were at full strength, while others had some surprises to spring. BRM appeared with a P578 for Graham Hill, while Ginther had to make do with a V8-engined 1961 P57 following testing and racing incidents that had written-off two new chassis. Cooper had a new T60 for McLaren and UDT-Laystall had a Lotus 24 for Ireland, their respective team-mates, Maggs and Gregory, running 1961 4-cylinder cars. Ferrari had entered three, basically 1961 specification 156/120° V6s, while Porsche arrived, somewhat unexpectedly, with two new type 804 flat-8-cylinder cars. The air-cooled engines were exquisitely crafted and new space frame chassis featured wishbone suspension with torsion bar springing.

By far the greatest surprise was provided by Colin Chapman and Team Lotus. Whereas everyone had assumed that the type 24 would be the regular Lotus contender for 1962, a new car was rolled out of the transporter at Zandvoort, altogether slimmer and lower than even the 24. Closer inspection revealed that this was no ordinary GP car but one that broke new ground in terms of chassis design. Colin Chapman was now introducing something new on an unsuspecting world – the monocoque chassis. This was the Lotus 25, the chassis of which comprised two D-section, fabricated aluminium side-members running the length of the wheelbase with the driver in a semi-reclining position between them. Fuel was contained in rubber bag tanks within the side-members, and the Coventry Climax engine, bolted rigidly into position, completed the structure. The result was lighter and more rigid than the 24, making it quite the lowest and most compact GP car yet seen, its cross sectional area being little larger than the external dimensions of the engine.

Rival designers were startled at this radical innovation, especially as the 25 arrived at Zandvoort untested and with a question mark hanging over the practicality of the basic concept. In the words of *Autosport* "... to break away entirely from accepted Grand Prix practice requires confidence (and ability) of the highest order."

Jim Clark had the option of running his regular 24 but clearly the 25 was the way to go, having secured third place on the grid for the race. Clark had total confidence in Chapman's ability to provide a race winner when, in similar circumstances, a lesser driver might have stayed with a tried and tested car. Chapman had been at the leading edge of chassis and suspension technology for some time but success in F1 had so far eluded him. With the

Opposite: With Clark gone, Graham Hill strolls to victory early in the race (all 8 stack pipe exhausts are still in place!), driving what will become 'Old Faithful' – BRM chassis 5781. Note the proximity of spectators to the track, 'protected' by a wire fence.

Grand Prix Drivers Association

On 11 May 1961 the GP drivers formed themselves into a new group to be known as the Grand Prix Drivers Association (GPDA). Of the 18 founder members, Stirling Moss and Jo Bonnier were elected Chairman and Vice-Chairman respectively. Following Moss' retirement from driving in 1963, Bonnier would take over as Chairman with Graham Hill elected as Vice-Chairman. The aims of the GPDA included obtaining international recognition and representation on the CSI, furthering the aims of motor racing in general and, finally, co-operating in improving safety provisions for spectators and drivers alike.

The association was to take no part in financial dealings between drivers, teams or organisers but it took a little while before the perception that it was a 'trades union' was put to rest. The aim of representation on the CSI was soon achieved, and agreement was reached with race organisers to carry out track inspections prior to each GP, with suggestions being made for improvements to safety, etc. The GPDA would be instrumental over subsequent years in the regulation specifying the fitting of oil catch tanks to cars and the innovation of 'dummy' starting grids.

Awards were made each year by the GPDA to the organiser of the best and most efficiently run GP of the season and to the most successful private entrant. The first organisers' award went to the Dutch GP in 1962 and subsequent awards went to Monaco (1963), Monza (1964) and Watkins Glen (1965). The private entrants award was presented in memory of 'Taffy' von Trips, the first recipient being Carel Godin de Beaufort in 1962. Thereafter, awards went to Jo Siffert (1963) and Bob Anderson (1964).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Lotus 25 he would establish himself as the leader in GP car design, a position he would maintain unchallenged through the 60s and into the 70s. The blending of the respective skills of Clark and Chapman would create the perfect partnership to take them to new levels of success over the course of the 1½-litre F1.

As for the GP itself, Clark took an immediate lead from Hill's BRM, soon establishing it at around 3sec. This was short-lived, however, as the Lotus developed a problem in the clutch hydraulic operating mechanism and Clark pulled into the pits for repairs after only 12 of the 70 laps. Nine laps were lost before he rejoined, using the race as an extended test session, finishing an unclassified ninth. Hill then dominated the race in the distinctive vertical 'stack pipe' exhaust BRM, interest switching to Trevor Taylor in the Team Lotus 24 and his attempt to close the gap on Phil Hill's Ferrari. He finally passed him 8 laps from the end, pulling away to take a well deserved second. McLaren had run second in the new Cooper following Clark's departure, until a quill shaft broke in the gearbox. Tony Maggs, in the other Cooper entry, impressed by taking fifth, the first 4-cylinder car home.

Dan Gurney had the new Porsche in third for a few laps until he pulled the gear lever out of its mounting. A stop for repairs was made but his race ended after 47 laps when the gearchange bracket sheared. Bonnier in the other Porsche never featured and it was left to Godin de Beaufort to claim a Constructors' point for the marque in his home GP after a fine run to sixth in his privately entered, two year old, 4-cylinder 718. Although Phil Hill had brought his Ferrari home third, the British V8s had eclipsed the previously dominant 'Sharknose' cars. Of the nine new generation V8s that had started, however, only two had finished untroubled. Nevertheless, a BRM had won, giving Graham Hill a well deserved maiden victory on a circuit that had been lucky for the team in 1959 when Jo Bonnier had scored the marque's only other GP victory.

BRM's racing history had been dotted with moments of encouragement but all too often any promise failed to be realised and previous form was against Hill repeating this winning performance. Previous form, however, did not reflect changes to the management structure that had been undertaken in late 1960. Tony Rudd was now in technical command and he and Hill worked well together. Rudd was also receptive to driver input, something that had been lacking within the team in the past. The new P578 chassis was strong and well engineered, and the new

1962 World Championship – Round 1

Grote Prijs van Nederland

Zandvoort 20 May 1962 80 laps
Starters 20 **Finishers** 7
208.43 miles (335.44km)
Weather Warm and sunnny

	Driver	Entrant	Car	Laps	Result
1	G Hill	Owen Racing Organisation	BRM P578 V8	80	2h 11m 02.1s
2	T Taylor	Team Lotus	Lotus 24 Climax V8	80	2h 11m 29.3s
3	P Hill	Ferrari SpA SEFAC	Ferrari 156/120° V6	80	2h 12m 23.2s
4	G Baghetti	Ferrari SpA SEFAC	Ferrari 156/120° V6	79	
5	A Maggs	Cooper Car Co	Cooper T55 Climax 4	78	
6	G de Beaufort	Ecurie Maarsbergen	Porsche 718 F4	76	
7	J Bonnier	Porsche System Engineering	Porsche 804 F8	75	
	R Rodriguez	Ferrari SpA SEFAC	Ferrari 156/120° V6	73	Accident
	R Ginther	Owen Racing Organisation	BRM P57 V8	71	N/C
	J Lewis	Ecurie Galloise	Cooper T53 Climax 4	70	N/C
	J Clark	Team Lotus	Lotus 25 Climax V8	70	N/C
	I Ireland	UDT-Laystall Racing Team	Lotus 24 Climax V8	61	Accident
	M Gregory	UDT-Laystall Racing Team	Lotus 18/21 Climax 4	54	Gearbox
	W Seidel	Ecurie Maarsbergen	Emeryson Climax 4	52	N/C
	D Gurney	Porsche System Engineering	Porsche 804 F8	47	Gear change
	B McLaren	Cooper Car Co	Cooper T60 Climax V8	21	Gearbox
	R Salvadori	Bowmaker Lola Racing Team	Lola Mk 4 Climax V8	12	Withdrawn
	J Surtees	Bowmaker Lola Racing Team	Lola Mk 4 Climax V8	8	Fr. suspension
	J Brabham	Brabham Racing Organisation	Lotus 24 Climax V8	4	Accident
	B Pon	Ecurie Maarsbergen	Porsche 787 F4	2	Accident

Grid

Clark 1-33.2	G Hill 1-32.6	**Surtees 1-32.5**
McLaren 1-33.9		Brabham 1-33.3
Gurney 1-34.7	Ginther 1-34.5	Ireland 1-34.1
Taylor 1-35.4		P Hill 1-35.0
Bonnier 1-37.0	Baghetti 1-36.3	Rodriguez 1-36.1
Maggs 1-37.5		de Beaufort 1-37.4
Pon 1-40.9	Salvadori 1-38.8	Gregory 1-38.0
Seidel 1-46.0		Lewis 1-43.2

Winner's speed 95.44mph (153.595km/h)
Fastest lap B McLaren 1m 34.4s, 99.36mph (159.902km/h)

Championship placings

Drivers		Constructors	
1. G Hill	9	1. BRM	9
2. Taylor	6	2. Lotus	6
3. P Hill	4	3. Ferrari	4
4. Baghetti	3	4. Cooper	2
5. Maggs	2	5. Porsche	5
6. de Beaufort	1		

V8 was powerful and effective. Team patron Sir Alfred Owen had ordered BRM to produce some concrete results in 1962 under threat of closure if it did not do so. A GP win was an excellent start but it needed to maintain the momentum.

The Monaco GP followed two weeks later and Hill was able to take the BRM, sporting a chopped 'Monaco' nose to minimise accident damage, into a clear lead despite the close attention of Jim Clark and the new Lotus in the second quarter of the race. Clark had started from pole position but had been put off line by a hard charging Willy Mairesse trying to barge his Ferrari into the lead from the second row. At the same time, mayhem broke out at the Gasworks Hairpin, only yards from the start line, as Ginther had the throttle of his BRM jam open, Gurney, Ireland, Trintignant and Taylor becoming involved in the ensuing collisions. Only Ireland and Taylor were able to continue but not competitively. It was particularly unfortunate for Gurney to be eliminated as it was his enthusiasm alone that had prompted Porsche to enter the race.

Questions were subsequently raised as to the advisability of having the start line so close to the first corner, as this inevitably led to pushing and shoving. The pits were actually on the leeward side of that part of the track and this seemed a far better position for the start, giving the field an opportunity to sort itself out on the way up to Ste Dévote.

1962 World Championship – Round 2

Monte Carlo 3 June 1962
Starters 16 **Finishers** 7

Grand Prix de Monaco

100 laps 195.42 miles (314.50km)
Weather Overcast

	Driver	Entrant	Car	Laps	Result
1	B McLaren	Cooper Car Co	Cooper T60 Climax V8	100	2h 46m 27.7s
2	P Hill	Ferrari SpA SEFAC	Ferrari 156/120° V6	100	2h 46m 31.0s
3	L Bandini	Ferrari SpA SEFAC	Ferrari 156/120° V6	100	2h 47m 53.8s
4	J Surtees	Bowmaker Lola Racing Team	Lola Mk 4 Climax V8	99	
5	J Bonnier	Porsche System Engineering	Porsche 718 F4	93	
6	G Hill	Owen Racing Organisation	BRM P578 V8	92	DNF - engine
7	W Mairesse	Ferrari SpA SEFAC	Ferrari 156/120° V6	90	DNF - engine
	J Brabham	Brabham Racing Organisation	Lotus 24 Climax V8	77	Accident
	I Ireland	UDT-Laystall Racing Team	Lotus 24 Climax V8	64	Fuel pump
	J Clark	Team Lotus	Lotus 25 Climax V8	55	Clutch
	R Salvadori	Bowmaker Lola Racing Team	Lola Mk 4 Climax V8	44	Suspension
	A Maggs	Cooper Car Co	Cooper T55 Climax 4	43	Gearbox
	T Taylor	Team Lotus	Lotus 24 Climax V8	24	Oil leak
	R Ginther	Owen Racing Organisation	BRM P57 V8	0	Accident
	D Gurney	Porsche System Engineering	Porsche 804 F8	0	Accident
	M Trintignant	RRC Walker Racing Team	Lotus 24 Climax V8	0	Accident

Winner's speed 71.46mph (113.396km/h)
Fastest lap J Clark 1m 35.5s, 73.70mph (118.554km/h))

Championship placings

Drivers		Constructors	
1. G Hill	10	1. Cooper	11
P Hill	10	2. BRM	10
3. McLaren	9	Ferrari	10
4. Taylor	6	4. Lotus	6
5. Bandini	4	5. Porsche	3
6. Baghetti	3	Lola	3
Surtees	3		
8. Maggs	2		
Bonnier	2		
10. de Beaufort	1		

Grid

McLaren 1-36.4	G Hill 1-35.8	**Clark 1-35.4**
Gurney 1-36.4	Mairesse 1-36.4	
Ireland 1-37.0	Trintignant 1-36.8	Brabham 1-36.5
Bandini 1-37.2	P Hill 1-37.1	
Ginther 1-39.0	Salvadori 1-38.5	Surtees 1-37.9
Bonnier 1-42.4	Taylor 1-40.0	
		Maggs 1-42.7

Monaco GP, Monte Carlo, 3 June 1962. Prelude to mayhem: Mairesse (Ferrari 156) is already getting out of shape as he cuts inside McLaren (Cooper). In the background, Trintignant (Walker Lotus 24 No.30) is sideways, as is Ginther (BRM P57) to the left.

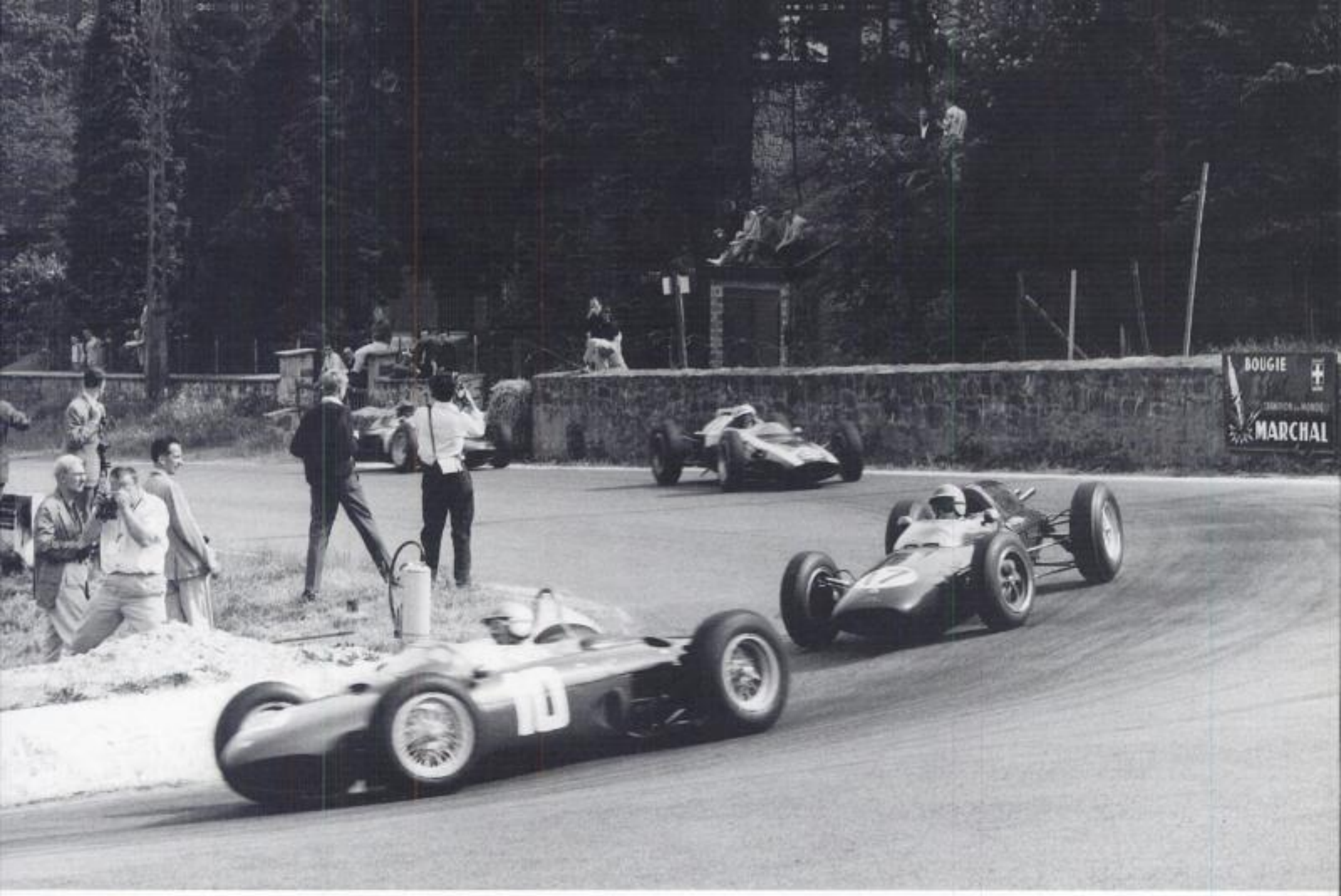
Clark had finished the first lap in sixth but was delayed in his efforts to work his way up to the front by a recurrence of the Zandvoort clutch trouble. Just after quarter distance he had moved into second and, with his clutch righting itself, was able to close on Hill's BRM, breaking the lap record several times in the process. By half distance, however, he was forced to reduce his pace as the clutch problems intervened again, within a further 5 laps his engine had given out. This left Hill with a lead of 50sec over McLaren, and the race looked to be in his pocket, until a mere 10 laps from the end when the BRM's engine started to sound rough, finally expiring 2 laps later at the Station.

Bruce McLaren now inherited the lead with a 15sec advantage over Phil Hill's Ferrari. Hill had been recovering from an early race spin and began to cut into McLaren's lead, reducing it to just 1.3sec by the flag and providing the crowd with some late race excitement. The Cooper was a lucky winner of its first GP since August 1960. Unfortunately the team would not win another during the life of this formula.

Two GPs completed and two different winners. BRM had still to prove that it could be a consistent finisher, while Lotus needed to overcome niggling little reliability problems. These concerns were resolved to some extent when Clark and the monocoque Lotus were victorious in the Belgian GP with Hill and the BRM as runners up.

Practice did not go well for Clark as an engine failure necessitated a replacement unit being flown out from England. He had managed 3 laps of practice for twelfth spot on the grid. Early Sunday morning he could be found running-in the new engine on the local roads around the track. Hill had qualified on the pole and led the first lap with Clark already up to fourth in a bunch of five cars running in close company. Hill lost the lead to Trevor

Aftermath: marshals sweep up around Trintignant's abandoned Lotus, Ginther walks along straw bales away from his BRM short of its right rear wheel, and Ireland (UDT-Laystall Lotus 24) tries to rejoin having been nudged backwards into the bales.



Belgian GP, Spa-Francorchamps, 17 June 1962. Destined to end in tears: Willy Mairesse (Ferrari 156) leads Trevor Taylor (Lotus 24) during their intense battle. Bruce McLaren (Cooper T60) follows, while eventual winner, Jim Clark (Lotus 25), is back in fifth running-in his Climax V8.

Taylor's Lotus 24 and the Ferrari of Willy Mairesse next time around. Taylor and Mairesse now became embroiled in a private battle that would last almost three-quarters of the race.

The Belgian 'Wild' Willy Mairesse tended to drive beyond the limit of his capabilities, particularly in this his home GP, and gained a reputation for wrecking expensive machinery. He was an experienced long distance sports and GT car driver and made his GP debut in 1960 in a Ferrari and was back with the team following Ginther's move to BRM. The intensity of his battle with Taylor was such that it was inevitable that it would end in disaster.

Meanwhile, with a quarter of the race run Clark, feeling that he had completed sufficient 'practice' laps, increased his pace and leapfrogged quite easily up the order to establish himself in the lead. In so doing he broke the lap record and had built up an advantage of 20sec by three-quarter distance. At this point the inevitable finally happened and Mairesse and Taylor collided. Mairesse had run too close to Taylor and nudged the Lotus out of gear with his 'Shark-nose'. Taylor went off, demolishing a telegraph pole while the Ferrari ended upside down and briefly on fire in a ditch. Taylor was shaken but otherwise unhurt while Mairesse suffered minor burns. Graham Hill was lucky to inherit second some 43sec down on Clark but over a minute ahead of the Ferraris of Phil Hill and Rodriguez. He had gradually lost ground

on Clark as a fractured exhaust on a new low level system lost him power. Clark's overwhelming victory had left little doubt as to the potential of the monocoque Lotus compared to its tube framed competitors. Three GPs, three different winners.

Graham Hill was leading the Championship by 2 points from Phil Hill despite the fact that the Ferraris were being comprehensively outclassed by the British V8s, his early season results being down to reliability rather than pace. In fact, Phil was becoming increasingly frustrated by the lack of effective development work that had left the once dominant 'Sharknoses' at 1961 levels of performance against ever improving opposition.

The situation within the team was also bad, with Phil receiving no support whatsoever from Eugenio Dragoni, the new team manager. To add to the problems, a bout of industrial unrest had broken out in the Italian metal working unions and Ferrari was unable to prepare cars for the French GP to be held at Rouen for the first time since 1957. There was a suspicion that Ferrari was using this unrest as an excuse for not appearing, and as a cover

1962 World Championship – Round 3

Spa-Francorchamps 17 June 1962 32 laps
Starters 19 **Finishers** 10

Grand Prix de Belgique

280.36 miles (451.20km))
Weather Warm and sunny

	Driver	Entrant	Car	Laps	Result
1	B McLaren	Cooper Car Co	Cooper T60 Climax V8	100	2h 46m 27.7s
2	G Hill	Owen Racing Organisation	BRM P578 V8	32	2h 08m 16.4s
3	P Hill	Ferrari SpA SEFAC	Ferrari 156/120° V6	32	2h 09m 38.8s
4	R Rodriguez	Ferrari SpA SEFAC	Ferrari 156/120° V6	32	2h 09m 38.9s
5	J Clark	Team Lotus	Lotus 25 Climax V8	32	2hr 07m 32.3s'
6	J Brabham	Brabham Racing Organisation	Lotus 24 Climax V8	30	
7	G de Beaufort	Ecurie Maarsbergen	Porsche 718 F4	30	
8	M Trintignant	RRC Walker Racing Team	Lotus 24 Climax V8	30	
9	L Bianchi	Equipe Nationale Belge	Lotus 18 Climax 4	29	
10	J Siffert	Ecurie Filipinetti	Lotus 21 Climax 4	29	
	T Taylor	Team Lotus	Lotus 24 Climax V8	25	Accident
	W Mairesse	Ferrari SpA SEFAC	Ferrari 156/120° V6	25	Accident
	R Ginther	Owen Racing Organisation	BRM P578 V8	22	Transmission
	A Maggs	Cooper Car Co	Cooper T60 Climax V8	21	Gearbox
	B McLaren	Cooper Car Co	Cooper T60 Climax V8	19	Engine
	J Campbell Jones	Emeryson Cars	Lotus 18 Climax 4	16	N/C
	M Gregory	UDT-Laystall Racing Team	Lotus 24 BRM V8	12	Withdrawn
	I Ireland	UDT-Laystall Racing Team	Lotus 24 Climax V8	8	Rear suspension
	G Baghetti	Ferrari SpA SEFAC	Ferrari 156/120° V6	3	Ignition

Winner's speed 131.89mph (212.265km/h)
Fastest lap J Clark 3m 55.6s, 133.87mph (215.449km/h)

Championship placings

Drivers		Constructors	
1. G Hill	16	1. BRM	16
2. P Hill	14	2. Lotus	15
3. McLaren	9	3. Ferrari	14
Clark	9	4. Cooper	11
5. Taylor	6	5. Lola	5
6. Surtees	5	6. Porsche	3
7. Bandini	4		
8. Baghetti	3		
Rodriguez	3		
10. Maggs	2		
Bonnier	2		

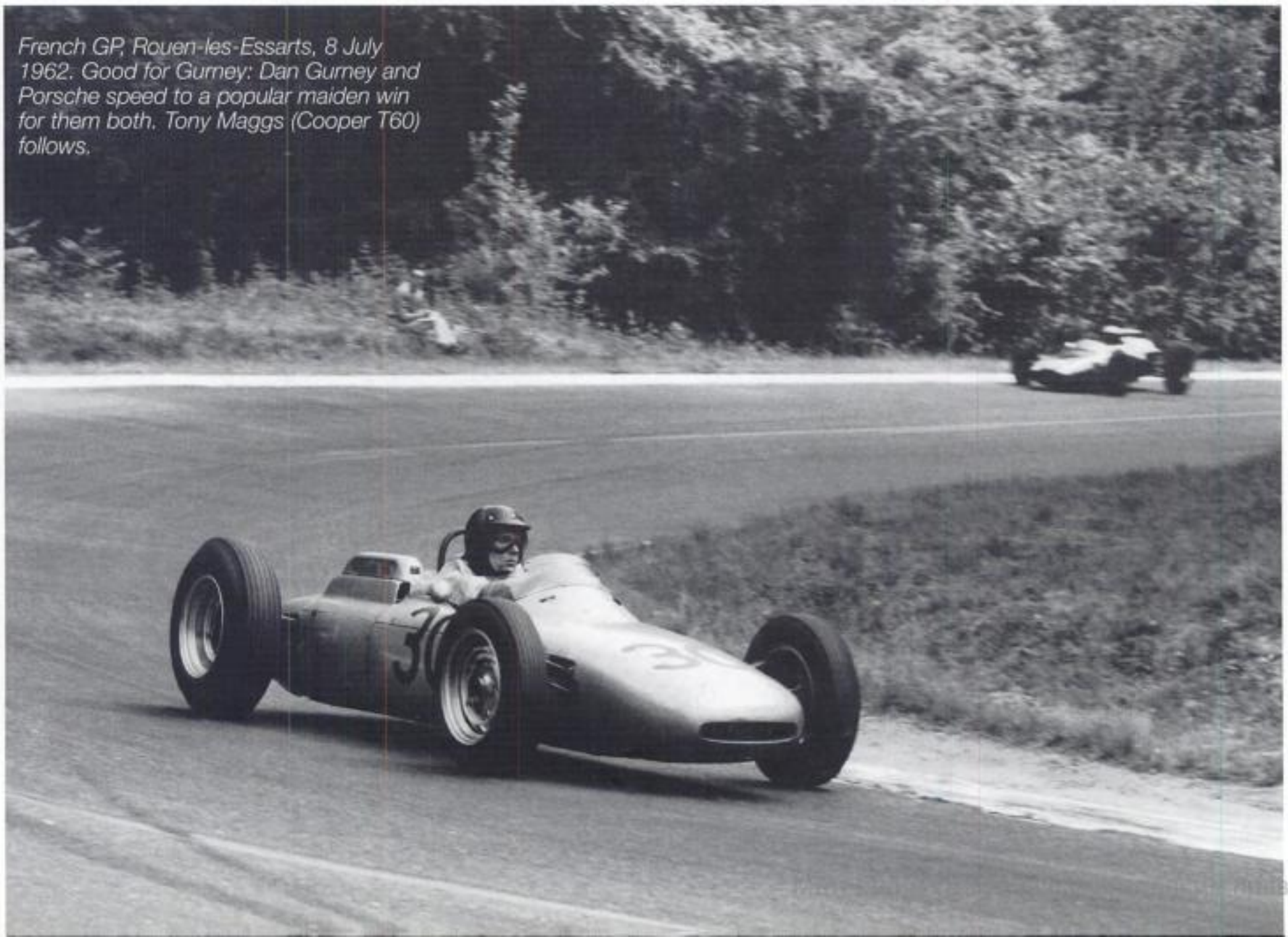
Grid

G Hill 3-57.0	McLaren 3-58.8	Taylor 3-59.3
P Hill 3-59.6		Ireland 3-59.8
Mairesse 3-59.8	Rodriguez 4-01.0	Gregory 4-01.0
Ginther 4-01.4		Maggs 4-03.6
Surtees 4-04.4	Clark 4-04.9	de Beaufort 4-07.7
Baghetti 4-08.0		Brabham 4-08.2
Trintignant 4-09.2	Siffert 4-11.6	Bianchi 4-18.0
Cam' Jones 4-26.9		

for the team's lack of performance. As Hill watched the race from the sidelines, he little knew that he would score only one further finish in the season, even then not adding to his points tally.

If Ferrari failed to appear, at least Porsche returned to the fray, having missed the Belgian GP. Ferry Porsche was particularly sensitive about the performance of his new F1 cars and would not let them run unless they had achieved specified performance targets. Rather than accrue race mileage he was quite happy to continue development back at Stuttgart in private. The cars were back in action at Rouen following testing at the Nürburgring where Dan Gurney had completed a full GP distance within the existing lap record. Changes to the car included a semi-reclining seating position, a feature inspired by Chapman's Lotus 25.

Graham Hill took the lead from the start, followed by Surtees in the developing Lola, then Clark and Gurney. Surtees was delayed by fuel feed problems, and Hill built a lead of 20sec over Clark within 20 of the 54 laps. Clark had been experiencing steering problems in both practice and the race but began to lap quicker. On lap 30 Hill was rammed by Jack Lewis, whose Cooper had suffered brake failure, forcing him into a spin. By the time he had restarted Clark was past and 7sec up the road. Hill began to claw back Clark's lead, setting fastest lap on the way, some 5.6sec inside the 1957 lap record set by a 2½-litre Maserati 250F. Within a couple of laps, however, Clark had retired to the pits with a broken front suspension ball joint, the source of his steering problems. Hill regained the lead 20sec ahead of Dan Gurney with 22 laps to run. His lead lasted only a further 9 laps before he too was forced into the pits with his throttle linkage adrift. This left the lead to Gurney, who had been lapping quietly and consistently, some 20sec down on Hill and Clark during their duel but at least a lap clear of the remainder of a decimated field. The Porsche completed the remaining 13 laps and the



French GP, Rouen-les-Essarts, 8 July 1962. Good for Gurney: Dan Gurney and Porsche speed to a popular maiden win for them both. Tony Maggs (Cooper T60) follows.

team was overjoyed at achieving its first GP win, particularly the wives and girlfriends of the mechanics who had vowed not to shave until Porsche won a GP. It was also particularly satisfying to see the popular Californian achieve his first GP victory at long last, although Dan admitted that there was nothing spectacular about inheriting a race and it was not, therefore, terribly thrilling. Nevertheless, he was really happy.

The finish of the race was marred by a spectacular accident involving the Lotuses of Taylor and Trintignant. Surtees struggled across the line and attempted to pull into his pit but was prevented from doing so by a long line of gendarmes. Trintignant, approaching at speed, swerved to avoid him straight into the path of a close following Taylor. Taylor's car, the original Lotus 25 chassis, was written-off in the ensuing collision.

The RAC had invited the British Automobile Racing Club (BARC) to hold the British GP at Aintree for the second consecutive year, to tie in with that club's Golden Jubilee. The event normally alternated with the British Racing Drivers Club's (BRDC) Silverstone circuit in Northants, and neither the club nor the circuit were pleased at having been passed over. It also provoked much correspondence in the motor sport press, the general feeling being that Silverstone was the 'home of British

1962 World Championship – Round 4

Grand Prix de l'ACF

Rouen-les-Essarts 8 July 1962 54 laps
219.51 miles (353.27km)

Starters 17 **Finishers** 8 **Weather** Warm and sunny

	Driver	Entrant	Car	Laps	Result
1	D Gurney	Porsche System Engineering	Porsche 804 F8	54	2h 07m 35.5s
2	A Maggs	Cooper Car Co	Cooper T60 Climax V8	53	
3	R Ginther	Owen Racing Organisation	BRM P578 V8	52	
4	B McLaren	Cooper Car Co	Cooper T60 Climax V8	52	
5	J Surtees	Bowmaker Lola Racing Team	Lola Mk 4 Climax V8	52	
6	G de Beaufort	Ecurie Maarsbergen	Porsche 718 F4	52	
7	M Trintignant	RRC Walker Racing Team	Lotus 24 Climax V8	51	
8	T Taylor	Team Lotus	Lotus 25 Climax V8	49	
	G Hill	Owen Racing Organisation	BRM P578 V8	44	N/C
	J Bonnier	Porsche System Engineering	Porsche 804 F8	42	Fuel pump
	J Clark	Team Lotus	Lotus 25 Climax V8	33	Front suspension
	J Lewis	Ecurie Galloise	Cooper T53 Climax 4	28	Brakes, accident
	R Salvadori	Bowmaker Lola Racing Team	Lola Mk 4 Climax V8	20	Carburetion, gearbox
	M Gregory	UDT-Laystall Racing team	Lotus 24 BRM V8	15	Ignition
	J Brabham	Brabham Racing Organisation	Lotus 24 Climax V8	10	Rear suspension
	J Siffert	Ecurie Filipinetti	Lotus 24 BRM V8	5	Clutch
	I Ireland	UDT-Laystall Racing Team	Lotus 24 Climax V8	1	Puncture

Winner's speed 103.225mph (166.124km/h)
Fastest lap G Hill 2m 16.9s, 106.896mph (172.032km/h)

Championship placings

Drivers		Constructors	
1. G Hill	16	1. BRM	20
2. P Hill	14	2. Cooper	17
3. McLaren	12	3. Lotus	15
4. Clark	9	4. Ferrari	14
Gurney	9	5. Porsche	12
6. Maggs	8	6. Lola	7
7. Surtees	7		
8. Taylor	6		
9. Bandini	4		
Ginther	4		

Grid

McLaren 2-15.4	G Hill 2-15.0	**Clark 2-14.8**
Surtees 2-16.3		Brabham 2-16.1
Ireland 2-17.5	Gregory 2-17.3	Gurney 2-16.5
Ginther 2-18.2		Bonnier 2-17.9
Trintignant 2-20.8	Taylor 2-19.1	Maggs 2-18.6
Siffert 2-23.4		Salvadori 2-21.3
	de Beaufort 2-26.5	Lewis 2-25.5

British GP, Aintree, 21 July 1962. Jim Clark leads the first lap from Surtees (Lola Mk 4), Gurney (Porsche 804), McLaren (Cooper T60), Brabham (Lotus 24), G Hill (BRM P578) and the rest and will continue to lead for all 75 laps.

motor racing' and far superior to the uninspiring Liverpool track. Nevertheless, the RAC had made its decision and stuck to it.

Everything went right for Clark on this occasion as he converted pole position into an unchallenged lead for the entire race distance. He finished 50sec ahead of John Surtees in the Bowmaker Lola in what turned out to be a somewhat dull, processional race. This was to be the first of a number of GP wins over the course of the 1½-litre F1 in which the 'flying Scot' (as *Autosport* labelled him) would totally dominate, leading from start to finish.

Dan Gurney, fresh from wins at Rouen and the non-Championship Solitude GP one week later on Porsche's home ground, suffered clutch slip. He gradually slipped down the field from third in the opening laps to an eventual ninth. In finishing second, John Surtees turned in the best result of the season so far for himself and the Lola. This was all the more merit worthy for the fact that he had been without fourth gear for the better part of the race. Second place was also a just reward for the development work carried out by the Bowmaker team on the Lola chassis since its GP debut at Zandvoort.

Graham Hill had struggled with the handling of his BRM on the Aintree circuit all weekend and settled for fourth behind McLaren's Cooper. Nursing a badly worn right rear tyre, Hill was in serious danger of being lapped by Clark in the closing stages. Ferrari turned up rather half-heartedly with a single entry for Phil Hill. His car was outclassed and he was put out of his misery by

an ignition fault, having run no higher than ninth in his 47 laps of the 75 lap race.

The German GP at the Nürburgring was all-important to the Porsche team, being its home GP. The efforts put into preparing the team's cars were rewarded with the fastest lap in the Friday practice session for Dan Gurney, some 10.6sec inside Phil Hill's 1961 record and 3sec quicker than second placeman Graham Hill. This became pole position for the race when heavy rain washed out Saturday practice.

The Ferrari team re-appeared with a four car entry but no discernable improvement in performance. Three 'Sharknose' 156s were supplemented by a new experimental car. This was of a lower build with a new chassis frame more akin to a British space frame and a conventional nose cone in place of the 'Sharknose'.

1962 World Championship – Round 5

RAC British Grand Prix

Aintree 21 July 1962 75 laps 225.00 miles (362.10km)
Starters 21 **Finishers** 14 **Weather** Warm and sunny

	Driver	Entrant	Car	Laps	Result
1	J Clark	Team Lotus	Lotus 25 Climax V8	75	2h 26m 20.8s
2	J Surtees	Bowmaker Lola Racing Team	Lola Mk 4 Climax V8	75	2h 27m 10.0s
3	B McLaren	Cooper Car Co	Cooper T60 Climax V8	75	2h 28m 05.6s
4	G Hill	Owen Racing Organisation	BRM P578 V8	75	2h 28m 17.6s
5	J Brabham	Brabham Racing Organisation	Lotus 24 Climax V8	74	
6	A Maggs	Cooper Car Co	Cooper T60 Climax V8	74	
7	M Gregory	UDT-Laystall Racing Team	Lotus 24 Climax V8	74	
8	T Taylor	Team Lotus	Lotus 24 Climax V8	74	
9	D Gurney	Porsche System Engineering	Porsche 804 F8	73	
10	J Lewis	Ecurie Galloise	Cooper T53 Climax 4	72	
11	T Settember	Emeryson Cars Ltd.	Emeryson Climax 4	71	
12	I Burgess	Anglo-American Equipe	Cooper T59 Climax 4	71	
13	R Ginther	Owen Racing Organisation	BRM P578 V8	70	
14	G de Beaufort	Ecurie Maarsbergen	Porsche 718 F4	69	
	J Chamberlain	Ecurie Excelsior	Lotus 18 Climax 4	64	N/C
	I Ireland	UDT-Laystall Racing Team	Lotus 24 Climax V8	61	N/C
	P Hill	Ferrari SpA SEFAC	Ferrari 156/120° V6	47	Valve
	R Salvadori	Bowmaker Lola Racing Team	Lola Mk 4 Climax V8	35	Flat battery
	J Bonnier	Porsche System Engineering	Porsche 804 F8	27	Transmission
	W Seidel	Autosport Team Wolfgang Seidel	Lotus 24 BRM V8	11	Engine
	A Shelly	John Dalton	Lotus 18/21 Climax 4	5	Overheating

Winner's speed 92.25mph (148.47km/h)
Fastest lap J Clark 1m 55.0s, 93.91mph (151.14km/h)

Championship placings

Drivers			Constructors	
1.	G Hill	19	1. Lotus	24
2.	Clark	18	2. BRM	23
3.	McLaren	16	3. Cooper	21
4.	P Hill	14	4. Ferrari	14
5.	Surtees	13	5. Lola	13
6.	Gurney	9	6. Porsche	12
	Maggs	9		
8.	Taylor	6		
9.	Bandini	4		
	Ginther	4		

Grid

Clark 1-53.6	Surtees 1-54.2	Ireland 1-54.4
McLaren 1-54.6		G Hill 1-54.6
Gurney 1-54.8	Bonnier 1-55.2	Ginther 1-55.2
Brabham 1-55.4		Taylor 1-56.0
Salvadori 1-56.2	P Hill 1-56.2	Maggs 1-57.0
Gregory 1-57.2		Lewis 1-59.4
Burgess 2-00.6	de Beaufort 2-01.4	Shelly 2-02.4
Settember 2-02.4		Chamberlain 2-03.4
Seidel 2-11.6		

A significant arrival was that of the new Brabham GP car. This workmanlike space-framed car suffered teething problems and the engine ran its bearings, seeing Brabham forced to run a 'bitsa' engine in both practice and the race. During practice, Graham Hill ran a new 'lightweight' chassis that had first appeared at Aintree. Unfortunately it was badly damaged in an accident sparked by a TV camera falling off de Beaufort's Porsche in front of him. Next along Tony Maggs went off on Hill's oil and he too would have to race a spare car, although in his case it was a 1961 4-cylinder Cooper T55. Luckily, nobody was injured.

The possibility of a Porsche victory brought out a tremendous crowd on race day, despite dreadful weather that delayed the start by over an hour. The race centred on the four front row men – Gurney, Hill, Clark and Surtees. Gurney led away from the start on a soaking track that helped to offset any shortage of power the Porsche might have had compared to its BRM and Climax-powered rivals. Before the end of the first lap, however, the Porsche's battery broke loose from its mounting by Gurney's left knee. Mindful of the danger of it shorting against the aluminium fuel tanks on either side of him, Dan managed to wedge it with his left leg but, in so doing, lost the lead to Hill on lap 3 and lost second to Surtees on lap 5. After 7 of the 15 laps, Hill led Surtees by 4sec with Gurney a further 4sec back but with his battery now relatively secure. Clark had been left on the grid when he neglected to switch on his fuel pumps but by this point had worked his way back up the order to fifth.

Gurney closed on Surtees but lacked the power to find a way past even though he felt that he could lap faster. They closed on Hill so that, at 10 laps, only 2.7sec covered the three of them. They continued to give an impressive display of car control in adverse conditions over the remaining 5 laps, never letting up for a moment. Nevertheless, the order remained unchanged and at the finish 4.4sec covered the trio after over 200 miles of nose to tail racing. Clark had closed to within 14sec of the leaders but

German GP, Nürburgring, 5 August 1962. Lap 2 and Gurney (Porsche 804) leads Hill (BRM P578) and Surtees (Lola Mk 4). They finish Hill-Surtees-Gurney after a truly impressive duel in adverse weather conditions.

1962 World Championship – Round 6

Grosser Preis von Deutschland

Nürburgring 5 August 1962 15 laps 212.60 miles (342.15km)
Starters 26 **Finishers** 16 **Weather** Heavy rain

	Driver	Entrant	Car	Laps	Result
1	G Hill	Owen Racing Organisation	BRM P578 V8	15	2h 38m 45.3s
2	J Surtees	Bowmaker Lola Racing Team	Lola Mk 4 Climax V8	15	2h 38m 47.8s
3	D Gurney	Porsche System Engineering	Porsche 804 F8	15	2h 38m 49.7s
4	J Clark	Team Lotus	Lotus 25 Climax V8	15	2h 39m 27.4s
5	B McLaren	Cooper Car Co	Cooper T60 Climax V8	15	2h 40m 04.9s
6	P Rodriguez	Ferrari SpA SEFAC	Ferrari 156/65° V6	15	2h 40m 09.1s
7	J Bonnier	Porsche System Engineering	Porsche 804 F8	15	2h 43m 22.6s
8	R Ginther	Owen Racing Organisation	BRM P578 V8	15	2h 43m 45.4s
9	A Maggs	Cooper Car Co	Cooper T55 Climax 4	15	2h 43m 52.3s
10	G Baghetti	Ferrari SpA SEFAC	Ferrari 156/120° V6	15	2h 47m 00.0s
11	I Burgess	Anglo-American Equipe	Cooper T59 Climax 4	15	2h 47m 00.6s
12	J Siffert	Ecurie Filipinetti	Lotus 21 Climax 4	15	2h 47m 03.8s
13	G de Beaufort	Ecurie Maarsbergen	Porsche 718 F4	15	2h 47m 57.1s
14	H Walter	Ecurie Filipinetti	Porsche 718 F4	14	
15	N Vaccarella	Scuderia SSS Republica di Venezia	Porsche 718 F4	14	
16	L Bianchi	Equipe National Belge	ENB Maserati 4	14	
	J Lewis	Ecurie Galloise	Cooper T53 Climax 4	10	Suspension
	J Brabham	Brabham Racing Organisation	Brabham BT3 Climax V8	9	Throttle linkage
	P Hill	Ferrari SpA SEFAC	Ferrari 156/120° V6	9	Rear suspension
	K Greene	Gilby Engineering Ltd	Gilby BRM V8	7	Wishbone
	M Trintignant	RRC Walker Racing Team	Lotus 24 Climax V8	4	Gearbox
	R Salvadori	Bowmaker Lola Racing Team	Lola Mk 4 Climax V8	4	Gearbox
	L Bandini	Ferrari SpA SEFAC	Ferrari 156/120° V6 62P	4	Accident
	H Schiller	Ecurie Filipinetti	Lotus 24 BRM V8	4	Engine
	B Collomb	B Collomb	Cooper T53 Climax 4	3	Engine
	T Taylor	Team Lotus	Lotus 24 Climax V8	0	Accident

Winner's speed 80.40mph (129.312km/h)
Fastest lap G Hill 10m 12.2s, 83.34mph (134.133km/h)

Championship placings

Drivers		Constructors	
1. G Hill	28	1. BRM	32
2. Clark	21	2. Lotus	27
3. Surtees	19	3. Cooper	23
4. McLaren	18	4. Lola	19
5. P Hill	14	5. Porsche	16
6. Gurney	13	6. Ferrari	15
7. Maggs	9		
8. Taylor	6		
9. Bandini	4		
Ginther	4		
Rodriguez	4		

Grid

Surtees 8-57.5	Clark 8-51.2	G Hill 8-50.2	**Gurney 8-47.2**
Ginther 9-05.9	Bonnier 9-04.0	McLaren 9-00.7	
Trintignant 9-19.0	Rodriguez 9-14.2	Salvadori 9-14.1	de Beaufort 9-12.9
Walter 9-30.0	Baghetti 9-28.1	P Hill 9-24.7	
Bandini 9-39.7	Siffert 9-39.3	Burgess 9-39.2	Vaccarella 9-33.8
Lewis 9-58.0	Schiller 9-51.5	Greene 9-47.1	
Bianchi 10-40.7	Brabham 10-21.6	Maggs 10-21.2	Collomb 10-09.7
		Taylor 9-57.0	

Italian GP, Monza, 16 September 1962. Ritchie Ginther had had a pretty lean time in his first season with BRM until finishing a splendid second to Graham Hill at Monza. Look at the size of that shrubbery!

by lap 12 was losing ground with fuel starvation problems. He finished fourth, nearly 38sec down on Gurney.

Autosport reported that "Graham Hill drove the greatest race of his career" and that it was "another joy day for the Owen organisation". The outlook for BRM certainly looked good after the years of disappointment. Hill now had a 7 point advantage in a Championship that was developing into a straight contest between himself and Clark with a further three rounds to run. Surtees and the Lola were looking increasingly strong after two consecutive second places and the possibility of a GP win seemed just around the corner. Unfortunately, a shortage of finance in the Bowmaker team, and poor engine reliability over the remainder of the season, conspired to prevent Surtees from scoring any further finishes. The new Ferrari went off the road without having proved anything and the Brabham had lasted 10 laps before the throttle linkage broke. Six different makes of car had filled the first six places – BRM, Lola, Porsche, Lotus, Cooper, Ferrari – a very rare occurrence in GP racing.

The AC d'Italia had abandoned the combined Monza banked/road circuit for the Italian GP in favour of the fast road circuit only. In point of fact, the uneven banking would never again be used for an Italian GP. The ramifications following the tragic death of Wolfgang von Trips in 1961 still cast a shadow over Italian motor sport and a civil action had been instituted in Italy against Jim Clark, amongst others, for his part in the accident. There was also some question about insurance liability and, in the weeks leading up to the 1962 GP, drivers were unsure as to their position in the event of a future accident involving spectators. The circuit manager quickly confirmed that the promoters were responsible for any insurance implications but Clark would continue to be haunted by threats of arrest and prosecution every time he raced at Monza over the following years.

Hill consolidated his Championship lead with a fine victory in the GP, his third win of the season, finishing nearly 30sec ahead of team-mate Ritchie Ginther to make it an impressive 1-2 for BRM. Jim Clark made an almost perfect start from pole position but Hill relieved him of the lead at Lesmo and was never headed again. On lap 3 Clark pulled into the pits with a seizing transmission, a recurrence of practice problems. He restarted a lap down but stopped for good after 12 laps. To add to a troubled weekend for Team Lotus, Trevor Taylor went out on lap 25, also with transmission failure.

Ginther and Surtees had disputed second place for nearly half the race until the Lola's engine holed a piston. Ginther continued for his best placing of the season on a day when BRM showed a marked superiority over its rivals. A tremendous battle had developed for fourth between the Coopers of McLaren and Maggs, the Porsches of Gurney and Bonnier, and the Ferraris of Mairesse, Baghetti and Rodriguez. This was resolved in favour of McLaren on the last lap after executing a neat slipstreaming overtaking manoeuvre on Mairesse, going well in

Safety

During the season, concern was raised that cockpits were becoming too compact. If a driver had to wriggle and squeeze his way into a car it would be equally difficult to get out should it catch fire. In addition, if a tight fit, any deformation of the chassis in an accident was likely to be at the expense of the driver's body. At Monza the GPDA discussed moves to specify minimum dimensions for cockpits; the only practical means of doing so appeared to be by building a pair of dummy legs of standard dimensions and insisting that they could be inserted into any cockpit. The Porsche mechanics made up a pair of cones from a wire frame covered with newspaper, 29½in long and tapering from a diameter of 6in at the top to 4.9in at the bottom. The 'legs' were duly tried out in a variety of cockpits but the matter was not pursued.

1962 World Championship – Round 7

Monza 16 September 1962 86 laps

Starters 21 **Finishers** 12

Gran Premio d'Italia

307.28 miles (494.50km)

Weather Overcast, some drizzle later

	Driver	Entrant	Car	Laps	Result
1	G Hill	Owen Racing Organisation	BRM P578 V8	86	2h 29m 08.4s
2	R Ginther	Owen Racing Organisation	BRM P578 V8	86	2h 29m 38.2s
3	B McLaren	Cooper Car Co	Cooper T60 Climax V8	86	2h 30m 06.2s
4	W Mairesse	Ferrari SpA SEFAC	Ferrari 156/120°V6 62P	86	2h 30m 06.6s
5	G Baghetti	Ferrari SpA SEFAC	Ferrari 156/120° V6	86	2h 30m 39.7s
6	J Bonnier	Porsche System Engineering	Porsche 804 F4	85	
7	A Maggs	Cooper Car Co	Cooper T60 Climax V8	85	
8	L Bandini	Ferrari SpA SEFAC	Ferrari 156/65° V6	84	
9	N Vaccarella	Scuderia SSS Republica di Venezia	Lotus 24 Climax V8	84	
10	G de Beaufort	Ecurie Maarsbergen	Porsche 718 F4	81	
11	P Hill	Ferrari SpA SEFAC	Ferrari 156/120° V6	81	
12	M Gregory	UDT-Laystall Racing Team	Lotus 24 BRM V8	77	
	D Gurney	Porsche System Engineering	Porsche 804 F8	66	Transmission
	R Rodriguez	Ferrari SpA SEFAC	Ferrari 156/120° V6	63	Ignition
	I Ireland	UDT-Laystall Racing Team	Lotus 24 Climax V8	45	Fr. suspension
	J Surtees	Bowmaker Lola Racing Team	Lola Mk 4 Climax V8	42	Engine
	R Salvadori	Bowmaker Lola Racing Team	Lola Mk 4 Climax V8	41	Engine
	T Taylor	Team Lotus	Lotus 25 Climax V8	25	Transmission
	T Settember	Emeryson Cars Ltd	Emeryson Climax 4	18	Head gasket
	M Trintignant	RRC Walker Racing Team	Lotus 24 Climax V8	17	Electrics
	J Clark	Team Lotus	Lotus 25 Climax V8	12	Transmission

Winner's speed 123.62mph (198.940km/h)

Fastest lap G Hill 1m 42.3s, 125.74mph (202.346km/h)

Championship placings (*5 best performances)

Drivers		Constructors	
1. G Hill	*36	1. BRM	*37
2. Clark	21	2. Lotus	27
3. McLaren	22	3. Cooper	*25
4. Surtees	19	4. Lola	19
5. P Hill	14	5. Ferrari	18
6. Gurney	13	6. Porsche	17
7. Ginther	10		
8. Maggs	9		
9. Taylor	6		
10. Baghetti	5		

Grid

	Clark 1-40.35	G Hill 1-40.38
Ginther 1-41.1		McLaren 1-41.8
	Ireland 1-41.8	Gregory 1-41.9
Gurney 1-41.9		Surtees 1-42.4
	Bonnier 1-42.6	Mairesse 1-42.8
Rodriguez 1-43.1		Maggs 1-43.2
	Salvadori 1-43.3	Vaccarella 1-43.4
P Hill 1-43.4		Taylor 1-44.2
	Bandini 1-44.3	Baghetti 1-44.4
Trintignant 1-44.4		de Beaufort 1-46.8
	Settember 1-49.1	

The Lola showed a lot of promise throughout the year but was let down by a lack of finance and poor engine reliability, as here at Monza.

US GP, Watkins Glen, 7 October 1962. Dan Gurney faded to 5th, one lap down, unaware that the flat-8 car was making its final GP appearance.

the experimental Ferrari in his first race since his Spa accident. Gurney dropped out with final drive failure on lap 67, Baghetti had a spin and Rodriguez went out with engine failure. Of the other two of the five Ferraris entered for its home GP, Bandini and Phil Hill finished several laps in arrears after making stops for fuel. The new Brabham had not appeared due to a dispute with the organisers over starting money.

At 307 miles, this had been the longest race held to date under the 1½-litre regulations. Contrary to some expectations, not a single driver had had to stop for a tyre change, the credit for this, of course, going to Dunlop. Also of concern, due to the length of the race, was fuel consumption. Extra tank space was squeezed in everywhere and the bulk of the field ran non-stop, of the front runners only Maggs needed to make a stop. The winning BRM had achieved approximately 10mpg, not excessive at a race speed of over 120mph.

Five days after the GP, on 21 September, Enzo Ferrari announced the withdrawal of his team from competition for the remainder of the year, citing industrial problems not of his making as the reason. His drivers were released from their contracts, marking the end of Phil Hill's career as a Ferrari driver. It had been a disastrous season with only modest success in the early races. To all intents and purposes, the 'Sharknose' 156s had not progressed beyond 1961 levels of performance and, with a busy endurance racing programme to maintain, there had been little or no development work until mid-season. It is easy to say that the team suffered from the loss of Carlo Chiti but his known avenues of development centred on the engine and transmission, not where it was needed in chassis and suspension. Phil Hill had had a frustrating season and was only too pleased to sever his ties with the team despite an otherwise long and happy association.

With only the US and South African GPs remaining, Jim Clark was under some pressure if he wished to keep his World Championship hopes alive. Only the five best scores of the nine Championship rounds counted, and Graham Hill was already in the position of dropping his lowest scores, while Clark could add both scores from the remaining rounds, having only finished in the points three times. Clark had to win both of these events to become Champion; a win for Hill in either event would decide the Championship in his favour.

In keeping with their rapidly growing reputation as the fastest combination on the track, Clark and the Lotus 25 were on pole position at Watkins Glen. He took an immediate lead from the start with Hill slotting into second, unable to make any impression until Clark was held up in traffic on lap 11. Hill took advantage of the situation to slip through into the lead but within 8 laps Clark had caught and passed him. Despite the lack of a clutch for the second half of the race, Clark was never headed again, finishing 9sec ahead of Hill, both of them having lapped the entire field at least once.

Bruce McLaren came out on top of a contest with Gurney, Ginther and Brabham to finish third. Jack Brabham drove his new Brabham into fourth to become the first driver to score Championship points in a car of his own construction. This was no great surprise, and indicative of a lot more to come from Jack's new marque. Gurney's Porsche faded to fifth, while Ginther went out with engine failure but had the consolation of having become a father the day before. Unknown to the Porsche team, this was its last GP. Despite the best efforts of Gurney, the flat-8 engine had disappointed, never developing quite enough power. Bonnier had never seemed able to get to grips with the car and was completely outshone by his team-mate despite having been the equal of him during 1961. Ferry Porsche was always reluctant to field the car in a race unless it was competitive and he decided not to continue in F1, rather to concentrate on what the company did best – endurance racing, a less costly, less competitive and more profitable outlet for resources.

Graham Hill now had 39 points to the 30 of Clark and could only improve his score by winning in South Africa on 29 December. A win for Clark would bring him level on points but give him the Championship by virtue of four wins to the three

1962 World Championship – Round 8

United States Grand Prix

Watkins Glen 7 October 1962 100 laps
230.00 miles (370.10km)
Starters 18 **Finishers** 11
Weather Overcast but dry

	Driver	Entrant	Car	Laps	Result
1	J Clark	Team Lotus	Lotus 25 Climax V8	100	2h 07m 13.0s
2	G Hill	Owen Racing Organisation	BRM P578 V8	100	2h 07m 22.2s
3	B McLaren	Cooper Car Co	Cooper T60 Climax V8	99	
4	J Brabham	Brabham Racing Organisation	Brabham BT3 Climax V8	99	
5	D Gurney	Porsche System Engineering	Porsche 804 F8	99	
6	M Gregory	UDT-Laystall Racing Team	Lotus 24 BRM V8	99	
7	A Maggs	Cooper Car Co	Cooper T60 Climax V8	97	
8	I Ireland	UDT-Laystall Racing Team	Lotus 24 Climax V8	96	
9	R Penske	Team Zerex	Lotus 24 Climax V8	96	
10	R Schroeder	John Mecom	Lotus 24 Climax V8	93	
11	H Sharp	H Sharp	Cooper T53 Climax 4	91	
	T Taylor	Team Lotus	Lotus 25 Climax V8	85	N/C
	J Bonnier	Porsche System Engineering	Porsche 804 F8	79	N/C
	R Ginther	Owen Racing Organisation	BRM P578 V8	35	Engine
	M Trintignant	RRC Walker Racing Team	Lotus 24 Climax V8	32	Brakes
	T Mayer	Cooper Car Co	Cooper T53 Climax 4	31	Gear lever
	J Surtees	Bowmaker Lola Racing Team	Lola Mk 4 Climax V8	20	Oil loss
	G de Beaufort	Ecurie Maarsbergen	Porsche 718 F4	9	Accident

Winner's speed 108.61mph (174.575km/h)
Fastest lap J Clark 1m 15.0s, 110.40mph (177.671km/h)

Championship placings (*5 best performances)

Drivers		Constructors	
1. G Hill	*39	1. BRM	*39
2. Clark	30	2. Lotus	36
3. McLaren	*24	3. Cooper	*27
4. Surtees	19	4. Lola	19
5. Gurney	15	5. Ferrari	18
6. P Hill	14	Porsche	18
7. Ginther	10	7. Brabham	3
8. Maggs	9	8. Lotus BRM	1
9. Taylor	6		
Brabham	6		

Grid

	Ginther 1-16.6	**Clark 1-15.8**
Gurney 1-16.9		G Hill 1-16.7
	McLaren 1-17.3	Brabham 1-16.9
Taylor 1-18.0		Gregory 1-17.9
	Maggs 1-19.7	Bonnier 1-19.0
Penske 1-21.3		Mayer 1-20.7
	Sharp 1-22.4	de Beaufort 1-21.8
Schroeder 1-24.0		Ireland 1-24.0
	Surtees 1-29.2	Trintignant 1-25.8

of Hill. The outcome would not be known for some twelve weeks, however, an incredibly long wait for the final round of the Championship. Never since has the title remained undecided for so long and until so late in the year. Before that, however, there came a shock announcement from Coventry Climax that it was to cease racing (see overleaf). Happily this decision was reversed two months later.

The sport lost a potential future star when 20-year-old Ricardo Rodriguez suffered a fatal accident in practice for the non-Championship Mexican GP on 2 November. Rodriguez had hired Rob Walker's Lotus 24 to race in front of his home crowd but crashed heavily when striving a little too hard for pole position during practice. Undoubtedly talented, he had fallen foul of his wild and apparently fearless attitude to racing.

The 1½-litre F1 had originally been planned to be operative until 31 December 1964. At a meeting of the CSI in early November, it was decided to extend the formula by a further twelve months. This decision, taken to ensure stability of the regulations, was

no doubt aimed at ensuring the future entry of Honda into F1, rumours of which had been circulating for some time.

90,000 spectators gathered at the East London circuit on 29 December to witness the first South African GP to qualify for the World Championship. In the absence of Ferrari and Porsche, it was very much a 'British' event with a few of the faster local drivers accepted for added interest. Rumours circulating in the East London paddock suggested that, in the absence of Porsche in F1 in 1963, Dan Gurney would be seen in the Brabham team. Coventry Climax had produced its first fuel-injected engines, one going to Team Lotus and a second to Cooper. Clark tried his in practice but declined to race it, while Cooper ran the other for McLaren in both practice and the race.

Jim Clark did everything right; he was fastest in practice and went straight into the lead from the fall of the flag. Graham Hill slotted into second but any chance of a duel between the two title contenders was neutralised by Clark who left the BRM at the rate of a second a lap over the opening laps. Approaching half distance, he was 24sec ahead and in complete command, racing well within his own and the car's capabilities. Hill was not putting a wheel wrong but was quite unable to make any impression on Clark. Unless mechanical failure intervened, Clark had the race and the Championship in the bag. Behind these two, the Coopers of McLaren and Maggs led the team's former leader in his new Brabham.

The whole picture changed on lap 61, however, as wisps of blue smoke began emitting from the rear of Clark's Lotus. At the end of lap 62, Clark pulled into the pits with fluctuating oil pressure. It was some time before Colin Chapman and chief mechanic Jim Endruweit discovered that a 2in long bolt locating the jackshaft had fallen out, letting the engine oil leak away. Further investigation revealed that a locking washer had never been fitted to the bolt.

It was all over. Hill and BRM were the Champions and had only to reel off the remaining 19 laps to win the race as well. Hill duly took the chequered flag to a tumultuous reception, a popular and worthy Champion. He joined Mike Hawthorn in the record books as the second Briton to achieve the honour but the first Briton to do so in a British car. For Sir Alfred Owen, owner of BRM, Tony Rudd and for the whole team it was a memorable day after the trials, tribulations and disappointments of previous years. No better response could have been made to Sir Alfred's pronouncement at the beginning of the season that the team would face the threat of closure if results were not forthcoming in 1962.

For Jim Clark it was a disappointing outcome, but one that he took in a typically relaxed manner. He had the satisfaction of proving that Chapman's monocoque chassis was an outstanding concept and that he and Lotus were now acknowledged as the fastest combination on the track. If greater mechanical reliability had been achieved, generally in components unrelated to the chassis, they would have swept the board. As it was, when Clark finished he generally won.

The new British V8s had performed probably better than anticipated, the BRM unit especially as it was (uncharacteristically) a potential winner from its first race onwards. Both the Climax and BRM V8s scored four wins apiece, although the Climax powered

Coventry Climax shock announcement

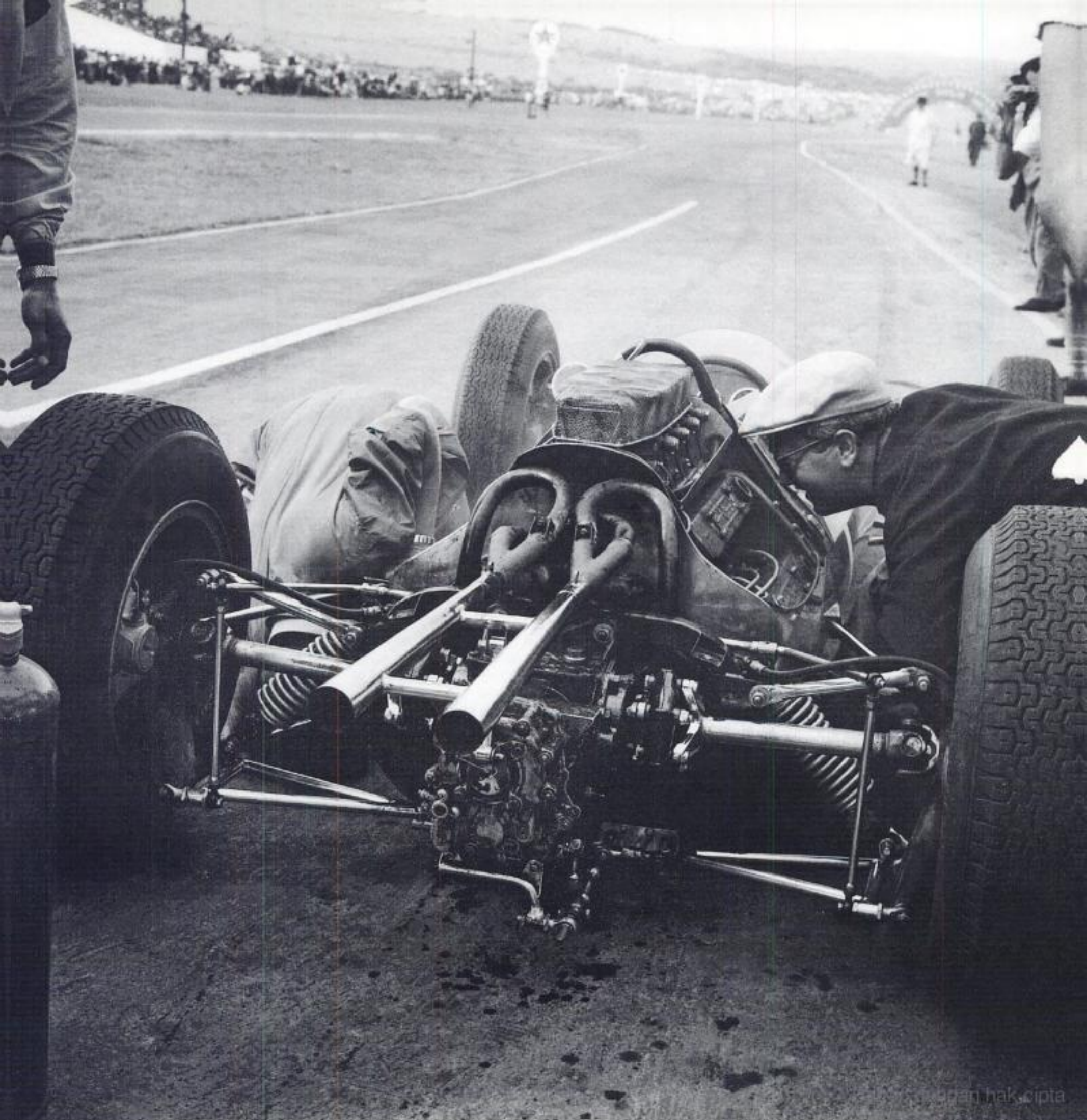
On the 17 October, at the 1962 London Motor Show, Coventry Climax managing director Leonard Lee made the shock announcement that he intended to stop the manufacture of the FWMV V8 GP engine and withdraw from racing at the end of the year. Lee said that racing was "no longer economic", continued development of the engine now being beyond the resources of his company. Climax was spending a lot more money than it was getting back on sales and service. With new engines being sold at £3000 each, the British F1 constructors were effectively being subsidised. In addition, up to forty skilled engineers were being involved who could otherwise be employed on the firm's more profitable activities: industrial engines, fire pumps and fork-lift trucks. This could not continue despite the prestige gained from 22 GP wins and two World Championships in the five years that the firm had actively supported F1. It was ironic that this should come at a time when the SMMT, after years of opposition to racing cars, was exhibiting examples of the BRM and Lotus Coventry Climax GP cars at the Earls Court Motor Show.

This came as a severe blow to constructors Cooper, Lotus, Lola and Brabham and Rob Walker's private team that was 100 per cent reliant on Climax for its continued participation in GP racing. They were faced with running 1962 specification engines into 1963 and beyond, that would continue to be serviced but not replaced. The BRM V8 was available for customer purchase but to a lesser specification than the works units. Race organisers were equally concerned as they would be faced with dwindling and lower quality grids as the competitiveness of the Climax engines declined.

Following Lee's announcement, leading members of the British motor industry gathered together and invited him to discuss the situation with them. Recognising the importance of GP racing as a testing ground for new motor engineering developments, they (in particular the fuel and tyre suppliers) proposed to increase their financial support to a limited number of F1 constructors who would, in turn, contribute towards Climax's development costs. As a result, Lee issued a statement on 14 December in which he was able to announce a reversal of his decision made just two months earlier. Development of the FWMV continued for a limited supply to Lotus, Cooper, Brabham and one or two selected non-factory entrants only.

The crisis had been averted.

Opposite: South African GP, East London, 29 December 1962. Lost: Colin Chapman (right) and mechanic Jim Endruweit try to locate the source of the oil leak that has lost Jim Clark and Lotus the 1962 World Championships.



24 Climax V8. 3. G Hill, Lotus 18/21 Climax 4. PP: J Clark, Lotus 24 Climax V8. FL: Surtees 95.67mph. *First F1 win for Lola as Clark stops with low oil pressure.*

Crystal Palace Trophy, Crystal Palace (GB), 11.6.62, 50.04 miles.
1. I Ireland, Lotus 24 BRM V8, 86.34mph. 2. R Salvadori, Lola Mk 4 Climax V8. 3. B McLaren, Cooper T55 Climax 4. PP: Salvadori. FL: Ireland 87.46mph. *Run on same day as Mallory Park 2000 Guineas.*

Grand Prix de Reims, Reims (F), 1.7.62, 257.90 miles.
1. B McLaren, Cooper T60 Climax V8, 126.32mph. 2. G Hill, BRM P578 V8. 3. I Ireland, Lotus 24 Climax V8. PP: J Clark, Lotus 25 Climax V8. FL: Hill 128.96mph. *Last 1½-litre F1 win for Cooper.*

Grosser Preis der Solitude, Stuttgart (D), 15.7.62, 177.23 miles.
1. D Gurney, Porsche 804 F8, 100.72mph. 2. J Bonnier, Porsche 804 F8. 3. T Taylor, Lotus 24 Climax V8. PP: J Clark, Lotus 25 Climax V8. FL: Gurney 108.37mph. *Popular home win for Gurney and Bonnier. Clark crashes out.*

Kanonloppet, Karlskoga (S), 12.8.62, 55.89 miles.
1. M Gregory, Lotus 24 BRM V8, 78.27mph. 2. R Salvadori, Lola Mk 4 Climax V8. 3. J Bonnier, Porsche 804 F8. PP: J Surtees, Lola Mk 4 Climax V8. FL: I Ireland Lotus 24 BRM V8 79.84mph. *Rare win for Gregory in unrepresentative field.*

Grand Premio del Mediterraneo, Pergusa (I), 19.8.62, 149.35 miles.
1. L Bandini, Ferrari 156/120° V6, 128.98mph. 2. G Baghetti, Ferrari 156/120° V6. 3. C Abate, Porsche 718 F4. PP: Bandini. FL: Bandini & Baghetti 132.92mph. *Ferrari demonstration in front of unrepresentative field.*

Danske Grand Prix, Roskildering (DK), 26.8.62, 59.20 miles.
1. J Brabham, Lotus 24 Climax V8, 59.96mph. 2. M Gregory, Lotus 24 BRM V8. 3. I Ireland Lotus 24 Climax V8. PP: Brabham. FL: Brabham 63.27mph. *Aggregate of three heats.*

International Gold Cup, Oulton Park (GB), 1.9.62, 201.48 miles.
1. J Clark, Lotus 25 Climax V8, 97.70mph. 2. G Hill, BRM P578 V8. 3. J Brabham, Brabham BT3 Climax V8. PP: R Ginther, BRM P578 V8. FL: Clark 99.40mph. *Clark leads procession.*

Gran Premio de Mexico, Mexico City (MEX), 4.11.62, 186.40 miles.
1. T Taylor/J Clark, Lotus 25 Climax V8, 90.31mph. 2. J Brabham, Brabham BT3 Climax V8. 3. I Ireland, Lotus 24 Climax V8. PP: Clark. FL: Clark 93.44mph. *Clark takes over Taylor's car after he is disqualified for a push-start. Ricardo Rodriguez killed in practice. A precursor to Championship status for 1963 event.*

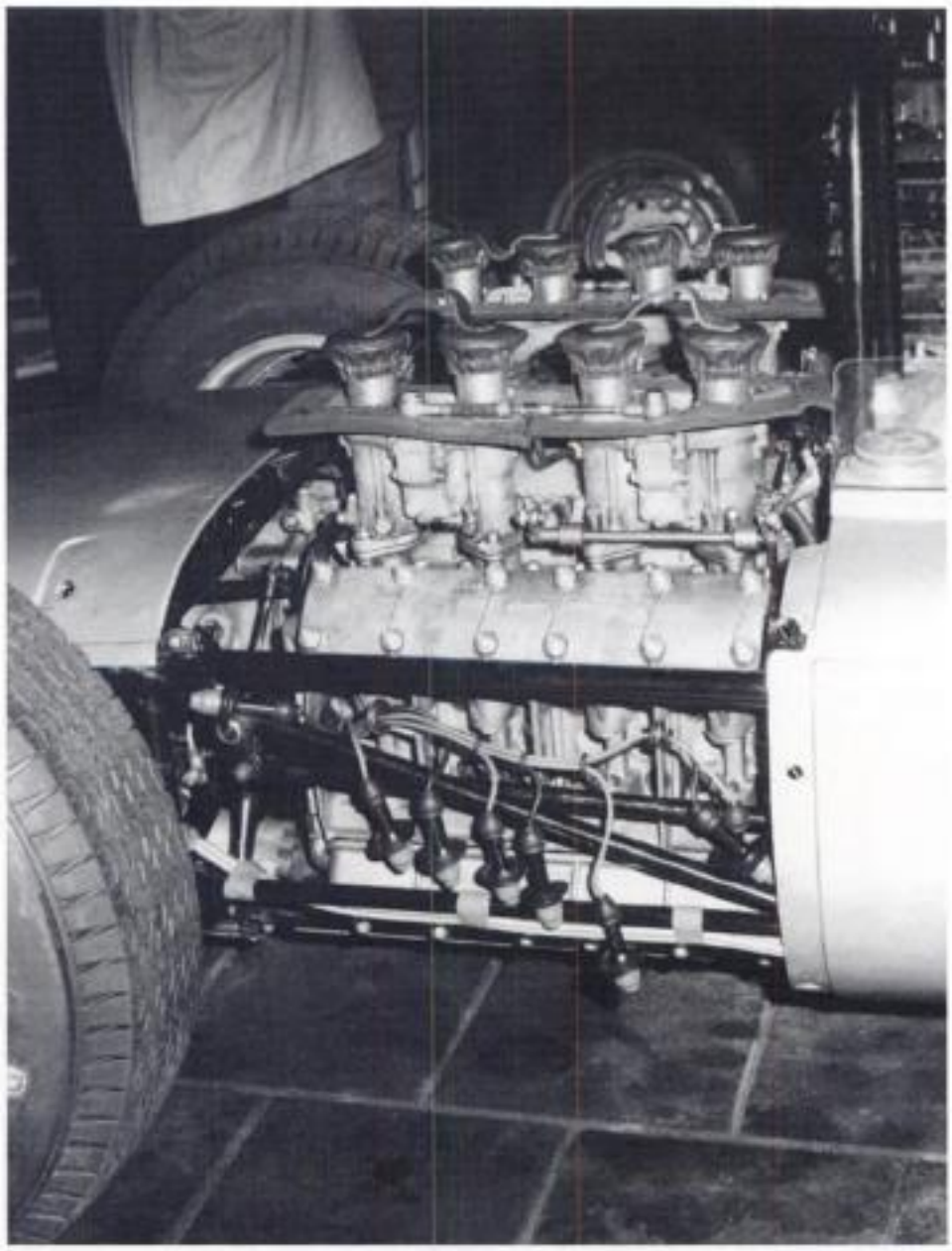
Rand Grand Prix, Kyalami (ZA), 15.12.62, 127.25 miles.
1. J Clark, Lotus 25 Climax V8, 94.4mph. 2. T Taylor, Lotus 25 Climax V8. 3. J Surtees, Lola Mk 4 Climax V8. PP: Clark. FL: Clark 96.90mph. *Team Lotus dominate after Hill's BRM fails.*

Natal Grand Prix, Westmead (ZA), 22.12.62, 74.91 miles.
1. T Taylor, Lotus 25 Climax V8, 92.47mph. 2. J Clark, Lotus 25 Climax V8. 3. R Ginther, BRM P578 V8. PP: Clark. FL: Taylor, 96.79mph. *Two heats and a final. Clark starts from back of grid in final after fuel vaporisation in his heat.*

Technical overview: 1962

Engine developments:
New 8-cylinder engines
While sharing a 90° vee configuration, the BRM and Coventry Climax V8s were quite different internally. The BRM P56 was intended from the outset for five figure engine speeds and was, therefore, designed around a relatively short stroke. The Climax FWMV by comparison was quite conservative, the ratio of bore to stroke being identical to that of the 2½-litre 4-cylinder FPF. Camshafts were chain driven and induction was by downdraught Weber carburettors, whereas the BRM had gear driven camshafts and newly developed Lucas port type fuel-injection. Power outputs were close, although the BRM unit had to be wound up to 10,250rpm for its claimed 193bhp. While not aiming for a dramatic increase in engine speed, the Coventry Climax approach was to incorporate the smallest valves and porting from which adequate power, in this case 186bhp at 8500rpm, could be obtained since this allowed maximum torque to be developed below the speed of maximum power, a higher compression ratio offsetting any lack of breathing at maximum speed. Both engines were fitted with two plane crankshafts, the Climax requiring the complex exhaust system interlinking pipes from cylinders in opposing banks to achieve evenly spaced gas flow pulses. The BRM seemed not to be so sensitive to exhaust tuning and a number of systems were tried before adoption of an orthodox four-into-one system per bank.

In the design of its new 8-cylinder engine, Porsche probably had little option other than to adopt the unique horizontally-opposed, air-cooled layout of its production engines in which it had accumulated a wealth of experience. It was a magnificent looking piece of engineering designed to the highest standards of efficiency but it was overcomplicated. The camshaft drive was by bevel gears and shafts, designed for engine speeds of up to 10,000 rpm. Surprisingly, induction was by



Unique: flat-8, air-cooled. The Porsche type 753 engine was a magnificent piece of engineering, but over-complicated.

downdraught Weber carburettors rather than the fuel-injection with which Porsche was known to have been experimenting. Porsche's engineers had considerable trouble in extracting sufficient power from the engine during development, eventually achieving about 178bhp at 9200rpm during the season, with a very narrow power band.

Transistorised ignition

The quest for increased engine speeds by BRM and Coventry Climax was aided by the development of a transistorised ignition system by Joseph Lucas Ltd, the British automotive electrics manufacturer. The traditional coil and contact breaker system was restricted to an output of around 400 sparks per second due to mechanical considerations. Similarly, the magneto would only run to around 500 sparks per second, insufficient to spark an engine running over 10,000rpm. The Lucas system eliminated most moving parts, including the contact breaker. Timing was controlled by pole pieces mounted on the back of the flywheel, running in conjunction with a magnetic pick up on the engine backplate. Other parts of the system were housed in a finned 'spark box' that had to be mounted in the airstream for cooling purposes. Power was provided by a battery (also needed to power the on-board electric starter required under F1 regulations) charged by an alternator driven off the engine. The new system had the capacity to produce 1000 sparks per second without a voltage drop, sufficient to run an 8-cylinder engine up to 15,000rpm.

Ferrari would continue to rely on a mechanical ignition system, firing the plugs by two twin contact breaker Marelli distributors with four 10-volt coils – one for each contact breaker. This enabled the engine to run at more than 11,000rpm.

Chassis developments

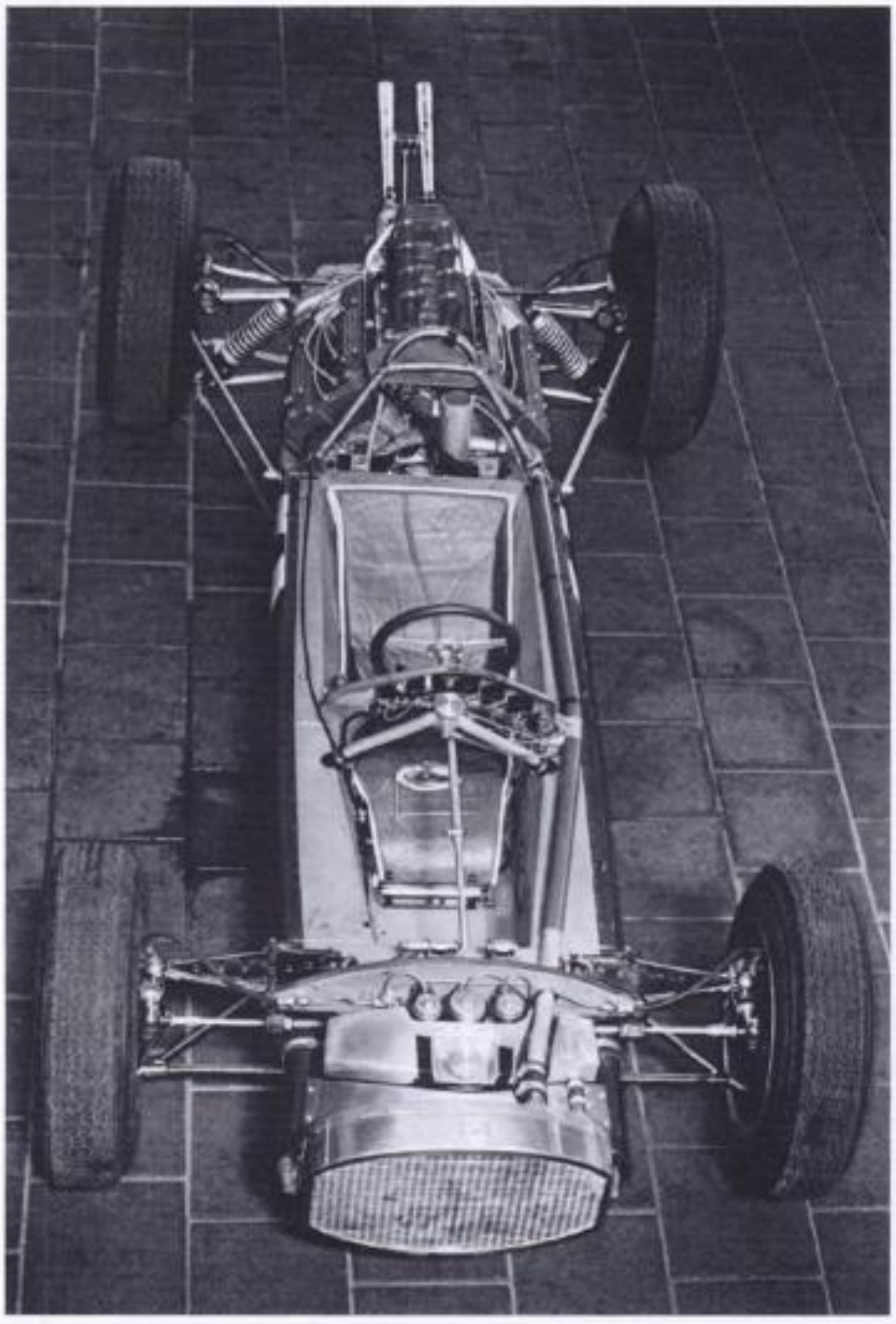
Monocoque construction

At a time when chassis design had become fairly stabilised, the introduction of a radical new method of construction that dispensed with the tubular frame created considerable interest.

The origins of monocoque construction can be found in the aeronautical industry. Aircraft fuselages had originally comprised a tubular framework with a non-structural outer skin. It was soon appreciated that the loadings applied to an aircraft in flight were mainly aerodynamic and spread over the entire outer skin, thus it proved possible to dispense with the tubular framework and for the fuselage to derive its strength from a load bearing stressed skin that would be both more rigid and lighter. The resultant fuselage shell came to be known as a 'monocoque' or 'single shell'.

Loadings applied to racing car chassis are more related to suspension reactions than aerodynamics and the monocoque concept did not initially appear to be practicable. In particular, the structure would be compromised by the need to provide openings in the monocoque for entry of the driver, installation of the engine and for servicing. Nevertheless, there were designers keen to apply the principles of monocoque construction to racing cars, the first such being the Indianapolis Cornelian of 1915. Other examples followed but they were unable to exploit the advantages of increased chassis rigidity and lower weight due to inadequacies in other areas. The first success for monocoque construction came with the 1955-57 Le Mans winning Jaguar D-type, yet it failed to set any trend either in its class or in single-seater racing cars.

During the development of the Lotus Elan backbone type chassis in 1961, Colin Chapman had the idea of applying a similar



Monocoque chassis: The slim profile achieved is apparent from this photograph of Colin Chapman's Lotus 25 chassis in the garage at Zandvoort. The fabricated sheet aluminium side-members run the length of the car, each side of the driver, reducing in depth in the engine bay. A steeply reclining seatback for the driver contributes to a low frontal area.

Dunlop's 1962 R5 tread pattern, here in the D12 synthetic compound for use on the low speed Monte Carlo circuit.

concept to an F1 car. In principle, the idea was to space the sides of the backbone chassis far enough apart for the driver to sit between them, boxing in the sides to carry fuel in rubber bag tanks. The latter solved the long standing problem of securing fabricated sheet aluminium fuel tanks to a space frame and preventing them from splitting due to vibration. The new chassis comprised two D-section side-members, fabricated in sheet aluminium, running the length of the car, either side of the driver, linked by fabricated sheet steel bulkheads and a stressed sheet undertray, all riveted into place. The engine, bolted rigidly into place, completed the structure. The top of the structure was open, allowing excellent accessibility to all the major components for servicing, and was completed by a detachable upper body panel moulded in glassfibre.

The bare weight of the structure was 65lb compared to 72lb for the Lotus 24 bare space frame, but torsional rigidity was up from around 700lb/ft per degree deflection to 1000lb/ft per degree. More dramatically, rigidity increased to 2400lb/ft per degree after installation of the Coventry Climax V8 engine. This increase in rigidity was exactly what was required to realise the improvements in tyre performance available from more sophisticated suspension systems.

Chapman described his new creation as a "twin-tube ladder frame, stressed-skin riveted structure". Nevertheless, it came to be generally referred to as a 'monocoque', more particularly of the open, 'bathtub' type. However you may choose to describe it, Chapman had set a new standard that would revolutionise GP car design and construction.

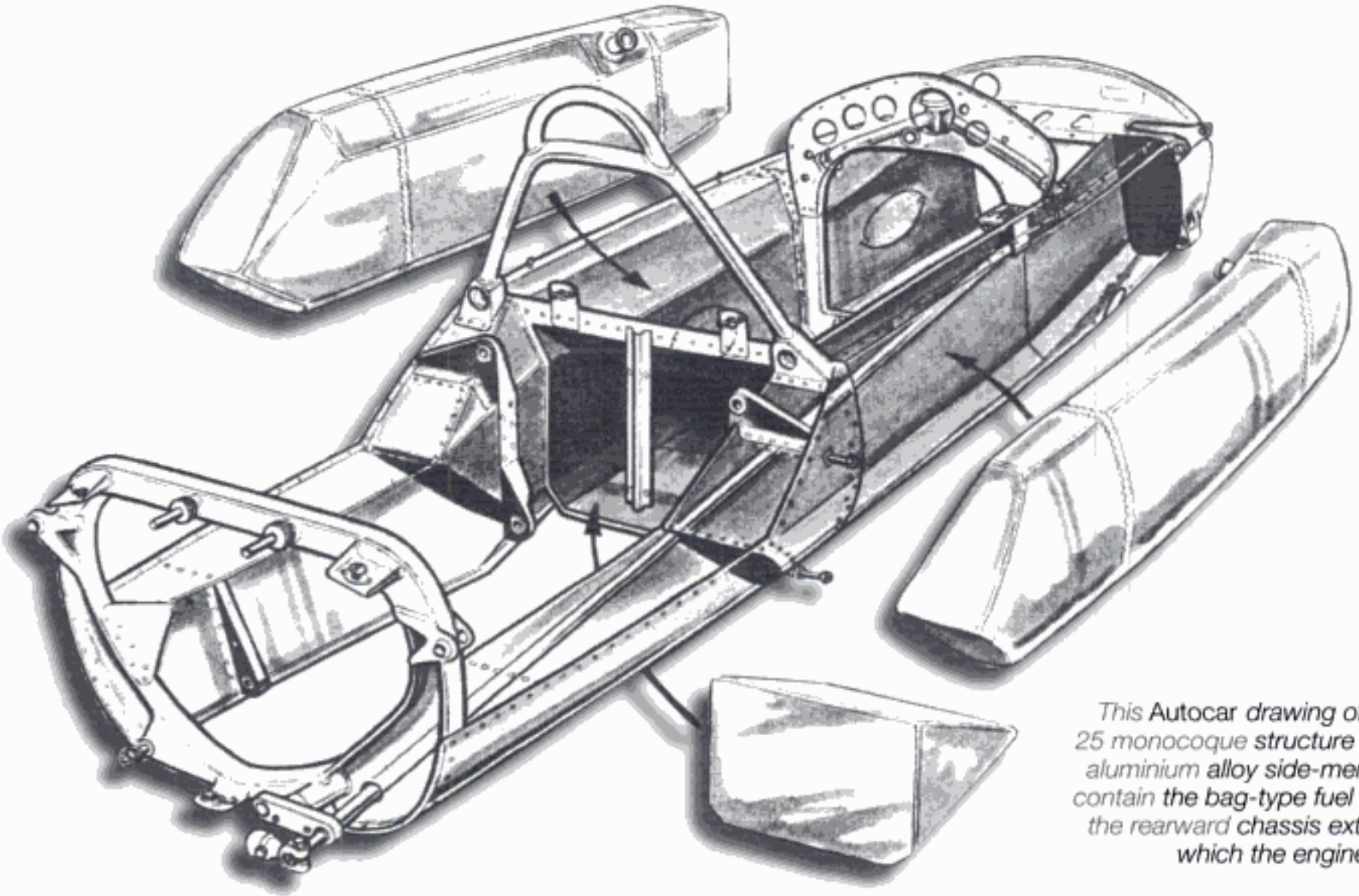
Tyre technology

Dunlop continued to supply the D9 and D12 compounds into 1962, for mounting on either 13 or 15in diameter front wheels with 6in rim width and 15in diameter rears with a 7in rim. Tread widths were 4.22in front, 4.7in rear. As Dunlop increased its knowledge and experience of the synthetic D12 compound, so it was released for dry weather use on slow and medium speed circuits. The D9 was retained for the high speed circuits of Spa, Reims and Monza.

Jim Clark used one set of D12s on his Lotus for three consecutive GPs, including practice sessions, which says a lot for the pace of development and the ability of the chassis so equipped.

Transmissions

Valerio Colotti introduced the GSD type 34 6-speed transmission for 1962 to match the new British 1½-litre V8's narrower power bands. It was a compact unit measuring 22in in length and weighing 60lb. Two input gears at the rear of the unit could be changed quickly for alteration of the overall ratios. The type 34 was used by Lola and Brabham, and both BRM and Lotus experimented with it on occasion.



This Autocar *drawing of the Lotus 25 monocoque structure shows the aluminium alloy side-members that contain the bag-type fuel tanks, and the rearward chassis extensions to which the engine is bolted.*

4 1963 – Clark and Chapman clean up (act 1)

The 1½-litre F1 had really got into its stride during its second season, producing some of the most competitive racing seen in years. Although the results had not indicated any domination by one driver or constructor, Jim Clark and the Lotus 25 had proved to be the fastest. Ultimately, however, it had been the speed and reliability of the BRM in the hands of Graham Hill that had taken both Drivers' and Constructors' Championship titles.

Into 1963 the emphasis would be on engine development. Modifications were being made to the BRM and Coventry Climax V8s, new 8 and 12-cylinder units were reportedly under development at Ferrari, a new V8 would appear from ATS, and the entry of Honda into GP racing – possibly with a V12 – was looming on the horizon. Chassis designers were beginning to react to Colin Chapman's introduction of monocoque type construction, although Cooper and Brabham would stick with the tubular frame, notably Brabham, with little adverse effect on performance. Dunlop had introduced the R6 tyre, designed to exploit the soft D12 compound on any type of circuit. Tread width was up both front and rear to give a 5 per cent increase in footprint and improvements to lateral stability.

BRM had reacted quickly to the new chassis technology but its version of the monocoque type structure would not be ready until mid-season. In the meantime it would rely on the 1962 P578 chassis in its lighter form, as seen at the South African GP. The powerful and reliable V8 would be retained with no major changes other than the adoption of a single-plane crankshaft, providing an easier solution to exhaust tuning. A new 6-speed gearbox had been designed to make better use of the narrow power band. Graham Hill and Ritchie Ginther continued for another season with the team.

In March, Jaguar Cars announced that it had acquired Coventry Climax, with Leonard Lee remaining managing director and GP engine production continuing as before. Extensive modifications had been made to the FWMV V8, including the adoption of Lucas fuel-injection, pioneered by BRM, in place of Weber carburettors. The stroke had been shortened to increase crankshaft speed by 1000rpm while a wider bore made room for larger valves to improve breathing. This Mk III 'short stroke' FWMV developed 195bhp at 9500rpm, up by 11bhp on the 1962 Mk II.

Colin Chapman had made only detail changes to the Lotus 25 chassis. Having previously gained a reputation for failing to develop his innovative designs fully, he would refine his already proven concept for 1963. He intended that Jim Clark and the Lotus should continue to be the fastest combination on the track. Cooper was another team to retain its 1962 driver line-up of Bruce McLaren and Tony Maggs, although the South African had been due to move to the Reg Parnell-run Lola team until the Bowmaker sponsorship had been withdrawn. The 1963 Cooper T66 chassis looked little different from its T60 predecessor but the car had been slimmed down thanks to a redistribution of its fuel load.

It seemed unlikely that Porsche would be taking part in any GPs during the year, although engine development was reported to be continuing. This was more likely to be concentrated on the 2-litre sports car version, however. In any event, the team drivers had been released; Jo Bonnier was joining Rob Walker's private team that was to run a new Cooper T66 chassis with Climax engine, and Dan Gurney was going to Brabham. After the successful introduction of his first F1 car in the latter part of 1962, Jack Brabham was to run a full, two-car team in 1963. He had approached Gurney to join the team as number 1 driver, leaving himself in more of a support role. The popular and highly talented Californian was impressed by the Brabham set-up and was pleased to join the new team. Detail improvements had been made to the chassis making it, in its 1963 BT7 form, some 55lb lighter than the BT3. The Brabham/Tauranac design philosophy considered that the increased rigidity and weight saving of a monocoque chassis was not justified by its increased vulnerability to accident damage. Team cars were now immaculately prepared in dark green with a gold stripe and noseband rather than the turquoise of 1962.

Ferrari fortunes had reached a low ebb by the end of 1962, but a new beginning was being made for 1963. The design team was developing new 8 and 12-cylinder engines, but, for the interim, an improved version of the familiar 120° V6 fitted with Bosch fuel-injection would be utilised. This would power a new tubular space frame chassis, very much based on the experimental 62P chassis seen at the Nürburgring and Monza in 1962. A great bonus to the team was the recruitment of John Surtees as team

leader, who brought with him up-to-date knowledge of British chassis and suspension technology from his time developing the Lola for the Bowmaker team in 1962. In fact, Surtees had first been approached to join Ferrari at the end of 1961, an offer he had wisely declined on the basis that he did not feel ready for such a role and he did not like the look of the set up with the large number of drivers under contract. Ferarri's fortunes in 1962 proved he was right to do so, but when the offer was repeated for 1963 he accepted, feeling that he could help put Ferrari back on track.

Surtees had a passionate interest in race car technology and a useful fund of chassis and suspension set-up knowledge that would prove invaluable to Ferrari. He was also no stranger to working in Italy from his motorcycle days with MV Augusta, and was popular with the tifosi, to whom he was known as 'Il Grande John' – John the Great. Having discharged all of its drivers at the end of 1962, Ferrari fell back on Willy Mairesse as number 2 to Surtees.

Two of Ferrari's former drivers, Phil Hill and Giancarlo Baghetti, had joined the new Automobili Tourismo e Sport (ATS) constructor from Italy. The ATS team had been put together from members of the Ferrari staff that had resigned en masse following the dispute at Maranello in the autumn of 1961. These included chief engineer Carlo Chiti and team manager Romolo Tavoni, with whom Hill had had a good working relationship. Having been thoroughly disillusioned at Ferrari during 1962, it seemed entirely logical for Hill to move to the apparently well-funded new team. The ATS tipo 100 with new V8 engine had been announced to the world shortly before Christmas 1962 but had yet to make its race debut. The appearance of the new contender was awaited with much interest, not least because of the team's stated intent of beating Ferrari at its own game.

Over the winter, Bowmaker had been obliged to withdraw its financial backing of the Reg Parnell-run team due to problems of its own. Parnell had acquired the Hounslow premises, staff and two of the team's 1962 specification Lolas from Bowmaker, and was to run the team in his own name. The team's regular driver would be Chris Amon, a promising 19-year-old New Zealander, who Parnell had spotted during the 'Tasman' series of races in Australia and New Zealand over the winter.

The UDT-Laystall backing for the British Racing Partnership had expired at the end of 1962. Team principals Ken Gregory and Alfred Moss recognised that it was unlikely that they would be able to purchase an up-to-date chassis from any of the leading manufacturers and had decided to construct their own. Chief Mechanic Tony Robinson had designed a monocoque, very much on the lines of the Lotus 25, to be powered by a BRM V8, as the team was excluded from supply of FWMV engines following the Coventry Climax cutback in its customer base announced the previous December. One BRP chassis had been completed for Innes Ireland to drive. Joining Innes in the team was the Texan Jim Hall who had been approached by Ken Gregory and was keen to try his hand at F1. Hall had previously run his own Lotus in recent US GPs but was better known as a successful sports car driver in the US, most recently with his own Chevrolet-engined Chaparral cars. He would drive a BRP Lotus 24 with BRM engine in Europe.

The early season non-Championship F1 races had been somewhat inconclusive, with many of the events featuring only small grids. In 1963, the average size of a GP grid began to decline as the number of privateers reduced. The older Cooper and Lotus chassis were now completely outclassed and, without the finance to run one of the new generation V8 engines, there was little point in entering only to fail to qualify.

Unusually, Ferrari did not appear until the Silverstone International Trophy, the only event to feature all the major contestants. Just two weeks ahead of the Championship opener at Monaco, the race proved to be a convincing win for Jim Clark, Lotus and the new short stroke Mk III Climax engine. Neither BRM finished, and Surtees' new Ferrari showed reasonably before falling out with no oil pressure.

The Cooper team faced the new GP season without the services of John Cooper who had suffered a severe road accident on 4 May on the Kingston bypass while driving a prototype twin-engined Mini. Recovery from cracked ribs, severe concussion and amnesia would take some months and Ken Tyrrell stepped in to run the team until John was fit. Tyrrell, a partner in a Surrey-based timber business with his brother, had raced Coopers himself since

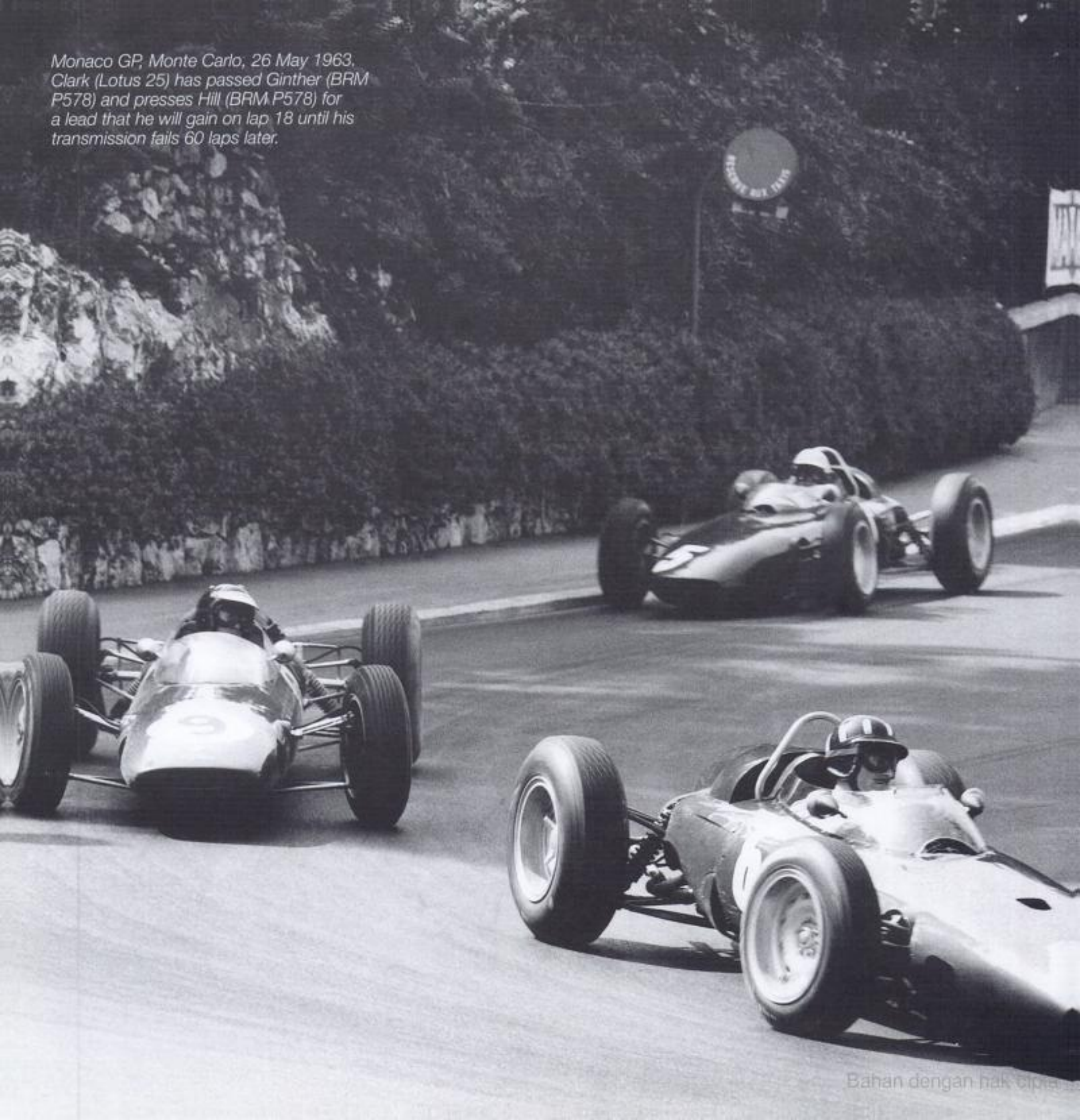
Stirling Moss announces his retirement

There was one question that had remained unanswered since Easter Monday 1962, one for which both the public and the press eagerly sought an answer: would Stirling Moss race again?

Moss had had other accidents. In 1960 he had broken both legs and crushed three spinal vertebrae at Spa when a wheel had come off his Lotus. Within two months he had been back in action. Goodwood had been more serious, however. Besides breakages, he had extensive bruising to the right side of the brain, leaving him in a coma for a month and paralysed down his left side for six months. There would be no quick recovery this time.

Moss mended slowly and, on 1 May 1963, he drove a racing car again. He spent half an hour at Goodwood in a BRP Lotus 19 sports racer and, on a damp track, lapped no better that 3sec outside a competitive time. He assessed himself as having not regained his former automatic reflexes. He issued a press statement stating that he had decided to retire; he would not race again.

With the benefit of hindsight, the decision made that day was premature. What Moss believed to be permanent loss of his reflexes was to a large extent only temporary. It would be well into 1966 before he was close to a full recovery but by then it was too late. His life was filled with business and other interests; there simply was no time to race again.



Monaco GP, Monte Carlo, 26 May 1963. Clark (Lotus 25) has passed Ginther (BRM P578) and presses Hill (BRM P578) for a lead that he will gain on lap 18 until his transmission fails 60 laps later.

the early 1950s before retiring to become an entrant. The Tyrrell Racing Organisation ran Coopers in FJ, providing a stepping-stone into F1 for Tony Maggs in 1962 and, in 1965, a young Jackie Stewart, about whom more later.

The organisers of the Monaco GP had wisely moved the start line to the inshore side of the Gasworks hairpin to avoid a repetition of the 1962 multiple pile-up. The grid would now line-up on a 2-by-2 basis and dash along the pits straight into the right-hand Ste Devote and up the hill to the casino. Only allowing a maximum of sixteen starters on the tight street circuit, the organisers had changed the method of qualification: previous winners and World Champions had a guaranteed place on the grid, giving places to Brabham, McLaren, Trintignant and the two Hills. Other entrants would have to qualify for the remaining eleven places. In the event, a number of entrants including the ATS team failed to show and mechanical problems reduced the number of starters to only fifteen.

Clark improved on his 1962 pole time in practice by 1.1sec, 0.7sec quicker than Hill's BRM, with Ginther and Surtees on the second row. Meanwhile, the Brabham team was having a fraught time with engines; Jack's engine dropped a valve so he flew it back to England himself for repair. On his return he found that Gurney's engine had piston trouble and the replacement engine was being used in the new BT7 chassis, leaving Jack as a non-starter. Into the breach stepped Colin Chapman with a loan of the spare Lotus 25. Such benevolence between rival GP

1963 World Championship – Round 1

Grand Prix de Monaco

Monte Carlo 26 May 1963 100 laps
195.42 miles (314.50km)
Starters 15 **Finishers** 7
Weather Warm and sunny

	Driver	Entrant	Car	Laps	Result
1	G Hill	Owen Racing Organisation	BRM P578 V8	100	2h 41m 49.7s
2	R Ginther	Owen Racing Organisation	BRM P578 V8	100	2h 41m 54.3s
3	B McLaren	Cooper Car Co	Cooper T66 Climax V8	100	2h 42m 02.5s
4	J Surtees	Ferrari SpA SEFAC	Ferrari 156/63 120° V6	100	2h 42m 03.8s
5	A Maggs	Cooper Car Co	Cooper T66 Climax V8	98	
6	T Taylor	Team Lotus	Lotus 25 Climax V8	98	
7	J Bonnier	RRC Walker Racing Team	Cooper T60 Climax V8	94	
	J Clark	Team Lotus	Lotus 25 Climax V8	78	Gearbox
	J Brabham	Brabham Racing Organisation	Lotus 25 Climax V8	77	N/C
	I Ireland	British Racing Partnership	Lotus 24 BRM V8	40	Accident
	W Mairesse	Ferrari SpA SEFAC	Ferrari 156/63 120° V6	37	Engine
	M Trintignant	Reg Parnell (Racing)	Lola Mk 4 Climax V8	34	Clutch
	D Gurney	Brabham Racing Organisation	Brabham BT7 Climax V8	25	Final drive
	J Hall	British Racing Partnership	Lotus 24 BRM V8	20	Gearbox
	J Siffert	Siffert Racing Team	Lotus 24 BRM V8	3	Engine

Winner's speed 72.42mph (116.555km/h)
Fastest lap J Surtees 1m 34.5s, 74.45mph (119.809km/h)

Championship placings

Drivers		Constructors	
1. G Hill	9	1. BRM	9
2. Ginther	6	2. Cooper	4
3. McLaren	4	3. Ferrari	3
4. Surtees	3	4. Lotus	1
5. Maggs	2		
6. Taylor	1		

Grid

Clark 1-34.3	G Hill 1-35.0	
Surtees 1-35.2		Ginther 1-35.2
Ireland 1-35.5	Gurney 1-35.8	
Mairesse 1-35.9		McLaren 1-36.0
Taylor 1-37.2	Maggs 1-37.9	
Bonnier 1-38.6		Siffert 1-39.4
Hall 1-41.0	Trintignant 1-41.3	
Brabham 1-44.7		

teams is difficult to believe in the current hyped-up world of commercialism.

Hill and Ginther stormed into the lead from the start, and it took Clark 5 laps to get up to second place. He hounded Hill for a further 13 laps before he was able to slip by into the lead at the Gasworks hairpin. Thereafter, he extended his lead steadily, breaking the lap record as he did so. After 70 of the 100 laps he had a comfortable 14sec advantage, but after a further 8 laps he was stationary on the circuit with the gearbox locked solid. He had been easing his pace and treating the gears gently but, in so doing, had not imparted sufficient effort into the gear change with the result that it had engaged second and fourth together.

Hill inherited the lead and, with Ginther some 4.6sec in arrears, they completed a superb 1-2 for BRM. Bruce McLaren took third with Surtees on his tail, having set a new record on the final lap. Surtees had been as high as second at one stage but had been troubled by oily goggles, cockpit heat and falling oil pressure. The inconsistent handling of the Ferrari had provided an exciting ride, the front wheels occasionally losing adhesion. Gurney's Brabham had expired at quarter distance while eighth

1963 World Championship – Round 2

Grand Prix de Belgique

Spa-Francorchamps 9 June 1963 32 laps
280.36 miles (451.20km)
Starters 20 **Finishers** 6
Weather Overcast and wet

	Driver	Entrant	Car	Laps	Result
1	J Clark	Team Lotus	Lotus 25 Climax V8	32	2h 27m 47.0s
2	B McLaren	Cooper Car Co	Cooper T66 Climax V8	32	2h 32m 41.6s
3	D Gurney	Brabham Racing Organisation	Brabham BT7 Climax V8	31	
4	R Ginther	Owen Racing Organisation	BRM P578 V8	31	
5	J Bonnier	RRC Walker Racing Team	Cooper T60 Climax V8	30	
6	G de Beaufort	Ecurie Maarsbergen	Porsche 718 F4	30	
	A Maggs	Cooper Car Co	Cooper T66 Climax V8	27	Accident
	T Settember	Scirocco-Powell Racing	Scirocco BRM V8	25	Accident
	J Surtees	Ferrari SpA SEFAC	Ferrari 156/63 120° V6	19	Fuel-injection
	G Hill	Owen Racing Organisation	BRM P578 V8	17	Gearbox
	L Bianchi	Reg Parnell (Racing)	Lola Mk 4 Climax V8	17	Accident
	J Hall	British Racing Partnership	Lotus 24 BRM V8	16	Accident
	J Siffert	Siffert Racing Team	Lotus 24 BRM V8	16	Accident
	P Hill	Automobili Tourismo e Sport	ATS T100 V8	13	Gearbox
	J Brabham	Brabham Racing Organisation	Brabham BT3 Climax V8	12	Fuel pump
	C Amon	Reg Parnell (Racing)	Lola Mk 4 Climax V8	10	Oil loss
	I Ireland	British Racing Partnership	BRP BRM V8	9	Gearbox
	G Baghetti	Automobili Tourismo e Sport	ATS T100 V8	7	Transmission
	W Mairesse	Ferrari SpA SEFAC	Ferrari 156/63 120° V6	7	Gearbox
	T Taylor	Team Lotus	Lotus 25 Climax V8	5	Oil pressure

Winner's speed 114.11mph (183.626km/h)
Fastest lap J Clark 3m 58.1s, 132.47mph (213.187km/h)

Championship placings

Drivers		Constructors	
1. McLaren	10	1. BRM	12
2. Clark	9	2. Cooper	10
G Hill	9	Lotus	10
Ginther	9	4. Brabham	4
5. Gurney	4	5. Ferrari	3
6. Surtees	3	6. Porsche	1
7. Maggs	2		
Bonnier	2		
9. Taylor	1		
De Beaufort	1		

Grid

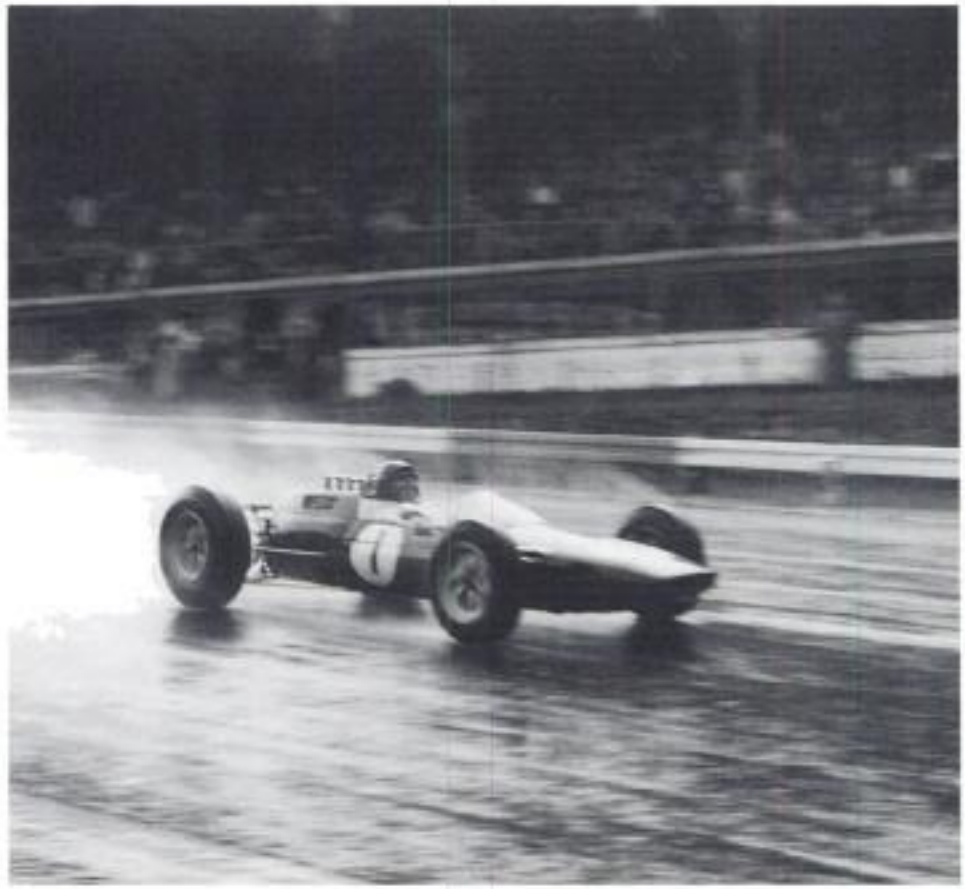
G Hill 3-54.1	Gurney 3-55.0	Mairesse 3-55.3
Maggs 3-56.0		McLaren 3-56.2
Brabham 3-56.6	Ireland 3-56.9	Clark 3-57.1
Ginther 3-57.6		Surtees 3-57.9
Taylor 3-58.1	Hall 4-00.1	Bonnier 4-00.1
Siffert 4-02.3		Amon 4-04.9
Bianchi 4-06.5	P Hill 4-06.7	de Beaufort 4-14.6
Settember 4-25.2		Baghetti 4-33.6

with final drive failure, and Brabham had an unhappy time in the unfamiliar Lotus, finishing 23 laps behind after suffering gear selection problems. With one round of the Championship completed, the pattern set in 1962 had been repeated – Clark fastest until failing, leaving success to the reliable BRM of Hill.

Once again the Dutch GP was out of its traditional place on the calendar and the Belgian GP became the second round of the Championship. A number of new cars appeared in practice, including the long awaited ATS, the BRP and the Scirocco. The ATS was an immediate disappointment, the chassis being crudely finished while the bodywork was ill fitting and roughly painted. Amazingly, additional chassis bracing had been welded into place over the engine bay and should an engine change have been necessary, it would only have been possible with the aid of a hacksaw. Hill and Baghetti put in a few slow laps, ending up seventeenth and twentieth on a grid of twenty. By contrast, the BRP monocoque was beautifully made and Ireland qualified it seventh. The BRM-engined Scirocco had arisen out of the remnants of Emeryson Cars and was bankrolled by wealthy young American Hugh Powell. It was described by *Autosport* as "workmanlike" in its blue and white American racing colours but would never set the track alight in the hands of Tony Settember, its instigator and a sometime US West Coast sports car driver.

Jim Clark and Colin Chapman arrived at Spa flushed with the success of a second place finish on Lotus' debut in the Indianapolis 500. Practice proved a shambles, however, with recurring gearbox problems, leaving Clark eighth on the grid and 3sec away from Graham Hill's BRM on pole. Team Lotus problems were compounded when a bolt securing the right rear suspension wishbone failed on Trevor Taylor's 25, the chassis being written-off in the ensuing high speed accident. Clark's Indianapolis team-mate Dan Gurney had put the improving Brabham into second spot on the grid with Mairesse's Ferrari third after one of his banzai laps in front of his home crowd.

While practice had been held in glorious weather, race day dawned dark and damp, with heavy rain falling prior to the start. On practice form it should have been Hill's race, with Clark hardly featuring, but this theory was soon blown away. Clark made an absolute blinder of a start from the third row to lead into the first corner at Eau Rouge. He completed the first three damp 8.71 mile laps 3sec quicker than Hill's BRM, his closest follower, and continued to extend his lead. By lap 15 he was 36sec ahead with the rest of the field nowhere. On lap 17, Hill dropped out with gearbox problems putting Gurney into second, 1min 32sec down on Clark. It had started to rain on some parts of the circuit by this time but Clark continued to draw away. At three-quarter distance, the heavens opened and lap times increased by 2 minutes. Conditions became so appalling that efforts were made by Colin Chapman and Tony Rudd to have the organisers stop the race but these proved fruitless. Even under these conditions



Belgian GP, Spa-Francorchamps, 9 June 1963. Clark (Lotus 25) splashes past the pits with a hopeful glance that the race might be stopped early – no such luck.

Clark's lead continued to extend so that he ran out the winner 4min 55sec ahead of Bruce McLaren in what had been the Spa circuit's slowest GP since 1954.

At one point Clark had lapped the entire field until, near the end, McLaren had managed to unlap himself. Gurney was third, unhappy with the handling of the Brabham in the wet, but neither Ferrari had finished. Godin de Beaufort survived the conditions to bring his old 4-cylinder Porsche 718 home sixth to claim a Championship point. Neither ATS had finished, both succumbing to gearbox problems after trundling around at the tail of the field, and the Scirocco had spun out. No driver had demonstrated quite such domination since Stirling Moss had left the scene just a year before and this performance seemed to indicate that Clark had truly taken on the mantle of the man to beat.

New for the Dutch GP, two weeks later, was a monocoque chassis BRM, the P61. Tony Rudd's interpretation of the concept was a full 360° centre section extending up and over the drivers legs, with a tubular sub-frame behind the driver to carry the engine and rear suspension. This permitted a much more compact car than the space frame P578 but it still appeared large compared to the Lotus 25. Brabham had completed a second

Dutch GP, Zandvoort, 23 June 1963. Gurney (Brabham BT7) slips inside Surtees (Ferrari 156/63) for second, having virtually driven through the field twice, firstly from the rear of the grid and then after a pit stop to secure a loose fuel line.

BT7 chassis to replace the BT3 driven by Jack in the opening GPs, while the ATS chassis now had detachable bracing over the engine bay, enabling the mechanics to leave their hacksaws back at base. Willy Mairesse had suffered burns in an accident during the Le Mans 24 Hours the previous weekend and Ferrari had nominated Lodovico Scarfiotti to partner John Surtees; the European Mountain Champion was making his GP debut. John Cooper made a welcome return to the pit lane, although only in the role of a spectator as he continued to recover from his road crash injuries.

Clark dominated practice 0.6sec quicker than a group comprising Graham Hill, McLaren, Brabham and Surtees, all of whom were covered by less than 1sec. Hill had tried the new BRM but locking rear brakes prevented any competitive times and he reverted to his regular P578. Dan Gurney's Brabham suffered an engine failure on the first day and he had to sit out practice awaiting delivery of a replacement from England. This only arrived on Saturday evening but a couple of laps in Brabham's car put him fourteenth on the grid.

Following on from his performance at Spa, Clark was pre-race favourite and he did not disappoint, taking an immediate lead into Tarzan corner. Once again he implemented his lightning getaway strategy on the opposition, running quick laps from the start to open out a 5sec lead over Hill and Brabham by lap 6. After 12 laps he was starting to double the tail enders and had extended his lead to 12sec by quarter distance. The margin increased to the extent that he had lapped the entire field by three-quarter distance, assisted in no small way by the unreliability of his opponents. Nevertheless, it was another dominant win.

Hill and Brabham had briefly contested second until problems with a broken throttle return spring hobbled the latter and Hill pitted with overheating that eventually led to engine failure. Dan Gurney scored a well deserved second, having driven forcefully through the field from the sixth row of the grid. Reaching fourth just after half distance, he made a quick stop to secure a fuel line, dropping him back to eighth. He was back up to third by three-quarter distance, swept past a spinning Surtees and established himself in a safe

1963 World Championship – Round 3 — Grote Prijs van Nederland

Zandvoort 23 June 1963 80 laps
208.43 miles (335.44km)
Starters 19 **Finishers** 9
Weather Warm and sunny

	Driver	Entrant	Car	Laps	Result
1	J Clark	Team Lotus	Lotus 25 Climax V8	80	2h 08m 13.07s
2	D Gurney	Brabham Racing Organisation	Brabham BT7 Climax V8	79	
3	J Surtees	Ferrari SpA SEFAC	Ferrari 156/63 120° V6	79	
4	I Ireland	British Racing Partnership	BRP BRM V8	79	
5	R Ginther	Owen Racing Organisation	BRM P578 V8	79	
6	L Scarfiotti	Ferrari SpA SEFAC	Ferrari 156/63 120° V6	78	
7	J Siffert	Siffert Racing Team	Lotus 24 BRM V8	77	
8	J Hall	British Racing Partnership	Lotus 24 BRM V8	77	
9	G de Beaufort	Ecurie Maarsbergen	Porsche 718 F4	75	
	G Hill	Owen Racing Organisation	BRM P578 V8	69	Engine
	J Brabham	Brabham Racing Organisation	Brabham BT7 Climax V8	68	Throttle
	T Taylor	Team Lotus	Lotus 25 Climax V8	66	N/C
	J Bonnier	RRC Walker Racing Team	Cooper T60 Climax V8	56	N/C
	C Amon	Reg Parnell (Racing)	Lola Mk 4 Climax V8	29	Water pump
	G Baghetti	Automobili Tourismo e Sport	ATS T100 V8	17	Engine
	P Hill	Automobili Tourismo e Sport	ATS T100 V8	15	Stub axle
	A Maggs	Cooper Car Co	Cooper T66 Climax V8	14	Overheating
	B McLaren	Cooper Car Co	Cooper T66 Climax V8	7	Gearbox
	G Mitter	Ecurie Maarsbergen	Porsche 718 F4	2	Clutch

Winner's speed 97.53mph (156.957km/h)
Fastest lap J Clark 1m 33.7s, 99.89mph (160.750km/h)

Championship placings

Drivers		Constructors	
1. Clark	18	1. Lotus	19
2. Ginther	11	2. BRM	14
3. McLaren	10	3. Cooper	10
Gurney	10	Brabham	10
5. G Hill	9	5. Ferrari	7
6. Surtees	7	6. BRP	3
7. Ireland	3	7. Porsche	1
8. Maggs	2		
Bonnier	2		
10. Taylor	1		

Grid

McLaren 1-32.3	G Hill 1-32.2	**Clark 1-31.6**
Surtees 1-33.0		Brabham 1-32.4
Bonnier 1-34.1	Ireland 1-33.3	Ginther 1-33.3
Taylor 1-35.2		Maggs 1-34.3
P Hill 1-36.0	Amon 1-35.9	Scarfiotti 1-35.6
Baghetti 1-37.8		Gurney 1-36.2
Hall 1-39.0	Siffert 1-39.0	Mitter 1-38.8
	de Beaufort 1-39.3	

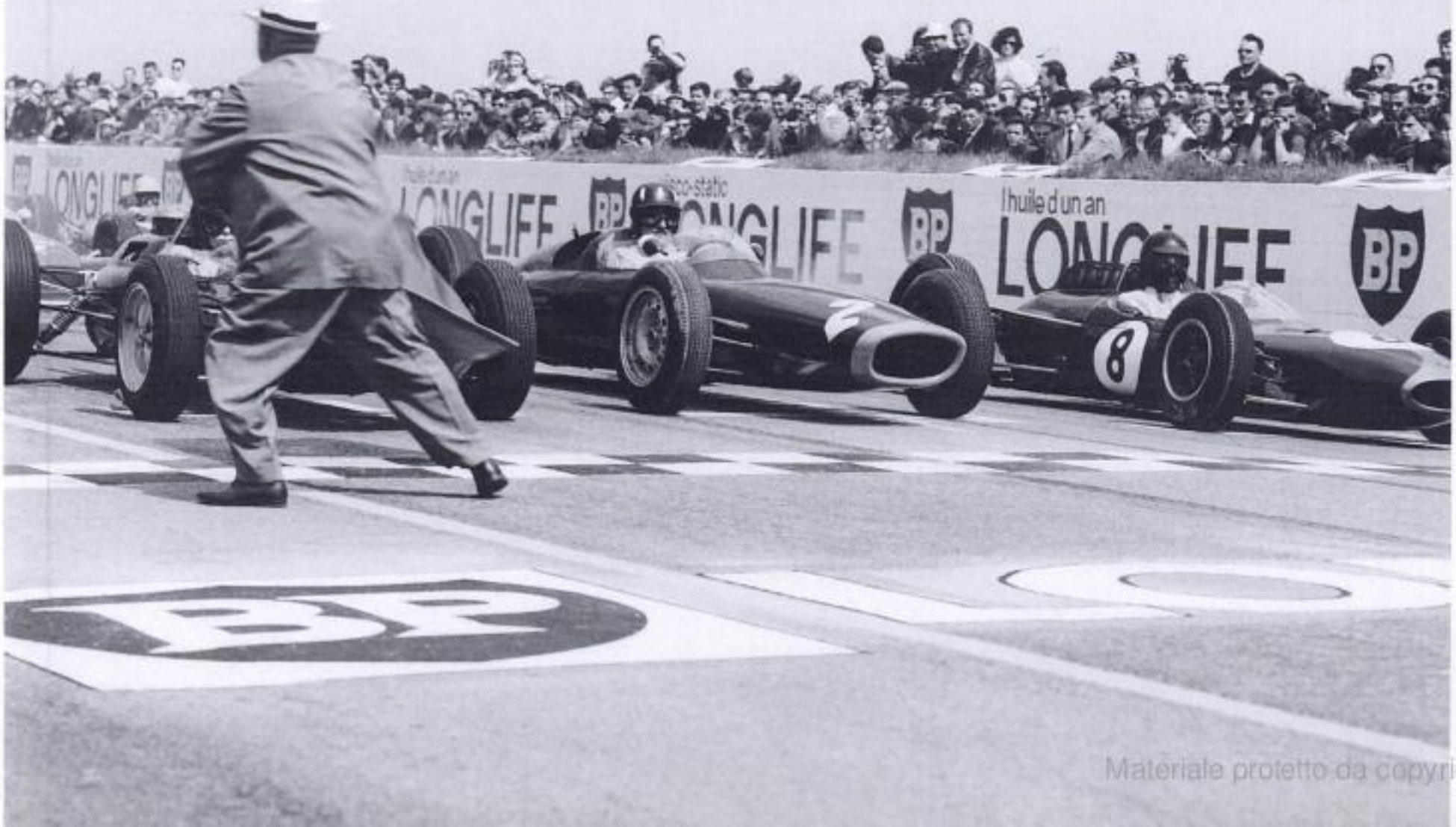
second to the finish. Surtees settled for a relatively uncompetitive third, while Innes Ireland drove steadily into fourth to claim BRP's first Championship points.

Would Clark score a hat trick at the French GP to be held on the fast Reims circuit? Yes, but an intermittent misfire made it touch and go at times. As was becoming the norm, Clark set the pace throughout practice and implemented his lightning getaway in the race to lead by 5sec after only two laps. He extended this to 19sec on lap 13 when his engine began to misfire due to an incorrect mixture setting that effectively limited his maximum revs to 8000, some 1500rpm down. His lead began to dwindle down to 12sec by lap 20 at which point rain began to fall. Clark, using his wet weather skills and driving within the limits of his engine, opened out the lead again to score his third win of the season by a margin of 65sec.

Clark's breakaway from the rest of the field was somewhat unusual for Reims, where slipstreaming along the long straights was the norm. His pursuers comprised two each of Brabham, BRM, and Cooper, and a single Ferrari for Surtees (Scarfiotti having written-off his car in practice with slight injuries to himself). Of these, Tony Maggs emerged in second after a steady drive in the Cooper. Brabham had held a solid second until stopping on the circuit at Muizon to re-attach an HT lead, rejoining and finishing fourth behind Graham Hill's BRM P61 having its first race, but suffering clutch slip in the latter stages. Dan Gurney recovered from an early stop to repair a broken gear lever to finish fifth.

There had been a moment of confusion just prior to the start when Hill stalled the BRM's engine. Raymond 'Toto' Roche, the enigmatic starter for the ACF, signalled for the car to be push-started and the BRM mechanics leapt into action, just slotting it back into place before the start. This action had contravened the FIA Championship regulations that required all F1 cars to start

French GP, Reims, 30 June 1963. 'Toto' Roche drops the flag to start the race, having allowed Hill (BRM P61 in centre of grid between Clark and Gurney) to be push-started, thereby incurring a 60sec penalty.



1963 World Championship – Round 4 — Grand Prix de l'ACF

Reims 30 June 1963 53 laps
273.41 miles (440.01km)
Starters 19 **Finishers** 11
Weather Showery

	Driver	Entrant	Car	Laps	Result
1	J Clark	Team Lotus	Lotus 25 Climax V8	53	2h 10m 54.3s
2	A Maggs	Cooper Car Co	Cooper T66 Climax V8	53	2h 11m 59.2s
3	G Hill	Owen Racing Organisation	BRM P61 V8	53	2h 13m 08.2s *
4	J Brabham	Brabham Racing Organisation	Brabham BT7 Climax V8	53	2h 13m 09.5s
5	D Gurney	Brabham Racing Organisation	Brabham BT7 Climax V8	53	2h 13m 27.7s
6	J Siffert	Siffert Racing Team	Lotus 24 BRM V8	52	
7	C Amon	Reg Parnell (Racing)	Lola Mk 4 Climax V8	50	
8	M Trintignant	Reg Parnell (Racing)	Lotus 24 Climax V8	50	
9	I Ireland	British Racing Partnership	BRP BRM V8	49	
10	L Bandini	Scuderia Centro Sud	BRM P578 V8	45	
11	J Hall	British Racing Partnership	Lotus 24 BRM V8	45	
	B McLaren	Cooper Car Co	Cooper T66 Climax V8	42	Ignition
	T Taylor	Team Lotus	Lotus 25 Climax V8	41	Transmission
	P Hill	Scuderia Filipinetti	Lotus 24 BRM V8	34	N/C
	J Bonnier	RRC Walker Racing Team	Cooper T60 Climax V8	32	N/C
	M Gregory	RHH Parnell	Lotus 24 BRM V8	30	Gearbox
	J Surtees	Ferrari SpA SEFAC	Ferrari 156/63 120° V6	12	Fuel pump
	T Settember	Scirocco-Powell Racing	Scirocco BRM V8	5	Rear hub bearing
	R Ginther	Owen Racing Organisation	BRM P578 V8	4	Radiator

*Includes 60sec penalty for push-start

Winner's speed 125.01mph (201.669km/h)
Fastest lap J Clark 2m 21.6s, 131.15mph (211.061km/h)

Championship placings*

Drivers		Constructors	
1. Clark	27	1. Lotus Climax	28
2. Gurney	12	2. Cooper	16
3. Ginther	11	3. BRM	14
4. McLaren	10	4. Brabham	13
5. G Hill	9	5. Ferrari	7
6. Maggs	8	6. BRP	3
7. Surtees	7	7. Porsche	1
8. Ireland	3	Lotus (BRM)	1
Brabham	3		
10. Bonnier	2		

*Assumes no score for G Hill/BRM for French GP

Grid

Gurney 2-21.7	G Hill 2-20.9	**Clark 2-20.2**
Brabham 2-21.9		Surtees 2-21.9
Maggs 2-24.4	Taylor 2-23.7	McLaren 2-22.5
Siffert 2-25.2		Ireland 2-25.1
P Hill 2-27.7	Ginther 2-25.9	Bonnier 2-25.7
Amon 2-30.5		Trintignant 2-28.3
Settember 2-36.7	Gregory 2-33.2	Hall 2-30.9
		Bandini 2-37.8

on the button, unassisted. Clearly Hill should have been black flagged and disqualified but, in the event, the ACF decided to impose a 60sec penalty, as laid down in its own supplementary regulations. This was not announced until some three-quarters of the way through the race. There was some uncertainty as to whether the FIA would support the ACF and it was generally assumed that Hill would lose his third place points when a ruling was obtained, although that would inevitably be a couple of months away.

ATS had declined to appear for this race, preferring to spend

time on development and preparation, leaving Phil Hill to accept a drive in the Scuderia Filipinetti Lotus 24. Unfortunately, he too had stalled on the grid and was awarded a 60sec penalty for receiving outside assistance, although it mattered little to the 1961 Champion as he was 9 laps down at the finish anyway.

The British GP returned to the wide-open spaces of Northamptonshire after two years in the suburbs of Liverpool, a location to which it would never return as the circuit faced threat of closure. Clark now led the Championship by 15 points and seemed to have an unassailable superiority over his rivals. Practice held few surprises, therefore, as he took his fourth pole position of the season.

1963 World Championship – Round 5

RAC British Grand Prix

Silverstone 20 July 1963 82 laps
240.1 miles (386.26km)
Starters 23 **Finishers** 13
Weather Warm and sunny

	Driver	Entrant	Car	Laps	Result
1	J Clark	Team Lotus	Lotus 25 Climax V8	82	2h 14m 09.6s
2	J Surtees	Ferrari SpA SEFAC	Ferrari 156/63 120° V6	82	2h 14m 35.4s
3	G Hill	Owen Racing Organisation	BRM P578 V8	82	2h 14m 47.2s
4	R Ginther	Owen Racing Organisation	BRM P578 V8	81	
5	L Bandini	Scuderia Centro Sud	BRM P578 V8	81	
6	J Hall	British Racing Partnership	Lotus 24 BRM V8	80	
7	C Amon	Reg Parnell (Racing)	Lola Mk 4 Climax V8	80	
8	M Hailwood	Reg Parnell (Racing)	Lotus 24 Climax V8	78	
9	A Maggs	Cooper Car Co	Cooper T66 Climax V8	78	
10	G de Beaufort	Ecurie Maarsbergen	Porsche 718 F4	76	
11	M Gregory	RHH Parnell	Lotus 24 BRM V8	75	
12	B Anderson	DW Racing Enterprises	Lola Mk 4 Climax V8	75	
13	J Campbell-Jones	Reg Parnell (Racing)	Lola Mk 4 Climax V8	74	
	J Siffert	Siffert Racing Team	Lotus 24 BRM V8	66	Gearbox
	J Bonnier	RRC Walker Racing Team	Cooper T66 Climax V8	65	Engine
	D Gurney	Brabham Racing Organisation	Brabham BT7 Climax V8	59	Engine
	I Raby	Ian Raby (Racing)	Gilby BRM V8	59	Gearbox
	I Burgess	Scirocco-Powell Racing	Scirocco BRM V8	36	Ignition
	J Brabham	Brabham Racing Organisation	Brabham BT7 Climax V8	27	Engine
	I Ireland	British Racing Partnership	BRP BRM V8	26	DSQ – push-start
	T Taylor	Team Lotus	Lotus 25 Climax V8	23	DSQ – push-start
	T September	Scirocco-Powell Racing	Scirocco BRM V8	20	Ignition
	B McLaren	Cooper Car Co	Cooper T66 Climax V8	6	Engine

Winner's speed 107.75mph (172.75km/h)
Fastest lap J Surtees 1m 36.0s, 109.76mph (176.65km/h)

Championship placings

Drivers		Constructors	
1. Clark	36	1. Lotus	37
2. Ginther	14	2. BRM	18
3. G Hill	13	3. Cooper	16
Surtees	13	4. Brabham	13
5. Gurney	12	Ferrari	13
6. McLaren	10	6. BRP	3
7. Maggs	8	7. Lotus (BRM)	2
8. Brabham	3	8. Porsche	1
Ireland	3		
10. Bonnier	2		

Grid

Brabham 1-35.0	G Hill 1-34.8	Gurney 1-34.6	**Clark 1-34.4**
Maggs 1-36.0	McLaren 1-35.4	Surtees 1-35.2	
Ireland 1-36.8	Taylor 1-36.8	Ginther 1-36.0	Bandini 1-36.0
Amon 1-37.2	Hall 1-37.0	Bonnier 1-36.8	
September 1-40.8	Hailwood 1-39.8	Anderson 1-39.0	Siffert 1-38.4
de Beaufort 1-43.4	Burgess 1-42.6	Raby 1-42.4	
		Cam'Jones 1-48.8	Gregory 1-44.2

Team Lotus appeared with a yellow band painted down the centre of its cars and this would remain part of the team livery until the advent of commercial sponsorship in 1968 dictated colour schemes. The Lotus also raced for the first time with a slot at the base of the windscreen that funnelled the airflow over the driver's head, leaving him in an area of comparatively still air and with his line of vision unimpeded by the Perspex windscreen.

The Brabham team had both cars on the front row of the 4-3-4 grid, with Graham Hill, back in the space frame BRM P578, between them. A third BRM appeared, entered by Scuderia Centro Sud, a team run by Guglielmo 'Mimo' Dei who ran a Rome-based Maserati dealership and race car preparation business before establishing the team with backing from BP Italia to help support young Italian driver talent. The team relocated to Monza and ran a racing drivers' school, and from 1956 began entering Maserati 250Fs in F1 races at home and abroad. By 1961, the shoestring operation was running Lorenzo Bandini, amongst others, in Maserati-engined Coopers. In 1963, the opportunity arose to purchase the ex-Graham Hill BRM P578 (underwritten by BP once again) for the then unemployed Bandini to demonstrate his talent.

The ATS team was still in Bologna so Phil Hill was without a ride, but British privateers made up the numbers, including racing motorcyclist Mike Hailwood who was to make his GP debut in a Parnell team Lotus 24. Hailwood had won his first World Championship on two wheels in 1961 and was keen to follow John Surtees and achieve success on four wheels.

Clark failed to make his lightning getaway and completed the first lap down in fifth, the crowd being treated to the sight of the Brabham team leading a GP in the order Brabham – Gurney. It took only 4 laps for Clark to work his way through to the front and then gradually ease away from his pursuers, establishing a

British GP, Silverstone, 20 July 1963. Hill (BRM P578) and Surtees (Ferrari 156/63) in inevitable pursuit of Jim Clark. They swap places on the last lap when the BRM runs short of fuel.

margin of 9sec by quarter distance. Gurney had moved ahead of his boss into second but Jack had his engine expire at Becketts on lap 27. By half distance the race had become processional, Gurney hanging on some 16sec down on Clark, with Hill and Surtees further back in third and fourth. Looking to have second in the bag with only another 23 laps to complete, the Brabham team suffered its second engine failure of the day when Dan's engine expired in a plume of smoke on the Hangar straight. Clark now had a 49sec lead over Hill and Surtees who had been contesting third over the course of the race. Clark eased off to win by over 25sec but on the penultimate lap, Surtees took second from Hill when the BRM faltered as it ran short of fuel. Hill was thankful to at least salvage third.

BRMs finished 3-4-5, Hill followed by Ginther and Bandini's red-painted Scuderia Centro Sud entry. The latter two, together with Bonnier in a new Rob Walker Cooper T66, had enjoyed a race long duel, only resolved in Ginther's favour after a spin by Bandini and engine failure for Bonnier. Jim Hall finished sixth to score his first Championship point and Mike Hailwood completed his debut GP in eighth, but 4 laps down on Clark.

Clark now looked to a win in Germany to equal Jack Brabham's 1960 achievement of five consecutive GP wins in a season. This looked a distinct possibility when he put his Lotus on the pole at the Nürburgring, almost 1sec quicker than John Surtees in the improving Ferrari. Surtees' development skills and work by the Bosch engineers on the fuel-injection were key to this performance, the car honed to perfection for the demanding circuit. Lorenzo Bandini caused a bit of a stir by putting his Centro Sud BRM (the 1962 winning chassis) into third on the grid, ahead of both works entries.

Clark made his usual lightning getaway pursued by a fast-starting Ritchie Ginther and a tardy Surtees. Part way around the opening lap, Clark's engine faltered and he dropped back to third. On lap 2 Surtees took Ginther, closely followed by a recovering Clark keen to regain the lead. This he achieved on lap 4 but Surtees was ahead again on lap 5. Clark now had a problem with the engine only running on all eight cylinders intermittently. When it lapsed onto seven, he would fall back, closing up again when it cleared. Surtees was able to use this to his advantage and pulled out a 5sec lead after 8 laps. At 10 laps he had extended this to nearly 14sec and had a new lap record to his credit despite a deterioration in the track surface after a hard winter. Clark's engine was now permanently on seven cylinders but he nursed the car through to the end to finish second, 1min 17sec behind the Ferrari. An overjoyed Surtees celebrated a well deserved first GP win. *Autosport* wrote: "Everyone knew that, sooner or later, John Surtees would win a grande épreuve. In 1962 he came within an ace of doing so... Now he has done it ... on the most difficult racing circuit in the world." It had been the first win for Ferrari since the 1961 Italian GP, almost two years earlier.

Ginther drove the sole surviving BRM into third, despite a blistered hand from having to hold the car in gear. Hill had stopped out on the circuit on lap 3 with a broken gearbox while Bandini had failed to live up to expectations when he made a poor start and took out both himself and Innes Ireland in an ambitious overtaking manoeuvre on the opening lap. Adding to the high rate of attrition amongst the front runners, Bruce McLaren had uncharacteristically crashed out following a rear wishbone breakage. Ending up unconscious in hospital, he was joined by Willy Mairesse who had broken his arm in a spectacular accident at the Flugplatz that unfortunately fatally injured a medical attendant. 'Wild' Willy had only recently left hospital since recovering from his Le Mans injuries. This latest accident would mark the end of his relationship with Ferrari and also his F1 career.

For the Brabham team, the race had been a disaster after the promise shown at Silverstone. Jack lost a lap at the start replacing a transistor box, while Gurney's engine refused to run properly, despite changing all the electrical components, and he eventually packed it in with gearbox trouble. All these problems left the promising West German FJ driver Gerhard Mitter in fourth place in the second of Godin de Beaufort's Porsche 718s, now in their fourth season of racing.

The ATS team had chosen this event to re-enter the Championship but failed to appear for practice after its transporter had run off the road near the Brenner Pass, damaging itself and its contents. It eventually arrived on Sunday morning, too late to take part and leaving Phil Hill and Baghetti as spectators once again.

Clark's string of victories may have been broken but he was now comfortably placed in the Championship with a 20 point lead over Surtees, his closest rival. A win at Monza would clinch the Championships for himself and for Lotus. Surtees needed to win the four remaining GPs to be in the unlikely position of snatching the title, as did Graham Hill to retain it for a second year.

At the end of August, the first details emerged of a new Ferrari that was expected to make its race debut at Monza. Powered by a new 90° V8, the chassis was a complete breakaway from previous Ferrari practice and obviously owed much to the trend set by Colin Chapman's Lotus 25. The chassis featured a simple tubular framework around which was riveted a duralumin skin to form D-section side-members containing the fuel tanks. In a leap ahead of British technology, the monocoque terminated behind the seat-back bulkhead and the engine was bolted directly to it, forming a structural member with the gearbox casing on which the rear suspension was mounted. Suspension was similar to the 1963 space frame car but featured rocker-arm type upper wishbones and inboard mounted coil spring/damper units. First impressions gained by John Surtees in testing were that the new

1963 World Championship – Round 6

Grosser Preis von Deutschland

Nürburgring 4 August 1963 15 laps
212.60 miles (342.15km)
Starters 22 **Finishers** 8 **Weather** Warm and sunny

	Driver	Entrant	Car	Laps	Result
1	J Surtees	Ferrari SpA SEFAC	Ferrari 156/63 120° V6	15	2h 13m **06.8s**
2	J Clark	Team Lotus	Lotus 25 Climax V8	15	2h 14m **24.3s**
3	R Ginther	Owen Racing Organisation	BRM P578 V8	15	2h 15m **51.7s**
4	G Mitter	Ecurie Maarsbergen	Porsche 718 F4	15	2h 21m **18.3s**
5	J Hall	British Racing Partnership	Lotus 24 BRM V8	14	
6	J Bonnier	RRC Walker Racing Team	Cooper T66 Climax V8	14	
7	J Brabham	Brabham Racing Organisation	Brabham BT7 Climax V8	14	
8	T Taylor	Team Lotus	Lotus 25 Climax V8	14	
	J Siffert	Siffert Racing Team	Lotus 24 BRM V8	10	Differential
	B Collomb	FB Collomb	Lotus 24 Climax V8	10	N/C
	G de Beaufort	Ecurie Maarsbergen	Porsche 718 F4	9	Lost wheel
	A Maggs	Cooper Car Co	Cooper T66 Climax V8	7	Engine
	D Gurney	Brabham Racing Organisation	Brabham BT7 Climax V8	6	Gearbox
	M Cabral	Scuderia Centro Sud	Cooper T60 Climax V8	6	Gearbox
	I Burgess	Scirocco-Powell Racing	Scirocco BRM V8	5	Accident
	T Settember	Scirocco-Powell Racing	Scirocco BRM V8	5	Accident
	B McLaren	Cooper Car Co	Cooper T66 Climax V8	3	Accident
	C Amon	Reg Parnell (Racing)	Lola Mk 4 Climax V8	2	Steering, accident
	G Hill	Owen Racing Organisation	BRM P578 V8	2	Gearbox
	W Mairesse	Ferrari SpA SEFAC	Ferrari 156/63 120° V6	1	Accident
	I Ireland	British Racing Partnership	Lotus 24 BRM V8	1	Accident
	L Bandini	Scuderia Centro Sud	BRM P578 V8	0	Accident

Winner's speed 95.8mph (154.222km/h)
Fastest lap J Surtees 8m 47.0s, 96.88mph (155.818km/h)

Championship placings

Drivers		Constructors	
1. Clark	42	1. Lotus	43
2. Surtees	22	2. Ferrari	22
3. Ginther	18	BRM	22
4. G Hill	13	4. Cooper	17
5. Gurney	12	5. Brabham	13
6. McLaren	10	6. Lotus (BRM)	4
7. Maggs	8	Porsche	4
8. Brabham	3	8. BRP	3
Ireland	3		
Bonnier	3		

Grid

G Hill 8-57.2	Bandini 8-54.3	Surtees 8-46.7	**Clark 8-45.8**
Mairesse 9-03.5	Ginther 9-02.8	McLaren 8-57.3	
Ireland 9-14.6	Maggs 9-11.6	Siffert 9-11.1	Brabham 9-04.2
Amon 9-20.1	Gurney 9-17.2	Bonnier 9-16.0	
Taylor 9-33.8	de Beaufort 9-25.1	Hall 9-22.7	Mitter 9-20.9
Collomb 10-01.0	Cabral 9-53.1	Burgess 9-52.2	
			Settember 10-02.0

car was an immediate improvement on the current version, even at such an early stage in development.

On 6 September, the CSI announced its ruling on Graham Hill's push-start at the French GP back in June. Hill was allowed to retain his third place finish but both he and BRM were disqualified from earning the Championship points otherwise due to them. Push starts being forbidden by the F1 regulations, this was not an unfair ruling.

Surtees demonstrated the potential of the new Ferrari chassis, dubbed 'Aero' by the team in deference to its aircraft

German GP, Nürburgring, 4 August 1963. John Surtees reaps the benefits of his labours to achieve his first GP win and the first for Ferrari since September 1961.

type construction, by putting it on pole position for the Italian GP by a margin of 1.2sec. This time was achieved using the familiar V6 as the new V8 had not yet demonstrated race reliability. Joining Surtees, in place of Willy Mairesse, was Lorenzo Bandini, his return to Ferrari having been earned by his recent performances in the Centro Sud BRM from which team principal 'Mimo' Dei was pleased to release him. Ferrari team manager Dragoni was overjoyed, having campaigned for his inclusion in the team with embarrassing vigour for some time. Bandini qualified sixth in the space frame 156 between the Brabhams of Gurney and Jack. Graham Hill shared the front row with Surtees, giving the monocoque BRM P61 its second race. Jim Clark was only third, hampered by an engine that would not rev properly. Mike Spence, a member of the Lotus FJ team, joined him in Team Lotus for this race. Spence, making his GP debut, was deputising for Trevor Taylor who was recovering from an accident in a non-Championship race at Pergusa.

The GP was scheduled to be run over the combined road course and banking, as in 1961. During Friday practice a number of cars suffered chassis and suspension damage due to the pounding handed out by the uneven surface of the banking. This prompted the entrants (including Ferrari) and drivers to petition the organisers to revert to the road course only. Coincidentally, the Commissione Provinciale di Vigilanza, responsible for public safety, had advised the organisers that spectators were at risk if a car ran off the banking. Late on Friday, therefore, it was announced that the race would be run on the road course only and the banking was closed off. The teams set to work changing suspension settings and gear and final drive ratios, while Dunlop had to organise a supply of softer compound tyres. The organisers also decided to reduce the number of starters from 30 to 20, much to the annoyance of the privateers who were more at risk of failing to qualify.

Graham Hill made the better start and completed the first lap ahead of Surtees, Clark, Bandini, Gurney and Ginther. The familiar Monza pattern soon emerged of bunches of cars circulating together, darting and weaving about and slipstreaming each other with the order changing at various points around the circuit. By lap 4, Surtees had moved into the lead ahead of Clark,

Italian GP, Monza, 8 September 1963. Early in the race Surtees (Ferrari Aero 156) leads Clark (Lotus 25), Hill (BRM P61) and Gurney (Brabham BT7). Only Clark will go the distance, clinching the World Championship.

the two of them pulling clear of Hill and Gurney who had split from Bandini, Ginther and the rest.

Surtees invariably crossed the line ahead but with Clark glued to his tail until the end of lap 16 when, to the groans of the tifosi, Clark came through on his own and Surtees peeled off into the pits to retire, his engine having expired. Lacking a tow, Clark fell back into the clutches of Hill and Gurney who now disputed the lead with Clark content to hang on, occasionally darting ahead to keep them on their toes. At half distance, Hill began to fall away with clutch slip, eventually retiring on lap 59. Clark now found that his main Championship rivals had been eliminated; the only driver remaining who could influence the title was Ginther, a long way back in third. Nevertheless, Gurney and Clark fought over the lead, lowering the lap record as they did. This lasted until Gurney was forced to pit with fuel feed problems. Clark could now ease off and win as he pleased, even allowing Ginther in second to unlap himself. It had been a tremendous race in the true Monza tradition with the lead changing no less than 27 times.

The BRP chassis continued to show promise, despite the team's limited resources, Innes Ireland looking certain for third only to have his engine seize solid within a lap of the finish but still be classified fourth, his second of the season. ATS had reappeared, Phil Hill actually finishing but down in 11th, some 7 laps behind. Baghetti had only been able to start after four faster private entrants had been 'encouraged' by the organisers to withdraw. His ATS was still running at the finish, unclassified, 23 laps down on Clark.

It was all over. Clark received the chequered flag and, with it, his first Drivers' Championship title and the first Constructors' title for Colin Chapman and Lotus. Mobbed by the crowd, Clark, Chapman and Spence did a lap of honour on the back of the winning car. Dubbed the 'Flying Scotsman' by *Autosport*, Clark had shown brilliant form with the ability to out drive his rivals aided by the superb, trendsetting monocoque Lotus chassis. The Championships may have been decided but

1963 World Championship – Round 7 Gran Premio d'Italia

Monza 8 September 1963 86 laps 307.28 miles (494.50km)
Starters 20 **Finishers** 12 **Weather** Warm and sunny

	Driver	Entrant	Car	Laps	Result
1	J Clark	Team Lotus	Lotus 25 Climax V8	86	2h 24m 19.6s
2	R Ginther	Owen Racing Organisation	BRM P578 V8	86	2h 25m 54.6s
3	B McLaren	Cooper Car Co	Cooper T66 Climax V8	85	
4	I Ireland	British Racing Partnership	BRP BRM V8	84	DNF – engine
5	J Brabham	Brabham Racing Organisation	Brabham BT3 Climax V8	84	
6	A Maggs	Cooper Car Co	Cooper T66 Climax V8	84	
7	J Bonnier	RRC Walker Racing Team	Cooper T66 Climax V8	84	
8	J Hall	British Racing Partnership	Lotus 24 BRM V8	84	
9	M Trintignant	Scuderia Centro Sud	BRM P578 V8	83	
10	M Hailwood	Reg Parnell (Racing)	Lola Mk 4 Climax V8	82	
11	P Hill	Automobili Tourismo e Sport	ATS T100 V8	79	
12	B Anderson	DW Racing Enterprises	Lola Mk 4 Climax V8	79	
	M Spence	Team Lotus	Lotus 25 Climax V8	73	Oil pressure
	D Gurney	Brabham Racing Organisation	Brabham BT7 Climax V8	64	Fuel feed
	G Baghetti	Automobili Tourismo e Sport	ATS T100 V8	63	N/C
	G Hill	Owen Racing Organisation	BRM P61 V8	59	Clutch
	J Siffert	Siffert Racing Team	Lotus 24 BRM V8	40	Oil pressure
	L Bandini	Ferrari SpA SEFAC	Ferrari 156/63 120° V6	37	Gearbox
	M Gregory	RHH Parnell	Lotus 24 BRM V8	26	Engine
	J Surtees	Ferrari SpA SEFAC	Ferrari Aero 156/120° V6	16	Engine

Winner's speed 127.74mph (205.575km/h)
Fastest lap J Clark 1m 38.9s, 130.05mph (209.302km/h)

Championship placings (*6 best performances)

Drivers		Constructors	
1. Clark	*51	1. Lotus	*51
2. Ginther	24	2. BRM	28
3. Surtees	22	3. Ferrari	22
4. McLaren	14	4. Cooper	21
5. G Hill	13	5. Brabham	15
6. Gurney	12	6. BRP	6
7. Maggs	9	7. Lotus (BRM)	4
8. Ireland	6	Porsche	4
9. Brabham	5		
10. Bonnier	3		

Grid

Surtees 1-37.3	G Hill 1-38.5	
Clark 1-39.0		Ginther 1-39.19
Gurney 1-39.25	Bandini 1-40.1	
Brabham 1-40.4		McLaren 1-40.5
Spence 1-40.9	Ireland 1-41.6	
Bonnier 1-41.9		Gregory 1-42.1
Maggs 1-42.2	P Hill 1-42.7	
Siffert 1-43.3		Hall 1-43.8
Hailwood 1-43.9	Anderson 1-44.2	
Trintignant 1-44.4		Baghetti 1-46.8

there remained three GPs to run and the runner-up positions to be settled.

On 20 September, *Autosport* ran an editorial criticising Ferrari for an announcement that it was to withdraw from racing for the remainder of the season. Apparently, having conceded the Championships to Clark and Lotus, Maranello felt it unnecessary to travel to North America and South Africa. The point made was that "it would be a disastrous thing for GP racing were Cooper, BRM, BRP, Brabham and others to follow Ferrari practice and withdraw merely because the Championships have been decided. To give up with three important races still to be staged, is fair weather motoring ..." The following week *Autosport* was able to report that "incensed by the remarks in *Autosport* and other magazines, Ferrari have entered cars for the American and Mexican Grands Prix."

One month after Monza, the GP circus assembled in North America, firstly for the US GP at Watkins Glen. Clark was not on pole, that honour going once again to Graham Hill in his regular BRM P578 by 0.1sec. The monocoque P61 had been left at home, Hill and the team having spent a lot of time on it but never able to match the handling of the P578. Ferrari had brought the Aero chassis for Surtees only for the right rear lower wishbone mounting to break away during practice. He reverted to the space frame 156 to record third fastest time. A notable absentee from the grid was Innes Ireland who was in hospital in Seattle with a dislocated hip following an accident the previous weekend in practice for a sports car race.

At the instigation of the GPDA, the Watkins Glen organisers decided to try a 'dummy grid' arrangement in which the cars formed up some yards behind the main starting grid and at the one minute signal moved forward under their own power to their starting positions. This was suggested on safety grounds to avoid collisions with stalled cars in the middle of the grid and would become the norm from 1964. Unfortunately on this occasion, the two grids were not sufficiently far enough apart. Jim Clark's engine refused to start on the dummy grid and in the process of moving forward to the starting positions he was left stranded in the middle of the grid. Tex Hopkins made his traditional leap in the air to start the race, luckily without incident, and as the remainder of the grid roared away, Clark's Lotus was pushed into the pits.

A faulty fuel pressure pump was worked on and a flat battery replaced before Clark could start a full lap in arrears. Once on his way, Clark immediately began to slice through the field, his being the fastest car on the track, despite the fuel pump continuing to play up. By lap 20 he was up to fourteenth, lap 40 tenth, lap 60 fifth, finally finishing third, unable to make up the lost lap on the leaders.

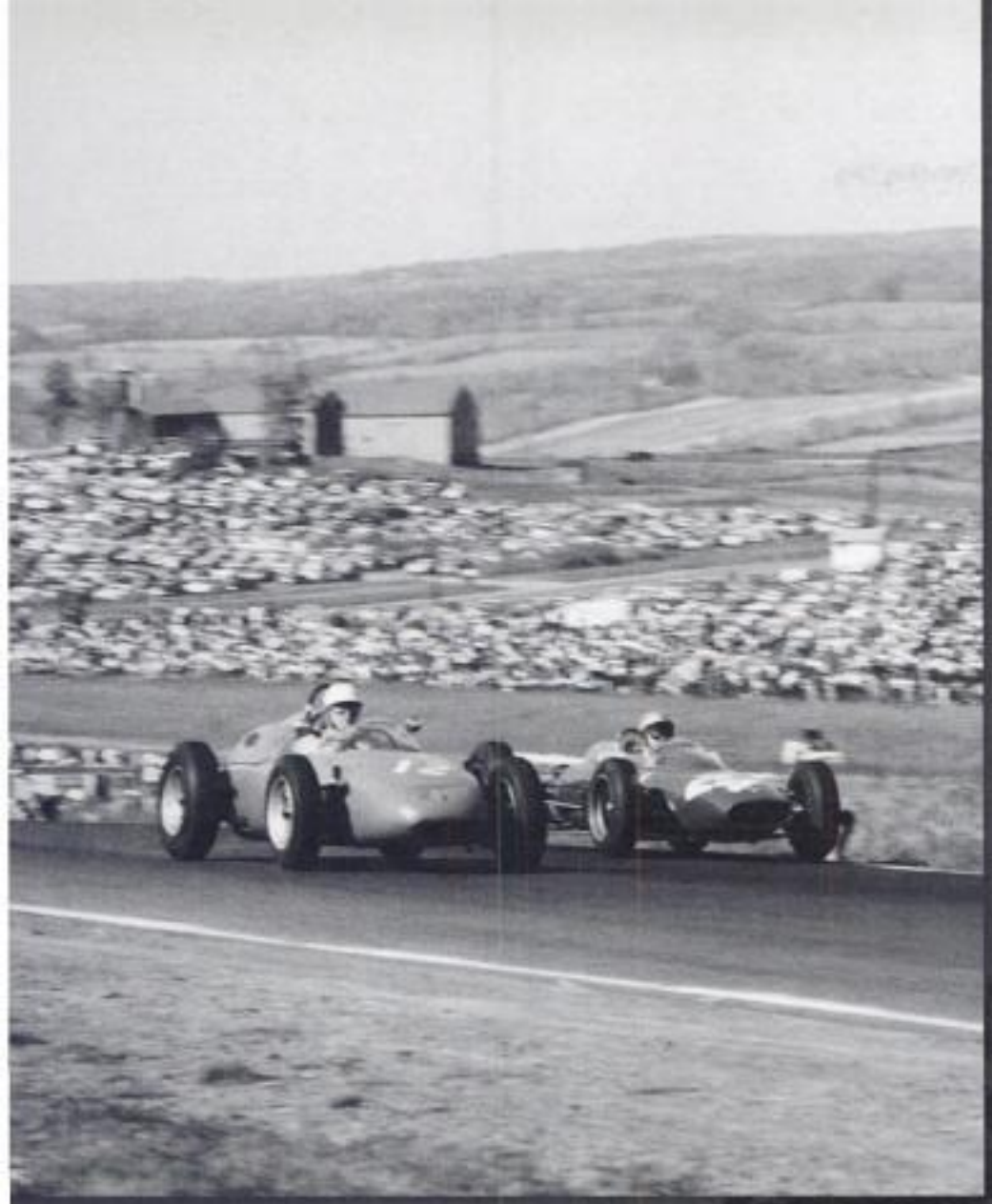
At the front Hill and Surtees had swapped the lead over the opening laps until Surtees was able to establish himself in the position, although unable to shake Hill off. Gurney and Ginther followed. The left link of Hill's rear anti-roll bar became detached and the deterioration in the BRM's handling allowed Surtees to pull away, opening up a gap of 4sec by half distance and 14sec within a further 20 laps. That was as much as Surtees could do, however, before engine failure sidelined him when victory appeared to be within his grasp. This left Hill to win his first GP since Monaco back in May, his left rear tyre almost bald as a result of the anti-roll bar failure. Ginther finished second once again to consolidate his second position in the Championship and make it another 1-2 finish for BRM. Gurney had pulled out before half distance with a broken chassis.

Godin de Beaufort trundled his reliable Porsche around to claim sixth and another Championship point as others fell by the wayside, including both ATS team cars with engine problems within the first six minutes of the race. As usual, the regular entries had been augmented by a number of local drivers hiring drives from the visitor teams. Pedro Rodriguez, the Mexican Ferrari sports car driver, made his GP debut in a third Team Lotus entry, retiring from sixth with water loss. Double Indianapolis 500 winner Rodger Ward made his second GP appearance, his first having been in the 1959 GP at Sebring where he drove a totally unsuitable Kurtis Midget racer. Driving a Parnell team Lotus 24, he was only a little more competitive and retired before half distance having battled with gearbox problems. Adding to the local interest was a Canadian built, Ford-powered Stebro driven by one Peter Broeker. This was basically an FJ chassis and was 15sec slower than pole position time in practice: it was lapped twenty-two times by the leaders in the race.

The second event in the North American tour was the Mexican GP. Having successfully organised a non-Championship F1 race in 1962, the Mexican Automobile Club had been granted World Championship status by the FIA for the 1963 event. The entry was virtually identical to that seen at Watkins Glen three weeks before. Pedro Rodriguez was in the spare Team Lotus 25 once again, and further local interest was provided by FJ driver Moises Solana who had hired the Centro Sud BRM P578 previously handled by Lorenzo Bandini. Ferrari had built a second Aero chassis and flown it out to supplement the original version and the two space frame chassis already in North America.

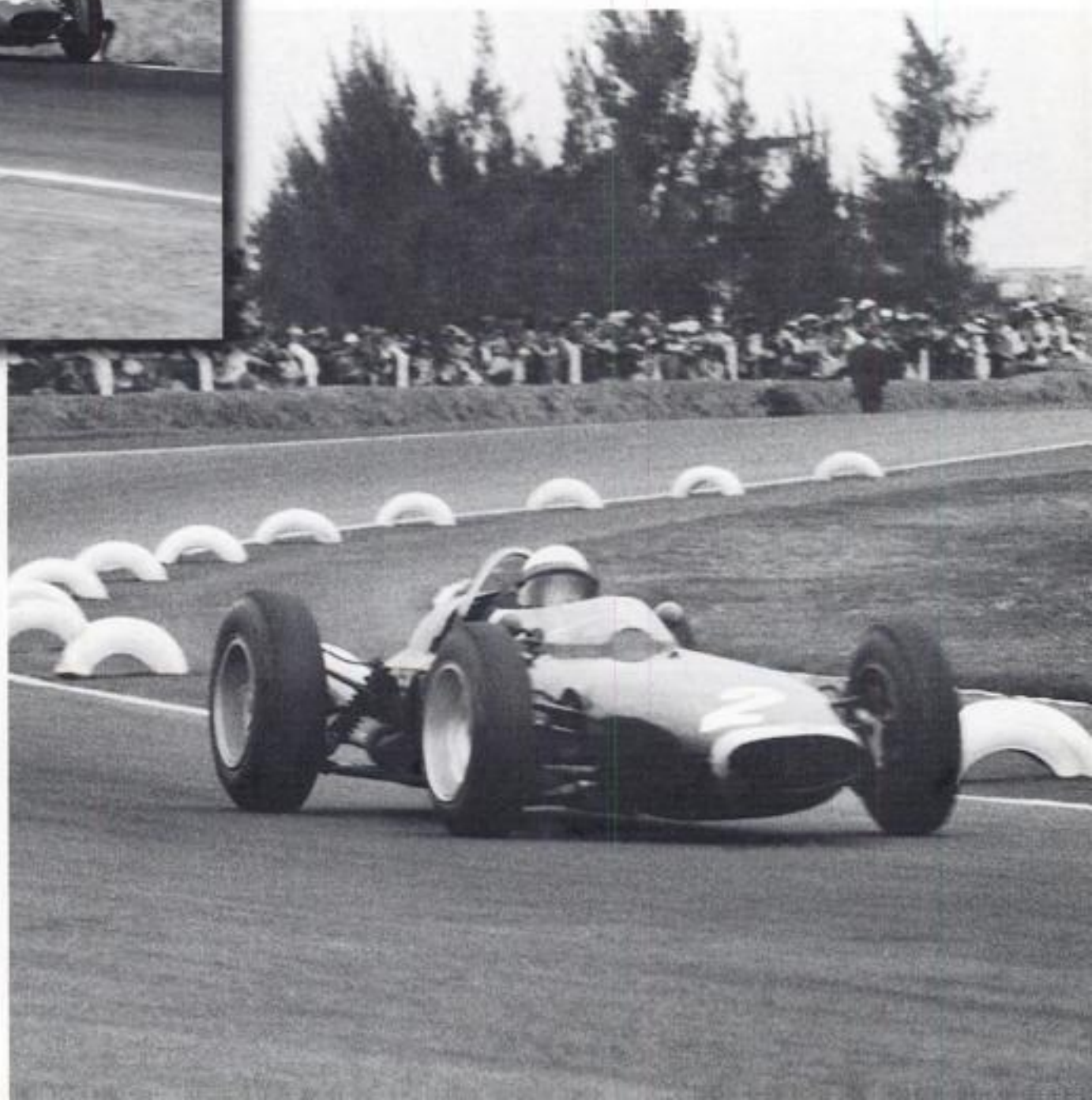
The 3.107 mile circuit was unique in being located at an altitude of 7400 feet above sea level. Come first practice on Friday, mechanics were busy adjusting fuel-injection systems to compensate for the lack of oxygen at that altitude. Jim Clark was the only driver to lap in under 2 minutes, next up being Surtees, 1.7sec slower in the original Aero Ferrari. Bandini was seventh quickest in the new Aero, 2sec slower than his team leader. Rain at the start of Saturday afternoon practice prevented all bar Jack Brabham from improving on Friday's times.

Clark made the best start, despite the flag being dropped



US GP, Watkins Glen, 6 October 1963. Godin de Beaufort (left) trundles his reliable old Porsche 718 to sixth and another Championship point. Bandini (Ferrari 156/63) laps him the first of seven times.

John Surtees was hampered by handling problems from the start, the front of his car bottoming on various parts of the circuit. He stopped to investigate and was unable to restart his engine. Accepting a push-start, he was immediately disqualified but would not have lasted much longer as his front suspension was collapsing. Both Coopers had gone out with engine failures, making a total of five failures for the team in North America. The team's competitiveness was declining, not helped by the failing health of Charles Cooper and son John's slow recovery from his road accident in May. The Cooper points score was insufficient to prevent being beaten by Brabham, the team set up by its former number one driver. Bruce McLaren was now looking to his future prematurely, and was never headed. He had a 5sec lead after 5 laps and extended this to 48sec by half distance. Despite fuel surge in the corners during the closing laps, he maintained an average lap time for the race of under 2 minutes and finished 1min 41sec ahead of second placed Jack Brabham. Dan Gurney had been comfortably in that place until two-thirds distance when the Brabham began to suffer fuel starvation. Inadvisably he untaped a fuel tap on what he thought was his reserve tank, letting fuel gush over his legs. A quick stop to close off the tap dropped him down the order to finish sixth.



Mexican GP, Mexico City, 27 October 1963. Ritchie Ginther (BRM P578) finished in the points on eight occasions in 1963, including third place here.

1963 World Championship – Round 8

United States Grand Prix

Watkins Glen 6 October 1963 110 laps
253.00 miles (407.11km)
Starters 21 **Finishers** 6 **Weather** Hot

	Driver	Entrant	Car	Laps	Result
1	G Hill	Owen Racing Organisation	BRM P578 V8	110	2h 19m 22.1s
2	R Ginther	Owen Racing Organisation	BRM P578 V8	110	2h 19m 56.4s
3	J Clark	Team Lotus	Lotus 25 Climax V8	109	
4	J Brabham	Brabham Racing Organisation	Brabham BT7 Climax V8	108	
5	L Bandini	Ferrari SpA SEFAC	Ferrari 156/63 120° V6	106	
6	G de Beaufort	Ecurie Maarsbergen	Porsche 718 F4	99	
	P Broeker	Canadian Stebro Racing	Stebro Mk 4 Ford 4	88	N/C
	J Bonnier	RRC Walker Racing Team	Cooper T66 Climax V8	85	N/C
	J Surtees	Ferrari SpA SEFAC	Ferrari 156/63 120° V6	82	Engine
	J Hall	British Racing Partnership	Lotus 24 BRM V8	76	Gearbox
	B McLaren	Cooper Car Co	Cooper T66 Climax V8	74	Fuel pump
	J Siffert	Siffert Racing Team	Lotus 24 BRM V8	56	Gearbox
	R Ward	Reg Parnell (Racing)	Lotus 24 BRM V8	44	Gearbox
	A Maggs	Cooper Car Co	Cooper T66 Climax V8	44	Engine
	D Gurney	Brabham Racing Organisation	Brabham BT7 Climax V8	42	Chassis
	P Rodriguez	Team Lotus	Lotus 25 Climax V8	36	Engine
	T Taylor	Team Lotus	Lotus 25 Climax V8	24	Electrics
	M Gregory	Reg Parnell (Racing)	Lola Mk 4 Climax V8	14	Oil pressure
	H Sharp	Reg Parnell (Racing)	Lotus 24 BRM V8	6	Engine
	P Hill	Automobili Tourismo e Sport	ATS T100 V8	4	Oil pump
	G Baghetti	Automobili Tourismo e Sport	ATS T100 V8	0	Oil pump

Winner's speed 109.91mph (176.882km/h)
Fastest lap J Clark 1m 14.5s, 111.14mph

Championship placings (*6 best performances)

Drivers		Constructors	
1. Clark	*51	1. Lotus	*51
2. Ginther	*28	2. BRM	*35
3. Surtees	22	3. Ferrari	24
G Hill	22	4. Cooper	21
5. McLaren	14	5. Brabham	18
6. Gurney	12	6. BRP	6
7. Maggs	9	7. Porsche	5
8. Brabham	8	8. Lotus (BRM)	4
9. Ireland	6		
10. Bandini	4		

Grid

Clark 1-13.5 — **G Hill 1-13.4**
Ginther 1-14.0 — Surtees 1-13.7
Gurney 1-14.5 — Brabham 1-14.2
Gregory 1-15.6 — Taylor 1-15.6
Maggs 1-15.8 — Bandini 1-15.8
Bonnier 1-16.3 — McLaren 1-15.6
Siffert 1-16.5 — Rodriguez 1-16.5
Hall 1-17.7 — P Hill 1-17.1
Sharp 1-20.0 — Ward 1-19.2
Baghetti 1-25.2 — de Beaufort 1-22.3
Broeker 1-28.6

and had set up Bruce McLaren Motor Racing Ltd. to run his own cars in other categories.

Predictably, both ATS cars retired and were destined never to appear in a GP again. The team had struggled to improve the car without success and the credibility of former Ferrari chief engineer Carlo Chiti had taken a severe knock. The car had put an end to the F1 career of Giancarlo Baghetti and that of Phil Hill would last only one further season.

With six GP wins to his credit, Clark now had the maximum possible score in the Championship. More significantly, he had equalled the record shared by Ascari (1952) and Fangio (1954) for the highest number of GP wins in a season. The final GP of the year in South Africa would give him the opportunity to better that record. Once again it was held so late in the year (28 December) that it was almost the opening round of the 1964 Championship. At least in 1962 it had been the Championship decider but this

year it was nearly four months after Clark had clinched the title at Monza and two months after Mexico. This situation would not be repeated as the 1964 event was postponed by a couple of days and, at a stroke, became the opening round of the 1965 Championship.

Missing from the entry list were the ATS (the company had now folded), BRP and Parnell teams. Numbers were made up by the faster contenders from the South African Gold Star series in their Alfa Romeo-engined specials or ex-F1 Cooper and Lotus chassis. Godin de Beaufort had made the trip with his Porsche without the guarantee of a start but was accepted by the organisers after lapping inside their qualification time. Two weeks earlier, Ferrari and Lotus had contested the non-Championship Rand GP at Kyalami. Surtees and Bandini had finished 1-2 after both Lotuses had been plagued by fuel vaporisation due to overheating fuel pumps. Relocating the pump ahead of the radiator solved this

1963 World Championship – Round 9

Gran Premio de Mexico

Mexico City 27 October 1963 65 laps
201.95 miles (325.00km)
Starters 21 **Finishers** 10 **Weather** Overcast but dry

	Driver	Entrant	Car	Laps	Result
1	J Clark	Team Lotus	Lotus 25 Climax V8	65	2h 09m 52.1s
2	J Brabham	Brabham Racing Organisation	Brabham BT7 Climax V8	65	2h 11m 33.2s
3	R Ginther	Owen Racing Organisation	BRM P578 V8	65	2h 11m 46.8s
4	G Hill	Owen Racing Organisation	BRM P578 V8	64	
5	J Bonnier	RRC Walker Racing Team	Cooper T66 Climax V8	62	
6	D Gurney	Brabham Racing Organisation	Brabham BT7 Climax V8	62	
7	H Sharp	Reg Parnell (Racing)	Lotus 24 BRM V8	61	
8	J Hall	British Racing Partnership	Lotus 24 BRM V8	61	
9	J Siffert	Siffert Racing Team	Lotus 24 BRM V8	59	
10	G de Beaufort	Ecurie Maarsbergen	Porsche 718 F4	58	
	M Solana	Scuderia Centro Sud	BRM P578 V8	57	Engine
	P Hill	Automobili Tourismo e Sport	ATS T100 V8	40	Rear wishbone
	L Bandini	Ferrari SpA SEFAC	Ferrari Aero 156/120° V6	35	Engine
	B McLaren	Cooper Car Co	Cooper T66 Climax V8	29	Engine
	P Rodriguez	Team Lotus	Lotus 25 Climax V8	26	Rear suspension
	M Gregory	Reg Parnell (Racing)	Lola Mk 4 Climax V8	23	Rear suspension
	T Taylor	Team Lotus	Lotus 25 Climax V8	18	Engine
	J Surtees	Ferrari SpA SEFAC	Ferrari Aero 156/120° V6	18	DSQ – push-start
	G Baghetti	Automobili Tourismo e Sport	ATS T100 V8	10	Engine
	C Amon	Reg Parnell (Racing)	Lotus 24 BRM V8	8	Gearbox
	A Maggs	Cooper Car Co	Cooper T66 Climax V8	7	Engine

Winner's speed 93.29mph (150.152km/h)
Fastest lap J Clark 1m 58.1s, 94.71mph (152.413km/h)

Championship placings (*6 best performances)

Drivers		Constructors	
1. Clark	*54	1. Lotus	*54
2. Ginther	*29	2. BRM	*36
3. G Hill	25	3. Ferrari	24
4 Surtees	22	Brabham	24
5. McLaren	14	5. Cooper	23
Brabham	14	6. BRP	6
7. Gurney	13	7. Porsche	5
8. Maggs	9	8. Lotus (BRM)	4
9. Ireland	6		
10. Bonnier	5		

Grid

Surtees 2-00.5 — **Clark 1-58.8**
Gurney 2-01.6 — G Hill 2-00.6
McLaren 2-02.3 — Ginther 2-01.8
Bonnier 2-02.6 — Bandini 2-02.4
Brabham 2-03.6 — Siffert 2-03.3
Taylor 2-04.9 — Solana 2-04.1
Gregory 2-05.5 — Maggs 2-05.2
Sharp 2-07.7 — Hall 2-06.1
de Beaufort 2-14.1 — P Hill 2-13.6
Rodriguez 2-15.3 — Amon 2-14.7
Baghetti 2-22.3

1963 World Championship – Round 10

South African Grand Prix

East London 28 December 1963 85 laps
207.06 miles (333.17km)
Starters 20 **Finishers** 12 **Weather** Hot and windy

	Driver	Entrant	Car	Laps	Result
1	J Clark	Team Lotus	Lotus 25 Climax V8	85	2h 10m 36.9s
2	D Gurney	Brabham Racing Organisation	Brabham BT7 Climax V8	85	2h 11m 43.7s
3	G Hill	Owen Racing Organisation	BRM P578 V8	84	
4	B McLaren	Cooper Car Co	Cooper T66 Climax V8	84	
5	L Bandini	Ferrari SpA SEFAC	Ferrari Aero 156/120° V6	84	
6	J Bonnier	RRC Walker Racing Team	Cooper T66 Climax V8	83	
7	A Maggs	Cooper Car Co	Cooper T66 Climax V8	82	
8	T Taylor	Team Lotus	Lotus 25 Climax V8	81	
9	J Love	J Love	Cooper T55 Climax 4	80	
10	G de Beaufort	Ecurie Maarsbergen	Porsche 718 F4	79	
11	D Serrurier	Otelle Nucci	LDS 6 Alfa Romeo 4	78	
12	T Blokdyk	T Blokdyk	Cooper T51 Maserati 4	77	
	J Brabham	Brabham Racing Organisation	Brabham BT7 Climax V8	70	Spin, fuel tank
	B Niemann	Ted Lanfear	Lotus 22 Ford 4	66	N/C
	P de Klerk	Otelle Nucci	Alfa Special Alfa Romeo 4	53	Gearbox
	D Prophet	David Prophet (Racing)	Brabham BT6 Ford 4	49	Oil pressure
	R Ginther	Owen Racing Organisation	BRM P578 V8	43	Half shaft
	J Surtees	Ferrari SpA SEFAC	Ferrari Aero 156/120° V6	43	Engine
	E Pieterse	Lawson Organisation	Lotus 21 Climax 4	3	Engine
	S Tingle	SA Tingle	LDS 2 Alfa Romeo 4	2	Half shaft

Winner's speed 95.10mph (153.049km/h)
Fastest lap D Gurney 1m 29.1s, 98.41mph (158.372km/h)

Championship placings (*6 best performances)

Drivers			Constructors	
1.	Clark	*54	1. Lotus	*54
2.	G Hill	29	2. BRM	*36
	Ginther	*29	3. Brabham	*28
4	Surtees	22	4. Ferrari	26
5.	Gurney	19	5. Cooper	*25
6.	McLaren	17	6. BRP	6
7.	Brabham	14	7. Porsche	5
8.	Maggs	9	8. Lotus (BRM)	4
9.	Ireland	6		
	Bandini	6		

Grid

Gurney 1-29.1	Brabham 1-29.0	**Clark 1-28.9**
Bandini 1-30.2	Surtees 1-29.8	
Taylor 1-30.4	Ginther 1-30.4	G Hill 1-30.3
Maggs 1-31.5	McLaren 1-31.2	
Love 1-34.6	Pieterse 1-34.5	Bonnier 1-32.0
Niemann 1-35.6	Prophet 1-35.5	
Serrurier 1-36.4	Tingle 1-35.8	de Klerk 1-35.7
de Beaufort 1-36.6	Blokdyk 1-36.5	

problem and Jim Clark was able to clock up his seventh pole position of the season at East London. Sharing the front row were the two Brabhams with the two Ferraris on row two.

The Brabhams made the better start but by the end of the opening lap Surtees was second to Clark who, as usual, was never headed again. Surtees was in engine trouble already, holding up the two Brabhams and allowing Clark to get away. After 5 laps Gurney and Brabham relegated Surtees to fourth, but Brabham had taken the edge off his engine and Surtees moved into third until his engine blew at half distance. Gurney was comfortably placed in second, a position he retained to the end, 66sec behind Clark and the only other driver to complete the full distance. It had been a promising first full season for the Brabham team, finishing third in the Constructors' Championship despite failing

South African GP, East London, 28 December 1963. The Brabham Racing Organisation runs in tandem, having disposed of Surtees (Ferrari Aero 156). Only Gurney (here behind his boss) will survive to take second, over 1min behind Clark.

understandably focussed on the preparation of Clark's car, the team seemed unable, or perhaps unwilling, to prepare a second car to the same standard. As a result, Trevor Taylor's second season as number two to Clark was a disaster. As in 1962, his season was punctuated by accidents, not all of his own making, but the car consistently let him down and he scored only a single Championship point.

Although beaten in the Championship, BRM had a far from disappointing season. Graham Hill scored two GP wins and Ritchie Ginther had a remarkably consistent season being placed

1963 Points Table

	Drivers	Monaco	Belgium	Holland	France	Britain	Germany	Italy	USA	Mexico	South Africa	Total	Best 6 Scores
1.	Jim Clark	-	9	9	9	9	6	9	4	9	9	73	54
2.	Graham Hill	9	-	-	-	4	-	-	9	3	4	29	29
3.	Ritchie Ginther	6	3	2	-	3	4	6	6	4	-	34	29
4.	John Surtees	3	-	4	-	6	9	-	-	-	-	22	22
5.	Dan Gurney	-	4	6	2	-	-	-	-	1	6	19	19
6.	Bruce McLaren	4	6	-	-	-	-	4	-	-	3	17	17
7.	Jack Brabham	-	-	-	3	-	-	2	3	6	-	14	14
8.	Tony Maggs	2	-	-	6	-	-	1	-	-	-	9	9
9.	Innes Ireland	-	-	3	-	-		3				6	6
	Lorenzo Bandini				-	2	-	-	2	-	2	6	6
	Jo Bonnier	-	2	-	-	-	1	-	-	2	1	6	6
12.	Gerhard Mitter						3					3	3
	Jim Hall	-	-	-	-	1	2	-	-	-		3	3
14.	Godin de Beaufort		1	-		-	-		1	-	-	2	2
15.	Trevor Taylor	1	-	-	-	-	-		-	-	-	1	1
	Lodovico Scarfiotti			1								1	1
	Jo Siffert	-	-	-	1	-	-	-	-	-		1	1
	Constructors												
1.	Lotus Climax	1	9	9	9	9	6	9	4	9	9	74	54
2.	BRM	9	3	2	-	4	4	6	9	4	4	45	36
3.	Brabham Climax	-	4	6	3	-	-	2	3	6	6	30	28
4.	Ferrari	3	-	4	-	6	9	-	2	-	2	26	26
5.	Cooper Climax	4	6	-	6	-	1	4	-	2	3	26	25
6.	BRP		-	3	-	-		3	-			6	6
7.	Porsche		1	-		-	3		1	-	-	5	5
8.	Lotus BRM	-	-	-	1	1	2	-	-	-		4	4

to score a win. The BT7 was light and handled well but all too often was plagued by engine-related problems and failures. Best of the local drivers was John Love in ninth in his ex-works 1961Cooper T55.

This seventh GP win of the season enabled Clark to surpass the record held by Ascari and Fangio and was really the only highlight of an otherwise processional race. 1963 would be remembered as the year in which the close working relationship between Jim Clark and Colin Chapman came of age. Chapman had produced a superb and reliable car in the Lotus 25, Coventry Climax a powerful engine and both driver and constructor had scored maximum points in their respective Championships. In the space of two seasons, Clark had won ten GPs and moved up to fourth in the list of all time GP winners behind Fangio, Moss and Ascari. Invariably he would be fastest in practice, would lead from start to finish and set fastest lap along the way. With attention

in eight out of ten starts. BRM was runner-up in the Constructors' title, and Hill and Ginther were second and third in the Drivers' title. The only other manufacturer to score a GP win was Ferrari, and that owed much to the determination and development skills of John Surtees. The new Aero monocoque displayed much promise at Monza but suffered chassis and engine failures in the succeeding events.

Summary of results of non-Championship F1 races

Lombank Trophy, Snetterton (GB), 30.3.63, 135.50 miles.
1. G Hill, BRM P578 V8, 95.47mph. 2. J Clark, Lotus 25 Climax V8. 3. I Ireland, Lotus 24 BRM V8. PP: Clark. FL: Hill 99.35mph. *Hill beats Clark from back of grid on wet track.*

Grand Prix de Pau, Pau (F), 15.4.63, 171.40 miles.
1. J Clark, Lotus 25 Climax V8, 61.62mph. 2. T Taylor, Lotus 25 Climax V8. 3. H Schiller, Porsche 718 F4. PP: Clark. FL: Clark 64.88mph. *Dominant win for Lotus twins against thin field – others at Goodwood.*

Glover Trophy, Goodwood (GB), 15.4.63, 100.80 miles.
1. I Ireland, Lotus 24 BRM, 102.44mph. 2. B McLaren, Cooper T66 Climax V8. 3. A Maggs, Lotus 24 Climax V8. PP: G Hill, BRM P578 V8. FL: Ireland 104.85mph. *Good win for Innes as BRMs and Brabham fail.*

Gran Premio Citta di Imola, Imola (I), 21.4.63, 155.87 miles.
1. J Clark, Lotus 25 Climax V8, 99.36mph. 2. J Siffert, Lotus 24 BRM V8. 3. B Anderson, Lola Mk 4 Climax V8. PP: Clark. FL: T Taylor, Lotus 25 Climax V8 103.62mph. *Clark all the way against little opposition.*

Gran Premio di Siracusa, Syracuse (I), 25.4.63, 194.77 miles.
1. J Siffert, Lotus 24 BRM V8, 90.77mph. 2. G de Beaufort, Porsche 718 F4. 3. C Abate, Cooper T51 Maserati 4. PP: Siffert. FL: Siffert 104.08mph. *Only two days before Aintree thus field left to ten private entrants.*

BARC 200, Aintree (GB), 27.4.63, 150.00 miles.
1. G Hill, BRM P578 V8, 94.39mph. 2. I Ireland, Lotus 24 BRM. 3. T Taylor/ J Clark, Lotus 25 Climax V8. PP: Clark. FL: Clark 96.60mph. *Clark left at start with flat battery, takes over Taylor's car and fights back to third.*

International Trophy, Silverstone (GB), 11.5.63, 152.20 miles.
1. J Clark, Lotus 25 Climax V8, 108.12mph. 2. B McLaren, Cooper T66 Climax V8. 3. T Taylor, Lotus 25 Climax V8. PP: I Ireland, Lotus 24 BRM. FL: Ireland 110.45mph. *First representative field includes Surtees with revitalised Ferrari team.*

Gran Premio di Roma, Vallelunga (I), 19.5.63, 159.04 miles.
1. B Anderson, Lola Mk 4 Climax V8, 78.94mph. 2. G de Beaufort, Porsche 718 F4. 3. I Raby, Gilby BRM V8. PP: de Beaufort. FL: Anderson 81.76mph. *Sole win for ex-motorcyclist Anderson against second-class field. Aggregate of two heats.*

Grosser Preis der Solitude, Stuttgart (D), 28.7.63, 177.23 miles.
1. J Brabham, Brabham BT3 Climax V8, 106.30mph. 2. P Arundell, Lotus 25 Climax V8, 3. I Ireland, BRP1 BRM V8. PP: J Clark, Lotus 25 Climax V8. FL: Clark 111.57mph. *Comfortable maiden win for Brabham marque. Clark breaks drive shaft on grid, starts after half distance and destroys lap record.*

Kanonloppet, Karlskoga (S), 11.8.63, 74.52 miles.
1. J Clark, Lotus 25 Climax V8, 69.38mph. 2. T Taylor, Lotus 25 Climax V8. 3. J Brabham, Brabham BT7 Climax V8. PP: Brabham. FL: Clark 75.00mph. *Brabham wins heat 2 but Team Lotus take aggregate.*

Gran Premio del Mediterraneo, Pergusa (I), 18.8.63, 178.80 miles.
1. J Surtees, Ferrari 156/63 120° V6, 137.84mph. 2. P Arundell, Lotus 25 Climax V8. 3. L Bandini, BRM P578 V8. PP: Surtees. FL: Surtees 141.67mph. *Follow up to German GP win for Surtees in fastest 1½-litre F1 race to date.*

Grosser Preis von Österreich, Zeltweg (A), 1.9.63, 159.07 miles.
1. J Brabham, Brabham BT3 Climax V8, 96.35mph. 2. T September, Scirocco BRM V8. 3. G de Beaufort, Porsche 718 F4. PP: J Clark, Lotus 25 Climax V8. FL: Brabham 100.26mph. *Brabham duels with Clark and Ireland until engine failures leave him to win by 5 lap margin.*

International Gold Cup, Oulton Park (GB), 21.9.63, 201.55 miles.
1. J Clark, Lotus 25 Climax V8, 98.34mph. 2. R Ginther, BRM P578 V8. 3. G Hill, BRM P578 V8. PP: Clark. FL: Clark 100.20mph. *Clark totally dominant, unusually Ginther beats Hill.*

Rand Grand Prix, Kyalami (ZA), 14.12.63, 127.25 miles.
1. J Surtees, Ferrari Aero 156/63 120° V6, 95.22mph. 2. L Bandini, 156/63 120° V6. 3. P de Klerk, Alfa Special Alfa Romeo 4. PP: Surtees. FL: Surtees 96.60mph. *Scuderia Ferrari dominant as Team Lotus suffer fuel vaporisation.*

Technical overview: 1963

Engine technology
Single-plane crankshafts

Both the BRM and Coventry Climax V8s had been designed with two-plane crankshafts in the interests of full dynamic balance and smoothness. This resulted in unequal firing impulses on each cylinder bank, however, presenting problems in exhaust system tuning as witnessed by the complex crossover system used on the Climax FWMV unit. For 1963, BRM changed to a single-plane crankshaft on the P56 engine in which the crankpins were disposed as on a 4-cylinder engine. This introduced the secondary unbalance forces of a 4-cylinder but, because of the relatively small diameter pistons and short stroke of the engine, there was no apparent increase in engine vibration – if anything, the P56 actually ran more smoothly. More importantly, the latitude for exhaust tuning was widened. On the 1963 engine the outlets from cylinders 1 and 4 and from 2 and 3 were joined in equal lengths before merging into a common tailpipe.

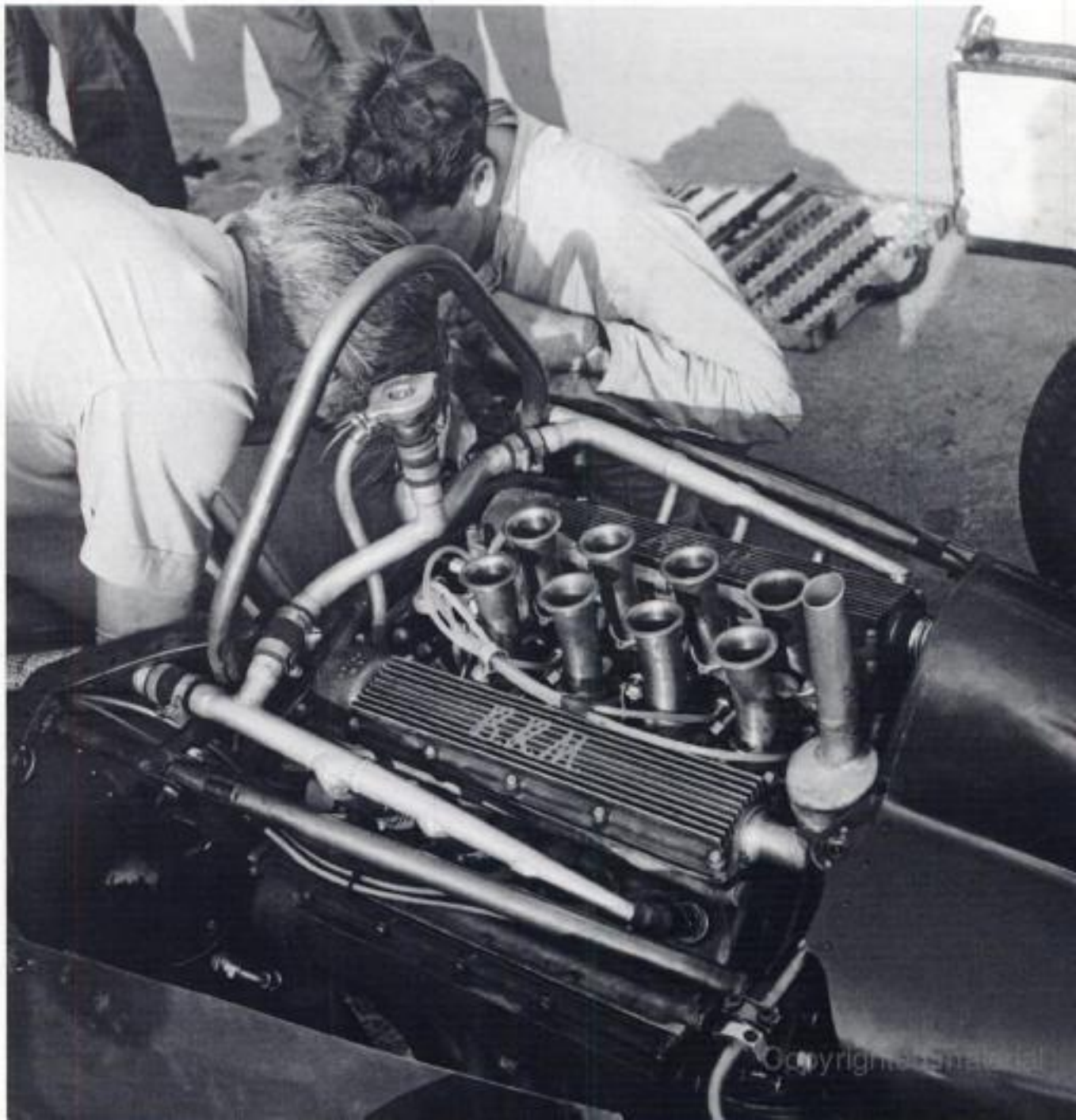
Interestingly, Coventry Climax had also built a single-plane crankshaft FWMV but for a different reason. This was to avoid the complicated crossover exhaust system and allow the engine to be installed in the front-engined, four-wheel-drive Ferguson chassis, although this installation never actually happened. Once again, it was found that the single-plane crankshaft did not result in the increased vibration that theory indicated would be present. A shortage of engines saw this engine pressed into service for Gurney's Brabham in the Dutch and French GPs, blowing up in the British GP.

More significantly, Coventry Climax had made a number of internal modifications to the FWMV for 1963, reducing the stroke as a means of increasing crankshaft speed and improving breathing. Peak power of 195bhp was now produced at 9500rpm, up by 1000rpm, but not yet into the five figure speeds of the BRM.

Fuel-injection

Despite its perceived benefits, fuel-injection took a very long time to attain universal acceptance by F1 engine designers. The first effective system to meter fuel under pressure directly into an engine's cylinders was developed in Germany during the 1930s. While this was already a feature of the diesel engine, the petrol application required a more controlled, and hence sophisticated, environment for efficient combustion. Working together, the engineers of Robert Bosch AG and the aero-engine division of Daimler-Benz developed a system that improved performance of the power units of Luftwaffe aircraft during World War II. Some work was also carried out on its application on Mercedes GP engines between 1937 and 1939 until war intervened to halt development.

Mercedes continued fuel-injection development with Bosch postwar for both road going and racing use, culminating in its adoption for the highly successful 1954/55 W196 GP car and 300SLR sports car. The Bosch system was 'direct' fuel-injection in that fuel was injected directly into each cylinder at the



Fuel-injection: BRM worked closely with Lucas on the application of fuel-injection to the P56 V8. This is the first public appearance of the engine at Monza in September 1961 – note the short inlet trumpets and clear plastic fuel pipes to injectors.

high-pressure of 1500psi. In its 8-cylinder racing application it comprised a sophisticated eight-plunger metering unit/high-pressure pump running off the engine. This regulated fuel distribution to an injector nozzle located beneath the inlet valve of each cylinder and directed a cone-shaped spray of fuel towards the lower edge of the exhaust valve.

Meanwhile, in Britain, Joseph Lucas Ltd was also working on fuel-injection with a view to producing a system for production car use. The Lucas system differed from Bosch in that it injected fuel into the inlet port rather than direct into the cylinder. This 'port-type injection system' made it more of a 'bolt-on accessory' whereas the Bosch system required precise tailoring to the engine to which it was to be applied and was consequently more costly to manufacture and maintain. By taking advantage of rapid airflow in the inlet tract to aid fuel atomisation, the Lucas system could be run at the much lower pressure of approximately 100psi. Lucas also separated the pressure pump from the metering unit and powered it electrically to provide freedom of location and the ability to divorce it from the heat of the engine bay, reducing the likelihood of vapour locks. The metering unit was driven off the engine and fed fuel to injectors that sprayed a cone of fuel upstream against incoming airflow in the inlet tract. Jaguar used the Lucas system on its 1956 D-type sports car, winning at Le Mans in 1957.

In 1956, Vanwall adopted the Bosch system for GP racing, fuel being injected into the inlet ports close to the valves. The regulation switch to 130 octane Avgas fuel from 1958 saw a reversion to the superior metering precision of the twin choke Weber carburettor, although Vanwall won the 1958 Constructors' Championship after modifying its Bosch system to cope. The introduction of the 1½-litre F1 regulations in 1961 generated renewed interest in fuel-injection as all engines now had to run on 101.5(RON) octane pump petrol. Potentially, it would provide smoother running at lower engine speeds when induction airflow velocity fell too low for efficient carburetion. Additionally, better fuel distribution would reduce consumption and additional power would be released by maximising inlet tract airflow without the constraint of holding an unstable fuel/air mixture in suspension.

The new formula opened with all the major players relying on the Weber carburettor. Porsche flirted with the German Kugelfischer fuel-injection for the first two GPs but dropped it when in failed to provide any advantage over the carburettor version of the flat-4 engine. As the 1961 season progressed, BRM was busy developing its new P56 V8 engine, and fuel-injection was specified from the outset as an integral part of the pursuit of high power at high engine speeds. The Lucas low-pressure port-type injection was chosen and the company worked closely with BRM on its application for the new V8. A sliding plate throttle was adopted (having been used in the Jaguar Lucas application) to remove the mid-tract obstruction of the butterfly spindle. Opening or closing the throttle was achieved by sliding circular openings in the plate into or out of alignment with the inlet tract, controlling the flow of fuel/air mixture into the engine. The system provided all the expected advantages and was compact, reliable and easy to maintain.

The Coventry Climax FWMV V8 ran on Weber carburettors during 1962. Experimental work with Lucas port type fuel-injection indicated that improvements in lap times could be achieved due to more precise throttle control. The Lucas system was adopted for the 1963 FWMV Mk III 'short stroke' engine, much to the annoyance of BRM that had believed that it had an exclusive deal with Lucas. The positioning of the injector nozzles differed noticeably from the upstream injection of the BRM. Climax found that this upset airflow and reduced power. By careful development, extended bell-mouthed air trumpets were evolved with the nozzles positioned on the central axes, injecting downstream, a considerable distance from the throttle plates.

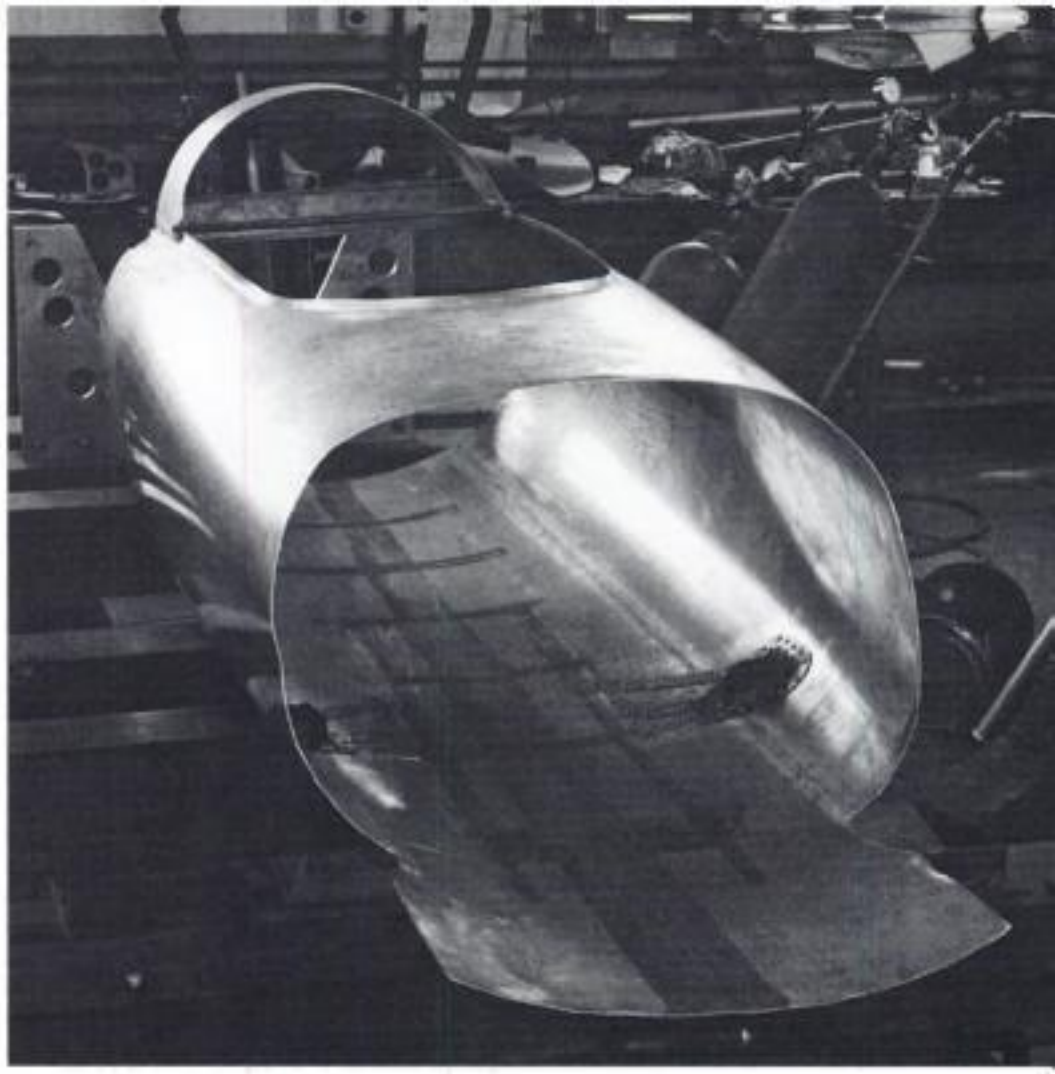
By 1963, the Ferrari Dino 156 120° V6 appeared to be approaching the end of its competition career until new life was breathed into it with fuel-injection. Swiss fuel-injection consultant and part-time race driver Michael May was brought in to match the Bosch high-pressure direct injection system to the engine. May had previously worked on the Bosch system at Mercedes and, briefly, at Porsche over the winter of 1961. The now normal sliding plate throttle was utilised, topped with long induction trumpets. An increase in power and mid-range torque was claimed.

Significantly, at the beginning of the third season of the 1½-litre F1 all the major players were now committed to fuel-injection. The first 1½-litre F1 victory for a fuel-injected car had been with BRM in the 1962 Dutch GP, and, less than five months later, Coventry Climax scored the last victory for a carburettor engine at Watkins Glen.

Power: driver ratios

The Coventry Climax FWMV Mk III produced some 195bhp for 1963 to power a chassis with a minimum weight of 992lb (450kg), without fuel but inclusive of oil and water. With such a comparatively low power output, it is easy to appreciate that any reductions in weight to achieve the target minimum were all important. Very few GP cars approached the minimum, with the possible exception of the Lotus 25. In addition, the Lotus carried one of the lighter drivers, Jim Clark weighing in at something like 140lb. It is interesting to compare this with the Brabham BT7, some 45lb heavier than the Lotus and driven by the tall Californian Dan Gurney who weighed some 185lb fully kitted out.

Assuming parity of engine performance, fuel load and road holding between the Lotus and Brabham, the added weight carried by the Brabham would require an additional 16bhp from



Monocoque developments: the outer shell of the BRM P61 chassis sitting in the workshop prior, to insertion of the fabricated inner structure forming the cockpit sides and driver's seat pan. This shows its full 360° construction rather than the open 'bath tub' monocoque of the Lotus 25.

the engine simply to allow it to race on equal terms with the Lotus – Gurney never stood a chance!

Tyre technology

Dunlop introduced the R6 tyre for 1963 to develop the synthetic D12 tread further. It became an all-weather tyre, and tread widths were widened both front and rear by approximately 0.5in to 4.62in and 5.2in respectively, still mainly on 15in diameter wheels, although some constructors chose 13in diameter fronts. Besides offering improved grip, wider, lower aspect ratio tyres gave improved lateral stability and a change in the construction of the nylon carcass helped to reduce running temperatures. The tread pattern was modified at this time to enhance the wet weather capabilities of the tyre, the R6 showing a clear 5 per cent advantage over the 1962 R5 under such conditions.

These developments were not without problems, however, as drivers found the R6 difficult to handle in the dry due to the change in carcass construction making the tyre too stiff. This was overcome by mating the R5 construction to the wider tread of the R6. Now cornering forces broke through the 1g barrier for the first time, at least on those chassis that were able to realise the potential offered.

Chassis developments

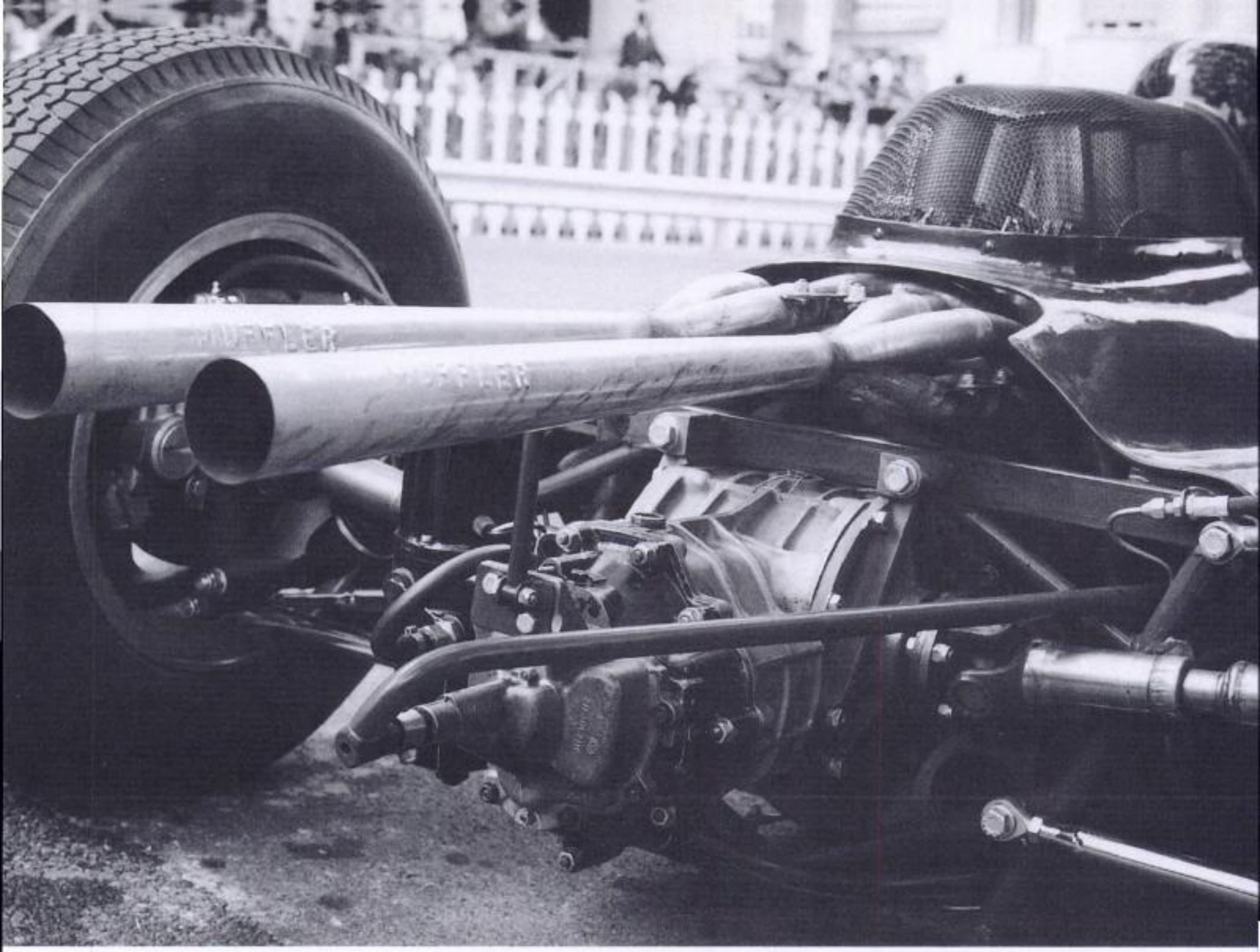
Colin Chapman's rivals watched the progress of the Lotus 25 with interest and soon realised that monocoque type construction was the way to go. Tony Rudd of BRM was quick to respond to the challenge and had his interpretation of the monocoque concept on the drawing board in summer 1962, at the same time as the space frame P578 was building up a lead in that year's Constructors' Championship. It was the British Racing Partnership, however, that had put F1's second monocoque on the track. Lacking a competitive customer chassis, BRP's experienced engineer, Tony Robinson, built-up a chassis following the layout of the Lotus 25 and utilising suspension and steering components from the team's Lotus 24 parts bins. Not as light as the Lotus, Robinson had carefully engineered the BRP chassis rather more substantially.

Tony Rudd's BRM P61 chassis differed from the Lotus 25 in that it was a full 360° structure rather than a 'bath tub' type monocoque. It comprised a single large diameter tube outer skin, into which was riveted a fabricated inner section forming the driver's seat pan, cockpit floor and sides. Fuel was contained in rubber bag tanks within the recesses between the inner and outer skins. The structure terminated behind the driver's seat where a tubular sub-frame supported the engine, transmission and rear suspension.

The first Ferrari monocoque appeared at Monza as part of the design renaissance under Mauro Forghieri. Designed to accept a new range of engines including a V8 and flat-12, Forghieri's interpretation of the monocoque concept owed much to aircraft construction, hence it being popularly referred to as the 'Aero'. It comprised four longitudinal steel tubes, that doubled as oil and water channels, welded to fabricated sheet steel bulkheads around which a duralumin skin was riveted, forming D-section side-members either side of the driver and containing the fuel tanks. The structure terminated at the bulkhead behind the driver to which the engine was rigidly attached. In the event, the V6 and V8 engines also required simple tubular sub-frames to support them but the flat-12 formed a structural member to which the rear suspension was attached. In so doing, Ferrari had moved one step ahead of Lotus.

Transmissions

The Brabham BT7 introduced Hewland transmissions to F1. From small beginnings in 1960, Mike Hewland's business had quickly developed into the most significant proprietary transmission manufacturer in the rapidly expanding FJ market. The Mk IV racing gearbox/final drive unit was based on a Volkswagen



Hewland transmission: the 'beefed-up' Mk IV in the rear of Gurney's Brabham BT7 during practice for the 1963 Monaco GP.

'Beetle' transmission casing with purpose-built internals and was intended for both FJ and small capacity sports racing cars. As one of its leading customers, it was logical for Brabham to sound out Hewland for an F1 transmission. The 5-speed HD unit, suitable for both F1 and larger capacity sports cars, was under development at the time and a pre-production example was obtained for the Brabhams. A beefed-up version of the Mk IV was also produced, despite Mike Hewland's reservation that using it for F1 was 'pushing it a bit'. One of the significant features of both the HD and Mk IV was the ease with which ratios could be changed by removal of the back of the casing and sliding out the internals. The entire operation could be completed in 30 minutes.

5 1964 – Ferrari fights back

Six marques appeared at Monaco for the opening round of the 1964 World Championship – Brabham, BRM, BRP, Cooper, Lotus and Ferrari. Of these, only Brabham and Cooper had not followed the monocoque type construction trend. The new Cooper T73 was slim and neat looking, and had adopted the almost universal inboard front suspension layout, but the chassis was something of a compromise being a simple tubular frame to which a sheet steel undertray had been welded to enhance stiffness. Brabham remained faithful to the pure multi-tubular space frame concept and the team was riding high following victories by Jack in non-Championship races at Aintree and Silverstone. The team was continuing with modified 1963 BT7 chassis, although a new BT11 had been produced. Initially, examples of this were being sold to private entrants, Brabham having now replaced Cooper and Lotus as supplier of customer chassis.

BRM had built a Mk 2 version of its 1963 P61 monocoque/tubular hybrid. The tubular sub-frame supporting the engine and suspension had been deleted in favour of an extension to the monocoque on either side of the engine, terminating at the rear suspension bulkhead. The P261 (i.e. Mk 2 P61) was altogether much more purposeful looking than its predecessor. It had been ready from the beginning of the season and had proved to be on the pace in the non-Championship races run to date.

The new Ferrari V8 engine, first seen in August 1963, had been developed over the winter into a raceworthy unit. John Surtees had used it to win the non-Championship Syracuse GP but the V8 was in short supply and Ferrari remained reliant on the 120° V6 as backup. The 'Aero' monocoque type chassis, as raced in the latter part of 1963, was retained in slightly modified form. As usual at this stage of the season, Ferrari was too busy with its Le Mans entries to spare much time for the GP team.

On the face of it there was no reason to suppose that the dominance achieved by the Lotus 25 and Jim Clark in 1963 would not continue into 1964. Despite Colin Chapman's preoccupation with winning the Indianapolis 500, he had instigated a number of improvements to the 25 concept, and newly built chassis were type numbered '33'. Unfortunately, the only example of the 33 had been badly damaged in an accident at Aintree when a back marker had tripped up Jim Clark. In the meantime, Team Lotus would rely on modified versions of the 25 incorporating 33 components, wherever possible. Two older 25 chassis had been sold to the Parnell team, where they were rebuilt and fitted with customer BRM V8 engines and Hewland transmissions.

The Reg Parnell team had suffered a severe shock when Reg had died unexpectedly on 7th January of a ruptured appendix despite emergency surgery. Reg had enjoyed a varied and successful career in racing both before and after World War II. On his retirement in 1957 he became team manager for Aston Martin until it withdrew from racing in 1960. Since 1961 he had run the Yeoman Credit team that became the Bowmaker Lola team in 1962. When Bowmaker withdrew he had purchased the team assets to form his own team, Reg Parnell (Racing). Reg's son Tim took over the running of the team, and the acquisition of the Lotus chassis was a much more competitive proposition than the Lolas and Lotus 24s run in 1963. Mike Hailwood had taken a financial stake in the team and he was to run his first full F1 season alongside Chris Amon.

Lurking on the horizon was the entrance of the Japanese Honda car and motorcycle manufacturer into GP racing. Rumours had been rife for many months but these would become reality in 1964 with what was believed to be a V12-engined car. Honda had built a reputation for high power outputs from its multi-cylinder motorcycle engines and few doubted that the output of the V12 would exceed the 200bhp of the current BRM and Climax V8s. What remained to be seen was whether the engine was reliable, how good the chassis was and who would drive it.

Dunlop had made a major technical advance for the new season with the introduction of a new generation of wide tread tyres of lower profile mounted on 13in diameter wheels rather than previous 15in. With 7in wide rims on the rear wheels, these tyres put an extra 2in wider footprint on the track. This contributed to increased grip and road holding and would reduce lap times significantly on some circuits. The scene had been set for the wide tyre revolution of the late 1960s.

There was little change in the driver line-up for the season: Graham Hill/Ritchie Ginther remained at BRM, Dan Gurney/Jack at Brabham, John Surtees/Lorenzo Bandini at Ferrari and Bruce McLaren and Jim Clark at Cooper and Lotus respectively. Cooper had signed the promising young American, Tim Mayer, after a

successful season with Ken Tyrrell's FJ team. Tragically, he was killed practising for an Australian Tasman series race in February and his place was to be taken by Phil Hill who had nowhere to go following the demise of ATS. Both Hill and former team-mate Giancarlo Baghetti were to have driven a pair of 1962 BRM P578s run by Scuderia Centro Sud, and the former Cooper number 2, the under rated Tony Maggs, would now join Baghetti at Centro Sud. Team Lotus had dropped Trevor Taylor in favour of FJ Champion Peter Arundell. The somewhat accident prone Taylor moved over to BRP to partner Innes Ireland as Jim Hall had decided to return to the USA to pursue his Chaparral sports car project. BRP was replacing its ageing Lotus 24s with further examples of its monocoque chassis introduced at Spa in 1963.

Of the private teams, Rob Walker, DW Racing Enterprises and Siffert Racing were newly equipped with the Brabham BT11 chassis (although not all of them were ready for the Monaco GP) to be driven by Jo Bonnier, Bob Anderson and Jo Siffert respectively.

Formula 1 Constructors Association

In January, formation of the Formula 1 Constructors Association (F1CA) had been announced, its purpose being to encourage a better understanding between constructors, promoters and organisers and promote the interests of F1 throughout the world. Its secretary was Andrew Ferguson, competitions manager for Team Lotus, who had originally founded the FJ Association, later to become F2 Association. Founder members were the British-based F1 constructors Brabham, BRM, Cooper and Lotus, with Honda joining in April. This association was the forerunner of FOCA (a change from F1 to FOne) that gained substantial power in the sport from the 1980s under the leadership of Bernie Ecclestone.

1964 World Championship – Round 1

Grand Prix de Monaco

Monte Carlo 10 May 1964 100 laps 195.42 miles (314.50km)
Starters 16 **Finishers** 6 **Weather** Hot

	Driver	Entrant	Car	Laps	Result
1	G Hill	Owen Racing Organisation	BRM P261 V8	100	2h 41m 19.5s
2	R Ginther	Owen Racing Organisation	BRM P261 V8	99	
3	P Arundell	Team Lotus	Lotus 25 Climax V8	97	
4	J Clark	Team Lotus	Lotus 25 Climax V8	96	DNF – engine
5	J Bonnier	RRC Walker Racing Team	Cooper T66 Climax V8	96	
6	M Hailwood	Reg Parnell (Racing)	Lotus 25 BRM V8	96	
	B Anderson	DW Racing Enterprises	Brabham BT11 Climax V8	86	Gearbox mounting
	J Siffert	Siffert Racing Team	Lotus 24 BRM V8	78	N/C
	P Hill	Cooper Car Co	Cooper T73 Climax V8	70	Suspension
	L Bandini	Ferrari SpA SEFAC	Ferrari Aero 156/120° V6	68	Transmission
	D Gurney	Brabham Racing Organisation	Brabham BT7 Climax V8	62	Gearbox
	M Trintignant	M Trintignant	BRM P578 V8	53	Overheating
	J Brabham	Brabham Racing Organisation	Brabham BT7 Climax V8	29	Fuel-injection
	B McLaren	Cooper Car Co	Cooper T66 Climax V8	17	Engine
	J Surtees	Ferrari SpA SEFAC	Ferrari 158 V8	15	Gearbox
	T Taylor	British Racing Partnership	BRP 1 BRM V8	8	Fuel leak

Winner's speed 73.04mph (117.546km/h)
Fastest lap G Hill 1m 33.9s, 74.92mph (120.575km/h)

Championship placings

Drivers		Constructors	
1. G Hill	9	1. BRM	9
2. Ginther	6	2. Lotus	4
3. Arundell	4	3. Cooper	2
4. Clark	3	4. Lotus (BRM)	1
5. Bonnier	2		
6. Hailwood	1		

Grid

Clark 1-34.0		Brabham 1-34.1
	G Hill 1-34.5	Surtees 1-34.5
Gurney 1-34.7		Arundell 1-35.5
	Bandini 1-35.5	Ginther 1-35.9
P Hill 1-35.9		McLaren 1-36.6
	Bonnier 1-37.4	Anderson 1-38.0
Trintignant 1-38.1		Taylor 1-38.1
	Hailwood 1-38.5	Siffert 1-38.7

Siffert had stepped up to F1 after a successful FJ season in 1961. Running a BRM-engined Lotus 24 as an independent in 1963, the GPDA had awarded him the Wolfgang von Trips Memorial Trophy as the most successful private entrant of the year. The purchase of a Brabham increased the competitiveness of the 27-year-old Swiss markedly.

The GP season opened around the streets of Monte Carlo although the race had come close to being boycotted over the AC de Monaco's decision that all entrants should qualify for the 16 places on the grid. F1CA had come to an agreement with GP race promoters that two entries from each member would gain automatic qualification for all GPs. Unfortunately the AC de Monaco was not represented at the meeting at which this agreement was reached and failed to comply. F1CA decided to boycott the

Monaco GP, Monte Carlo, 10 May 1964. Hill (BRM P261) hounds Gurney (short nose Brabham BT7) through Casino Square prior to relieving him of the lead on lap 37.

Left: Monaco GP, Monte Carlo, 10 May 1964. Graham Hill gets crossed-up through the Chicane. ***Below left:*** *Dutch GP, Zandvoort, 24 May 1964. Hill (BRM P261) presses on to finish fourth despite being plagued by fuel vaporisation.*

GP unless the organisers rescinded the qualification regulation. After a few days in which the fate of the GP hung in the balance, F1CA backed down and Monaco agreed to fall into line with the agreement from 1965. *Autosport* was not impressed: "Altogether an unhappy affair and one that should never have arisen – particularly in view of the wide publicity which resulted. A boycott would have had tremendous adverse repercussions and it is a good thing that the association had to climb down in the end." In the event, the F1CA members all qualified without difficulty, making the "... threatened boycott seem pretty pointless". In the 1960s it was still not the done thing to bring the sport into disrepute through the threat of boycotts, although the British teams had boycotted the 1960 Italian GP. In that case they were 'justified' in their actions, of course.

Jim Clark began where he had left off at the end of 1963 by taking the lead from pole position. After 10 laps he had an advantage of 7sec over Brabham, Hill, Gurney and Surtees. Two laps later Gurney leapfrogged up the order to second in his 'Monaco-short-nosed' Brabham but made little impression on Clark who was running at unabated pace despite a detached rear anti-roll bar. Once again he was demonstrating his ability to drive around a problem, this one the result of having clipped the straw bales at the Chicane on the opening lap. Nevertheless, he pitted on lap 36 to have the roll bar removed, rejoining in third. Gurney held the lead for 16 laps but was gradually being hindered by a gearbox problem and fuel leaking on to his legs that saw him pull in to retire on lap 62.

Graham Hill proceeded to hold off Clark until 4 laps from the end the Lotus ground to a halt with zero oil pressure. This left a plucky Ritchie Ginther in second having fought all afternoon against an inoperative clutch, blistered hands and the after effects of injuries sustained in an accident at Aintree three weeks before.

Hill and Ginther reeled off the remaining laps to record BRM's second consecutive 1-2 finish at Monaco, ahead of only four other finishers in a typically gruelling race.

Bonnier and Hailwood finished fourth and fifth on the road, only to be demoted to fifth and sixth behind Clark's abandoned Lotus. Entrants Rob Walker and Tim Parnell were somewhat put out by this but the race regulations clearly stated that the race order would be determined according to the number of laps completed when the winner crossed the finish line. At that point Bonnier and Hailwood had not passed the Lotus but did so before crossing the finish line. This was an unsatisfactory and confusing situation for competitors and spectators alike. The race order

would have been more accurately determined according to the number of laps completed after the winner had crossed the line.

Fourteen days later, the GP circus gathered once more at the seaside town of Zandvoort for the Dutch GP. The entry was mainly as at Monaco, with the exception of the BRP team that was unable to complete two serviceable chassis for the race, Innes Ireland having crashed his new BRP 2 at Silverstone and wrecked a Lotus 24 in practice at Monaco. Rob Walker had his new Brabham BT11 for Jo Bonnier while Jo Siffert was racing his similarly new, untried version. The Centro Sud BRMs were present and local hero, Godin de Beaufort, was out once again with his venerable 4-cylinder Porsche 718.

Dan Gurney's Brabham took pole ahead of Clark, although most timekeepers thought it should have been the other way around. The field formed up on the 'dummy grid', first tried at Watkins Glen in 1963 and now a feature of all GP starts following a directive from the CSI issued in the interests of safety. It was Clark who made the best start from the middle of the front row to lead Hill, Gurney and Surtees. By lap 15 he had a 5sec lead and was never to be headed, easily outpacing pursuers and setting the first 100mph lap of Zandvoort on the way. Gurney had broken his steering wheel in his determination to stay with the BRM of Hill that was later plagued by fuel vaporisation, necessitating a quick stop for a top-up at half distance. This left John Surtees to finish second, the only other driver to remain unlapped, yet some 54sec behind Clark at the finish. Clark had never put a foot wrong and was already looking likely to repeat his 1963 performances unless the opposition could raise its level of competitiveness.

An otherwise high-speed procession was enlivened only by numerous dogfights amongst the other runners from time to time. Bob Anderson finished a creditable sixth in his carburettor equipped Climax-engined Brabham but de Beaufort's normally reliable Porsche dropped a valve on only his 9th lap.

The 1964 Belgian GP would go down in history as one of the most amazing and dramatic Championship GPs ever run. It was totally dominated by Dan Gurney in his Brabham who seemed set to score the team's first GP victory. He was fastest from the first day of practice and took pole position by a margin of 1.8sec over the BRM of Graham Hill, with Jack Brabham filling the other

1964 World Championship – Round 2

Zandvoort 24 May 1964 80 laps
Starters 17 **Finishers** 10

Grote Prijs van Nederland

208.43 miles (335.44km)
Weather Hot

	Driver	Entrant	Car	Laps	Result
1	J Clark	Team Lotus	Lotus 25 Climax V8	80	2h 07m 35.4s
2	J Surtees	Ferrari SpA SEFAC	Ferrari 158 V8	80	2h 08m 29.0s
3	P Arundell	Team Lotus	Lotus 25 Climax V8	79	
4	G Hill	Owen Racing Organisation	BRM P261 V8	79	
5	C Amon	Reg Parnell (Racing)	Lotus 25 BRM V8	79	
6	B Anderson	DW Racing Enterprises	Brabham BT11 Climax V8	78	
7	B McLaren	Cooper Car Co	Cooper T73 Climax V8	78	
8	P Hill	Cooper Car Co	Cooper T73 Climax V8	76	
9	J Bonnier	RRC Walker Racing Team	Brabham BT11 BRM V8	76	
10	G Baghetti	Scuderia Centro Sud	BRM P578 V8	74	
	R Ginther	Owen Racing Organisation	BRM P261 V8	64	N/C
	M Hailwood	Reg Parnell (Racing)	Lotus 25 BRM V8	57	Transmission
	J Siffert	Siffert Racing Team	Brabham BT11 BRM V8	55	N/C
	J Brabham	Brabham Racing Organisation	Brabham BT7 Climax V8	44	Ignition
	D Gurney	Brabham Racing Organisation	Brabham BT7 Climax V8	23	Steering wheel
	L Bandini	Ferrari SpA SEFAC	Ferrari 158 V8	20	Injection pump drive
	G de Beaufort	Ecurie Maarsbergen	Porsche 718 F4	8	Engine

Winner's speed 98.02mph (157.743km/h)
Fastest lap J Clark 1m 32.8s, 101.07mph (162.659km/h)

Championship placings

Drivers		Constructors	
1. G Hill	12	1. Lotus	13
Clark	12	2. BRM	12
3. Arundell	8	3. Ferrari	6
4. Ginther	6	4. Lotus (BRM)	3
Surtees	6	5. Cooper	2
6. Bonnier	2	6. Brabham	1
Amon	2		
8. Hailwood	1		
Anderson	1		

Grid

G Hill 1-31.4	Clark 1-31.3	**Gurney 1-31.2**
McLaren 1-33.3	Surtees 1-32.8	
Ginther 1-34.0	Brabham 1-33.8	Arundell 1-33.5
Bandini 1-35.0	P Hill 1-34.8	
Amon 1-35.9	Bonnier 1-35.4	Anderson 1-35.4
Maggs DNS	Hailwood 1-36.1	
Siffert 1-44.0	de Beaufort 1-39.9	Baghetti 1-38.0

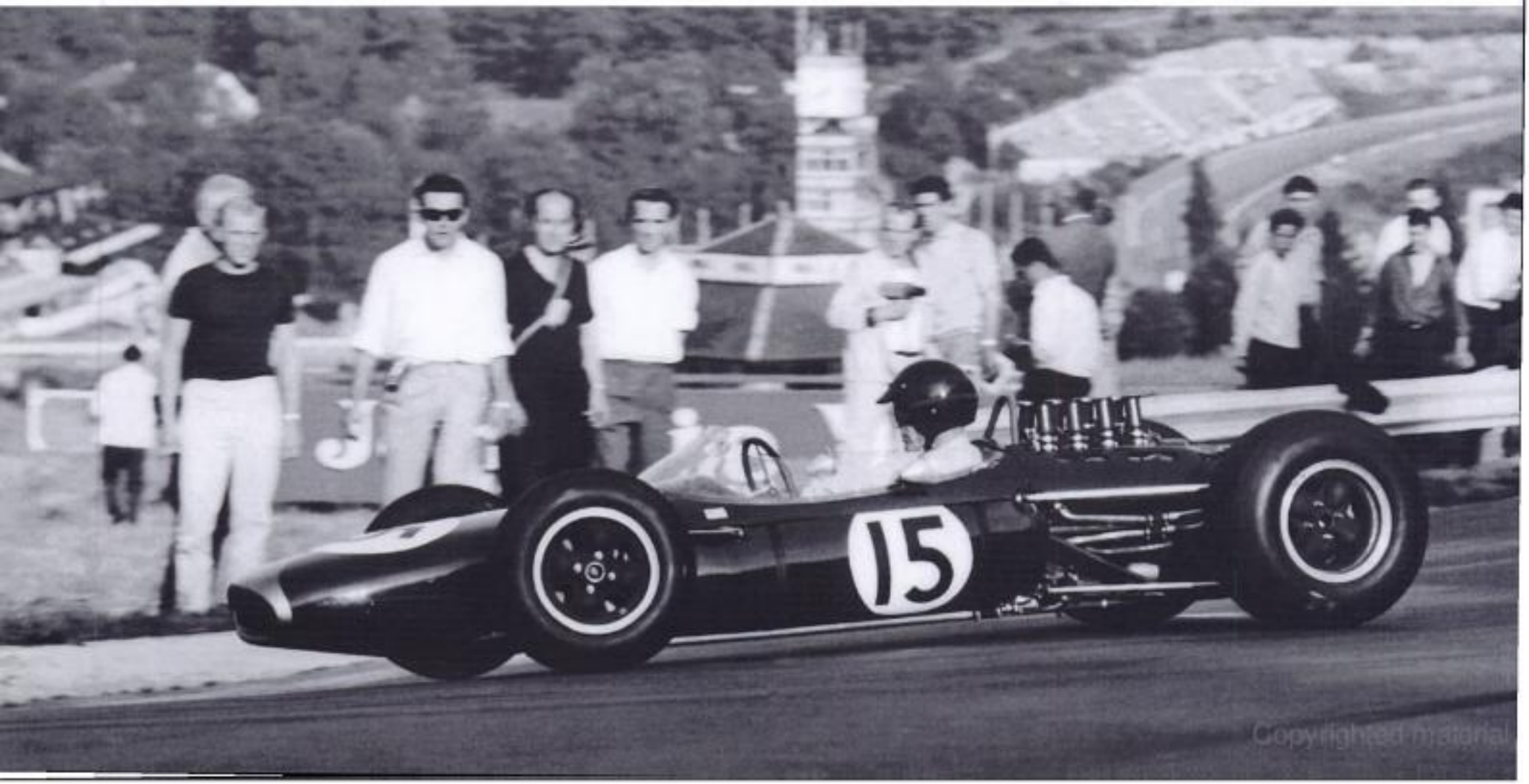
front row position. For the third year running, Jim Clark was off the pace due to engine problems and could qualify no higher than sixth. Fastest privateer, and tenth on the grid, was American Peter Revson, a surprising performance in an old Lotus 24 run from a corner of the Parnell team workshops. Despite family connections with Revlon cosmetics, he was making his own way in F1, and after four unsuccessful starts in the year, he would revert to F2, F3 and sports cars, and not be seen regularly in GP racing again until 1972.

Gurney led from the start, with only a brief challenge from John Surtees before the Ferrari's engine expired on lap 4. By lap 5, his lead was over 12sec and he steadily extended his advantage to 38sec by lap 28. In the process he repeatedly lowered the lap record, breaking the 220km/h barrier for Spa at 221.465km/h (137.60mph). Behind him, a trio comprising Hill, Clark and McLaren was engaged in a superb battle for second.

The drama began to unfold 4 laps from the end of the 32 lap race when Clark pitted briefly to take on water as his engine had been running increasingly hot. Team Lotus had no water and had to borrow from the Cooper pit. At the same time, Gurney began to slow, his engine spluttering in fast corners as fuel surged away from the pickups of the rapidly emptying tanks. Hill passed him into the lead as he pulled into his pit on lap 30 for a top-up, only to find that the Brabham team had no fuel immediately available. While he was stationary, McLaren went by and he rejoined in third, hopeful of at least a finish. Entering the last lap, Hill led McLaren by 20sec, Gurney was 6sec further back in third, with a recovering Clark fourth but apparently out of contention. McLaren's alternator drive belt had broken and, as the battery flattened, the electric fuel pumps started cutting out intermittently. Gurney closed on the Cooper but finally ran out of fuel before he could catch it. Meanwhile, Hill's engine suddenly cut out with fuel pump failure and he rolled to a halt beyond Stavelot, some 3 miles short of the finish.

The seconds ticked by as the officials waited on the finish line with the chequered flag for the overdue Hill, finally giving it in error to the BRM of Ginther in fourth. McLaren was actually leading but his engine cut out completely approaching La Source, the last corner, and he coasted downhill to the finish line. Suddenly Clark appeared running at full speed and swept past McLaren to cross the line and win the race, although the officials never gave him the flag. The drama continued as Clark ran out of fuel on his slowing down lap and he rolled to a halt out on the circuit before Stavelot, near Gurney. The two drivers commiserated with each

Belgian GP, Spa, 14 June 1964. Runaway: Dan Gurney (Brabham BT7) in the process of building a 38sec lead and setting a near 138mph lap record. In the background, the pits in the valley below and the track curving up from Eau Rouge.



other over their failure to finish, unaware that Clark had actually won. Once again Gurney had been beaten by bad luck but Clark had been overly fortunate to win his third successive Belgian GP. McLaren was second and Hill and Gurney classified fifth and sixth respectively.

It had been an incredible ending to a GP that belonged to Gurney but for a few pints of fuel. He was generally considered to be long overdue for another GP victory and attention turned now to the French GP, returning to the tricky and demanding Rouen circuit where the popular Californian had scored his first win in 1962.

Jim Clark set the fastest lap in practice, his first pole since Monaco. The Lotus 33 had been rebuilt following the Aintree accident and he tried it in practice, as he had at Spa, but decided to stay with his normal 25 for the race. Such had been the pace of F1 development since 1962, in particular in tyre technology, that Clark's pole time was an amazing 7.3sec quicker than Graham Hill's existing lap record. In all, 14 of the 17 starters qualified within the lap record. During practice, Clark was persuaded to try an ERA due to run in the historic support race to the GP. Demonstrating his versatility, within three laps he had got down to a time 2sec better than its owner achieved while winning the race.

Despite a delayed start to fix an oil leak from his engine, Clark took the initiative to head Gurney, Brabham, Arundell, Phil Hill and, initially, Graham Hill. The latter had not been competitive in practice and spun on lap 3 dropping back to 13th. He now began to work his way back into contention. Clark had pulled out a lead of 14sec over Gurney by lap 22 but 6 laps later he was in the pits with a sick sounding engine. He restarted only to be posted as a retirement on lap 31 with a broken piston. This left Gurney with a lead of 62sec over team-mate Brabham who was beginning to come under pressure from the recovering Hill, now up to third. Hill took second on lap 37 and Brabham spent the remaining 20 laps doing his utmost to regain the place, losing out by 0.8sec at the finish but having set a new lap record in the process. Gurney had only to reel off the second half of the

1964 World Championship – Round 3

Grand Prix de Belgique

Spa-Francorchamps 14 June1964 32 laps
280.36 miles (451.20km)
Starters 18 **Finishers** 10
Weather Overcast but dry

	Driver	Entrant	Car	Laps	Result
1	J Clark	Team Lotus	Lotus 25 Climax V8	32	2h 06m 40.5s
2	B McLaren	Cooper Car Co	Cooper T73 Climax V8	32	2h 06m 43.9s
3	J Brabham	Brabham Racing Organisation	Brabham BT7 Climax V8	32	2h 07m 28.6s
4	R Ginther	Owen Racing Organisation	BRM P261 V8	32	2h 08m 39.1s
5	G Hill	Owen Racing Organisation	BRM P261 V8	31	DNF – fuel pump
6	D Gurney	Brabham Racing Organisation	Brabham BT7 Climax V8	31	DNF – out of fuel
7	T Taylor	British Racing Partnership	BRP 2 BRM V8	31	
8	G Baghetti	Scuderia Centro Sud	BRM P578 V8	31	
9	P Arundell	Team Lotus	Lotus 25 Climax V8	28	Overheating
10	I Ireland	British Racing Partnership	BRP 1 BRM V8	28	
	P Revson	Revson Racing (America)	Lotus 24 BRM V8	28	DSQ – push-start
	J Siffert	Siffert Racing Team	Brabham BT11 BRM V8	14	Engine
	P Hill	Cooper Car Co	Cooper T73 Climax V8	13	Engine
	L Bandini	Ferrari SpA SEFAC	Ferrari 158 V8	12	No oil
	A Pilette	Equipe Scirocco Belge	Scirocco Climax V8	11	Engine
	J Bonnier	RRC Walker Racing Team	Brabham BT11 BRM V8	8	Driver ill
	J Surtees	Ferrari SpA SEFAC	Ferrari 158 V8	4	Engine
	C Amon	Reg Parnell (Racing)	Lotus 25 BRM V8	4	Engine

Winner's speed 132.79mph (213.709km/h)
Fastest lap D Gurney 3m 49.2s, 137.60mph (221.465km/h)

Championship placings

Drivers		Constructors	
1. Clark	21	1. Lotus	22
2. G Hill	14	2. BRM	15
3. Ginther	9	3. Cooper	8
4. Arundell	8	4. Ferrari	6
5. Surtees	6	5. Brabham	5
McLaren	6	6. Lotus (BRM)	3
7. Brabham	4		
8. Bonnier	2		
Amon	2		
10. Hailwood	1		
Anderson	1		
Gurney	1		

Grid

Gurney 3-50.9	G Hill 3-52.7	Brabham 3-52.8
Arundell 3-52.8		Surtees 3-55.2
Clark 3-56.2	McLaren 3-56.2	Ginther 3-57.2
Bandini 3-58.8		Revson 3-59.9
Amon 4-00.1	Taylor 4-00.2	Siffert 4-02.7
Bonnier 4-02.7		P Hill 4-02.8
Ireland 4-04.0	Baghetti 4-07.6	Pilette 4-22.9

Left: *Belgian GP, Spa, 14 June 1964. Who won? The famous photograph of Gurney (left) and Clark stranded out on the circuit, unaware that Clark has actually won the race.* ***Below left:*** *French GP, Rouen, 28 June 1964. At last: Dan Gurney crosses the cobbles at Nouveau Monde hairpin to go the distance and win his second GP at Rouen and the first for Brabham.*

race to win, not necessarily an easy task for this talented, yet frustratingly unlucky driver. Although his lead was reduced by the battling duo behind him, he had the situation well in hand and, with no last minute problems, he finished 25sec ahead of them to score a superb and well deserved win. He had given the hard trying Brabham team its long overdue first GP win, as he had Porsche at the same venue in 1962.

The Brands Hatch circuit had been extended to 2.65 miles in length in 1960 to bring it up to international status, and was now offered the opportunity to host its first British GP. Thereafter, it would replace Aintree, the future of which was now in doubt following a change in ownership, and alternate with Silverstone as the venue of the GP. The entry list was the largest seen that year, with 20 accepted entries assured of a place on the grid and a further 5 places open to the fastest qualifiers. In the event, there were 23 starters. The only change in the driver line-up was the appointment of Mike Spence from the Lotus F2 team to deputise for the injured Peter Arundell as number 2 to Jim Clark. Arundell had been badly injured in an F2 event the previous weekend at Reims and would remain in hospital until October. That effectively ended a promising F1 career that had seen him in third place in the point standings. Although he returned to GP racing in 1966, he was never quite the same again and retired from the sport at the end of that year.

Of considerable technical interest was an experimental four-wheel-drive car

1964 World Championship – Round 4 — Grand Prix de l'ACF

Rouen-les-Essarts 28 June1964 57 laps 231.71 miles (372.89km)
Starters 17 **Finishers** 11 **Weather** Overcast but dry

	Driver	Entrant	Car		Laps	Result
1	D Gurney	Brabham Racing Organisation	Brabham BT7 Climax V8	57	2h 07m 49.1s	
2	G Hill	Owen Racing Organisation	BRM P261 V8	57	2h 08m 13.2s	
3	J Brabham	Brabham Racing Organisation	Brabham BT7 Climax V8	57	2h 08m 14.0s	
4	P Arundell	Team Lotus	Lotus 25 Climax V8	57	2h 08m 59.7s	
5	R Ginther	Owen Racing Organisation	BRM P261 V8	57	2h 10m 01.2s	
6	B McLaren	Cooper Car Co	Cooper T73 Climax V8	56		
7	P Hill	Cooper Car Co	Cooper T73 Climax V8	56		
8	M Hailwood	Reg Parnell (Racing)	Lotus 25 BRM V8	56		
9	L Bandini	Ferrari SpA SEFAC	Ferrari 158 V8	55		
10	C Amon	Reg Parnell (Racing)	Lotus 25 BRM V8	53		
11	M Trintignant	M Trintignant	BRM P578 V8	52		
	B Anderson	DW Racing Enterprises	Brabham BT11 Climax V8	50	N/C	
	I Ireland	British Racing Partnership	BRP 1 BRM V8	32	Accident	
	J Clark	Team Lotus	Lotus 25 Climax V8	31	Engine	
	J Surtees	Ferrari SpA SEFAC	Ferrari 158 V8	22	Engine	
	T Taylor	British Racing Partnership	BRP 2 BRM V8	6	Brakes, accident	
	J Siffert	Siffert Racing Team	Brabham BT11 BRM V8	4	Clutch	

Winner's speed 108.90mph (175.042km/h)
Fastest lap J Brabham 2m 11.4s, 111.40mph (179.232km/h)

Championship placings

Drivers		Constructors	
1. Clark	21	1. Lotus	25
2. G Hill	20	2. BRM	21
3. Ginther	11	3. Brabham	14
Arundell	11	4. Cooper	9
5. Gurney	10	5. Ferrari	6
6. Brabham	8	6. Lotus (BRM)	3
7. McLaren	7		
8. Surtees	6		
9. Bonnier	2		
Amon	2		

Grid

Clark 2-09.6	Gurney 2-10.1	Surtees 2-11.1
Arundell 2-11.6		Brabham 2-11.8
G Hill 2-12.1	McLaren 2-12.4	Bandini 2-12.8
Ginther 2-13.9		P Hill 2-14.5
Ireland 2-14.8	Taylor 2-14.9	Hailwood 2-16.2
Amon 2-16.4		Anderson 2-16.9
Trintignant 2-21.5	Siffert 2-23.6	

from BRM, built as a test bed for the anticipated change to 3-litre F1 regulations from 1966. The car was built around a space frame chassis and wishbone suspension and fitted with the Ferguson four-wheel-drive system as last seen in 1961 on Ferguson's own P99 car. Driven by FJ and F2 regular Richard Attwood in practice, the handling proved to be poor, the car switching from oversteer on the overrun to understeer under power. It was some 7sec away from Clark's pole time and was not raced, the team citing uncertainty over clutch life as the reason.

Despite setting fastest lap in the first practice session and earning 100 bottles of champagne for his trouble, Dan Gurney was unable to repeat his Spa and Rouen performances. Jim Clark had secured pole in the second session and led away from the start closely pursued by Gurney for the first 2½ laps. Dan's engine spluttered and he was quickly taken by Hill, Surtees and Brabham before stopping at his pit. He lost 4 laps while an overheating transistor box was replaced, restarted and eventually finished 13th. Graham Hill took over the pursuit, never more than a second or so behind Clark but never looking likely to challenge for the lead, until, at three-quarter distance, he eased off with fluctuating oil pressure and lost 7sec to Clark but partly made this up to finish 2.8sec down at the end. John Surtees held third throughout the

1964 World Championship – Round 5

RAC British Grand Prix

Brands Hatch 11 July 1964 80 laps
211.95 miles (341.20km)
Starters 23 **Finishers** 13 **Weather** Overcast but dry

	Driver	Entrant	Car	Laps	Result
1	J Clark	Team Lotus	Lotus 25 Climax V8	80	2h 15m 07.0s
2	G Hill	Owen Racing Organisation	BRM P261 V8	80	2h 15m 09.8s
3	J Surtees	Ferrari SpA SEFAC	Ferrari 158 V8	80	2h 16m 27.6s
4	J Brabham	Brabham Racing Organisation	Brabham BT7 Climax V8	79	
5	L Bandini	Ferrari SpA SEFAC	Ferrari Aero 156/120° V6	78	
6	P Hill	Cooper Car Co	Cooper T73 Climax V8	78	
7	B Anderson	DW Racing Enterprises	Brabham BT11 Climax V8	78	
8	R Ginther	Owen Racing Organisation	BRM P261 V8	77	
9	M Spence	Team Lotus	Lotus 25 Climax V8	77	
10	I Ireland	British Racing Partnership	BRP 2 BRM V8	77	
11	J Siffert	Siffert Racing Team	Brabham BT11 BRM V8	76	
12	G Baghetti	Scuderia Centro Sud	BRM P578 V8	76	
13	D Gurney	Brabham Racing Organisation	Brabham BT7 Climax V8	75	
	J Taylor	Gerard Racing	Cooper T73 Ford 4	56	N/C
	J Bonnier	RRC Walker Racing Team	Brabham BT11 BRM V8	45	Brake pipe
	P Revson	Revson Racing (America)	Lotus 24 BRM V8	43	Differential
	A Maggs	Scuderia Centro Sud	BRM P578 V8	38	Gearbox
	I Raby	Ian Raby (Racing)	Brabham BT3 BRM V8	37	Accident
	T Taylor	British Racing Partnership	Lotus 24 BRM V8	23	Driver ill
	M Hailwood	Reg Parnell (Racing)	Lotus 25 BRM V8	17	Oil pipe
	C Amon	Reg Parnell (Racing)	Lotus 25 BRM V8	9	Clutch
	B McLaren	Cooper Car Co	Cooper T73 Climax V8	7	Gearbox
	F Gardner	John Willment (Automobiles)	Brabham BT10 Ford 4	0	Accident

Winner's speed 94.14mph (151.504km/h)
Fastest lap J Clark 1m 38.8s, 96.56mph (155.398km/h)

Championship placings

Drivers			Constructors	
1.	Clark	30	1. Lotus	34
2.	G Hill	26	2. BRM	27
3.	Ginther	11	3. Brabham	17
	Arundell	11	4. Cooper	10
	Brabham	11	Ferrari	10
6.	Gurney	10	6. Lotus (BRM)	3
	Surtees	10		
8.	McLaren	7		
9.	Bonnier	2		
	Amon	2		
	Bandini	2		

Grid

Gurney 1-38.4	G Hill 1-38.3	**Clark 1-38.1**
Surtees 1-38.7		Brabham 1-38.5
Bandini 1-40.2	Anderson 1-39.8	McLaren 1-39.6
Ireland 1-40.8		Bonnier 1-40.2
Spence 1-41.4	Hailwood 1-41.4	Amon 1-41.2
P Hill 1-42.6		Ginther 1-41.6
T Taylor 1-42.8	Raby 1-42.8	Siffert 1-42.8
J Taylor 1-43.2		Gardner 1-43.0
Maggs 1-45.0	Revson 1-43.4	Baghetti 1-43.4

splendid seventh on the grid, first privateer and ahead of five works drivers. The race had been very processional and served only to open up the gap in the World Championship between Clark/Lotus, Hill/BRM and the rest.

After a long period of rumours, denials, sneak photos and uncertainty, the Honda GP car finally made its first public appearance and began testing at Zandvoort in late July. As suspected, the engine was a 60° V12 unit mounted transversely across the chassis in a tubular sub-frame attached to a monocoque centre section. Suspension followed standard practice with inboard mounted spring/damper units at both front and rear. The engine was believed to be developing over 200bhp on carburettors in an operating range of between 8500 and 12,000 rpm. The car was still very much in the development stage, and certainly looked it.

Honda's choice of Ronnie Bucknum as driver was interesting. Unknown outside the USA, this 28-year-old had experience only in US West Coast sports car racing. It was apparent that Honda was making a low-key entry into GP racing and the choice of Bucknum was consistent with that strategy – if the car was slow it was down to the driver, but if it was fast it was down to Honda. Both Honda and Bucknum were set to make their European GP debuts in the next Championship round, the German GP at the Nürburgring: not the easiest of venues at which to do so.

Having fulfilled its commitment to defending its Endurance Championship title (particularly at Le Mans) against the new

afternoon and Jack Brabham recovered from a spin and pit stop to claim fourth. Lorenzo Bandini and Phil Hill scored their first point finishes of the season with fifth and sixth respectively. Just out of the points by 1sec was Bob Anderson who had taken a

British GP, Brands Hatch, 11 July 1964. Clark (Lotus 25) leads Gurney (Brabham BT7), Hill (BRM P261), Surtees (Ferrari 158) and Brabham (Brabham BT7) around South Bank on the first lap. With the exception of the inevitably unlucky Gurney, they will finish in this order 2 hours later.

Finance

During the 1960s, before sponsorship was permitted and TV revenues had been invented, the cost of running a GP team was financed from three main sources – starting or appearance money, prize money and contributions from the motor industry.

Starting or appearance money was the amount the organisers paid for each car and driver to take part in their GP. At one time the amount was settled by haggling, and, if agreement was not reached, the team would give the event a miss. The Monte Carlo scale, an agreement reached between organisers and constructors at that venue, replaced this somewhat unsatisfactory arrangement and obliged the organisers to accept two entries from each of the established constructors. Of these, BRM, Lotus and Cooper, as potential winners, received more than Ferrari, who in turn received more than Brabham. In addition, a bonus was paid to the current World Champions. In round terms, start money amounted to £1000 per car shared equally between the constructor and driver.

In November 1963, the Paris Scale was drawn up to improve team finances and came into force from 1964. This was a more complex scale and divided constructors into two categories. Category 1 comprised a maximum of three constructors whose cars had achieved two wins or more (or their equivalent) in the previous year's Championship. Category 2 comprised those constructors who had achieved one win (or its equivalent) in the previous year. For assessment purposes, two second places were deemed to equate to a win, two thirds to a second – lower placings were not taken into account. Category 1 constructors were paid start money at the rate of £800 per car with £600 per car for Category 2. In addition, organisers paid drivers at the rate of £20 per Championship point earned in the previous year, subject to a minimum of £150 and a maximum of £450. The current World Champion would receive a bonus of £100 with the two previous years Champions receiving £50 each. The lengthy agreement also covered contributions towards travelling expenses for non-starters and laid down minimum race performance targets before start money could be paid in full. In 1964 all this added up to total start money of £550 per GP for reigning champion Jim Clark, with £800 going to Team Lotus for his car. The top teams were better off under this scale but it was riddled with anomalies, not making provision, for example, for private teams that had to continue to haggle with organisers or compete with others to qualify for a place on the grid for a share of any start money. Nevertheless, it was thought at the time to be a great improvement over previous arrangements.

Prize money was unpredictable, of course, but, even when added to start money, the total failed to meet the costs of taking part in a GP, which included travel and accommodation for the team. The 1963 British GP paid the winner £750, with £350 for second and £125 for third, down to £40 for sixth. By 1965 this had risen to £1000 for a win, and £500 for second. The US GP tended to be more remunerative than its European counterparts, with $5000 (£1790) for a win down to $300 (£107) for sixth. In any event, there was no standard prize money package throughout the GP series.

The major source of finance was found from the motor sport industry that included accessory manufacturers (e.g. clutch and brake linings, shock absorbers, electrical components, etc.), tyre suppliers, and fuel and oil companies. Accessory manufacturers paid bonuses based on race results but the fuel and oil companies gave by far the greatest support. Each fuel company had its contracted teams to which it would supply fuel and oil, and make cash injections – Brabham and Lotus were supported by Esso, BRM and Ferrari by Shell (which also supplied research facilities to BRM in the development of the P56 V8 engine), and Cooper by BP. The budget for the two-car Brabham team for 1963 was £10,000, most of which was funded from its contract with Esso. It would improve its finances by a further £10,000, in 1965, for contracting to run on Goodyear tyres.

GP racing in the 1960s was a relatively expensive occupation by the standards of the time and would not have survived without the support of the fuel and oil companies. This was never more apparent than at the end of 1962, when Coventry Climax announced its withdrawal from F1 engine development on the grounds of cost. Only after intervention from the fuel companies with increased financial support was continued participation of Coventry Climax in GP racing ensured.

factory Ford team, Ferrari could now give proper attention to the GP programme. With only three points finishes in ten starts, one of which was scored by the old V6, the new V8 had not achieved its objective of meeting the challenge of the British BRM and Climax V8s. As if to demonstrate the increase in effort, John Surtees qualified the V8 on the pole at the Nürburgring and was looking to repeat his 1963 victory. Clark and Gurney were next up, with team-mate Bandini fourth in the V6. Bucknum was the slowest qualifier in the Honda, nearly a minute down on Surtees.

Saturday practice was marred by an accident in which Godin de Beaufort lost his Porsche at the Bergwerk and hit a tree. The 30-year-old Dutchman succumbed to his injuries on the Monday following the GP. De Beaufort had been a familiar figure in his outdated, yet reliable, orange-painted Porsche 718. Since 1961

1964 World Championship – Round 6

Grosser Preis von Deutschland

Nürburgring 2 August 1964 15 laps
212.60 miles (342.15km)
Starters 22 **Finishers** 10
Weather Overcast but dry

	Driver	Entrant	Car	Laps	Result
1	J Surtees	Ferrari SpA SEFAC	Ferrari 158 V8	15	2h 12m 04.8s
2	G Hill	Owen Racing Organisation	BRM P261 V8	15	2h 13m 20.4s
3	L Bandini	Ferrari SpA SEFAC	Ferrari Aero 156/120° V6	15	2h 16m 57.6s
4	J Siffert	Siffert Racing Team	Brabham BT11 BRM V8	15	2h 17m 27.9s
5	M Trintignant	M Trintignant	BRM P578 V8	14	Flat battery
6	A Maggs	Scuderia Centro Sud	BRM P578 V8	14	
7	R Ginther	Owen Racing Organisation	BRM P261 V8	14	
8	M Spence	Team Lotus	Lotus 33 Climax V8	14	
9	G Mitter	Team Lotus	Lotus 25 Climax V8	14	
10	D Gurney	Brabham Racing Organisation	Brabham BT7 Climax V8	14	
	C Amon	Reg Parnell (Racing)	Lotus 25 BRM V8	12	Suspension
	J Brabham	Brabham Racing Organisation	Brabham BT7 Climax V8	11	Final drive
	R Bucknum	Honda R&D Co	Honda RA271 V12	11	Accident
	P Revson	Revson Racing (America)	Lotus 24 BRM V8	10	Accident
	J Clark	Team Lotus	Lotus 33 Climax V8	7	Engine
	B McLaren	Cooper Car Co	Cooper T73 Climax V8	4	Engine
	B Anderson	DW Racing Enterprises	Brabham BT11 Climax V8	4	Suspension
	E Barth	RRC Walker Racing Team	Cooper T66 Climax V8	3	Clutch
	G Baghetti	Scuderia Centro Sud	BRM P578 V8	2	Throttle linkage
	P Hill	Cooper Car Co	Cooper T73 Climax V8	1	Engine
	J Bonnier	RRC Walker Racing Team	Brabham BT11 BRM V8	0	Electrics
	M Hailwood	Reg Parnell (Racing)	Lotus 25 BRM V8	0	Engine

Winner's speed 96.57mph (155.428km/h)
Fastest lap J Surtees 8m 39.0s, 98.30mph (158.220km/h)

Championship placings

Drivers		Constructors	
1. G Hill	32	1. Lotus	34
2. Clark	30	2. BRM	33
3. Surtees	19	3. Ferrari	19
4. Ginther	11	4. Brabham	17
Arundell	11	5. Cooper	10
Brabham	11	6. Lotus (BRM)	3
7. Gurney	10	Brabham (BRM)	3
8. McLaren	7		
9. Bandini	6		
10. Siffert	3		

Grid

Bandini 8-42.6	Gurney 8-39.3	Clark 8-38.8	**Surtees 8-38.4**
McLaren 8-47.1	Brabham 8-46.6	G Hill 8-43.8	
Ginther 8-57.9	Siffert 8-56.9	Amon 8-54.0	P Hill 8-52.7
Trintignant 9-06.8	Hailwood 9-01.9	Bonnier 9-01.3	
Revson 9-13.0	Spence 9-09.9	Maggs 9-09.6	Anderson 9-07.5
Baghetti 9-14.6	Barth 9-14.2	Mitter 9-14.1	
			Bucknum 9-34.3

German GP, Nürburgring, 2 August 1964. Rising sun on a damp afternoon: Ronnie Bucknum (all new V12 Honda RA271) in the pit lane during a troubled practice in which he had difficulty completing the necessary qualifying 5 laps to start.

he had made 22 GP starts with 17 finishes, and had scored Championship points in both 1962 and 1963. Realising that his generous proportions were a performance handicap in an F1 car, he had embarked on a strict diet and ordered a new Brabham to replace the Porsche.

Team Lotus had at last switched over to the type 33 chassis and Clark used his to lead the first lap from Surtees, Gurney and Graham Hill. His lead was short-lived as he lost places to Surtees and Gurney on successive laps, falling into the clutches of Hill. All was not well with his engine and he was out of the race on lap 7 with a suspected broken valve. Meanwhile, Surtees and Gurney were swapping the lead until the Brabham slowed with an overheating engine, having picked up a piece of litter that was obstructing airflow to the radiator. Gurney's bad luck had struck again and, after two stops for water, he could finish only tenth and last.

Surtees was now out on his own, some 30sec clear of Hill, and he increased the margin to over a minute by the finish. The BRM's engine was running an over-rich mixture at certain revs, causing it to falter, and Hill was pleased to finish in second, putting him 2 points ahead of Clark in the Championship. The Ferrari team was jubilant at having scored its second successive German GP victory, made even better by Bandini's third place in the V6 car. Jo

Austrian GP, Zeltweg, 23 August 1964. Lorenzo Bandini, in the winning Ferrari Aero 156, rides the concrete. Note the proximity of the straw bales and aircraft hangar backdrop.

Siffert had his best finish to date with fourth in his privately run Brabham, while Bucknum had driven the Honda steadily before going off the road at the Karussel on lap 11 after something had broken in the steering.

An F1 Austrian GP was first held in 1963 as a non-Championship event when it was won by Jack Brabham but for 1964 it was awarded Championship status. The circuit was laid out on the Zeltweg operational airfield and was quite featureless, comprising two blasts up and down a runway linked by a hairpin at one end and a triple cornered loop section at the other. The surface was extremely uneven, especially over the seams between the concrete sections of the main runway. This had quite an extraordinary effect on the outcome of the race as, one by one, the main contenders dropped out with suspension or transmission breakages due to the punishment meted out by the rough surface. Several teams suffered structural failures during practice and replacement parts were at a premium, many spare cars being cannibalised for their components. The facilities at Zeltweg were as temporary as the circuit, as evidenced by the use of a double-decker London bus for the timing equipment.

The Brabham team had the luxury of its first 1964 BT11

chassis at last, all the others having being supplied to customers. Jack Brabham used this, his BT7 being sold on to Rob Walker for Jo Bonnier to drive. Bonnier had been unhappy with the high revving BRM V8 in his regular BT11 and this was entered for local driver Jochen Rindt to make his GP debut. Rindt had made his name by beating the established stars in a Whitsun F2 event at Crystal Palace and looked to be a promising talent for the future. The Honda team did not appear, preferring to prepare for the Italian GP in two weeks time.

Despite being on the front row of the grid, both Jim Clark (gear selection) and Graham Hill (wheel spin) made poor starts and were 11th and 12th respectively on the opening lap. Hill was soon out with a broken distributor drive but Clark set about working his way through to the front, taking second on lap 9. Dan Gurney had led off the start but was quickly demoted to second by a charging John Surtees until the Ferrari ploughed into the straw bales at the hairpin on lap 6 after a rose joint broke in the rear suspension. Gurney now led Clark comfortably through to

1964 World Championship – Round 7

Zeltweg 23 August 1964 105 laps
Starters 20 **Finishers** 8

Grosser Preis von Österreich

208.78 miles (336.00km)
Weather Slightly overcast but dry

	Driver	Entrant	Car	Laps	Result
1	L Bandini	Ferrari SpA SEFAC	Ferrari Aero 156/120° V6	105	2h 06m 18.23s
2	R Ginther	Owen Racing Organisation	BRM P261 V8	105	2h 06m 24.41s
3	B Anderson	DW Racing Enterprises	Brabham BT11 Climax V8	102	
4	A Maggs	Scuderia Centro Sud	BRM P578 V8	102	
5	I Ireland	British Racing Partnership	BRP 2 BRM V8	102	
6	J Bonnier	RRC Walker Racing Team	Brabham BT7 Climax V8	101	
7	G Baghetti	Scuderia Centro Sud	BRM P578 V8	98	
8	M Hailwood	Reg Parnell (Racing)	Lotus 25 BRM V8	95	
	J Brabham	Brabham Racing Organisation	Brabham BT11 Climax V8	73	N/C
	J Rindt	RRC Walker Racing Team	Brabham BT11 BRM V8	58	Steering
	P Hill	Cooper Car Co	Cooper T66 Climax V8	58	Accident, fire
	D Gurney	Brabham Racing Organisation	Brabham BT7 Climax V8	47	Front suspension
	B McLaren	Cooper Car Co	Cooper T73 Climax V8	43	Engine
	M Spence	Team Lotus	Lotus 33 Climax V8	41	Drive shaft
	J Clark	Team Lotus	Lotus 33 Climax V8	40	Drive shaft
	T Taylor	British Racing Partnership	BRP 1 BRM V8	21	Rear suspension
	J Siffert	Siffert Racing Team	Brabham BT11 BRM V8	18	Accident
	J Surtees	Ferrari SpA SEFAC	Ferrari 158 V8	9	Rear suspension
	C Amon	Reg Parnell (Racing)	Lotus 25 BRM V8	7	Engine
	G Hill	Owen Racing Organisation	BRM P261 V8	5	Distributor drive

Winner's speed 99.20mph (159.650km/h)
Fastest lap D Gurney 1m 10.56s, 101.57mph (163.462km/h)

Championship placings (*6 best performances)

Drivers		Constructors	
1. G Hill	32	1. BRM	*36
2. Clark	30	2. Lotus	34
3. Surtees	19	3. Ferrari	28
4. Ginther	17	4. Brabham	21
5. Bandini	15	5. Cooper	10
6. Arundell	11	6. Lotus (BRM)	3
Brabham	11	Brabham (BRM)	3
8. Gurney	10	8. BRP	2
9. McLaren	7		
10. Anderson	5		

Grid

G Hill 1-09.84	Surtees 1-10.12	Clark 1-10.21	Gurney 1-10.40
Ginther 1-10.40	Brabham 1-10.57	Bandini 1-10.63	
Spence 1-11.00	McLaren 1-11.25	Bonnier 1-11.59	Ireland 1-11.60
Siffert 1-11.82	Rindt 1-12.00	Anderson 1-12.04	
Baghetti 1-12.10	Taylor 1-12.23	Amon 1-12.28	Hailwood 1-12.40
Maggs 1-12.40	P Hill 1-13.15		

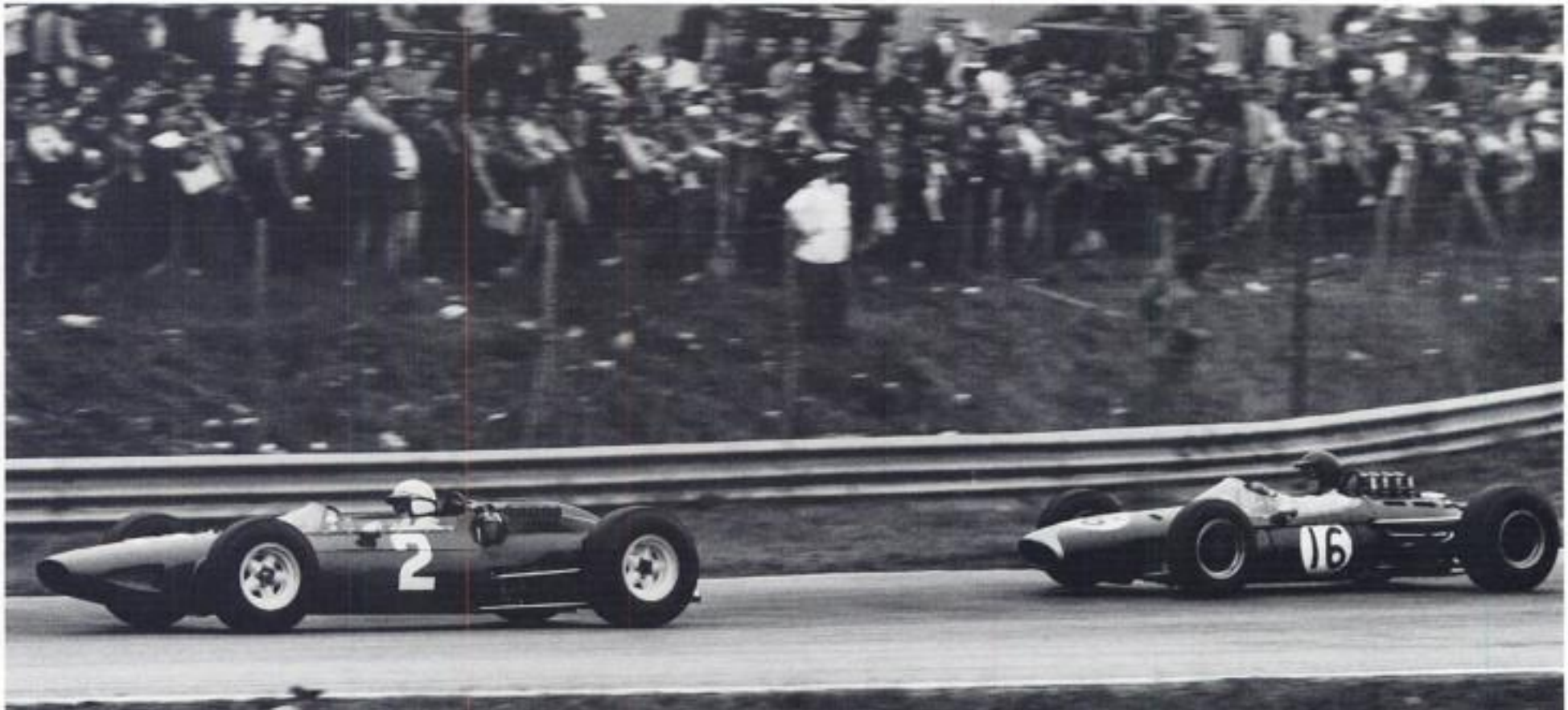
lap 40 when the Lotus dropped out with a broken drive shaft. 7 laps later, Gurney went out, a front radius arm having dislocated.

All this left Lorenzo Bandini in the V6 Ferrari, with a lead that he never lost, to score his first GP victory – the second on the trot for Ferrari. This also provided the faithful 120° V6 engine with its final GP victory. Ginther brought his BRM into second 6.5sec behind while, with the works teams decimated, privateer Bob Anderson finished an excellent third in his Brabham, although 3 laps down on Bandini. A particularly fraught time was had by Phil Hill who had damaged his Cooper during practice. Running the spare in the race, a 1963 T66, he lost control of that and rammed the straw bales; the car burst into flames and was destoyed.

The World Championship would not return to Austria until 1970, by which time the magnificent Österreichring had been opened a few miles away and Zeltweg was used as a parking lot for the drivers' executive jets. In 1964, however, there was now a two week gap in which to repair damage and prepare for the Italian GP at Monza. Prior to the GP, an Italian court had at last declared Jim Clark blameless for the tragic accident at Monza in 1961 when Wolfgang von Trips and 14 spectators had lost their lives. The threat of legal action had hung over Clark since that weekend and the annual visit to Monza was always likely to result in him being pursued by both the Italian police and press for new information that just did not exist.

Ferrari was out in strength on its home ground with five cars – two V8s, two V6s and a brand new flat-12. Three cars were entered for the GP, Surtees and Bandini in V8s, supplemented by Lodovico Scarfiotti from the sports car team in a V6. The flat-12 had first been seen at the annual Ferrari press conference back in January, and development since then had included the adoption of Lucas fuel-injection to replace the previous Bosch system. Bandini drove a new chassis fitted with this engine in the wet practice session on Saturday but lap times were not impressive and it was decided not to run it in the race.

BRM arrived with a V8 equipped with revised cylinder heads. The heads had effectively been reversed to position the exhaust ports in the centre of the vee with the inlet tracts entering the cylinders between the camshafts. Originally part of an unsuccessful four valve per cylinder development, the heads obviated the need for the exhaust system to pass through the monocoque on either side of the engine, releasing this space for additional fuel tankage. Honda reappeared, now with the company's own fuel-injection system fitted to the V12. An unexpected entry was made by ATS. One of the 1963 F1 cars had been acquired by Vic Derrington and Alf Francis (former mechanic to Stirling Moss) and rebuilt with a new chassis. Entered as a Derrington-Francis ATS, it was a considerable improvement on the original and was uniquely shod with Goodyear tyres.



Italian GP, Monza, 6 September 1964. Surtees (Ferrari 158) versus Gurney (Brabham BT7) in their intense duel for the lead, the Brabham being cheated by a flat battery.

For this GP, John Cooper had decided to 'rest' Phil Hill, his place being taken by John Love who had driven in FJ for the Tyrrell team, driven Mini-Coopers in saloon car racing and was a regular Cooper driver in South Africa. There was an uncomfortable clash of personalities between John Cooper and Hill and his replacement and resulted directly from his performances in Germany and Austria, having blown an engine in the former and damaged two cars in accidents in the latter, one of which was totally destroyed by fire. Hill's car was very much number 2 in the team; his disappointing performances were not helped by less than perfect race preparation. Hill was upset by his suspension and it was somewhat ironic that Love failed to qualify for the race, having lapped some 9sec slower than McLaren. Hill was reinstated for the US and Mexican GPs but would finish only in the latter to end a fruitless and miserable season with the team. After the 1964 season, he concentrated on endurance and sports car racing, always his more successful categories.

To the delight of the tifosi, John Surtees was on splendid form and qualified his Ferrari on the pole with Dan Gurney and Graham Hill completing the front row. Jim Clark shared the second row with Bruce McLaren. Hill's clutch failed at the start and the BRM remained stationary as McLaren took full advantage of the ensuing confusion to snatch a short-lived lead into the first corner. By the end of the lap, Gurney led Surtees with McLaren and Clark hanging on in their slipstream. Behind these four, a second group of twelve cars darted in and out of each other's slipstream, swapping positions all around the circuit. The pace of the leaders soon took them clear of the second group, the gap stretching out to 35sec by lap 15. Ronnie Bucknum came up from the tail of group two and demonstrated the speed of the Honda by surging through the group on the pit straight, actually reaching fifth momentarily before retiring on lap 13 with no front brakes.

The intense battle between Surtees and Gurney had the crowd on the edges of their seats, the lead changing on each lap, neither driver having the upper hand. Clark dropped out of the group on lap 27 with a broken piston,

1964 World Championship – Round 8 — Gran Premio d'Italia

Monza 6 September 1964 78 laps — 278.68 miles (448.50km)

Starters 20 — **Finishers** 13 — **Weather** Overcast but dry

	Driver	Entrant	Car	Laps	Result
1	J Surtees	Ferrari SpA SEFAC	Ferrari 158 V8	78	2h 10m 51.8s
2	B McLaren	Cooper Car Co	Cooper T73 Climax V8	78	2h 11m 57.8s
3	L Bandini	Ferrari SpA SEFAC	Ferrari 158 V8	77	
4	R Ginther	Owen Racing Organisation	BRM P261 V8	77	
5	I Ireland	British Racing Partnership	BRP 2 BRM V8	77	
6	M Spence	Team Lotus	Lotus 33 Climax V8	77	
7	J Siffert	Siffert Racing Team	Brabham BT11 BRM V8	77	
8	G Baghetti	Scuderia Centro Sud	BRM P578 V8	77	
9	L Scarfiotti	Ferrari SpA SEFAC	Ferrari Aero 156/120° V6	77	
10	D Gurney	Brabham Racing Organisation	Brabham BT7 Climax V8	75	Flat battery
11	B Anderson	DW Racing Enterprises	Brabham BT11 Climax V8	75	
12	J Bonnier	RRC Walker Racing Team	Brabham BT7 Climax V8	74	
13	P Revson	Revson Racing (America)	Lotus 24 BRM V8	72	
	J Brabham	Brabham Racing Organisation	Brabham BT11 Climax V8	59	Engine
	J Clark	Team Lotus	Lotus 25 Climax V8	27	Engine
	M Cabral	Derrington-Francis Racing Team	Derrington-Francis ATS V8	25	Ignition
	M Trintignant	M Trintignant	BRM P578 V8	22	Fuel-injection
	R Bucknum	Honda R&D Co	Honda RA271 V12	13	Brakes
	M Hailwood	Reg Parnell (Racing)	Lotus 25 BRM V8	5	Engine
	G Hill	Owen Racing Organisation	BRM P261 V8	0	Clutch

Winner's speed 127.77mph (205.634km/h)

Fastest lap J Surtees 1m 38.8s, 130.12mph (209.514km/h)

Championship placings (*6 best performances)

Drivers		Constructors	
1. G Hill	32	1. Ferrari	37
2. Clark	30	2. BRM	*36
3. Surtees	28	3. Lotus	35
4. Ginther	20	4. Brabham	21
5. Bandini	19	5. Cooper	16
6. McLaren	13	6. BRP	4
7. Arundell	11	7. Lotus (BRM)	3
Brabham	11	Brabham (BRM)	3
9. Gurney	10		
10. Anderson	5		

Grid

Surtees 1-37.4	Gurney 1-38.2	G Hill 1-38.7
Clark 1-39.1	McLaren 1-39.4	
Siffert 1-39.7	Bandini 1-39.8	Spence 1-40.3
Ginther 1-40.4	Bucknum 1-40.4	
Brabham 1-40.8	Bonnier 1-41.0	Ireland 1-41.0
Anderson 1-41.3	Baghetti 1-41.4	
Scarfiotti 1-41.6	Hailwood 1-41.6	Revson 1-42.0
Cabral 1-42.6	Trintignant 1-43.3	

and McLaren, devoid of a tow, began to fall back but was over 60sec ahead of group two. By lap 35, this group was down to eight cars covered by 1.3sec – Ginther, Bandini, Bonnier, Baghetti, Brabham, Ireland, Siffert and Spence, but not necessarily in that order as they chopped and changed trying to break the tow of their pursuers. Eventually the group began to thin further as the pace took its toll and developed into a series of battling duos: Bandini vs Ginther, Spence vs Siffert and Baghetti vs Scarfiotti.

The battle for the lead continued unabated until Gurney's engine began to falter on lap 62. Once again a trivial fault would cheat him out of a possible win, this time a flattening battery. He pitted twice, struggling on to finish a disappointing tenth. This allowed Surtees to score an immensely popular victory ahead of McLaren, the only other driver to go the full distance. It had been one of the most exciting races of the 1½-litre F1 and suddenly Surtees was in a position to challenge for the Championship, only 4 points behind Hill, the current leader. In addition, Ferrari's third win in a row had put it 1 point ahead of BRM to lead the Constructors' title.

Confirming speculation, BRM announced that Jackie Stewart would drive for the team in 1965 as number two to Graham Hill. The young Scot had had a meteoric rise to fame in 1964 having won 11 F3 races from 13 starts and was widely regarded as a great talent for the future. The future of BRM's current number two, Ritchie Ginther, was unknown although his name had been linked with Honda where his test and development expertise would be fully appreciated.

For the first time, the World Championship would be decided on the North American continent. At this stage Graham Hill led the race for the Championship with 32 points, 2 ahead of Clark, who was in turn 2 ahead of Surtees. Hill had already scored in six GPs and could only increase his total by finishing higher than fifth. Both Clark and Surtees had only finished four times and would add both their point scores in the USA and Mexico to their totals. All three drivers needed to win both these final two GPs to clinch the Championship.

The organisers of the US GP at Watkins Glen ended up with 17 entries from Europe, supplemented by local drivers Walt Hansgen and Hap Sharp in additional entries hired from Team Lotus and Rob Walker. Ferrari, unfamiliar in the blue and white colours of NART (the North American Racing Team – see panel), turned up with four cars for two drivers – two V8s, a V6 and the new flat-12. Surtees stayed with a V8, while Bandini would give the flat-12 its race debut. Graham Hill had the reversed cylinder head BRM V8 from Monza and Ronnie Bucknum would have the advantage of running the Honda on his home soil.

While the teams were practising at the Glen, Charles Cooper suffered a fatal heart attack and died at the age of 71. An experienced and capable racing mechanic who built up his own garage business immediately before and after World War II, he built a rear-engined 500cc F3 racing car with his son John in 1947. Eventually, Cooper dominated F3, and when he and John successfully moved up to F2 and then F1 with a rear-engined chassis, the face of GP racing was changed forever. Well known for his blunt and forthright manner, he was widely respected amongst the British motor sport fraternity.

The three Championship contenders plus Dan Gurney occupied the first four places on the grid and the bulk of the race would be fought out between them. Surtees led the first 12 laps until passed by Clark who managed to pull out a 5sec lead over the other three by lap 40. Four laps later, however, he was in the pits with a rough sounding engine, leaving Hill, Surtees and Gurney to battle it out over the next 25 laps. Dan Gurney was next to fall out with a broken engine on lap 69 and Surtees spun on the increasingly oily surface, restarting without losing second. Hill, now on his own, continued to complete the remaining distance to record his second win of the season, 40sec clear of Surtees who had settled for a safe second.

In a splendid third, one lap down was Jo Siffert in his BRM-powered Brabham, entered in the North American races by Rob Walker for whom he would drive in 1965. Ritchie Ginther was fourth and continued his unbroken run of finishes in every GP, although only scoring points in six of them. In 1964, he seemed to have lost some of his sparkle, in particular his practice times were no better than in 1963 despite what should have been a quicker

Enzo Ferrari hands in competition licence

A dispute had blown up between Enzo Ferrari and the Automobile Club d'Italia over homologation of the Ferrari 250LM GT car. Ferrari claimed that he was persuaded by the Club to submit a homologation application and reassured that it would go through. In the event, the application was thrown out by the FIA, as the required production run of 100 examples had not been built. Ferrari blamed the Club for putting him in this invidious position and swore that no further factory-entered Ferraris would ever race in Italy again.

Having handed in his competition licence as part of his protest, the entries for the remaining GPs of 1964 were handled by Luigi Chinetti and run in the USA and Mexico in the blue and white colours of his North American Racing Team (NART). Chinetti was an old friend of Enzo Ferrari and a three times Le Mans winner, the third having given Ferrari its first of nine wins in the 24 Hours. By that time he had become a US citizen with a garage business in New York and had been appointed US East Coast concessionaire for Ferrari cars. As part of his promotional activities, Chinetti formed NART to enter Ferraris in races across the USA and also at Le Mans. He was also successful in introducing drivers from North America to the Ferrari team, including Phil Hill, Dan Gurney and the Rodriguez brothers.

Needless to say, this would all blow over and Ferrari would enter his scarlet cars in all the 1965 GPs. The 250LM would not be homologated until 1966, however, when the required production run was reduced from 100 to 50 examples.

US GP, Watkins Glen, 4 October 1964. Ferrari line-up: resplendent in their NART colours, three of the four cars available await practice.

car. The BRM management felt that he had not made best use of the equipment available and had no hesitation in dropping him in favour of Jackie Stewart for 1965. In his role of test driver, perhaps he knew too much about the car and drove to finish, not necessarily to win, but it was a fact that his BRM was quite often below par compared to that of Graham Hill on whom the team's efforts seemed to centre that year.

In an attempt to maximise Constructors' Championship points, Colin Chapman had brought in Mike Spence and put Clark in his car. In the event, this strategy failed as Spence's car also developed an engine problem. Of the others, Bandini had retired the 12-cylinder Ferrari while the other 12-cylinder car from Honda had blown a head gasket. During practice Bucknum had hit a straw bale and damaged the suspension. Strangely Honda was without spares and had to rush a man 3000 miles to Los Angeles for the necessary parts. After this performance, Honda decided to pack up and return to Japan to prepare for a more concerted effort for the 1965 season.

Hill now led the Championship by 5 points from Surtees with Clark a further 4 points down in third. Hill's total of 39 points

1964 World Championship – Round 9

United States Grand Prix

Watkins Glen 4 October 1964 110 laps
253.00 miles (407.11km)
Starters 19 **Finishers** 8
Weather Warm and sunny

	Driver	Entrant	Car	Laps	Result
1	G Hill	Owen Racing Organisation	BRM P261 V8	110	2h 16m 38.0s
2	J Surtees	North American Racing Team	Ferrari 158 V8	110	2h 17m 08.5s
3	J Siffert	RRC Walker Racing Team	Brabham BT11 BRM V8	109	
4	R Ginther	Owen Racing Organisation	BRM P261 V8	107	
5	W Hansgen	Team Lotus	Lotus 33 Climax V8	107	
6	T Taylor	British Racing Partnership	BRP 2 BRM V8	106	
7	M Spence/J Clark	Team Lotus	Lotus 33 Climax V8	102	Fuel starvation
8	M Hailwood	Reg Parnell (Racing)	Lotus 25 BRM V8	101	Oil pipe
	D Gurney	Brabham Racing Organisation	Brabham BT7 Climax V8	69	Engine
	H Sharp	RRC Walker Racing Team	Brabham BT11 BRM V8	65	N/C
	L Bandini	North American Racing Team	Ferrari 1512 F12	58	Engine
	J Clark	Team Lotus	Lotus 25 Climax V8	54	Fuel-injection
	R Bucknum	Honda R&D Co	Honda RA271 V12	50	Head gasket
	C Amon	Reg Parnell (Racing)	Lotus 25 BRM V8	47	Starter motor
	J Bonnier	RRC Walker Racing Team	Brabham BT7 Climax V8	37	Stub axle
	B McLaren	Cooper Car Co	Cooper T73 Climax V8	27	Engine
	J Brabham	Brabham Racing Organisation	Brabham BT11 Climax V8	14	Engine
	P Hill	Cooper Car Co	Cooper T73 Climax V8	4	Ignition
	I Ireland	British Racing Partnership	BRP 2 BRM V8	2	Gear lever

Winner's speed 111.10mph (178.798km/h)
Fastest lap J Clark 1m 12.7s, 113.11mph (183.292km/h)

Championship placings (*6 best performances)

Drivers		Constructors	
1. G Hill	*39	1. Ferrari	43
2. Surtees	34	2. BRM	*42
3. Clark	30	3. Lotus	*36
4. Ginther	23	4. Brabham	21
5. Bandini	19	5. Cooper	16
6. McLaren	13	6. Brabham (BRM)	7
7. Arundell	11	7. BRP	5
Brabham	11	8. Lotus (BRM)	3
9. Gurney	10		
10. Siffert	7		

Grid

	Surtees 1-12.78	**Clark 1-12.65**
G Hill 1-12.92		Gurney 1-12.90
	Spence 1-13.33	McLaren 1-13.10
Bandini 1-13.85		Brabham 1-13.63
	Ireland 1-14.35	Bonnier 1-14.07
Siffert 1-14.65		Amon 1-14.43
	Bucknum 1-14.90	Ginther 1-14.67
Hailwood 1-15.65		Taylor 1-15.30
	Sharp 1-18.23	Hansgen 1-15.90
		P Hill 1-19.63

from his six best performances could only be improved if he finished higher than fourth in Mexico. Surtees could win the title provided he finished in the top two and Hill did not add to his score. Clark could take the title only by winning with Hill and Surtees finishing no higher than third and fourth respectively. In so doing he would equal Hill's points score but claim the title by virtue of a greater number of wins in the season. All would be resolved in three weeks time ...

Four transporters conveyed the cars and spares from Watkins Glen, 2800 miles south down the road to Mexico City. In the absence of Honda, the number of starters was made up by the addition of local boy Pedro Rodriguez in a third NART Ferrari, the V6 engined spare. A second local, Moises Solana, had taken Walt Hansgen's place in the third Team Lotus. Practice saw the teams acclimatising themselves to the altitude of the circuit and the heat. Jim Clark was consistently fastest, with Dan Gurney alongside him on the grid, John Surtees was fourth and Graham Hill was back in sixth after engine problems. Clark drove one of his brilliant opening laps to lead Gurney and Bandini (in the flat-12 Ferrari) from an impressive third on the grid. Both Surtees

1964 World Championship – Round 10 Gran Premio de Mexico

Mexico City 25 October 1964 65 laps
201.95 miles (325.00km)
Starters 19 **Finishers** 13 **Weather** Warm and sunny

	Driver	Entrant	Car	Laps	Result
1	D Gurney	Brabham Racing Organisation	Brabham BT7 Climax V8	65	2h 09m 50.32s
2	J Surtees	North American Racing Team	Ferrari 158 V8	65	2h 10m 59.26s
3	L Bandini	North American Racing Team	Ferrari 1512 F12	65	2h 10m 59.95s
4	M Spence	Team Lotus	Lotus 25 Climax V8	65	2h 11m 12.18s
5	J Clark	Team Lotus	Lotus 33 Climax V8	64	DNF – engine
6	P Rodriguez	North American Racing Team	Ferrari Aero 156/120° V6	64	
7	B McLaren	Cooper Car Co	Cooper T73 Climax V8	64	
8	R Ginther	Owen Racing Organisation	BRM P261 V8	64	
9	P Hill	Cooper Car Co	Cooper T73 Climax V8	63	Engine
10	M Solana	Team Lotus	Lotus 33 Climax V8	63	
11	G Hill	Owen Racing Organisation	BRM P261 V8	63	
12	I Ireland	British Racing Partnership	BRP 2 BRM V8	61	
13	H Sharp	RRC Walker Racing Team	Brabham BT11 BRM V8	60	
	C Amon	Reg Parnell (Racing)	Lotus 25 BRM V8	46	Gearbox
	J Brabham	Brabham Racing Organisation	Brabham BT11 Climax V8	44	Ignition
	M Hailwood	Reg Parnell (Racing)	Lotus 25 BRM V8	12	Overheating
	J Siffert	RRC Walker Racing Team	Brabham BT11 BRM V8	11	Fuel pump
	J Bonnier	RRC Walker Racing Team	Brabham BT7 Climax V8	9	Wishbone
	T Taylor	British Racing Partnership	BRP 2 BRM V8	6	Overheating

Winner's speed 93.33mph (150.186km/h)
Fastest lap J Clark 1m 58.37s, 94.49mph (152.066km/h)

Championship placings (*6 best performances)

Drivers		Constructors	
1. Surtees	40	1. Ferrari	*45
2. G Hill	*39	2. BRM	*42
3. Clark	32	3. Lotus	*37
4. Ginther	23	4. Brabham	30
Bandini	23	5. Cooper	16
6. Gurney	19	6. Brabham (BRM)	7
7. McLaren	13	7. BRP	5
8. Arundell	11	8. Lotus (BRM)	3
Brabham	11		
10. Siffert	7		

Grid

	Gurney 1-58.10	**Clark 1-57.24**
Surtees 1-58.70		Bandini 1-58.60
	G Hill 1-59.80	Spence 1-59.21
Bonnier 2-00.17		Brabham 1-59.99
	McLaren 2-01.12	Rodriguez 2-00.90
Amon 2-01.17		Ginther 2-01.15
	Solana 2-01.43	Siffert 2-01.37
Ireland 2-02.35		P Hill 2-02.00
	Taylor 2-04.90	Hailwood 2-04.11
		Sharp 2-06.9

Mexican GP Mexico City, 25 October 1964. Top dog: a victorious John Surtees returns to the pits having become the first man to win Championships on both two and four wheels.

and Hill had made poor starts and were down in 10th and 13th respectively. By lap 10, Clark had a 10sec lead over Gurney, with Hill now fourth and Surtees up to seventh. On the next lap Hill took third from Bandini and regained the Championship lead from Clark. Interest was focussed on Bandini's efforts to regain third from Hill. These efforts reached a climax on lap 31 when Bandini, right on Hill's tail, took a tighter line going into the hairpin and slid into the back of the BRM, spinning it backwards into the guard rail. Bandini restarted behind Surtees in fourth, while Hill hobbled around the lap to stop at his pit to have his crumpled exhaust opened up. A further stop was necessary later as the damaged engine cover was fouling the throttle linkage. By then he was 2 laps down on the leaders, his Championship hopes gone. There would always be those who saw Bandini's action as a deliberate tactic to assist Surtees' Championship chance but, in truth, it was a moment of over exuberance in an attempt to regain third place in the race.

With Gurney in a solid second behind Clark, Surtees was effectively out of the title race, even more so when Bandini regained third from him. Ten laps from the finish, however, Clark was in trouble. He had identified an oil slick on the circuit as coming from his car and, while appearing to be cruising towards his second Championship, he was actually desperately nursing his car to the finish. On the final lap his engine seized and the Lotus ground to a halt out on the circuit. Gurney went past to win the GP and the NART Ferrari pit managed to signal Bandini, over a minute behind, to let Surtees through into second to triumphantly claim the World Championship. In so doing, John had achieved his ambition of adding a four-wheel title to his two-wheel World Championship titles, the first occasion on which a driver had done so. Appropriately, HRH the Duke of Edinburgh, patron of the BRDC, was present in Mexico to witness the fourth British driver to become World Champion. Having begun on the streets of Monte Carlo in May, the titles had been decided on the last lap of the last race five months later.

Almost lost in the Championship celebrations was Dan Gurney's second GP win of the season. Dan had been extremely competitive throughout the year, consistently running at the head of the field until thwarted by trivial reliability problems. His domination at Spa had been a highlight of the season but two wins and one other placing was sufficient only for sixth in the Championship.

1964 had been the most competitive season seen under the 1½-litre F1 regulations with four drivers winning nine out of the ten GPs and three of those drivers remaining in contention for the Championship right up to the final round. Jim Clark had given every indication of repeating his domination of 1963 after winning three GPs in the first half of the season. In the second half, however, he added only 2 points to his total because of engine-related problems. Graham Hill took over the Championship lead when Clark stopped scoring, and looked set to win his second title in a BRM that may not have been the fastest car but was certainly the most reliable. Ferrari had, as usual, given early season priority to Le Mans and defending its endurance racing title, and, at the halfway point in the season, Surtees had scored only 10 points, 20 less than Clark. Once the team concentrated fully on F1, he quickly scored two wins and two seconds, sufficient to snatch the Drivers' title and the Constructors' title for Ferrari. Without doubt Ferrari's return to success was down to Surtees' ability to galvanise the team into action and bring it on a technical par with the British teams.

1964 Points Table

	Drivers	Monaco	Holland	Belgium	France	Britain	Germany	Austria	Italy	USA	Mexico	Total	Best 6 scores
1.	John Surtees	-	6	-	-	4	9	-	9	6	6	40	40
2.	Graham Hill	9	3	2	6	6	6	-	-	9	-	41	39
3.	Jim Clark	3	9	9	-	9	-	-	-	-	2	32	32
4.	Lorenzo Bandini	-	-	-	-	2	4	9	4	-	4	23	23
	Ritchie Ginther	6	-	3	2	-	-	6	3	3	-	23	23
6.	Dan Gurney	-	-	1	9	-	-	-	-	-	9	19	19
7.	Bruce McLaren	-	-	6	1	-	-	-	6	-	-	13	13
8.	Peter Arundell	4	4	-	3							11	11
	Jack Brabham	-	-	4	4	3	-	-	-	-	-	11	11
10.	Jo Siffert	-	-	-	-	-	3	-	-	4	-	7	7
11.	Bob Anderson	-	1		-	-	-	4	-			5	5
12.	Tony Maggs					-	1	3				4	4
	Mike Spence					-	-	-	1	-	3	4	4
	Innes Ireland			-	-	-		2	2	-	-	4	4
15.	Jo Bonnier	2	-	-		-	-	1	-	-	-	3	3
16.	Chris Amon		2	-	-	-	-	-		-	-	2	2
	Maurice Trintignant	-			-		2		-			2	2
	Walt Hansgen									2		2	2
19.	Mike Hailwood	1	-		-	-	-	-	-	-	-	1	1
	Phil Hill	-	-	-	-	1	-	-		-	-	1	1
	Trevor Taylor	-		-	-	-		-		1	-	1	1
	Pedro Rodriguez										1	1	1
	Constructors												
1.	Ferrari	-	6	-	-	4	9	9	9	6	6	49	45
2.	BRM	9	3	3	6	6	6	6	3	9	-	51	42
3.	Lotus Climax	4	9	9	3	9	-	-	1	2	3	40	37
4.	Brabham Climax	-	1	4	9	3	-	4	-	-	9	30	30
5.	Cooper Climax	2	-	6	1	1	-	-	6	-	-	16	16
6.	Brabham BRM		-	-	-	-	3	-	-	4	-	7	7
7.	BRP	-		-	-	-	-	2	2	1	-	5	5
8.	Lotus BRM	1	2	-	-	-	-	-	-	-	-	3	3

Summary of results of non-Championship F1 races

The 1964 season saw the introduction of a new F2 category, a stepping-stone to F1 not seen since 1960 when, of course, the then F2 became the new F1. Many of the non-Championship F1 races became F2 events (as many had been previously anyway), as F1 races were becoming more and more expensive to put on and faced declining grids as the once numerous private entrants found it increasingly difficult to compete with the factory entries. Many F1 drivers competed in F2, giving 'newcomers' the chance to compete against them on equal terms. This proved to be a highly successful formula with over-subscribed grids and exciting racing. On the debit side, the number of non-Championship F1 races dropped from a high of 21 in 1961 to only 8 this season:

Daily Mirror **Trophy, Snetterton (GB), 14.3.64, 94.85 miles.**
1. I Ireland, BRP 1 BRM V8, 78.08mph. 2. J Bonnier, Cooper T66 Climax V8. 3. B McLaren, Cooper T66 Climax V8. PP: J Clark, Lotus 25 Climax V8. FL: P Arundell, Lotus 25 Climax V8, 87.73mph. *Rain, sleet and mist shorten race from 50 to 35 laps. Hill aquaplanes of straight and writes-off new BRM P261.*

News of the World **Trophy, Goodwood (GB), 30.3.64, 100.80 miles.**
1. J Clark, Lotus 25 Climax V8, 104.91mph. 2. P Arundell, Lotus 25 Climax V8. 3. T Taylor, Lotus 24 BRM V8. PP: J Brabham, Brabham BT7 Climax V8. FL: G Hill, BRM P261 V8, 106.67mph. *Lucky win for Clark as Hill's BRM fails within 2 laps of flag.*

Gran Premio di Siracusa, Syracuse (I), 12.4.64, 139.48 miles.
1. J Surtees, Ferrari 158 V8, 102.63mph. 2. L Bandini, Ferrari Aero 156/63 120° V6. 3. M Spence/P Arundell, Lotus 25 Climax V8. PP: Bandini. FL: Bandini 108.02mph. *Debut win for new Ferrari V8. Bandini in exciting charge after stop for new goggles.*

BARC 200, Aintree (GB), 18.4.64, 201.00 miles.
1. J Brabham, Brabham BT7 Climax V8, 93.46mph. 2. G Hill, BRM P261 V8. 3. P Arundell, Lotus 25 Climax V8. PP: Hill. FL: J Clark, Lotus 33 Climax V8, 96.26mph. *Battle between Hill, Clark and Brabham. Clark tripped by backmarker, severely damages new Lotus 33.*

International Trophy, Silverstone (GB), 2.5.64, 152.36 miles.
1. J Brabham, Brabham BT7 Climax V8, 110.35mph. 2. G Hill, BRM P261 V8. 3. P Arundell, Lotus 25 Climax V8. PP: D Gurney, Brabham BT7 Climax V8. FL: Brabham 112.58mph. *Thrilling win for Brabham as he takes Hill on outside of last corner.*

Grosser Preis der Solitude, Stuttgart (D), 19.7.64, 141.78 miles.
1. J Clark, Lotus 33 Climax V8, 91.50mph. 2. J Surtees, Ferrari 158 V8. 3. B Anderson, Brabham BT11 Climax V8. PP: Clark. FL: Clark 106.99mph. *Clark and Surtees battle it out on soaking track. Seven cars out in accidents on first lap.*

Gran Premio del Mediterraneo, Pergusa (I), 16.8.64, 178.80 miles.
1. J Siffert, Brabham BT11 BRM V8, 137.88mph. 2. J Clark, Lotus 25 Climax V8. 3. I Ireland, BRP 2 BRM V8. PP: Siffert. FL: M Spence, Lotus 25 Climax V8, 141.49mph. *Superb Siffert out-qualifies and beats Clark in slipstreamer by 0.1sec.*

Rand Grand Prix, Kyalami (ZA), 12.12.64, 127.25 miles.
1. G Hill, Brabham BT11 BRM V8, 92.20mph. 2. P Hawkins, Brabham BT10 Ford 4. 3. B Anderson, Brabham BT11 Climax V8. PP: J Stewart, Lotus 33 Climax V8. FL: Stewart 95.40mph. *Aggregate of 2 heats – Hill unfamiliar in private Brabham, Jackie Stewart makes F1 debut in one-off outing for Team Lotus.*

Technical overview: 1964

Engine technology:
12 cylinders and beyond
By mid-1963, it was becoming apparent that an engine output of at least 240bhp might be necessary to avoid being overshadowed by other manufacturers the final seasons of the formula. Substantial increases in the power of a naturally aspirated engine of a given capacity running on a regulation fuel can only be obtained by increasing the operating speed of the engine. At higher operating speeds a higher volume of air can be flowed into the engine and mixed with fuel to produce the additional power, although merely increasing the volume of air is no guarantee of increased power. Unfortunately, as operating speeds increase, so the engine's ability to breathe – its volumetric efficiency – tends to reduce. While volumetric efficiency can be maintained by enlarging the porting and valves, at lower engine speeds larger valves do not flow well and larger porting does not accelerate airflow sufficiently to generate adequate turbulence for efficient combustion. Besides turbulence, combustion efficiency is dependent upon the actual design of the combustion chamber. The key challenge for engine designers was to achieve the best compromise between volumetric and combustion efficiencies at increasing operating speeds.

The stresses to which an engine is subject increase dramatically as operating speeds rise. Increasing the operating speeds of an engine would be limited by the stress considerations of connecting rods and pistons and the weight of its valve gear. A reduction in the dimensions of the reciprocating parts would reduce their inertia and hence lessen stress. In simplistic terms, the lesser mass of a smaller cylinder generates less stress. Smaller valves are lighter to operate and easier to control as they are less likely to suffer valve spring surge, while the stress levels in

connecting rods and pistons can be reduced by shortening the stroke and, to some extent, lengthening the connecting rods. It is for this reason that short stroke 'over square' (i.e. wide bore, short stroke) engines are generally associated with higher operating speeds. Thus, the 8-cylinder engine was now being viewed as inadequate for the job and the necessity for even smaller cylinders was paving the way for engines with 12 or even 16 cylinders.

Honda had gained a tremendous amount of experience in developing power from small cylinders through its success in motorcycle racing. It had a 250cc, 16-valve, 4-cylinder engine producing 180bhp per litre, equivalent to a 1½-litre giving 270bhp, although 24-cylinders would have resulted in an overly complex engine. Honda had, therefore, opted for a 60° V12 that, on its debut in August, had a claimed power output comfortably in excess of 200bhp working in a rev band between 8500 and 12,000rpm. For the 1965 season this would increase to 230bhp at 11,000rpm and, when it was running on-song, the engine clearly demonstrated a power advantage over its rivals.

Ferrari, possibly anticipating the entry of Honda into GP racing, had instigated the design of a 12-cylinder engine in late 1962. It was generally expected that this would follow Ferrari tradition with cylinders arranged in a 60° vee format but something of a surprise had been created at the annual Ferrari press conference in January 1964 when the type 1512 was revealed to have horizontally-opposed cylinders, i.e. the so called flat-12 layout. A flat-12 had not previously been raced in any category and the Ferrari version initially produced 210bhp at 11,500rpm.

Coventry Climax had become concerned about maintaining its dominant position against the perceived threat from the 12-cylinder Honda and Ferrari engines. By the end of the season it was known that a 16-cylinder engine was being developed, detailed investigations revealing that the greater piston area of that number of cylinders should achieve an output of approximately 240bhp. Built with a horizontally-opposed cylinder layout for ease of chassis installation, the FWMW engine was plagued with torsional vibration problems, despite being designed with a power take-off from the centre of the crankshaft. Development was slow but, in the event, the expected challenge from Honda and Ferrari during 1965 would fail to materialise and reliance continued on the faithful FWMV V8 with four-valves per cylinder. Further development of the flat-16 was unnecessary and it was abandoned.

Fuel-injection

Ferrari ran the 158 V8 engine throughout 1964 on Bosch direct fuel-injection, and first showed the 1512 flat-12 with the same system. By the time it raced, however, it was running on the British Lucas port type system. The year had also seen the debut of the Honda V12, initially fitted with twin choke Keihin carburettors but replaced with Honda manufactured fuel-injection for its second GP at Monza. This was of the constant flow, low pressure, port type that seemed to work well at Honda's peak 11,000rpm but was less effective at lower speeds until perfected late in 1965.

Tyre technology

Throughout the period, Dunlop's engineers sought to devise a tyre design free of internal stress when inflated. Experience with shapes, combined with contemporary wheel diameters, generated a broad, squat 'doughnut'-shaped race tyre. This tyre was introduced in 1964 as the new R6 for mounting on 13in diameter wheels. It had already been established that tyre performance increased if mounted on a wheel rim wider than the tyre section and the R6 capitalised on this. Tread width at the rear increased by 2in to 7.2in and mounted on a 9.5in rim, the tyre had an aspect ratio of under 60%. Construction, compound and tread pattern remained as previous but the extra grip generated by the increased width brought cornering forces up to 1.1g. The tyre contact patch was now wider than it was long and the extra rubber on the track dictated a smoother, neater driving style and increased further the emphasis on sophisticated suspension design and wheel control.

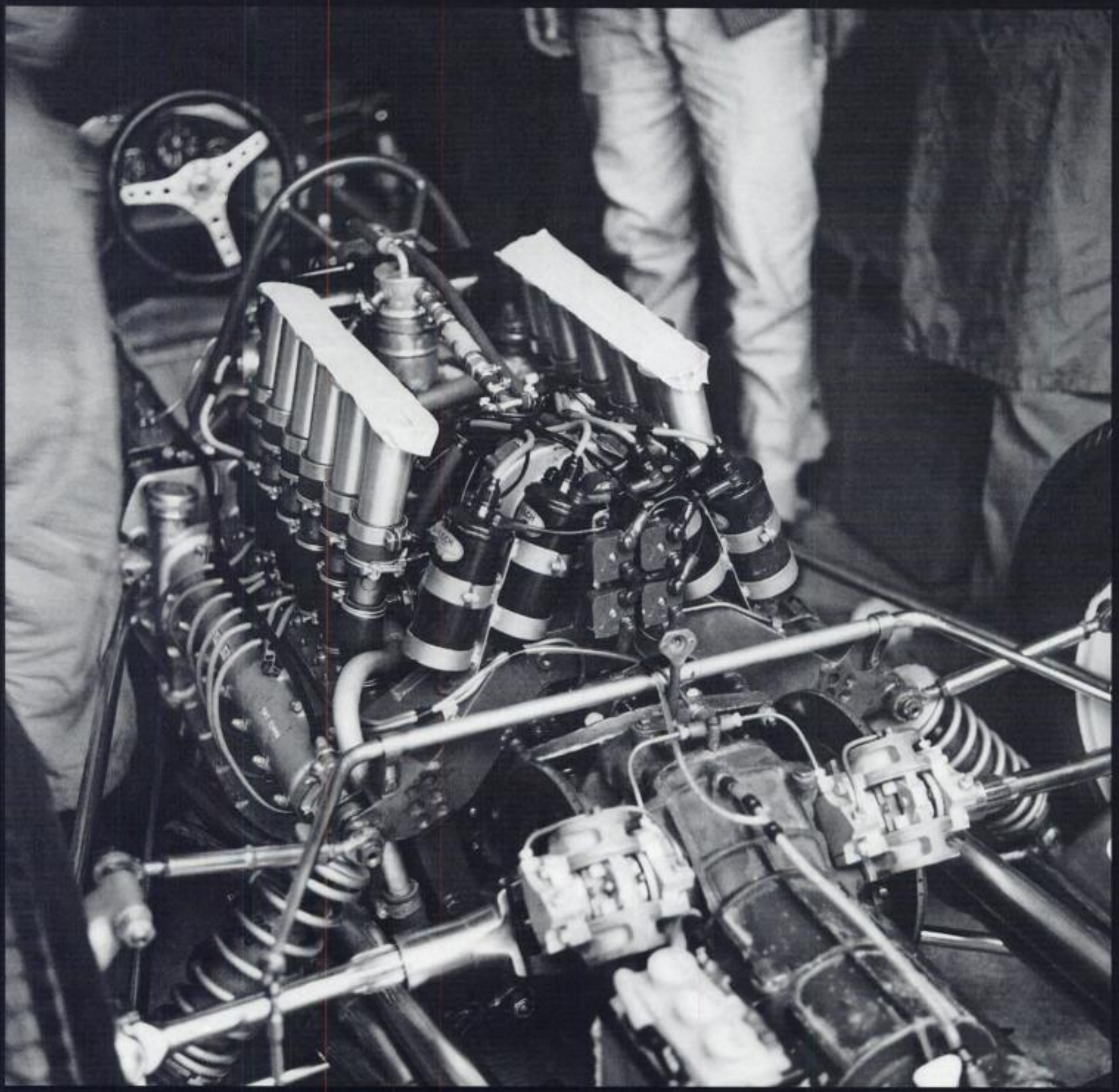
Suspension technology

Front suspension layout had become somewhat standardised, comprising inboard mounted coil spring/damper units operated by a rocker arm pivoting on the chassis. Pioneered by Colin Chapman for the 1961 Lotus 21, it was not a new idea but was used to maximum advantage by all constructors with the exception of Brabham which continued with a 'conventional' outboard spring set up. Similarly, rear suspensions followed the Lola/Lotus layout of a reversed wishbone and single transverse link located by twin radius rods picking up from the seat-back bulkhead. BRM had adopted this layout for the P261 monocoque chassis, leaving only Cooper with a layout incorporating double wishbones located by a single upper radius rod.

Chassis developments

A limited race programme in 1963 had proved the handling of the monocoque BRM P61 to be compromised by insufficient rigidity in the tubular sub-frame supporting the engine and transmission. This was corrected for 1964 by the introduction of the P261 chassis in which the sub-frame had been replaced by

Opposite: 12 cylinders: Ferrari became the first engine manufacturer to race a flat-12 design in any category. Here it is as first shown at Monza in September with four coils powering single ignition, Lucas fuel-injection and long inlet trumpets to extend the torque range.



two stressed skin extensions to the main monocoque structure running either side of the engine. Initially it was necessary to provide tunnels in these side extensions for the exhaust system to pass through until the reverse cylinder head engine became available with central exhausts.

The tubular sub-frame was not dead, however, and appeared on the Honda RA271. The width of the transversely-mounted V12 made it virtually impossible to extend the monocoque beyond the seatback, the only option being a tubular sub-frame. Honda managed to make a better job of it than BRM, possibly aided by the shorter longitudinal length of the transverse engine than the orthodox BRM V8.

By 1964, only Brabham and Cooper retained tubular chassis construction. Cooper had actually started work on a monocoque during 1963 with a 360º aluminium alloy skin strengthened internally with glass fibre and aluminium honeycomb. It proved expensive to manufacture, and development was taking so long that it was shelved. Cooper resorted to stiffening its multi-tubular frame with a sheet steel undertray, wrapped around and spot welded to it. Brabham had had an ultra competitive season with the space frame BT7 and 11 chassis, despite the trend towards monocoque construction by its rivals. The Brabham space frame was extremely well engineered, fully triangulated and highly efficient.

Transmissions

Hewland introduced the HD 5-speed transmission for 1964. Suitable for F1 power outputs, this used Hewland's own magnesium casing, was only 18.6in long and weighed 85lb complete with clutch operating mechanism but without oil. Many of the features of the Mk IV were carried over to the HD, including the ability to change ratios within 30 minutes. Such was their quality and reliability, Hewland transmissions soon became standard wear throughout most categories of the sport, usurping what had briefly been GSD's market. Besides Brabham, they were used on the Parnell BRM-engined Lotus 25s in F1.

Despite expectations that 6-speed gearboxes would become the norm, both Brabham and Lotus found 5 speeds to be perfectly adequate for the lower revving Coventry Climax V8. BRM initially matched its new V8 to a 5-speed unit derived from its 2½-litre F1 car of 1960. By 1963, a new 6-speed transmission had been designed in response to increasing engine speeds and a narrower power band, and this was superseded by a lighter version in 1964. Similarly, Ferrari moved up to 6 speeds in 1963 for its V6 and subsequent V8 and flat-12 engines. The high-revving Honda V12 was fitted with a 6-speed transmission from inception.

6 1965 – Clark and Chapman clean up (act 2)

The final year of a formula is generally lacking in technical innovation, as there is little to be gained from investing time and money in new engines or chassis that will become obsolete within a few months. This could not be said of the final season of the 1½-litre F1, however. Both Ferrari and Honda had introduced new 12-cylinder engines during 1964 and were set to contest a full season with them while Coventry Climax had an exciting new multi-cylinder engine on the stocks.

The Ferrari flat-12 had been raced in the North American GPs and had acquitted itself well in the rarefied atmosphere of Mexico City. Winter development would see the engine run a full season in 1965, although the Championship-winning V8 would be available as a backup. John Surtees was eager to defend his World Championship title, backed up by Lorenzo Bandini, in improved versions of the 'Aero' monocoque chassis. The Honda had shown an impressive turn of speed at Monza but had been plagued with overheating problems in the USA. These problems should have been quickly resolved over the winter months, allowing the engine to realise its true potential. Honda was in the unfortunate position of having to live up to a reputation gained in motorcycle racing and there was a general expectation that it would dominate GP racing in the same way. A two-car team of tidied-up versions of the RA271 chassis would be run in 1965, and, with new recruit Ritchie Ginther's test and development skills, prospects looked encouraging.

Coventry Climax had developed 4-valve per cylinder heads for the FWMV V8 that helped increase power to approximately 212bhp. Only two engines had been built, one each for Brabham and Lotus – the days of Cooper featuring strongly in Climax strategy were long gone. Coventry Climax was anxious to maintain its position in the final year of the formula, although chief engineer Wally Hassan recognised that the FWMV could not match the output of the 12-cylinder opposition. An advanced and technically interesting flat-16 cylinder engine had been designed in an attempt to put Climax one step ahead of its rivals. This looked to be a somewhat optimistic move, given the complexity of the engine and the shortage of development time before the start of the European season. There would inevitably be teething problems and the likelihood of it having any impact on the outcome of the World Championship seemed slim. This would, in fact, be Coventry Climax's swansong as it had been announced in February that the company was withdrawing from F1 racing at the end of the year. F1 development had become an almost full time occupation for its engineers, and the company continued to subsidise production of the FWMV V8. Investment in a new 3-litre F1 engine for 1966 was seen as prohibitively expensive. Henceforth, Climax resources were to be directed towards developing new power units for Jaguar Cars, of which it was now a part.

BRM, by contrast, had settled for a more conservative approach, preferring to develop the P56 V8 further. Having failed to achieve any worthwhile benefits from 4-valves per cylinder, work concentrated on extracting more power from the reverse flow 2-valve cylinder heads first raced at Monza in 1964. This revolved around combustion chamber shape and had produced a peak output of 211bhp. Driving for BRM would be Graham Hill in his sixth year with the team, partnered by Jackie Stewart in place of the 'dropped' Ritchie Ginther. Stewart had dominated the F3 category in 1964 and had some success in a few F2 outings. The 26-year-old Scot was recognised as an outstanding talent and his performances had attracted offers of F1 drives from Cooper, Lotus and BRM. The opportunity to partner his friend, Jim Clark, at Lotus was tempting but he reasoned that no second driver had succeeded in a team in which all attention was focussed on Clark. He thought he could learn more from Graham Hill at BRM where he would also get more testing time and this proved to be the case. By the start of the European GP season he had won his first F1 race, the International Trophy at Silverstone.

The man to beat would, as always, be Jim Clark in the Lotus 33. Mike Spence continued as his number 2 in the absence of Peter Arundell, still recovering from his injuries sustained in 1964. Dan Gurney continued with Jack Brabham's team, both now in BT11 chassis, as sold to customers in 1964. Having proved the Brabham to be a winner in 1964, Dan was looking, as always, to improved reliability. Denis Hulme, who had enjoyed successful seasons with Brabham in both FJ and F2, would also get some F1 drives. Prompted by Gurney, the Brabhams were to run on Goodyear tyres. Dunlop had been the sole supplier of F1 rubber since 1959 and the challenge of a new tyre supplier to F1 generated great interest. The American Goodyear Tyre & Rubber Company had

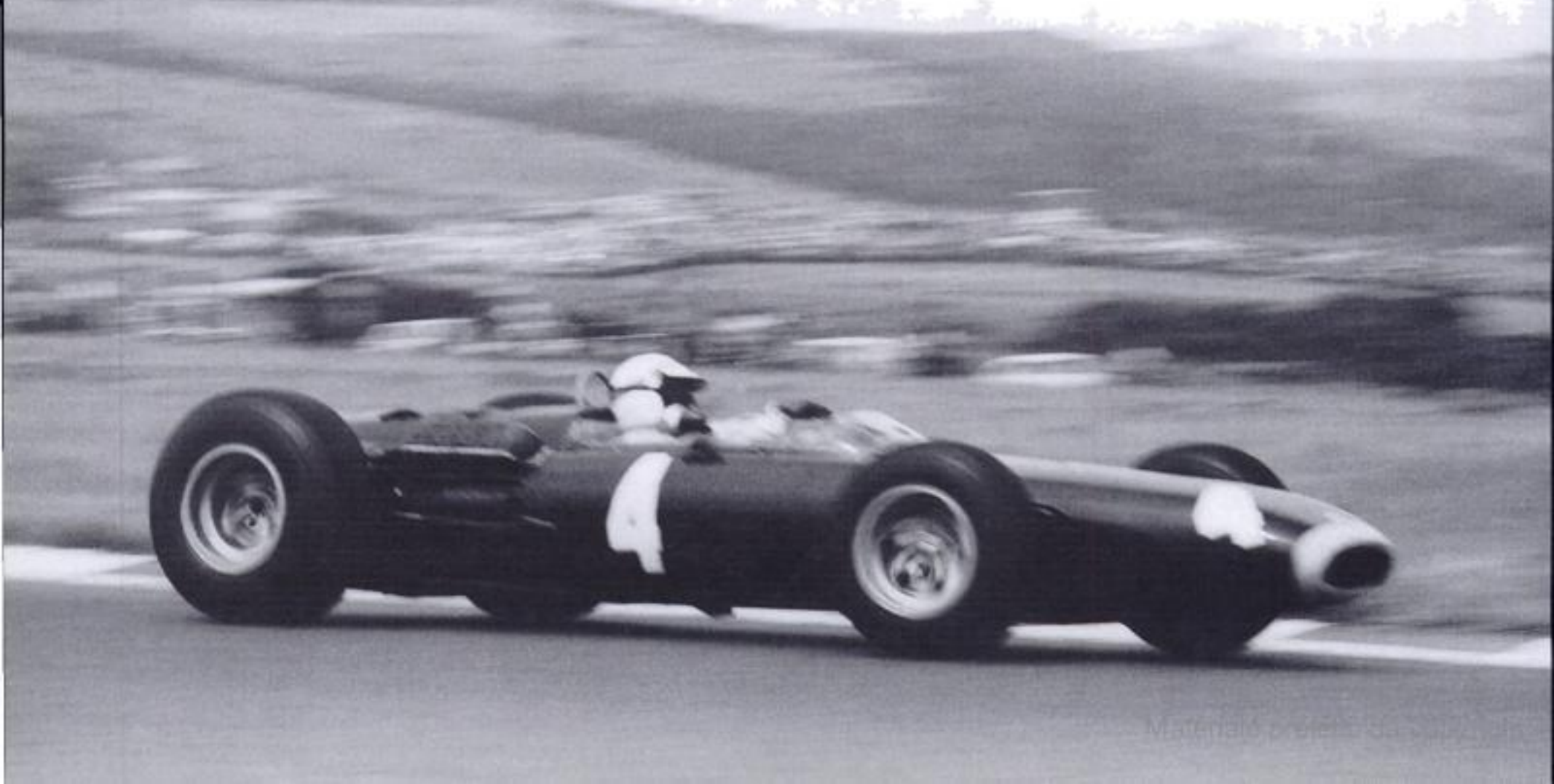
embarked on a competition programme in the USA that had extended to Europe in 1964 with the Shelby American Cobra challenge for the FIA GT Championship and with Ford's bid to win the Le Mans 24 Hours. The company had plans to break into F1 at a later date but Gurney's involvement had brought these forward, suitable tyres being developed for the 1965 season. By the Monaco GP, Honda had joined Brabham in signing with Goodyear in the initial skirmish that would develop into the tyre war of the later 1960s.

After a disastrous and unhappy season at Cooper in 1964, former World Champion Phil Hill had run his last GP. His place was taken by the 23-year-old Austrian, Jochen Rindt, who had made his name in F2, beating the established stars in the process. He had acquitted himself well on his GP debut in Austria in 1964, driving a Rob Walker-entered Brabham BRM. This prompted Dennis Druitt, competitions manager of BP to which Rindt was contracted, to start negotiations with Cooper, resulting in a three year contract for Rindt with the team from 1965. Both he and team leader Bruce McLaren would run new Cooper T77 chassis, little changed from the 1964 T73. Of the private entrants, the Parnell team continued with its BRM-engined Lotus 25s and Rob Walker now had a two-car team, having absorbed Jo Siffert and his Brabham into his operation alongside Jo Bonnier.

Missing from the line-up was BRP and its self-constructed

Cooper sells out to Chipstead Motor Group

Over the winter of 1964/65, John Cooper began discussing with friends his concerns for the future of the Cooper Car Co. His father had died the previous October and he remained unfit following his road accident back in 1963. Former Cooper driver, Roy Salvadori, who had retired from F1 at the end of 1962, suggested that he might sell the company and introduced him to Jonathan Sieff, head of the Chipstead Motor Group, a member of the Marks & Spencer family and a one-time race driver. Agreement was reached and the Chipstead Group purchased Cooper for around £200,000 at the end of April 1965, relieving John of his immediate concerns. He remained on board, taking responsibility for F1 race car preparation while Salvadori became team manager from the Monaco GP onwards.



1965 World Championship – Round 1

East London 1 January 1965 85 laps
Starters 20 **Finishers** 11

South African Grand Prix

206.98 miles (333.17km)
Weather Overcast but dry

	Driver	Entrant	Car	Laps	Result
1	J Clark	Team Lotus	Lotus 33 Climax V8	85	2h 06m 46.0s
2	J Surtees	Eugenio Dragoni	Ferrari 158 V8	85	2h 07m 15.0s
3	G Hill	Owen Racing Organisation	BRM P261 V8	85	2h 07m 17.8s
4	M Spence	Team Lotus	Lotus 33 Climax V8	85	2h 07m 40.4s
5	B McLaren	Cooper Car Co	Cooper T73 Climax V8	84	
6	J Stewart	Owen Racing Organisation	BRM P261 V8	84	
7	J Siffert	RRC Walker Racing Team	Brabham BT11 BRM V8	83	
8	J Brabham	Brabham Racing Organisation	Brabham BT11 Climax V8	81	
9	P Hawkins	John Willment (Automobiles)	Brabham BT10 Ford 4	81	
10	P de Klerk	Otelle Nucci	Alfa Special Alfa Romeo 4	79	
11	A Maggs	Reg Parnell (Racing)	Lotus 25 BRM V8	77	
	F Gardner	John Willment (Automobiles)	Brabham BT11 BRM V8	75	N/C
	S Tingle	SA Tingle	LDS 2 Climax 4	73	N/C
	D Prophet	David Prophet (Racing)	Brabham BT10 Cosworth 4	71	N/C
	L Bandini	Eugenio Dragoni	Ferrari 1512 F12	66	Electrics
	B Anderson	DW Racing Enterprises	Brabham BT11 Climax V8	50	N/C
	J Bonnier	RRC Walker Racing Team	Brabham BT7 Climax V8	42	Clutch
	J Rindt	Cooper Car Co	Cooper T73 Climax V8	39	Electrics
	J Love	J Love	Cooper T55 Climax 4	20	Half shaft
	D Gurney	Brabham Racing Organisation	Brabham BT11 Climax V8	11	Electrics

Winner's speed 97.97mph (157.668km/h)
Fastest lap J Clark 1m 27.6s, 100.10mph (161.091km/h)

Championship placings

Drivers		Constructors	
1. Clark	9	1. Lotus	9
2. Surtees	6	2. Ferrari	6
3. Hill	4	3. BRM	4
4. Spence	3	4. Cooper	2
5. McLaren	2		
6. Stewart	1		

Grid

Brabham 1-28.3	Surtees 1-28.1	**Clark 1-27.2**
Hill 1-28.6	Spence 1-28.3	
McLaren 1-29.4	Bonnier 1-29.3	Bandini 1-29.3
Rindt 1-30.4	Gurney 1-29.5	
Maggs 1-31.3	Anderson 1-31.0	Stewart 1-30.5
Gardner 1-32.3	Siffert 1-31.8	
Love 1-33.8	de Klerk 1-33.3	Hawkins 1-33.1
Tingle 1-34.6	Prophet 1-33.9	

monocoque chassis. The team had been excluded from the agreement between the GP organisers and the F1 constructors that drew up the scale of starting money to be paid to constructors at the instigation of Colin Chapman. He alleged that BRP was not a bona fide constructor, as it did not manufacture enough of its own components to qualify. The truth of the matter was that BRP built its own chassis but used Lotus suspension parts – hardly grounds for exclusion. BRP had struggled through 1964 but, without adequate starting money, could not survive, and in December had announced its withdrawal from F1.

The 1965 GP season actually began on New Year's Day in South Africa. Having taken place in December 1962 and December 1963, the organisers moved the date of the 1964 GP on by a couple of days and suddenly it was the first GP of 1965. Being closer to the final round of the 1964 Championship than the second round of the 1965 one by some three months, the entry was more akin to 1964 than to the new season. Driver changes had taken place but little else.

Nevertheless, it provided Jim Clark with an untroubled flag-to-flag victory at a record speed and with the first 100mph lap of the East London circuit to his credit. For nearly two-thirds of the race Mike Spence had impressed by holding second, finally finishing fourth after a spin. John Surtees was second in the Ferrari 158, 29sec adrift of Clark. Bandini failed to finish in the 1512 (flat-12), both Ferraris back in their traditional scarlet colour schemes but entered in the name of team manager Eugenio Dragoni as Enzo Ferrari had yet to have his entrants licence reinstated following his disagreement with the AC d'Italia the previous autumn.

Graham Hill brought his BRM home third, with new team-mate Stewart claiming his first World Championship point in sixth. The Brabham team had a typically problematic race, Gurney completing only 11 laps with an obscure electrical problem and

Opposite: South African GP, East London, 1 January 1965. New boy at BRM: Jackie Stewart (BRM P261) scores his first Championship point on his first run in chassis 2617.

Monaco GP, Monte Carlo, 30 May 1965. Bandini (Ferrari 1512) gives the flat-12-engined car one of its best runs of the season, leading eventual winner Hill (BRM P261). Surtees (Ferrari 158) follows.

Brabham finishing 4 laps down on Clark after a terminal came loose in his transistor box. Goodyear tyres made their GP debut on Gurney's Brabham and were also in evidence on a number of the privateers' cars. Even Hill tried them on the spare BRM, although only during practice as the team was contracted to Dunlop.

The teams returned to their bases to continue winter development programmes and contest the early season non-Championship races. There were only five of these as organisers switched to F2 events that were cheaper to put on and gave the up-and-coming drivers an opportunity to race against the established stars. Jim Clark proved to be dominant in the F1 races he started, although he experienced a slight hiccup in the Race of Champions at Brands Hatch in which he ran off the road under pressure from Dan Gurney and wrecked his Lotus 33. Qualifying for the Indianapolis 500 kept him away from the Silverstone

International, allowing Jackie Stewart his first F1 win, as already mentioned.

The Indianapolis 500 also had an effect on the entry for the opening round of the European GP season at Monaco at the end of May, both events taking place over the same weekend. Clark and Dan Gurney were contesting the '500' but FIA regulations now stipulated that a driver could not participate in two international races in a 24 hour period. Their places were to be taken by Pedro Rodriguez and Denny Hulme respectively, but, with Clark absent, the AC de Monaco decided that both Rodriguez and Spence would have to qualify for a place on the grid so Team Lotus withdrew its entries in protest. In the end, there were only 17 entries for 16 places on the grid, the unlucky non-qualifier being Jochen Rindt who had a troubled practice with his Cooper. Honda made its 1965 debut, the team not having made the trip to South Africa. Both cars were slow and started from the back of the grid. Ginther was actually slower than Rindt but, having a guaranteed start, bumped him off the grid. Strangely, only twelve months before, F1CA was threatening to boycott the GP because the AC de Monaco was not complying with an agreement that member teams should automatically qualify for GPs. Monaco had agreed to fall in line with the agreement from 1965 but it had not – Lotus had withdrawn but Cooper said nothing. Where was F1CA? Well, the secretary was at Indianapolis in his other role as competitions manager for Team Lotus ...

Graham Hill led from pole, closely followed by Stewart, around a circuit looking unfamiliar following demolition of the station and gasworks, buildings long identified with names of corners. Hill's lead lasted for 24 laps until he was forced to take the escape road at the Chicane to avoid Anderson's slow Brabham. By the time he had restarted he was back in fifth, some 20sec down on leader Stewart. Five laps later, Stewart spun down to fourth and Bandini led in the flat-12 Ferrari from Brabham's Brabham and Surtees V8 Ferrari. Brabham took a short-lived lead

Monaco GP, Monte Carlo, 30 May 1965. Looking pretty pleased with himself, Graham Hill stands with Princess Grace and Prince Rainier for the national anthem for the third year on the trot.

on lap 34, which terminated when his 32-valve Climax V8 blew as he had been running with a non-functioning rev counter.

Bandini inherited the lead once again but Hill was grimly working his way back into contention, taking second from Surtees just after half distance, both of them taking turns at breaking the lap record in their battle. Hill closed on Bandini who responded by lowering the lap record further but still Hill regained the lead on lap 65. Bandini kept up the pressure on Hill until easing off and letting Surtees through on the way up Ste Devote. Surtees could make little impression on Hill who lowered the lap record again on lap 82 on his way to completing a remarkable hat trick of wins on the demanding Monte Carlo circuit. Surtees ran out of fuel on the penultimate lap and was credited with fourth behind Bandini and Stewart in an enthralling race.

Neither Honda had featured, both suffering mechanical problems – Ginther's on the opening lap. Paul Hawkins had re-enacted Ascari's incident with a Lancia during the 1955 race when he spun his Lotus 33 at the Chicane and disappeared backwards through the straw bales into the waters of the harbour. This marked the last GP for Mike Hailwood in the Parnell team Lotus BRM, having become disillusioned as an also-ran, whereas a return to motorcycle racing saw him regain his former position of a front-runner. He would return to F1 again in 1971, when he would enjoy somewhat more success with both the Surtees and McLaren teams. Innes Ireland replaced Hailwood in the team alongside Richard Attwood, newly promoted from F2.

Over in the USA, Jim Clark and the Ford-powered Lotus had won the Indianapolis 500 at the third attempt and netted a cool $166,621 (£59,150) in the process. This was a triumph for Colin Chapman and finally brought US single-seater race car design into the twentieth century. Project instigator and fellow F1 refugee Dan Gurney had suffered engine failure after only 42 of the 200 laps.

Trouble brewed in practice for the Belgian GP when the Royal Automobile Club de Belge announced that it would pay start money to only four of the eight invited private entrants – the twelve works entries from Brabham, Cooper, BRM, Honda, Ferrari and Lotus being guaranteed entries, of course. The private entrants objected to this treatment, did not take part in Friday's practice and were fully prepared to pack up and go home. The dispute raged until, on Friday evening, a compromise was reached in which the organisers agreed to increase the start money to cover six starters (about Belgian Fr500,000) to be shared between the eight entries.

Meanwhile, the works entries practised; Hill, Clark, Stewart and Ginther all getting under Gurney's 1964 lap record, Gurney himself only

1965 World Championship – Round 2

Grand Prix de Monaco

Monte Carlo 30 May 1965 100 laps
Starters 16 **Finishers** 8
195.42 miles (314.50km)
Weather Overcast but dry

	Driver	Entrant	Car	Laps	Result
1	G Hill	Owen Racing Organisation	BRM P261 V8	100	2h 37m 39.6s
2	L Bandini	Ferrari SpA SEFAC	Ferrari 1512 F12	100	2h 38m 43.6s
3	J Stewart	Owen Racing Organisation	BRM P261 V8	100	2h 39m 21.5s
4	J Surtees	Ferrari SpA SEFAC	Ferrari 158 V8	99	Out of fuel
5	B McLaren	Cooper Car Co	Cooper T77 Climax V8	98	
6	J Siffert	RRC Walker Racing Team	Brabham BT11 BRM V8	98	
7	J Bonnier	RRC Walker Racing Team	Brabham BT7 Climax V8	97	
8	D Hulme	Brabham Racing Organisation	Brabham BT7 Climax V8	92	
	B Anderson	DW Racing Enterprises	Brabham BT11 Climax V8	85	N/C
	P Hawkins	DW Racing Enterprises	Lotus 33 Climax V8	79	Accident
	R Attwood	Reg Parnell (Racing)	Lotus 25 BRM V8	43	Lost wheel
	J Brabham	Brabham Racing Organisation	Brabham BT11 Climax V8	43	Engine
	R Bucknum	Honda R&D Co	Honda RA272 V12	33	Gear linkage
	F Gardner	John Willment Automobiles	Brabham BT11 BRM V8	29	Chassis
	M Hailwood	Reg Parnell (Racing)	Lotus 25 BRM V8	12	Gearbox
	R Ginther	Honda R&D Co	Honda RA272 V12	0	Drive shaft

Winner's **speed** 74.34mph (119.637km/h)
Fastest **lap** G Hill 1m 31.7s, 76.72mph (123.467km/h)

Championship placings

Drivers		Constructors	
1. G Hill	13	1. BRM	13
2. Clark	9	2. Ferrari	12
Surtees	9	3. Lotus	9
4. Bandini	6	4. Cooper	4
5. Stewart	5	5. Brabham (BRM)	1
6. McLaren	4		
7. Spence	3		
8. Siffert	1		

Grid

Hill 1.32.5		Brabham 1-32.8
	Stewart 1-32.9	Bandini 1-33.0
Surtees 1-33.2		Attwood 1-33.9
	McLaren 1-34.3	Hulme 1-34.8
Anderson 1-35.5		Siffert 1-36.0
	Gardner 1-36.0	Hailwood 1-36.5
Bonnier 1-36.5		Hawkins 1-37.0
	Bucknum 1-37.0	Ginther 1-39.7

able to equal it. With Ginther in fourth on the grid, the Honda was beginning to show its potential, while Bandini was only 15th on a circuit expected to suit the flat-12 Ferrari.

After dry practice sessions, Sunday was wet. Hill led from pole but Clark was ahead by Malmedy and had a 3sec lead at the end of the lap. Disregarding the rain that varied in intensity from one side of the circuit to the other, Clark stretched his lead to 27sec by lap 5, Hill having fallen back behind Stewart and Surtees but ahead of Ginther. The rain had eased by half distance but there were more dark clouds overhead shortly after and the cars were soon immersed in spray again. Lap times see-sawed throughout the afternoon as the rain eased or intensified, it being worse on the Malmedy/Stavelot side of the circuit. The top six places had stabilised with Clark 70sec ahead of Stewart on lap 25, who had nearly a lap advantage over McLaren, Hill, Brabham and Ginther. McLaren always did well at Spa and this would be his best finish of his final season with Cooper prior to running his own F1 operation from 1966.

Nobody had come remotely close to Clark as he won his fourth consecutive Belgian GP on a circuit that he openly disliked. Only the impressive Stewart completed the distance with Clark. Ginther scored the first Championship point for Honda in sixth but Dan Gurney had a disappointing race compared to his dominant performance in 1964, finishing 2 laps down in tenth and not finding his Goodyears a match for the Dunlops in the wet. Champion Surtees had gone out with engine trouble in the V8 Ferrari on lap 5 and Bandini had managed only ninth in the flat-12. Richard Attwood had been hounding Ginther's Honda in the Parnell Lotus BRM but hit a puddle, spun out of control and hit a telegraph pole before bursting into flames. A quick thinking onlooker pulled him free and he was taken to hospital with painful but not serious burns. A somewhat processional race, notable only for the performances of Clark and new boy Stewart.

Clark and Stewart did a repeat performance (dubbed "double Scotch" by *Autosport*) at the next round in France. This year the Grand Prix de l'ACF made the first of a number of visits to the impressive Circuit Montagne d'Auvergne near Clermont-Ferrand in central France. The 5 mile circuit was something of a mini- Nürburgring with 51 corners, 24 of them hairpins. F1 cars

1965 World Championship – Round 3

Grand Prix de Belgique

Spa-Francorchamps 13 June 196 32 laps
280.42 miles (451.20km)
Starters 19 **Finishers** 12 **Weather** Heavy rain

	Driver	Entrant	Car	Laps	Result
1	J Clark	Team Lotus	Lotus 33 Climax V8	32	2h 23m 34.8s
2	J Stewart	Owen Racing Organisation	BRM P261 V8	32	2h 24m 19.6s
3	B McLaren	Cooper Car Co	Cooper T77 Climax V8	31	
4	J Brabham	Brabham Racing Organisation	Brabham BT11 Climax V8	31	
5	G Hill	Owen Racing Organisation	BRM P261 V8	31	
6	R Ginther	Honda R&D Co	Honda RA272 V12	31	
7	M Spence	Team Lotus	Lotus 33 Climax V8	31	
8	J Siffert	RRC Walker Racing Team	Brabham BT11 BRM V8	31	
9	L Bandini	Ferrari SpA SEFAC	Ferrari 1512 F12	30	
10	D Gurney	Brabham Racing Organisation	Brabham BT11 Climax V8	30	
11	J Rindt	Cooper Car Co	Cooper T77 Climax V8	29	
12	L Bianchi	Scuderia Centro Sud	BRM P578 V8	29	
	I Ireland	Reg Parnell (Racing)	Lotus 25 BRM V8	27	N/C
	R Attwood	Reg Parnell (Racing)	Lotus 25 BRM V8	26	Accident
	M Gregory	Scuderia Centro Sud	BRM P578 V8	12	Fuel pump
	J Bonnier	RRC Walker Racing Team	Brabham BT7 Climax V8	9	Ignition
	R Bucknum	Honda R&D Co	Honda RA272 V12	9	Engine
	J Surtees	Ferrari SpA SEFAC	Ferrari 158 V8	5	Engine
	F Gardner	John Willment (Automobiles)	Brabham BT11 BRM V8	3	Ignition

Winner's speed 117.16mph (188.550km/h)
Fastest lap J Clark 4m 12.9s, 124.72mph (200.711km/h)

Championship placings

Drivers		Constructors	
1. Clark	18	1. BRM	19
2. G Hill	15	2. Lotus	18
3. Stewart	11	3. Ferrari	12
4. Surtees	9	4. Cooper	8
5. McLaren	8	5. Brabham	3
6. Bandini	6	6. Honda	1
7. Spence	3	Brabham (BRM)	1
Brabham	3		
9. Siffert	1		
Ginther	1		

Grid

Hill 3-45.4	Clark 3-47.5	Stewart 3-48.8
Ginther 3-49.0		Gurney 3-49.2
Surtees 3-49.5	Bonnier 3-49.7	Siffert 3-50.7
McLaren 3-51.3		Brabham 3-51.5
Bucknum 3-52.3	Spence 3-52.6	Attwood 3-53.2
Rindt 3-53.3		Bandini 3-54.0
Ireland 3-57.4	Bianchi 3-59.0	Gardner 3-59.4
	Gregory 4-02.8	

Belgian GP, Spa, 13 June 1965. Jim Clark at Eau Rouge on his way to his fourth consecutive Belgian GP victory on a circuit that he disliked intensely.

had not previously run there and lap times were expected to be in the region of 3m 25s. In the event most drivers were under this, Clark taking only his second pole of the season with 3m 18.3s. Graham Hill hit a wall in first practice and managed only a lowly twelfth on the grid.

Race morning was wet and misty but it was dry by the start as Clark rushed off into the lead, completing the opening lap with a 2sec advantage over the rest. Stewart moved up into second on lap 2 and there he stayed, the gap to Clark opening out to 20sec by half distance. By the end, Clark had an advantage of 26sec on Stewart who was over 2 minutes ahead of John Surtees, the Ferrari running with a very sick sounding V8. Denny Hulme claimed his first World Championship points in fourth, Jack Brabham having stepped down in his favour for this GP. Retirement was beginning to feature in Jack's mind and he was heavily involved in planning for the new 3-litre F1 in 1966. Team leader Dan Gurney had run in the top four until his engine put a rod through its side, but not before he had set a fastest lap, beaten inevitably by Clark in the closing stages. Graham Hill's recovery from the middle of the grid had been hampered by an inoperative clutch but he gradually worked his way into fifth, one lap down, while Jo Siffert took another point for Rob Walker's team. The Hondas had not featured, both suffering ignition problems, and Bandini in the other 12-cylinder car had faded from a good start, eventually losing a wheel after colliding with the scenery.

Clark had dominated another unspectacular race, and his third win of the season had put him 10 points clear of

French GP, Auvergne, 27 June 1965. Jim Clark wins again, despite reverting to the 'old' Lotus 25 chassis R6 on this impressive drivers' circuit.

his nearest rivals, Hill and Stewart. A fourth win came his way two weeks later at Silverstone but last minute drama made it an extremely lucky one. He had led for all but the first mile or so, building a lead of 36sec over Hill and Surtees by three-quarter distance. At this point, interest in the race was suddenly reinvigorated as his 32-valve Climax engine began to falter. Hill and Surtees, urged on by their respective pits, began to chop into his lead at the rate of 3sec a lap. Clark's engine was running out of oil and he was coasting through corners to conserve it and nurse it through to the finish. With 5 laps to go, his lead was down to 15sec and the excitement mounted as Hill reduced it to 13sec, 11.5, 9 and then 5sec going into the last lap. Despite poor brakes and rain tyres on his rear wheels on a dry track, Hill made fastest lap on that final tour but failed to catch the ailing Lotus by 3.2sec. It was a tribute to Clark's ability to compensate for deficiencies in his car and nurse it through to win a fourth consecutive British GP.

Ritchie Ginther, running the sole Honda entry, had put the screaming V12 on the front row of the grid and made a spectacular start to lead into the first corner. Clark slipped by on Hangar Straight and Ritchie dropped behind Hill and Surtees on lap 2, eventually retiring on lap 17 with ignition and injection problems. Surtees' third place was his first run in the flat-12 Ferrari, relegating Bandini to the V8, an engine that he promptly over-revved and blew up on lap 2. Jack Brabham's three car entry of himself, Gurney and Hulme was reduced to two on the warm-up lap when Gurney's newly fitted 32-valve Climax failed. Jack handed his car over to Gurney who had an uncomfortable ride in a cockpit unsuited to his lanky frame, nevertheless finishinig sixth for his first Championship point of the season.

The RAC had attracted the largest entry of the year with six factory teams and eleven private entries. With the factory teams being guaranteed a place on the grid, the sole qualification criteria for the privateers was that they should practice within 110% of the third fastest driver or drivers on the grid. This was seen by *Autosport* as "an extremely fair way of selecting runners and does ensure that a comparatively reasonable standard of driver ability is obtained". Only one entry failed to reach this standard.

The Dutch GP had slipped from its traditional date in May to July, only eight days after the British GP. Ritchie Ginther once again demonstrated the potential of the Goodyear-shod Honda by putting it on

1965 World Championship – Round 4

Grand Prix de l'ACF

Auvergne 27 June 1965 — 40 laps — 200.20 miles (322.20km)

Starters 17 — **Finishers** 8 — **Weather** Warm and dry

	Driver	Entrant	Car	Laps	Result
1	J Clark	Team Lotus	Lotus 25 Climax V8	40	2h 14m 38.4s
2	J Stewart	Owen Racing Organisation	BRM P261 V8	40	2h 15m 04.7s
3	J Surtees	Ferrari SpA SEFAC	Ferrari 158 V8	40	2h 17m 11.9s
4	D Hulme	Brabham Racing Organisation	Brabham BT11 Climax V8	40	2h 17m 31.5s
5	G Hill	Owen Racing Organisation	BRM P261 V8	39	
6	J Siffert	RRC Walker Racing Team	Brabham BT11 BRM V8	39	
7	M Spence	Team Lotus	Lotus 33 Climax V8	39	
8	L Bandini	Ferrari SpA SEFAC	Ferrari 1512 F12	36	Lost wheel
	B Anderson	DW Racing Enterprises	Brabham BT11 Climax V8	34	Ignition
	B McLaren	Cooper Car Co	Cooper T77 Climax V8	23	Steering
	J Bonnier	RRC Walker Racing Team	Brabham BT7 Climax V8	21	Alternator drive
	C Amon	Reg Parnell (Racing)	Lotus 25 BRM V8	20	Fuel feed
	I Ireland	Reg Parnell (Racing)	Lotus 25 BRM V8	18	Gearbox
	D Gurney	Brabham Racing Organisation	Brabham BT11 Climax V8	16	Engine
	R Ginther	Honda R&D Co	Honda RA272 V12	9	Ignition
	R Bucknum	Honda R&D Co	Honda RA272 V12	4	Ignition
	J Rindt	Cooper Car Co	Cooper T77 Climax V8	3	Accident

Winner's speed 89.22mph (143.580km/h)
Fastest lap J Clark 3m 18.9s, 90.59mph (145.791km/h)

Championship placings

Drivers		Constructors	
1. Clark	27	1. Lotus	27
2. G Hill	17	2. BRM	25
Stewart	17	3. Ferrari	16
4. Surtees	13	4. Cooper	8
5. McLaren	8	5. Brabham	6
6. Bandini	6	6. Brabham (BRM)	2
7. Spence	3	7. Honda	1
Brabham	3		
Hulme	3		
10. Siffert	2		

Grid

Clark 3-18.3	Stewart 3-18.8	Bandini 3-19.1
Surtees 3-19.1		Gurney 3-19.8
Hulme 3-20.5	Ginther 3-21.4	Amon 3-23.0
McLaren 3-23.2		Spence 3-23.4
Bonnier 3-23.4	Rindt 3-23.6	Hill 3-23.7
Siffert 3-25.2		Anderson 3-26.0
Bucknum 3-26.3	Ireland 3-30.5	

Left: British GP, Silverstone, 10 July 1965. Brabham privateers: the Rob Walker Brabhams of Bonnier (BT7 Climax) and Siffert (BT11 BRM) sandwich Frank Gardner in the John Willment-entered BT11 BRM. ***Below:*** *Dutch GP, Zandvoort, 18 July 1965. Ritchie Ginther (Honda RA272) momentarily hangs on to second ahead of Clark (Lotus 33), having led for the first 2 laps until being zapped by Hill's BRM going in to Tarzan.*

the front row and making another spectacular start to lead for a full two laps. Thereafter, he faded to an eventual sixth place finish, the team having concentrated on only a single entry once again. Graham Hill was first to pass Ginther and led for a couple of laps until he was inevitably overtaken by Jim Clark on lap 5, at which point the race was virtually over. Hill dropped back with a broken rev counter and it was Jackie Stewart who came through in the second BRM to claim second place on lap 32 and keep Clark honest. Stewart was 8sec down on Clark at the end of their third 'double scotch' 1-2 finish. Dan Gurney had his best finish of the season with a solid third for Brabham and Goodyear, 5sec behind Stewart and 32sec ahead of Hill.

Clark had now scored five wins from five starts and looked to have his second World Championship sewn up. Only Hill had a chance of overhauling him but, to do so, would have to win each of the remaining four races with Clark never finishing higher than third. An unlikely scenario by any standard.

Driving technique

The front-engined F1 car of the late 1950s had been a lumbering beast with a power output that exceeded the levels of grip generated by the tyres and suspension system. Cornering had been achieved by braking in a straight line followed by a quick flick of the steering into the corner to provoke a four wheel drift that could be maintained through it by both throttle control and ample use of opposite lock. The balance of this technique depended largely on whether the car had under or oversteer characteristics and upon the degree of surplus power. The rear-engined revolution introduced cars that were much more manoeuvarable and responsive thanks to their lighter weight and improvements made in suspension and chassis design. Even so, power output still exceeded grip.

The introduction of the 1½-litre regulations saw a reduction in engine power outputs from between 250 and 275bhp to less than 200bhp and the GP car now lacked the excess power to drift through corners. The lack of power narrowed the gap between the skilful drivers and those of lesser ability. Cornering the lighter, softer sprung and more responsive cars became a precise art requiring tremendous finesse to drive them quickly. With so much less power it was important not to waste any in slides. The developments in chassis and suspension sophistication, together with the unprecedented levels of grip available from the tyres, enabled the more skilful drivers to brake later into the apex of a corner and get back onto the throttle quicker, matching deceleration into the corner with acceleration out of it. Flailing elbows had now given way to delicate flicks of the wrist.

The event was marred by a pre-race incident between Colin Chapman and the Dutch police on the starting grid. Chapman did not have his entrant's pass sufficiently visible, a policeman tried to evict him and a scuffle ensued. Following the race he was charged with assaulting an officer in the course of his duties and spent race night in a police cell, much to the embarrassment of the Dutch organising club that abandoned the evening's prize giving. The British Consul was informed and every effort made to have Chapman released but all to no purpose as the police insisted on pressing charges.

Clark had yet to win a GP at the Nürburgring, a remarkable situation given that he had won at nearly all the other circuits on the GP schedule. In 1961 he had finished fourth, fourth again in 1962 after a fluffed start, second in 1963 on only 7-cylinders and a non-finish in 1964. If he won on this visit he would clinch the 1965 World Championship with a maximum points score of 54. He was expected to face stiff opposition from John Surtees who had won the event in 1963 and 1964 and was keen for a repeat performance to give him a hat trick. In the event, Surtees' hopes were quashed almost immediately with gear selection problems as he accelerated away from the start and he spent 2½ laps in the pits while the Ferrari mechanics worked on his car. He restarted to try for a new lap record but gave up after 11 laps with further gearbox problems. John had been unable to effectively defend his Championship title, the prevailing trend running in favour of Clark's Lotus and, to a lesser extent, Hill and Stewart's BRMs. The Ferrari V8 had been good only for a second and a couple of thirds, while the flat-12 lacked development and was only now coming on stream.

Clark set about his task with typical determination and, running his 32-valve Climax engine, ended up on pole position having sliced a remarkable 16sec off Surtees 1964 lap record. In all, nine drivers were under the old

1965 World Championship – Round 5

Silverstone 10 July 1965 80 laps
Starters 21 **Finishers** 11

RAC British Grand Prix

234.24 miles (376.84km)
Weather Overcast but dry

	Driver	Entrant	Car	Laps	Result
1	J Clark	Team Lotus	Lotus 33 Climax V8	80	2h 05m 25.4s
2	G Hill	Owen Racing Organisation	BRM P261 V8	80	2h 05m 28.6s
3	J Surtees	Ferrari SpA SEFAC	Ferrari 1512 F12	80	2h 05m 53.0s
4	M Spence	Team Lotus	Lotus 33 Climax V8	80	2h 06m 05.0s
5	J Stewart	Owen Racing Organisation	BRM P261 V8	80	2h 06m 40.0s
6	D Gurney	Brabham Racing Organisation	Brabham BT11 Climax V8	79	
7	J Bonnier	RRC Walker Racing Team	Brabham BT7 Climax V8	79	
8	F Gardner	John Willment (Automobiles)	Brabham BT11 BRM V8	78	
9	J Siffert	RRC Walker Racing Team	Brabham BT11 BRM V8	78	
10	B McLaren	Cooper Car Co	Cooper T77 Climax V8	77	
11	I Raby	Ian Raby (Racing)	Brabham BT3 BRM V8	73	
	M Gregory	Scuderia Centro Sud	BRM P578 V8	70	N/C
	R Attwood	Reg Parnell (Racing)	Lotus 25 BRM V8	63	N/C
	J Rindt	Cooper Car Co	Cooper T77 Climax V8	62	Engine
	I Ireland	Reg Parnell (Racing)	Lotus 25 BRM V8	41	Engine
	J Rhodes	Gerard Racing	Cooper T60 Climax V8	38	Ignition
	B Anderson	DW Racing Enterprises	Brabham BT11 Climax V8	33	Gearbox
	D Hulme	Brabham Racing Organisation	Brabham BT7 Climax V8	29	Alternator belt
	R Ginther	Honda R&D Co	Honda RA272 V12	26	Ignition/fuel-injection
	L Bandini	Ferrari SpA SEFAC	Ferrari 158 V8	2	Piston
	J Brabham	Brabham Racing Organisation	Brabham BT11 Climax V8	0	DNS

Winner's speed 112.02mph (180.280km/h)
Fastest lap G Hill 1m 32.2s, 114.29mph (183.925km/h)

Championship placings

Drivers		Constructors	
1. Clark	36	1. Lotus	36
2. G Hill	23	2. BRM	31
3. Stewart	19	3. Ferrari	20
4. Surtees	17	4. Cooper	8
5. McLaren	8	5. Brabham	7
6. Bandini	6	6. Brabham (BRM)	2
Spence	6	7. Honda	1
8. Brabham	3		
Hulme	3		
10. Siffert	2		

Grid

Stewart 1-31.3	Ginther 1-31.3	Hill 1-31.0	**Clark 1-30.8**
Gurney 1-31.9	Spence 1-31.7	Surtees 1-31.3	
McLaren 1-32.8	Hulme 1-32.7	Bandini 1-32.7	Brabham 1-32.5
Bonnier 1-33.5	Gardner 1-33.4	Rindt 1-32.9	
Siffert 1-34.2	Anderson 1-34.1	Attwood 1-33.8	Ireland 1-33.6
Rhodes 1-39.4	Raby 1-36.0	Gregory 1-35.9	

1965 World Championship – Round 6

Grote Prijs van Nederland

Zandvoort 18 July 1965 80 laps
208.40 miles (335.44km)
Starters 17 **Finishers** 12
Weather Overcast but dry

	Driver	Entrant	Car	Laps	Result
1	J Clark	Team Lotus	Lotus 33 Climax V8	80	2h 03m 59.1s
2	J Stewart	Owen Racing Organisation	BRM P261 V8	80	2h 04m 07.1s
3	D Gurney	Brabham Racing Organisation	Brabham BT11 Climax V8	80	2h 04m 12.1s
4	G Hill	Owen Racing Organisation	BRM P261 V8	80	2h 04m 44.2s
5	D Hulme	Brabham Racing Organisation	Brabham BT11 Climax V8	79	
6	R Ginther	Honda R&D Co	Honda RA272 V12	79	
7	J Surtees	Ferrari SpA SEFAC	Ferrari 1512 F12	79	
8	M Spence	Team Lotus	Lotus 25 Climax V8	79	
9	L Bandini	Ferrari SpA SEFAC	Ferrari 158 V8	79	
10	I Ireland	Reg Parnell (Racing)	Lotus 25 BRM V8	78	
11	F Gardner	John Willment (Automobiles)	Brabham BT11 BRM V8	77	
12	R Attwood	Reg Parnell (Racing)	Lotus 25 BRM V8	77	
	J Siffert	RRC Walker Racing Team	Brabham BT11 BRM V8	55	N/C
	J Rindt	Cooper Car Co	Cooper T77 Climax V8	48	Engine
	B McLaren	Cooper Car Co	Cooper T77 Climax V8	36	Transmission
	J Bonnier	RRC Walker Racing Team	Brabham BT7 Climax V8	16	Engine
	B Anderson	DW Racing Enterprises	Brabham BT11 Climax V8	11	Head gasket

Winner's speed 100.87mph (162.326km/h)
Fastest lap J Clark 1m 30.6s, 103.91mph (166.608km/h)

Championship placings

Drivers		Constructors	
1. Clark	45	1. Lotus	45
2. G Hill	26	2. BRM	37
3. Stewart	25	3. Ferrari	20
4. Surtees	17	4. Brabham	11
5. McLaren	8	5. Cooper	8
6. Bandini	6	6. Brabham (BRM)	2
Spence	6	7. Honda	2
8. Hulme	5		
Gurney	5		
10. Brabham	3		

Grid

Ginther 1-31.0	Clark 1-31.0	**Hill 1-30.7**
Gurney 1-31.2	Surtees 1-31.0	
Spence 1-32.2	Hulme 1-32.0	Stewart 1-31.4
Siffert 1-32.9	McLaren 1-32.6	
Ireland 1-33.4	Bandini 1-33.1	Gardner 1-32.9
Bonnier 1-33.8	Rindt 1-33.7	
	Attwood 1-34.6	Anderson 1-34.1

record but Clark was over 3sec clear of next man Stewart, having achieved the first 100mph lap of the Nürburgring. He made an immaculate start, was in front by the first corner and had a 3sec lead over Hill's BRM at the end of the opening lap. He continued unhindered, increasing his lead over Hill to 14sec by half distance, with Gurney third in his Brabham. The race ran its processional course with Clark, having eased off slightly, the winner by 16sec, with Hill 8.5sec ahead of Gurney. Jochen Rindt achieved his best performance to date, bringing his Cooper home fourth. The talented privateer Bob Anderson had gone off during practice and badly damaged his Brabham. Unfortunately neither he nor his car would be seen again this season.

Clark had broken his Nürburgring duck, recorded the first 100mph lap record for the circuit and assured himself of the 1965 Drivers' Championship and brought Lotus Coventry Climax the Constructors' Championship, with three GPs still to run. As *Autosport* put it: "The record of Scotland's Jim Clark ... is really astonishing. Six Grands Prix, six victories, the World Championship of Drivers, outright victory at Indianapolis, and the collecting of the Formula 1 Constructors' title for Lotus Coventry Climax is the sort of thing that might well be the theme of a highly improbable novel or film. Clark's brilliant driving, the genius of Colin Chapman, the engineering skill of Coventry Climax and the dedication of the Team Lotus mechanics have combined to produce the most successful racing organisation of our time."

At the prize giving ceremony that evening, the organisers of the Dutch GP also presented their awards, their ceremony having been postponed in the wake of the incident involving Colin Chapman and the Dutch police.

Even though the Championships had been decided, there seemed little possibility of preventing Clark from winning the remaining GPs, given his speed and the reliability of the Lotus. The Italian GP was always unique, however, inevitably being a high speed slipstreamer and providing little opportunity for Clark to make a break and pull out a healthy lead. Continuous high speed slipstreaming required drivers to have total trust in each other's judgement as one small error could lead to disaster. A newcomer to GP racing had to convince his fellows that he was going to act sensibly before being accepted into the elite group. In general, the drivers disliked this form of racing but it was undeniably a great spectacle for the paying public. Monza and Reims were two circuits where slipstreaming was a significant race tactic and regularly provided the spectacle.

German GP, Nürburgring, 1 August 1965. Stewart (BRM P261) leaves the ground before leaving the race – a good spectator spot.

German GP, Nürburgring, 1 August 1965. Top three on the 'podium'. Winner Clark is flanked by Hill to the left and smiling Gurney to the right.

1965 World Championship – Round 7

Grosser Preis von Deutschland

Nürburgring 1 August 1965 15 laps
212.48 miles (342.15km)
Starters 19 **Finishers** 8
Weather Overcast but dry

	Driver	Entrant	Car	Laps	Result
1	J Clark	Team Lotus	Lotus 33 Climax V8	15	2h 07m 52.4s
2	G Hill	Owen Racing Organisation	BRM P261 V8	15	2h 08m 08.3s
3	D Gurney	Brabham Racing Organisation	Brabham BT11 Climax V8	15	2h 08m 13.8s
4	J Rindt	Cooper Car Co	Cooper T77 Climax V8	15	2h 11m 22.0s
5	J Brabham	Brabham Racing Organisation	Brabham BT11 Climax V8	15	2h 12m 33.6s
6	L Bandini	Ferrari SpA SEFAC	Ferrari 158 V8	15	2h 13m 01.0s
7	J Bonnier	RRC Walker Racing Team	Brabham BT7 Climax V8	15	2h 13m 50.9s
8	M Gregory	Scuderia Centro Sud	BRM P578 V8	14	
	J Surtees	Ferrari SpA SEFAC	Ferrari 1512 F12	11	Gearbox
	J Siffert	RRC Walker Racing Team	Brabham BT11 BRM V8	9	Engine
	R Attwood	Reg Parnell (Racing)	Lotus 25 BRM V8	8	Water pipe, engine
	M Spence	Team Lotus	Lotus 33 Climax V8	8	Drive shaft
	G Mitter	Team Lotus	Lotus 25 Climax V8	7	Water leak
	B McLaren	Cooper Car Co	Cooper T77 Climax V8	6	Gear selector
	D Hulme	Brabham Racing Organisation	Brabham BT7 Climax V8	5	Fuel leak
	P Hawkins	DW Racing Enterprises	Lotus 33 Climax V8	3	Oil pipe
	C Amon	Reg Parnell (Racing)	Lotus 25 BRM V8	2	Electrical
	J Stewart	Owen Racing Organisation	BRM P261 V8	2	Suspension
	F Gardner	John Willment (Automobiles)	Brabham BT11 BRM V8	0	Transmission

Winner's speed 99.79mph (160.542km/h)
Fastest lap J Clark 8m 24.1s, 101.23mph (162.896km/h)

Championship placings

Drivers		Constructors	
1. Clark	54	1. Lotus	54
2. G Hill	32	2. BRM	43
3. Stewart	25	3. Ferrari	21
4. Surtees	17	4. Brabham	15
5. Gurney	9	5. Cooper	11
6. McLaren	8	6. Brabham (BRM)	2
7. Bandini	7	Honda	2
8. Spence	6		
9. Hulme	5		
Brabham	5		

Grid

Surtees 8-27.8		Hill 8-26.8	Stewart 8-26.1	**Clark 8-22.7**
	Bandini 8-33.8	Spence 8-33.4	Gurney 8-29.0	
Siffert 8-39.6		McLaren 8-39.0	Bonnier 8-37.9	Rindt 8-37.5
	Brabham 8-44.9	Hulme 8-42.3	Mitter 8-40.4	
Gregory 9-14.3		Gardner 8-59.3	Attwood 8-57.7	Amon 8-50.5
			Hawkins 9-16.8	

and then Bandini fell back from the leaders. Laps 62 and 63 were notable for the retirement of both Team Lotus entries when first Spence stopped with a broken alternator and then Clark with fuel pump failure. This left Hill and Stewart to lead from Gurney who had dropped 9sec from the two BRMs. Either could have won, but it was decided when Hill went wide at the South Curve, enabling Stewart to slip through and chalk up his first GP win after only eight starts in his first F1 season. It was also a fillip for the BRM team giving it another 1-2 finish. Behind Gurney came Bandini while Bruce McLaren hung on for a good fifth on a circuit that always suited him. The final point went, for the second time in the season, to the Parnell team and Richard Attwood. The Honda team had reappeared at full strength having given the German GP a miss but both cars went out with misfiring and power loss.

Ferrari fortunes suffered a setback at the end of September when John Surtees was seriously injured at the wheel of his Lola T70 sports car during practice for the Canadian GP at Mosport Park in Canada. He would be out of action for the remainder of the season with serious back injuries, leaving Bandini to represent the team in the North American races supported by local drivers Pedro Rodriguez and Bob Bondurant. Rodriguez was now a regular in the North American GPs but Bondurant would make his GP debut at Watkins Glen. The American was a member of the Shelby Cobra and Ford teams and had run a few F2 events in a Tyrrell-entered Cooper while in Europe. The number of North

The Italian GP would be the last European GP to be run under the 1½-litre regulations and, as anticipated, provided the usual Monza spectacular with the lead changing from corner to corner. The leading group comprised Clark, Hill, Stewart, Gurney and Bandini, with Surtees coming through the field from 13th to join in after a clutch hydraulic problem at the start. Both Surtees and Bandini were driving improved flat-12 Ferraris but the tifosi groaned with disappointment shortly before half distance when Surtees toured in to retire, his clutch completely gone,

1965 World Championship – Round 8

Monza 12 September 1965 76 laps
Starters 23 **Finishers** 9

Gran Premio d'Italia

271.55 miles (437.00km)
Weather Warm and sunny

	Driver	Entrant	Car	Laps	Result
1	J Stewart	Owen Racing Organisation	BRM P261 V8	76	2h 04m 52.8s
2	G Hill	Owen Racing Organisation	BRM P261 V8	76	2h 04m 56.1s
3	D Gurney	Brabham Racing Organisation	Brabham BT11 Climax V8	76	2h 05m 09.3s
4	L Bandini	Ferrari SpA SEFAC	Ferrari 1512 F12	76	2h 06m 08.7s
5	B McLaren	Cooper Car Co	Cooper T77 Climax V8	75	
6	R Attwood	Reg Parnell (Racing)	Lotus 25 BRM V8	75	
7	J Bonnier	RRC Walker Racing Team	Brabham BT7 Climax V8	74	
8	J Rindt	Cooper Car Co	Cooper T73 Climax V8	74	
9	I Ireland	Reg Parnell (Racing)	Lotus 33 BRM V8	74	
	J Clark	Team Lotus	Lotus 33 Climax V8	63	Fuel pump
	M Spence	Team Lotus	Lotus 33 Climax V8	62	Alternator
	N Vaccarella	Ferrari SpA SEFAC	Ferrari 158 V8	58	Engine
	R Bussinello	Scuderia Centro Sud	BRM P578 V8	58	Oil pressure
	R Ginther	Honda R&D Co	Honda RA272 V12	56	Engine
	D Hulme	Brabham Racing Organisation	Brabham BT11 Climax V8	46	Front suspension
	F Gardner	John Willment (Automobiles)	Brabham BT11 BRM V8	45	Engine
	J Siffert	RRC Walker Racing Team	Brabham BT11 BRM V8	43	Gearbox
	'Geki'	Team Lotus	Lotus 25 Climax V8	37	Gearbox
	J Surtees	Ferrari SpA SEFAC	Ferrari 1512 F12	34	Clutch
	R Bucknum	Honda R&D Co	Honda RA272 V12	27	Engine
	M Gregory	Scuderia Centro Sud	BRM P578 V8	22	Gearbox
	G Baghetti	Brabham Racing Organisation	Brabham BT7 Climax V8	12	Engine
	G Bassi	Scuderia Centro Sud	BRM P578 V8	8	Engine

Winner's speed 130.10mph (209.961km/h)
Fastest lap J Clark 1m 36.4s, 133.43mph (214.730km/h)

Championship placings (*6 best performances)

Drivers			Constructors	
1.	Clark	54	1. Lotus	54
2.	G Hill	*34	2. BRM	*42
3.	Stewart	*33	3. Ferrari	24
4.	Surtees	17	4. Brabham	19
5.	Gurney	13	5. Cooper	13
6.	McLaren	10	6. Brabham (BRM)	2
	Bandini	10	Honda	2
8.	Spence	6	8. Lotus (BRM)	1
9.	Hulme	5		
	Brabham	5		

Grid

Clark 1-35.90	Surtees 1-36.10	Stewart 1-36.60
Hill 1-37.10	Bandini 1-37.20	
Bucknum 1-37.30	Rindt 1-37.70	Spence 1-37.80
Gurney 1-38.11	Siffert 1-38.12	
McLaren 1-38.26	Hulme 1-38.30	Attwood 1-38.85
Bonnier 1-38.90	Vaccerella 1-38.91	
Gardner 1-38.98	Ginther 1-39.60	Ireland 1-39.80
Baghetti 1-40.90	'Geki' 1-41.73	
Bussinello 1-41.76	Bassi 1-45.40	Gregory 1-45.60

Americans seeking rides in the US GP in particular had gradually dwindled, only these two and Mexican regular Moises Solana running this year.

It was cold and windy as Graham Hill made the better start at Watkins Glen for the US GP. Clark slipped through on lap 2 but did not pull away and the BRM regained the lead on lap 5 never to be headed again. Clark lasted only a further 6 laps before a piston broke and, once again, the team's Championship-winning reliability had disappeared, leading one to suppose that Team Lotus was now relaxing. Clark's exit left Hill with a 14sec lead over the Brabhams of Gurney and Jack himself. A heavy rain shower made the track slippery and, hindered by a locking front brake, Hill's lead began to evaporate to the extent that by half distance Gurney was right on his tail. Once the track had begun to dry, however, Hill began to increase his lead once more and, aided by more efficient braking, he ran out the winner by 12sec. This was Graham's third consecutive US GP win to add to his other hat trick completed at Monaco back in May.

Gurney was 45sec ahead of Brabham followed by Bandini and Rodriguez in the flat-12 Ferraris, one lap down. The other 12-cylinder cars from Honda had not proved competitive, once again, although they had both finished: Ginther 2 laps down and Bucknum unclassified. Jochen Rindt had brought

his Cooper into the points for the second time in what had otherwise been a somewhat scrappy first season for him, the one highlight being his fourth place finish at the Nürburgring.

After five seasons and 46 GPs, the 1½-litre F1 was about to have its final fling at Mexico City. Despite the end of term feeling, the Honda team was treating things very seriously and arrived at the circuit two days before official practice to sort out fuel-injection settings and handling. This seemed to pay off as both cars ran well in practice with Ginther qualifying third on the grid behind Clark and Gurney. Ginther flew into the lead from the start, heading Stewart, Spence, Gurney and Hill. Such was his lead at the end of lap 1, Ginther was convinced that he must have laid down an oil slick on which the remainder of the field had spun. In fact, his Honda never missed a beat and, using only 11,000 of his permitted 12,000rpm, he had a lead of 6sec by quarter distance. Behind him Gurney had fought his way into second ahead of Mike Spence by lap 20 and set about closing on the Honda. This proved to be no easy task and, despite his best efforts and a new lap record in the closing stages, he could get no closer than 2.89sec to Ginther whose big smile betrayed his pleasure at his first GP win. At the halfway point in the season Gurney had scored only a single point but a series of top three finishes in the second half had pulled him up to fourth in the Championship. After the two wins in 1964, it was a disappointing season for the Brabham team that, with a little more investment in preparation and testing, could have reaped greater rewards. Finance was never plentiful, however, and Jack ran a tight ship to keep the team within its budget.

Jim Clark had not featured, his engine going sick at the start and lasting only 9 laps, a remarkable lapse in reliability following the team's run of six wins from six starts up to the three-quarter point of the season. BRM team reliability had similarly collapsed with clutch failure for Stewart and a blown engine for Hill in his first non-finish of the year. He had, however, accumulated sufficient points to take the runner-up place in the Championship for the third consecutive year with Stewart in third in his debut season. Jo Siffert was fourth for Rob Walker and Ronnie Bucknum brought the second Honda home fifth for his first finish of the

1965 World Championship – Round 9

Watkins Glen 3 October 1965 110 laps
Starters 18 **Finishers** 11

	Driver	Entrant
1	G Hill	Owen Racing Organisation
2	D Gurney	Brabham Racing Organisation
3	J Brabham	Brabham Racing Organisation
4	L Bandini	Ferrari SpA SEFAC
5	P Rodriguez	North American Racing Team
6	J Rindt	Cooper Car Co
7	R Ginther	Honda R&D Co
8	J Bonnier	RRC Walker Racing Team
9	B Bondurant	Ferrari SpA SEFAC
10	R Attwood	Reg Parnell (Racing)
11	J Siffert	RRC Walker Racing Team
	M Solana	Team Lotus
	R Bucknum	Honda R&D Co
	J Stewart	Owen Racing Organisation
	J Clark	Team Lotus
	B McLaren	Cooper Car Co
	M Spence	Team Lotus
	I Ireland	Reg Parnell (Racing)

Winner's speed 107.98mph (173.773km/h)
Fastest lap G Hill 1m 11.9s, 115.16mph (185.328km/h)

Championship placings (*6 best performances)

Drivers		Constructors	
1. Clark	54	1. Lotus	54
2. G Hill	*40	2. BRM	*45
3. Stewart	*33	3. Ferrari	*26
4. Gurney	19	4. Brabham	*24
5. Surtees	17	5. Cooper	14
6. Bandini	13	6. Brabham (BRM)	2
7. McLaren	10	7. Honda	2
8. Brabham	9	8. Lotus (BRM)	1
9. Spence	6		
10. Hulme	5		

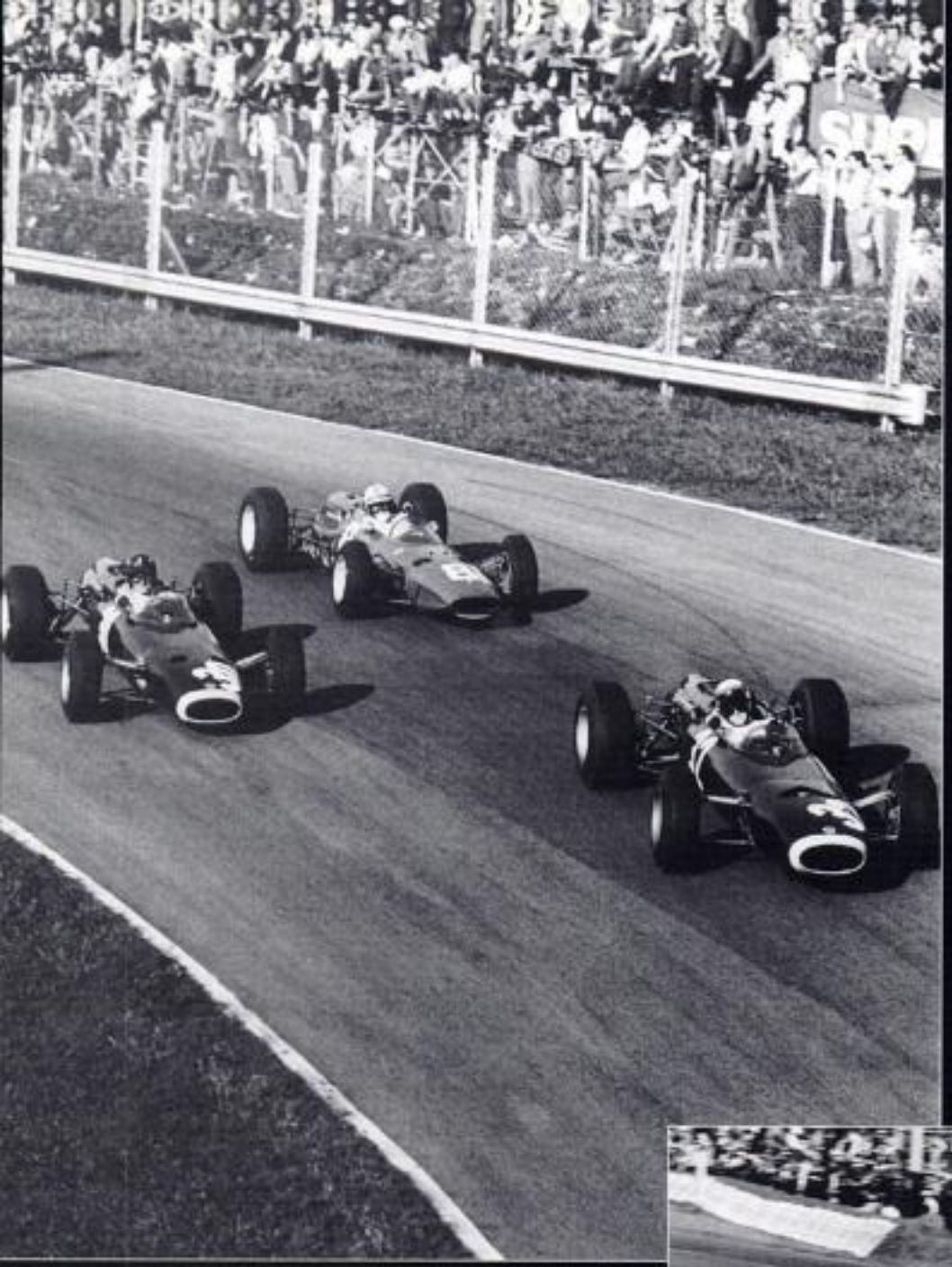
United States Grand Prix

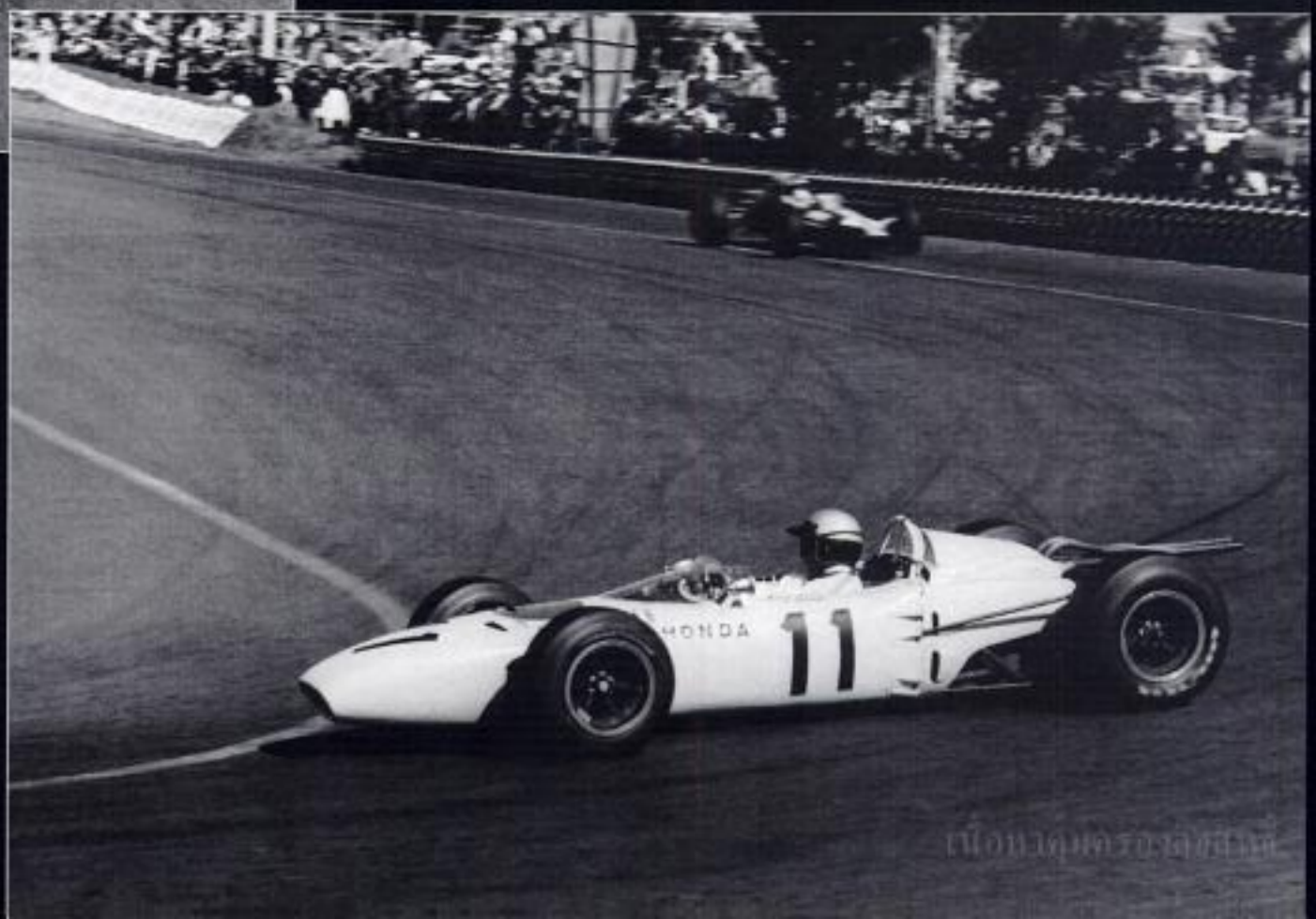
253.00 miles (407.11km)
Weather Windy and showery

Car	Laps	Result
BRM P261 V8	110	2h 20m 36.1s
Brabham BT11 Climax V8	110	2h 20m 48.6s
Brabham BT11 Climax V8	110	2h 21m 33.6s
Ferrari 1512 F12	109	
Ferrari 1512 F12	109	
Cooper T77 Climax V8	108	
Honda RA272 V12	108	
Brabham BT7 Climax V8	107	
Ferrari 158 V8	106	
Lotus 25 BRM V8	101	
Brabham BT11 BRM V8	99	
Lotus 25 Climax V8	95	N/C
Honda RA272 V12	92	N/C
BRM P261 V8	12	Suspension
Lotus 33 Climax V8	11	Piston
Cooper T77 Climax V8	11	Oil pressure
Lotus 33 Climax V8	9	Piston
Lotus 33 BRM V8	9	Driver ill

Grid

Clark 1-11.35	**Hill 1-11.25**
Spence 1-11.50	Ginther 1-11.40
Stewart 1-11.76	Bandini 1-11.73
Gurney 1-12.25	Brabham 1-12.20
Bonnier 1-12.45	McLaren 1-12.45
Bucknum 1-12.70	Siffert 1-12.50
Bondurant 1-12.90	Rindt 1-12.90
Attwood 1-13.70	Rodriguez 1-13.00
Ireland 1-15.00	Solana 1-13.70





Clockwise from above: *Italian GP, Monza, 12 September 1965. Slipstream spectacular: Stewart (BRM P261) holds off teammate Hill (BRM P261) and Surtees (Ferrari 1512); US GP, Watkins Glen, 3 October 1965. Graham Hill, Tony Rudd and BRM mechanics celebrate another hat trick of wins; Mexican GP, Mexico City, 24 October 1965. Ritchie Ginther ahead for Honda and Goodyear. Mike Spence (Lotus 33) follows breathlessly, early in the race.*

1965 World Championship – Round 10

Gran Premio de Mexico

Mexico City 24 October 1965 65 laps
201.93 miles (325.00km)
Starters 17 **Finishers** 8
Weather Warm and sunny

	Driver	Entrant	Car	Laps	Result
1	R Ginther	Honda R&D Co	Honda RA272 V12	65	2h 08m 32.10s
2	D Gurney	Brabham Racing Organisation	Brabham BT11 Climax V8	65	2h 08m 34.99s
3	M Spence	Team Lotus	Lotus 33 Climax V8	65	2h 09m 32.25s
4	J Siffert	RRC Walker Racing Team	Brabham BT11 BRM V8	65	2h 10m 26.52s
5	R Bucknum	Honda R&D Co	Honda RA272 V12	64	
6	R Attwood	Reg Parnell (Racing)	Lotus 25 BRM V8	64	
7	P Rodriguez	North American Racing Team	Ferrari 158 V8	62	
8	L Bandini	Ferrari SpA SEFAC	Ferrari 1512 F12	62	
	G Hill	Owen Racing Organisation	BRM P261 V8	56	Engine
	M Solana	Team Lotus	Lotus 25 Climax V8	55	Electrics
	J Bonnier	RRC Walker Racing Team	Brabham BT7 Climax V8	43	Chassis
	J Rindt	Cooper Car Co	Cooper T77 Climax V8	39	Ignition
	J Brabham	Brabham Racing Organisation	Brabham BT11 Climax V8	38	Oil leak
	J Stewart	Owen Racing Organisation	BRM P261 V8	35	Clutch
	B Bondurant	Reg Parnell (Racing)	Lotus 33 BRM V8	29	Rear suspension
	B McLaren	Cooper Car Co	Cooper T77 Climax V8	25	Gear selector
	J Clark	Team Lotus	Lotus 33 Climax V8	9	Engine

Winner's speed 94.26mph (151.700km/h)
Fastest lap D Gurney 1m 55.84s, 96.59mph (155.387km/h)

Championship placings (*6 best performances)

Drivers		Constructors	
1. Clark	54	1. Lotus	*54
2. G Hill	*40	2. BRM	*45
3. Stewart	*33	3. Brabham	*27
4. Gurney	25	4. Ferrari	*26
5. Surtees	17	5. Cooper	14
6. Bandini	13	6. Honda	11
7. Ginther	11	7. Brabham (BRM)	5
8. McLaren	10	8. Lotus (BRM)	2
Spence	10		
10. Brabham	9		

Grid

	Gurney 1-56.24	**Clark 1-56.17**
Brabham 1-56.78	Ginther 1-56.49	
	Spence 1-57.22	Hill 1-57.06
Stewart 1-57.53	Bandini 1-57.31	
	Bucknum 1-57.88	Solana 1-57.55
Bonnier 1-58.22	Siffert 1-57.94	
	McLaren 1-59.15	Rodriguez 1-59.06
Attwood 2-00.61	Rindt 1-59.30	
		Bondurant 2-00.80

season. Only two Ferraris ran, Rodriguez finishing seventh in a V8 on Firestone tyres with Bandini eighth in a flat-12, both having made pit stops. Bob Bondurant had taken up a last minute offer of a Parnell team Lotus BRM following Innes Ireland's sacking for turning up late for practice.

The final GP of the 1½-litre era had been won, and with it a number of memorable firsts had been achieved – the first GP win for Honda, for Ritchie Ginther and for Goodyear tyres in a formula otherwise monopolised by Dunlop.

Summary of results of non-Championship F1 races

Further defections to F2 left only 5 non-Championship F1 races this season, either in Italy or Britain:

Mexican GP, Mexico City, 24 October 1965. Ritchie and Honda Chief Engineer Nakamura look quite pleased with the afternoon's work.

1965 Points Table

	Drivers	South Africa	Monaco	Belgium	France	Britain	Holland	Germany	Italy	USA	Mexico	Total	Best 6 Scores
1.	Jim Clark	9		9	9	9	9	9	-	-	-	54	54
2.	Graham Hill	4	9	2	2	6	3	6	6	9	-	47	40
3.	Jackie Stewart	1	4	6	6	2	6	-	9	-	-	34	33
4.	Dan Gurney	-		-	-	1	4	4	4	6	6	25	25
5.	John Surtees	6	3	-	4	4	-	-	-			17	17
6.	Lorenzo Bandini	-	6	-	-	-	-	1	3	3	-	13	13
7.	Ritchie Ginther		-	1	-	-	1		-	-	9	11	11
8.	Mike Spence	3		-	-	3	-	-	-	-	4	10	10
	Bruce McLaren	2	2	4	-	-	-	-	2	-	-	10	10
10.	Jack Brabham	-	-	3				2		4	-	9	9
11.	Denis Hulme		-		3	-	2	-	-			5	5
	Jo Siffert	-	1	-	1	-	-	-	-	-	3	5	5
13.	Jochen Rindt	-		-	-	-	-	3	-	1	-	4	4
14.	Pedro Rodriguez									2	-	2	2
	Ronnie Bucknum		-	-	-				-	-	2	2	2
16.	Richard Attwood		-	-		-	-	-	1	-	1	2	2
	Constructors												
1.	Lotus Climax	9		9	9	9	9	9	-	-	4	58	54
2.	BRM	4	9	6	6	6	6	6	9	9	-	61	45
3.	Brabham Climax	-	-	3	3	1	4	4	4	6	6	31	27
4.	Ferrari	6	6	-	4	4	-	1	3	3	-	27	26
5.	Cooper Climax	2	2	4	-	-	-	3	2	1	-	14	14
6.	Honda		-	1	-	-	1		-	-	9	11	11
7.	Brabham BRM	-	1	-	1	-	-	-	-	-	3	5	5
8.	Lotus BRM	-	-	-	-	-	-	-	1	-	1	2	2

Race of Champions, Brands Hatch (GB), 13.3.65, 211.95 miles.
1. M Spence, Lotus 33 Climax V8, 97.20mph. 2. J Stewart, BRM P261 V8. 3. J Bonnier, Brabham BT7 Climax V8. PP: J Clark, Lotus 33 Climax V8. FL: Clark 100.00mph. *Aggregate of 2 heats. Dan Gurney pressures Clark into uncharacteristic error and writes-off Lotus. Rare win for a Lotus number 2 driver.*

Gran Premio di Siracusa, Syracuse (I), 4.4.65, 194.77 miles.
1. J Clark, Lotus 33 Climax V8, 110.60mph. 2. J Surtees, Ferrari 158 V8. 3. L Bandini, Ferrari 1512 F12. PP: Clark. FL: Clark 115.90mph. *Siffert vs Surtees until Jo buzzes engine and Clark slips through for lucky win.*

***Sunday Mirror* Trophy, Goodwood (GB), 19.4.65, 100.80 miles.**
1. J Clark, Lotus 25 Climax V8, 105.07mph. 2. G Hill, BRM P261 V8. 3. J Brabham, Brabham BT11 Climax V8. PP: J Stewart, BRM P261 V8. FL: Clark/Stewart 107.40mph. *Straight forward win for Clark. Siffert demolishes chicane in last ever F1 race at Sussex circuit.*

International Trophy, Silverstone (GB), 15.5.65, 152.36 miles.
1. J Stewart, BRM P261 V8, 111.66mph. 2. J Surtees, Ferrari 158 V8. 3. M Spence, Lotus 33 Climax V8. PP: G Hill, BRM P261 V8. FL: Surtees 113.30mph. *First F1 victory for Stewart after Hill and Brabham fail. Clark and Gurney at Indianapolis.*

Gran Premio del Mediterraneo, Pergusa (I), 15.8.65, 178.80 miles.
1. J Siffert, Brabham BT11 BRM V8, 139.22mph. 2. J Clark, Lotus 25 Climax V8. 3. F Gardner, Brabham BT11 BRM V8. PP: Clark. FL: Clark 141.59mph. *Repeat of 1964 slipstreamer win for Siffert. Spence uninjured after excursion into lake.*

Technical overview: 1965

Engine technology

Four valves per cylinder

The application of four valves per cylinder was not a new idea, of course, having been seen on the successful 1912 Peugeot and 1914 Mercedes GP cars ,and more recently on racing motorcycles. The concept had been ignored for some years as a hemispherical shaped combustion chamber, in which two valves fitted easily, had been considered to be the ideal. Four valves, by contrast, would require a pent-roof-shaped combustion chamber that had not previously proved itself to be advantageous. In the pursuit of higher power outputs, however, four valves provided a potential improvement in breathing at higher operating speeds and an alternative route to reducing reciprocating weight in the valve gear compared to more complex 12 or 16-cylinder engines.

The first indication that 4-valve heads were under consideration during the 1½-litre regulations came from Ferrari where Carlo Chiti had been working on a variety of new cylinder heads for the Dino-based 120° V6, including a 4-valve head. In the event, these heads failed to materialise, Ferrari preferring to go to 12-cylinders in its pursuit of power. Tony Rudd had initiated development of 4-valve heads for the BRM P56 V8 during 1963. Despite giving encouraging results on the airflow rig, the 4-valve heads disappointed on the dynamometer, particularly at the top of the rev range and development was abandoned.

It was left to Coventry Climax to successfully implement 4-valves per cylinder on an existing engine. It had been intended to introduce the 4-valve heads during 1964 and an engine was running early in the year. Initial power output was no better than the 2-valve Mk IV, however, and it took a lot of development before Wally Hassan and Peter Windsor-Smith were able to release some of the potential that they knew existed. The solution, on to which they stumbled almost by accident, lay in greatly advanced

ignition. Allied to other internal modifications, including a switch to gear driven camshafts, they were able to attain some 212bhp. Development had taken so long that the 32-valve engine was not raced until 1965 and then only two engines were built, one each for Team Lotus and Brabham. Jim Clark used his to score three of his six wins, while Brabham's unit never ran successfully.

The only engine designed with 4 valves per cylinder from the outset was the Honda V12. This was no great surprise considering the company's wealth of experience from motorcycle racing that had seen a 250cc 4-valve headed 4-cylinder engine develop 170bhp per litre.

Engine performance 1961-65

As we have already seen (Technical overview: 1964), the key challenge for engine designers had been to achieve the best compromise between volumetric and combustion efficiencies.

	Engine	Max bhp/ rpm	Bhp/litre	Bhp/litre/ 1000rpm
1961	Coventry Climax FPF Mk II	151 @ 7500	100.7	13.4
	Ferrari Dino 156 120° V6	192 @ 9500	128.0	13.5
1962	BRM P56	193 @ 10,250	128.7	12.6
	Coventry Climax FWMV Mk II	186 @ 8500	124.0	14.6
	Porsche type 753	180 @ 9200	120.0	13.0
1963	Coventry Climax FWMV Mk III	195 @ 9500	130.0	13.7
	Ferrari Dino 156 120° V6/63	200 @ 9200	133.3	14.5
1964	BRM P56	208 @ 10,750	138.7	12.9
	Coventry Climax FWMV Mk IV	200 @ 9750	133.3	13.7
	Ferrari 158	210 @ 11,000	140.0	12.7
1965	BRM P56	220 @ 11,750	146.7	12.5
	Coventry Climax FWMV Mk VI	212 @ 10,300	141.3	13.7
	Ferrari 1512	225 @ 11,500	150.0	13.0
	Honda V12	230 @ 11,000	153.3	13.9

One measure of the success, or otherwise, of achieving that compromise was the power output per litre per 1000rpm. The following table illustrates what was achieved during the period:

At the beginning of the formula, both Coventry Climax and Ferrari were evenly matched in terms of bhp/litre/1000rpm, the Ferrari engine's ability to rev higher generating the additional bhp. It has to be said, however, that in the early 1960s it was never entirely clear if there was any relationship between Ferrari 'claimed' and 'actual' engine outputs. Into 1962, with the British V8s on stream, the Climax FWMV with its good spread of power was achieving 14.6bhp/litre/1000rpm while BRM at only 12.6bhp/1000rpm indicated that it had yet to keep volumetric and combustion efficiencies up with rising rpm. BRM, committed to high operating speeds, improved only marginally in 1964 before declining in 1965. Coventry Climax's conservative approach, however, was to increase engine speed in stages and, in so doing, its bhp/1000rpm remained remarkably consistent from the Mk III to the Mk VI versions. It was only beaten by the Honda V12 towards the end of 1965 and one is left to wonder whether the performance that engine demonstrated in winning the Mexican GP would have been repeated had the 1½-litre F1 continued for one more season.

Tyre supply developments

Continued development by Dunlop saw the introduction of the R7 tyre in 1965. While being the same basic design as the 1964 R6, a major advance in compound technology greatly improved grip. In addition, further improvements in tread pattern enhanced its wet weather performance. The latest generation of wide tread tyres was more prone to aquaplaning in the wet until the R7 was modified by reducing the number of rows of tread pattern and widening the circumferential grooves to aid drainage. The improved compound increased traction in both the wet and dry, with claimed reductions in lap times of 2% and 4% respectively.

After six years as the sole supplier of GP rubber, Dunlop faced competition in 1965 from the US tyre company Goodyear. Goodyear had not shown any interest in race tyre production until 1958 when it introduced an all-weather tread pattern for sports car racing. This tyre, the RR1, was used at Le Mans in 1959 by a number of American teams and was used over a season of European endurance races by the Camoradi Maserati team in 1960. The venture into Europe became more serious in 1964 with the establishment of an International Racing Division at Wolverhampton, England, directed by former race driver Fred Gamble. This operation imported tyres from the US to service the Shelby American Cobra challenge in the FIA GT Championship. Tyres were also supplied to entrants in the British Saloon Car Championship, F2, F3 and rallying.

Interest in F1 was aroused when Ritchie Ginther introduced Gamble to BRM's Tony Rudd. BRM tested the tyres but could not race them due to its existing contract with Dunlop. The experience proved useful, however, not just to Goodyear but also as a spur to Dunlop (if one were needed) to further development. Goodyear began race tyre production at Wolverhampton in August 1964 and, with Dan Gurney acting as a catalyst, signed up to supply Brabham with race tyres for the 1965 GP season. A development programme commenced to match the RR series tyre to European conditions, the result being the K type with the WA wet weather tyre. For 1965, the K tyres were available for 13in diameter wheels with tread widths from 6.2 to 7.2in, while the WA 'wets' were available in 9.2 to 11in tread widths, mounted on rim widths of up to 12in – huge for the time.

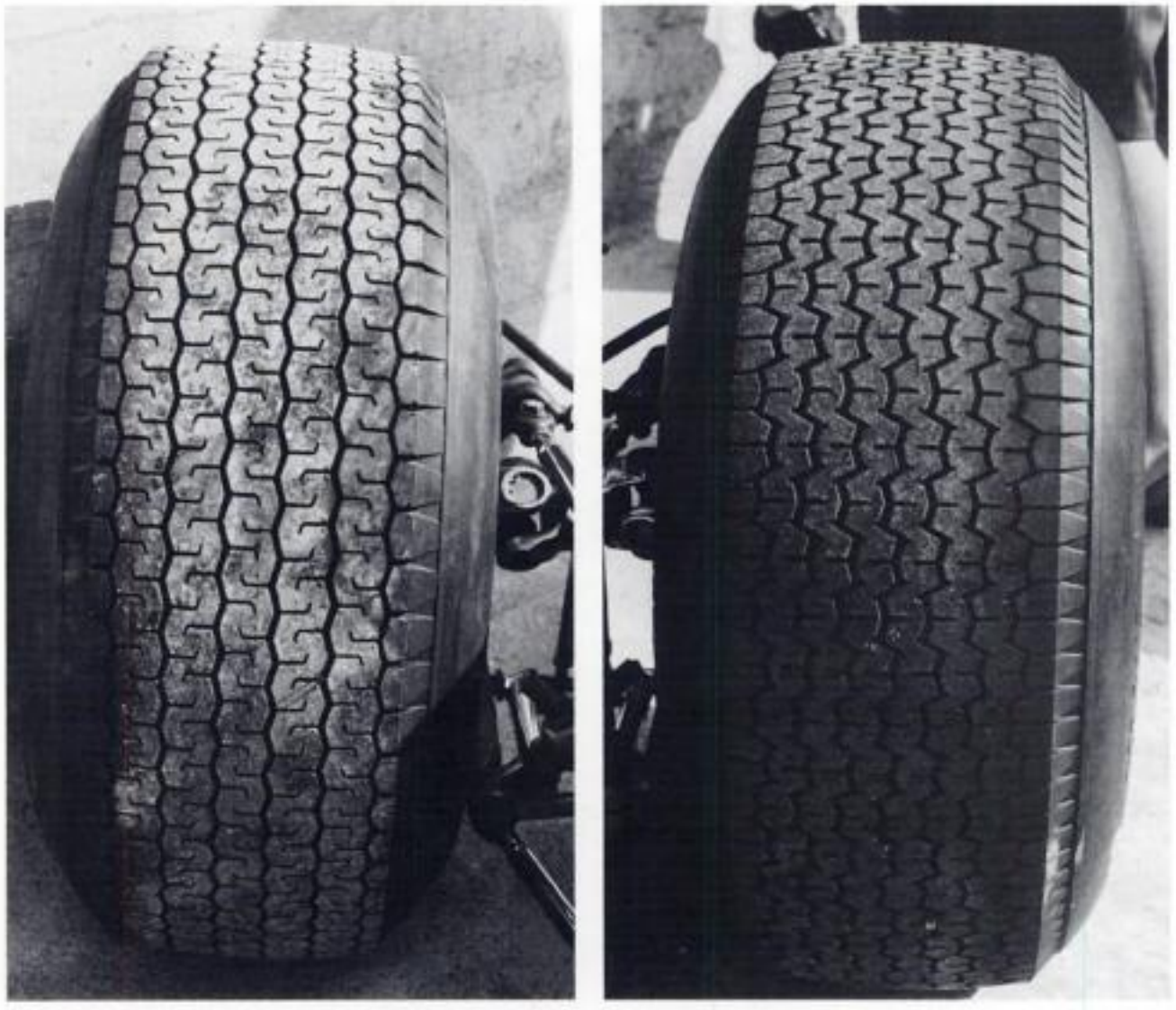
Honda had also signed with Goodyear by the beginning of the European GP season and both BRM and Lotus tried the tyres for comparison purposes while remaining contracted to Dunlop. In testing at Brands Hatch, Jim Clark achieved the first 100mph lap, convincing Goodyear that it had a competitive product. With only the Brabham and Honda teams committed to running the tyres, however, Goodyear did not have a large enough share of the market to prove the point. The Brabhams had a disappointing first half to the season and Honda was busy sorting its V12 engine but, in the final GP of the season, it all came good when Ritchie Ginther scored the maiden victory for Goodyear, with Dan Gurney in second making it a 1-2 finish.

Aerodynamics

Little attention had been given to aerodynamics in the development of the rear-engined GP car up to 1961, body panels being shaped more for aesthetics, or simply to enclose the mechanical elements, than for scientific streamlining. The transition from front-engined to rear-engined cars had reduced frontal areas by nearly 50 per cent, a dramatic gain in any context and more than enough to play with in the short term. The 1961 1½-litre F1 regulations effectively reduced engine power by some 100bhp and banned all-enveloping streamliner bodywork, thus airflow turbulence from the exposed wheels would be common to all constructors. This focussed attention on other ways of making up the power deficit, in particular it was recognised that a reduction in drag was equivalent to an increase in engine power and, hence, straight line speed. Drag is a product of the non-dimensional drag coefficient and the car's frontal area but there would be a trend only towards minimising frontal areas rather than applying any scientific drag reduction theories.

The smaller fuel loads carried by the 1½-litre cars provided scope for further reductions in frontal area, and it was Colin Chapman who lead this quest with the 1961 Lotus 21, the key component of which was the reclining of the driver's seat from the vertical to lower him about 2in down into the cockpit out of the airstream. The arrival of the Lotus 25 in 1962 continued where the 21 had left off and inclined the driver further, to 35° from the horizontal, putting the top of his helmet only marginally higher than the engine carburettor intakes. The elimination of the space frame chassis in favour of monocoque type construction saved internal space and, at a width of just 27.5in, the Lotus 25 was little wider than the Coventry Climax engine that powered it.

In cross section, the Lotus chassis/body was elliptical but with a flattened base in the interests of reasonable ground clearance. Chapman specified tight-fitting, sleek body panels that would encourage the airflow to remain attached for as much of the length of the upper surfaces of the car as possible as drag inducing turbulence is created when the airflow detaches. Inevitably this will have occurred aft of the cockpit opening despite the smoothly faired in sides of the engine. The rounded flanks of the car enabled the drag inducing swirling vortices generated between the speeding underside and static road surface to escape freely. Initially the car wore a tail fairing but this was soon deleted in the interests of transmission cooling and



The first skirmishes in what will become a tyre war in the later '60s – the Dunlop R7 tread pattern for 1965 (left) and the Goodyear WA type reply (right).

the acceptance that it contributed nothing to drag reduction. The front suspension coil spring/damper units were mounted inboard, out of the airstream, although the effect on drag would have been only marginal.

By the beginning of 1964 virtually all the constructors had followed Chapman's lead to produce 'cigar' shaped chassis/body units of varying degrees of slimness, complete with inboard front suspension springing units. Of the major constructors, only Ferrari was reported to have undertaken any wind tunnel development, that on the 1961 'Sharknose' car. While that looked suitably dramatic, it is difficult to see what a twin nostril radiator intake added to the aerodynamics. In any event, this feature was not repeated after 1962. It was left to Jack Brabham and Ron Tauranac to carry out the only serious wind tunnel development. Tauranac knew Malcolm Sayer, who had been responsible for the aerodynamics of the Jaguar D-type, and, through this connection, a Brabham was taken along to the MIRA wind tunnel. This experience taught Brabham and Tauranac the benefits of running the cars closer to the ground to restrict the airflow passing under the nose, reducing the generation of aerodynamic lift. It was noticeable that the bottom edge of the Brabham air intake ran much closer to the road than its competitors, whose ground clearance was generally generous and whose nose cones actually curved upwards away from the road. The slightly more bulky Brabhams were the equal of anyone in a straight line and no doubt the reduction in front end lift contributed to their excellent handling and road holding.

Other drag reduction experimentation centred on the airflow into and out of the front-mounted radiator. In 1963, Cooper fitted the T66 with a small entry, high penetration nose cone that continued rearwards into a sleeker, narrower cockpit opening, although it did not feature in subsequent years. Ferrari

In 1963, Cooper attempted to reduce drag by narrowing the cockpit opening and providing a high penetration nose cone. Bruce McLaren peeks out at Spa during the Belgian GP.

also tried a high penetration nose cone at Spa in 1963 but, once again, it was not seen thereafter. Colin Chapman found that efficient ducting to the radiator both improved efficiency and enabled it to be reduced it size and weight. Some attention was paid to exhausting hot air away from the back of the radiator, if only to relieve the driver of the heat. The hot air was generally persuaded out of the sides or bottom of the car ahead of the front bulkhead, either around a suitably shaped oil tank or by the provision of ducting. The 1964 BRM P261 had two large nostrils cut into the top of the nose cone to achieve the same objective.

Reflections ...

Despite all the reservations and violent objections expressed at its inception, the 1½-litre F1 had proved to be very successful, particularly for the British interests that had originally rubbished it. British drivers and British-built cars had been the dominant force in all but the first season of the formula. Even Ferrari's second Championship year of 1964 owed much to a British driver and British chassis and suspension technologies.

Following the forced retirement of Stirling Moss, a new breed of British driver had come to the fore, and, by the end of the formula, Jim Clark, Graham Hill and John Surtees had become household names. Between them they had accounted for over two-thirds of all GP wins, and each had won a World Championship.

Statistically, the formula had been dominated by the combination of Lotus chassis, Coventry Climax engines and driver Jim Clark. Together they won 19 (40%) of the 47 qualifying GPs and a slightly higher percentage of pole positions and fastest laps. Individually, Lotus chassis won 22 GPs (twice as many as next up BRM) and Coventry Climax had powered over half of all the winners.

Those supposedly 'in the know' had predicted that no engine manufacturer would produce the prohibitively expensive multi-cylinder engines needed to remain competitive in such a small capacity formula. In the event, 8-cylinder engines had been produced by ATS, BRM, Coventry Climax, Ferrari and Porsche, while Ferrari and Honda had moved on to 12-cylinders. Engine speeds had risen to 13,000rpm and power outputs had exceeded 150bhp per litre. Engine technology now embraced fuel-injection, electronic ignition and four valves per cylinder.

A wide variety of chassis manufacturers, not all of which had survived, had contested GPs. Chassis technology had been revolutionised by monocoque type construction and the improvements in structural rigidity had generated more sophisticated suspension technology. Both of these factors would have generated advances in road holding in their own right, however, when allied to advances in tyre technology developed by Dunlop unprecedented levels of grip were made available.

By 1965, the levels of grip available had far outstripped engine power outputs. Most interests within the sport now agreed that it was an appropriate time to reverse the trend and move to more powerful cars in which power outputs exceeded the levels of grip. Nevertheless, the smallest capacity, naturally-aspirated F1 had served its purpose.

7 An evaluation of the leading Grand Prix drivers 1961-65

Evaluating number 1

The choice of the top driver of the 1½-litre F1 can quickly be narrowed down to two names: Stirling Moss and Jim Clark. Choosing between them is infinitely more difficult, not least because Moss competed in only one season to Clark's five. Only in that one season did they compete against each other and, even then, Moss was at his peak and recognised as 'the man to beat'; Clark was still gathering experience but would be ready to inherit Moss' crown following his enforced retirement. If statistics were the only measure, then Clark would top the list with 19 GP wins against the 2 of Moss during the period. It is important to consider other criteria, however, including determination to win, all-round ability, weaknesses and the equipment available to them.

Both men shared the same level of determination to win, second was not good enough. In fact, if they did not win they rarely finished. This applied to all categories of racing, of which Moss had by far the greater breadth of experience – Clark tended to drive only for Lotus, effectively limiting his possibilities. Moss seemed to have no weaknesses at all in his make-up and attitude, whereas there was always a question mark hanging over Clark's ability to cope under pressure, possibly because he had so little experience of it. Clark liked to dictate a race from the front and he had the advantage of a superior car in which to do so, a significant factor in his achievements. Moss' determination to race for Rob Walker's private team meant that he achieved his brilliant successes in 1961 with an inferior car.

In conclusion, there is really no level playing field on which to compare meaningfully their performances; Moss was clearly the number 1 driver of 1961, Clark was number 1 from 1962 to 1965. Taking all factors into consideration, however, Moss takes the top placing on the basis that he appeared to have no weaknesses whatsoever.

1. Stirling Moss

By 1961, Moss was 31 and at the peak of his career. His first regular GP season had been in 1953 and since then he had been runner-up in the World Championship four times, never quite favoured with that extra element of luck to take the title for himself. He was rightly regarded as the man to beat, the standard against which all other drivers were measured, a position that he had inherited on the retirement of the great five-times Champion Juan Fangio in 1958. In such circumstances, the lack of a Championship title seemed of little consequence. He was an outstanding ambassador for the sport and for Britain, and rightly regarded by the public as 'Mr Motor Racing'.

Moss was an immaculate stylist at the wheel who never gave less than 100 per cent and never gave up. Whatever the conditions or situation he was always a potential winner if the car could match his commitment and, even if it could not, he had the ability to compensate for its mechanical deficiencies and still win. He was a true all-rounder, brilliant in a wide variety of cars and categories of racing, slipping easily from F1 to F2, sports cars and GT cars in the space of a single afternoon. His manner of winning varied; if possible he would lead a race from start to finish but he could perform equally well under pressure and was an outstanding wet weather driver.

Moss would have been welcomed into any factory team but he preferred to drive cars entered and prepared by his friend Rob Walker's privately run team. He had total confidence in the mechanics and enjoyed the relaxed atmosphere in the team. Racing for Walker did not allow him the most competitive chassis in 1961 (the Lotus 21) due to conflicting

Stirling Moss – another day, another win.

fuel contracts, leaving him in the position of something of an underdog. He did not object to this challenge but felt the odds were well and truly stacked against him. Nevertheless, he took the fight to the Ferraris, defeating them memorably in his all-time great GP drives at Monaco and the Nürburgring. Moss confided to Rob Walker that he was confident he could handle Clark in 1962, given an equal car. Unfortunately, he never had the chance to prove the point. Whether he would ever have had an equal car is a matter of conjecture but whatever car he had driven, there is no doubt that Moss would have remained competitive and achieved the impossible with it.

2. Jim Clark

Jim Clark's talent in Club racing had taken him into FJ with Team Lotus in 1960, a category he quickly dominated. He had also driven in F2, and Colin Chapman soon promoted him to the F1 team where he had a steady season with a highest placing of third from just eight starts. Clark and the Lotus 21 were something of a disappointment in 1961 except in Holland where he harried Phil Hill's Ferrari for second but had to settle for third. Clark would have been expected to show more of his talent but failed to do so, perhaps because of bad luck, poor preparation or unreliability of his car, or a combination of all three. When the Lotus 21 did win, it was in the hands of Lotus team-mate Innes Ireland. Having said that, however, Moss had been watching Clark, and by the end of the year had recognised him as a potential threat to his position as 'the man to beat'.

Jim Clark – waiting to dominate another day.

At the wheel of the Lotus 25 or 33 Clark drove smoothly, precisely and elegantly in an apparently unhurried fashion. Out of the cockpit, however, the shy, introverted Scot lacked confidence, was never really relaxed, chewed his fingernails and was indecisive. He liked to dictate GPs from the front; invariably starting from pole position, he would set a series of lightning-fast opening laps to put himself clear of his rivals and, thereafter, gradually extend his lead. Despite this, he would not let up, and it was not uncommon for him to set the fastest lap of the race in its closing stages. He would dominate in dry or wet conditions and would not give in to circuits that he disliked. The only question mark hung over his ability to race under pressure as he had so little experience of it, his races usually run lonely at the head of the field, unchallenged from start to finish. He may not have been very technically minded but he knew how to get the best out of his car with an exceptional ability to both nurse an ailing car through to the finish and compensate for any mechanical deficiency it might have.

Colin Chapman, Clark and the revolutionary Lotus 25 quickly became the combination to beat. The relationship between Clark and Chapman developed into the greatest driver/constructor alliance of all time; Clark had complete trust in Chapman while Chapman had complete faith in his driver and was able to provide him with a car vastly superior to any of their rivals. The results, a total of 19 wins and two World Championships (which could have been four given better engine reliability), speak for themselves.

3. Dan Gurney

Dan Gurney won only three GPs between 1961 and 1965, and never came close to challenging for the World Championship, and yet his great friend and rival, Jim Clark, considered him the only driver that he truly feared. Both he and Clark were the class of the field but Gurney never attracted the luck that seemed to favour Clark. The tall Californian was the best American GP driver of the time and a natural at the wheel, with a relaxed style and a tremendous enthusiasm for his racing. Even when his cars failed him he never lost his humour or became bitter. Out of the car he generated natural warmth that endeared him to his legion of fans.

Dan Gurney – a class act.

To some he seemed hard on his cars because he once broke the gear change during a GP and another time the steering wheel. Two instances in 44 GP starts over the period, and his relaxed style, hardly give this theory credence. If he had a failing, it was his tendency to make last minute adjustments to his car prior to the start of a race that added little to its performance. The fact is that he was very fussy about the set up of his car and needed to be convinced that it was as good as it was going to get.

In 1962 his infectious enthusiasm lifted spirits in the Porsche team in the development of the disappointing flat-8 car that rewarded him with his first, long overdue GP victory at Rouen. Driving for Brabham from 1963, he gave the team its first GP victory at the same circuit in 1964, a year in which he was a consistent front runner yet so often frustrated by trivial faults and failures in his car. He excelled on the classic 'drivers' circuits of the Nürburgring and, notably, Spa where, in 1964, he totally dominated the event from pole position until, typically, he ran out of fuel on the last lap.

He was equally at home in sports and GT cars, driving for both Ford and the Shelby Cobra team, and was instrumental in introducing Colin Chapman to the Indianapolis 500 and bringing in Ford to provide engines. While teammate Clark won the event in 1965, it was Gurney's Lotus that would fail to last the distance.

4. Graham Hill

While Moss, Clark and Gurney were regarded as naturals, Graham Hill earned his success through sheer determination and unbelievable single mindedness, having started his career from nothing. That is not to say that he was without talent, he just had to prove it. His early days were spent as a mechanic for Colin Chapman at Lotus, and the technical insight he gained during that period paid-off handsomely in later years in an ability to set a car up to his liking. Having not initially rated him as a driver, Chapman was sufficiently convinced by his performances in Lotus sports racers to bring him into Team Lotus in its formulative years in F1.

Graham Hill – OK, despite excursion into bush.

Hill joined BRM in 1960 and spent the duration of the 1½-litre F1 with the team. His name became synonymous with BRM over this period and he was able to fulfil both his and the team's potential in 1962 with four GP wins and the Drivers' and Constructors' World Championships. This was a timely achievement as BRM was under threat of closure if it failed to achieve any success in the year. Hill remained a consistent front-runner with Clark, Gurney and Surtees over the following three seasons but had to settle for the runner-up position in the Championships in each season, an achievement in itself. He established himself as a master of the demanding Monaco circuit with a memorable hat trick of victories between 1963 and 1965, a feat he repeated in the US GP in the same years. He also established himself as an all-rounder driving Ferraris in sports and GT racing for Maranello Concessionaires.

Over the period he became extremely popular with the public who took to his suave, relaxed and easy-going character and very dry sense of humour. This was one area in which he was easily superior to his rivals.

5. John Surtees

John Surtees is widely remembered as the only man to win World Championships on both two and four wheels, and never has the transition between the two disciplines been made with such ease. Between 1956 and 1960 he was the outstanding rider of the day, winning seven World Titles in the 350cc and 500cc classes for MV Augusta. In March 1960 he made his four-wheel debut, finishing second to an upcoming Jim Clark in an FJ race at Goodwood. By May of that year he had made his F1 debut, driving for Team Lotus when his motorcycle commitments allowed.

Surtees' first full year in F1 coincided with the new 1½-litre formula and he chose to drive for the Reg Parnell-run Yeoman Credit/Bowmaker team to gain experience and learn his craft. He had turned down an offer to drive for Ferrari at the end of 1961 but he accepted a subsequent offer for 1963, feeling the time was right. Ferrari fortunes were at a low ebb but Surtees was able to galvanise the team both as a driver and technically from

John Surtees – pensive.

his experience of developing the Lola chassis in 1962. Efforts to bring Ferrari technology on a par with its British rivals paid off with consecutive wins at the Nürburgring in 1963 and in 1964, the year in which he won the World Championship and a year in which all the teams were evenly matched. Endurance racing priorities in the first half of 1965 slowed development of the flat-12 engine and Ferrari did not build on the 1964 success. Surtees did not win again in a season shortened by a massive accident in his own Lola T70 in Canada.

Never one to mince his words, he was a man who honoured his commitments and stuck to his principles.

6. Phil Hill

Despite being the first American to win the World Championship, Phil Hill was more successful driving Ferraris in endurance races, winning the Le Mans 24 Hours three times as well as most of the other classic races. His success in sports cars held back his single-seater debut, but once Ferrari gave him a drive, his performance ensured his GP future. He was probably at his best in 1960 driving the outclassed, front-engined Ferrari Dino 246 but success came his way in 1961 with the dominant 'Sharknose' Ferrari, garnering two wins, five pole positions and two fastest laps. The World Championship was decided in his favour with a win at Monza in tragic circumstances. Fellow contender Wolfgang von Trips had been killed in a second lap accident, putting a damper on the team's celebrations. Some suggest that, but for the accident, von Trips would have been Champion but only Phil had the foresight to change engines between practice and the race. None of his team-mates had and each one retired with engine failure.

An intelligent and perceptive man, Hill drove with a calm composed style and, like fellow Californian Dan Gurney, he excelled on classic circuits such as Spa and the Nürburgring. His F1 fortunes declined after 1961. Ferrari failed to supply him with an adequate car to defend his title in 1962, and a disastrous year followed with ATS in 1963. After an unhappy 1964 season with Cooper, his F1 career came to an end.

Phil Hill – you talking to me?

7. Jackie Stewart

In 1964 a new F3 category was introduced, and a young Scotsman in a Ken Tyrrell-run Cooper dominated the season. Jackie Stewart's performances impressed Colin Chapman and he was given F2 rides for Lotus. For the 1965 season he was offered F1 drives with BRM and with his friend, Jim Clark, at Lotus. Wisely he chose BRM where, he reasoned, he could learn much from Graham Hill and get more testing time. The Lotus was the better car but no second driver to join Jim Clark had ever made the grade purely because all the emphasis was put on the preparation of Clark's car.

Stewart's assessment paid off and after a careful start to the season, he became the equal of team-mate Hill. Three second places to Clark followed, one on the difficult Clermont Ferrand circuit, establishing him as a serious rival to Clark alongside the established stars Hill, Gurney and Surtees. He then capped his season by beating Hill to win the Italian GP, his first of many. He had shown the signs of the professionalism and the confidence and precision behind the wheel that would mark him out for the future.

Jackie Stewart – not glum, talented.

8. Bruce McLaren

At the age of 22, Bruce McLaren won the 1959 US GP to become the youngest driver ever to win a GP. He had arrived in England on a scholarship from the New Zealand Grand Prix Association, and joined the Cooper team where he was happy to run as number 2 to Jack Brabham in his Championship years, learning much from him. He stayed with Cooper throughout the 1½-litre F1, inheriting leadership of the team when Brabham moved on at the end of 1961 to build his own cars. A GP win came in 1962 with several good placings but Cooper's failure to keep pace with technology condemned it to a decline in fortunes over subsequent years. McLaren always seemed to score well at Spa and Monza but, by 1965, the placings had become fewer and further between despite

Bruce McLaren – waiting to be his own master.

his own input into the design and development process.

By 1964 McLaren had formed Bruce McLaren Motor Racing to pursue his interests in large capacity sports car racing and the Tasman winter series. At the end of 1965 he would leave Cooper to build and run his own F1 cars like his predecessor, Brabham.

A modest and friendly man, McLaren never really looked like a front runner during the period but was usually a consistent points scorer with a best World Championship placing of third in 1962.

Ritchie Ginther – always smiling.

9. Ritchie Ginther

Ritchie Ginther was renowned for his skills as a test and development driver and for his mechanical sympathy. His ability to sense that an engine was about to fail was legendary at Ferrari, which he joined in 1960 as a development driver and occasional racer. He worked on development of the 'Sharknose' Ferrari, gaining a regular F1 drive in 1961 and impressed with his pursuit of Stirling Moss at Monaco. Snubbed by Ferrari at the end of 1961, he took up the offer of a place at BRM alongside Graham Hill, and was heavily involved in the development of the car with which the team achieved its long awaited success. In 1963, he finished in eight out of ten GPs, each time in the points. He went one better in 1964, finishing nine out of ten GPs, but that year he was not always on the pace and he was dumped by BRM management who felt that he was not making best use of the equipment available.

The fledgling Honda team took him on for 1965, bringing to it much needed experience. This move rejuvenated him and he became a front runner with the V12-engined car while it ran. His work for the team came good in Mexico where he achieved an historic first GP win for himself, Honda and Goodyear tyres.

This small and cheerful, freckle faced Californian never considered himself a front runner in the Clark-Hill-Gurney category but was consistent and reliable, and a perfect number 2 team player.

10. Wolfgang von Trips

Graf Berghe Wolfgang von Trips was a dashing and handsome German aristocrat with a passion for racing cars. He was skilled and fearless, perhaps too fearless as he gained something of a reputation in his early years for having substantial accidents. Much of his early career was spent in sports cars, notably with Porsches, with only occasional GP drives. In 1960, he finally gained a permanent seat in the Ferrari GP team and began to settle down.

For the 1961 season he was torn between moving to Porsche or staying with Ferrari. He chose the latter and seemed to be gaining a new maturity in the 'Sharknose' Ferrari, winning two GPs. Going into the Italian GP he was leading the World Championship from team-mate Phil Hill. On the second lap he clipped Jim Clark's Lotus, lost control and crashed to his death in an accident that also took the lives of fourteen spectators.

Wolfgang von Trips – lost hero.

11. Jack Brabham

World Champion in 1959 and 1960,

Brabham achieved his ambition of building his own cars. Stood back to run as number 2 to Dan Gurney between 1963 and 1965.

12. Lorenzo Bandini
A loyal number 2 to John Surtees and Ferrari, who had yet to prove his talent. Happy to race for his home team.

13. Jo Siffert
A fearless Swiss, but never a polished driver, whose commitment overcame lack of finance to take him into F1. Top private entrant of 1963 and 1965, the latter with the Walker Team.

14. Tony Maggs
A consistent and talented South African who suffered as Cooper fortunes declined. Lingered into 1964 with Centro Sud BRMs before retiring in 1965.

15. Peter Arundell
Seemed to be getting the better of the traditional number 2 status at Team Lotus until a big accident in F2 ended his aspirations.

16. Chris Amon
Talent spotted by Reg Parnell on his home circuits in New Zealand and Australia. Little luck in Reg's under-funded team but better times lay ahead.

17. Bob Anderson
An ex-motorcyclist who achieved some good placings in an under-funded team, winning 1964's best private entrant award.

18. Innes Ireland
Born too late to join with other fun loving, smoking and drinking F1 drivers of the 1950s. Dumped after winning first GP for Team Lotus in 1961. Some good finishes for BRP but not the driver he could have been.

19. Mike Spence
Deputised for Peter Arundell as No.2 at Team Lotus and tried hard to duck out of the shadow of Jim Clark.

20. Jochen Rindt
A talent equal to that of Jackie Stewart demonstrated in F2 during 1964. A contract with a declining Cooper was never likely to do him any favours and it would be a few years before he was able to realise his true promise.

All point scorers 1961-65

	Driver	1st	2nd	3rd	4th	5th	6th	Gross points	PP	FL
1.	Jim Clark	19	1	3	3	1	-	200	24	22
2.	Graham Hill	10	8	4	4	4	2	172	8	7
3.	John Surtees	3	7	4	3	4	-	102	4	5
4.	Dan Gurney	3	7	5	-	3	4	99	3	4
5.	Ritchie Ginther	1	7	5	5	3	2	94	-	2
6.	Bruce McLaren	1	4	7	3	5	3	83	-	1
7.	Phil Hill	2	3	4	-	-	1	53	5	2
8.	Jack Brabham	-	1	3	7	3	2	47	1	2
9.	Lorenzo Bandini	1	1	4	2	4	1	46		
10.	Jackie Stewart	1	3	1	-	1	1	34		
11.	Wolfgang von Trips	2	2	-	1	-	-	33	1	-
12.	Tony Maggs	-	2	1	1	2	3	26		
13.	Innes Ireland	1	-	-	3	3	-	24		
14.	Stirling Moss	2	-	-	1	-	-	21	1	1
15.	Jo Bonnier	-	-	-	-	5	5	15		
16.	Giancarlo Baghetti	1	-	-	1	1	-	14	-	1
	Mike Spence	-	-	1	3	-	1	14		
18.	Jo Siffert	-	-	1	2	-	3	13		
19.	Peter Arundell	-	-	2	1	-	-	11		
20.	Trevor Taylor	-	1	-	-	-	2	8		
21.	Tony Brooks	-	-	1	-	1	-	6	-	1
22.	Bob Anderson	-	-	1	-	-	1	5		
	Denis Hulme	-	-	-	1	1	-	5		
24.	Ricardo Rodriguez	-	-	-	1	-	1	4		
	Godin de Beaufort	-	-	-	-	-	4	4		
	Jochen Rindt	-	-	-	1	-	1	4		
27.	Olivier Gendebien	-	-	-	1	-	-	3		
	Jack Lewis	-	-	-	1	-	-	3		
	Willy Mairesse	-	-	-	1	-	-	3		
	Gerhard Mitter	-	-	-	1	-	-	3		
	Jim Hall	-	-	-	-	1	1	3		
	Pedro Rodriguez	-	-	-	-	1	1	3		
33.	Roy Salvadori	-	-	-	-	-	2	2		
	Chris Amon	-	-	-	-	1	-	2		
	Maurice Trintignant	-	-	-	-	1	-	2		
	Walt Hansgen	-	-	-	-	1	-	2		
	Ronnie Bucknum	-	-	-	-	1	-	2		
	Richard Attwood	-	-	-	-	-	2	2		
39.	Masten Gregory	-	-	-	-	-	1	1		
40.	Neville Lederle	-	-	-	-	-	1	1		
	Lodovico Scarfiotti	-	-	-	-	-	1	1		
	Mike Hailwood	-	-	-	-	-	1	1		

World Championship placings (top 15 point scorers):						
	Driver	**1961**	**1962**	**1963**	**1964**	**1965**
1.	Jim Clark	7th	2nd	1st	3rd	1st
2.	Graham Hill	15th=	1st	2nd	2nd	2nd
3.	John Surtees	12th	4th	4th	1st	5th
4.	Dan Gurney	4th	5th	5th	6th	4th
5.	Ritchie Ginther	5th	8th	3rd	5th	7th
6.	Bruce McLaren	8th	3rd	6th	7th	9th
7.	Phil Hill	1st	6th	-	12th=	
8.	Jack Brabham	11th	9th	7th	9th	10th
9.	Lorenzo Bandini	-	12th	10th	4th	6th
10.	Jackie Stewart					3rd
11.	Wolfgang von Trips	2nd				
12.	Tony Maggs	-	7th	8th	12th=	-
13.	Innes Ireland	6th	16th	9th	14th	-
14.	Stirling Moss	3rd				
15.	Jo Bonnier	15th=	15th	11th	15th	-

Who drove what, when, and for whom

Record of drivers who started in one or more Grands Prix between 1961 & 1965

Year	Chassis	Engine	Entrant	Starts	Finishes	Wins	2nd	3rd	4th	5th	6th	Points	PP	FL
ALLISON, Cliff (GB) 8.2.32 – 7.4.05														
1961	Lotus 18	Climax 4	UDT-Laystall Racing Team	1	1									
AMON, Chris (NZ) b. 20.7.43														
1963	Lola Mk 4	Climax V8	Reg Parnell (Racing)	5	2	-	-	-	-	-	-	-	-	-
	Lotus 24	BRM V8	Reg Parnell (Racing)	1	-									
1964	Lotus 25	BRM V8	Reg Parnell (Racing)	8	2	-	-	-	-	1	-	2	-	-
1965	Lotus 25	BRM V8	Reg Parnell (Racing)	2	-									
			Total	16	4	-	-	-	-	1	-	2	-	-
ANDERSON, Bob (GB) 19.5.31 – 14.8.67														
1963	Lola Mk 4	Climax V8	DW Racing Enterprises	2	2	-	-	-	-	-	-	-	-	-
1964	Brabham BT11	Climax V8	DW Racing Enterprises	7	4	-	-	1	-	-	1	5		
1965	Brabham BT11	Climax V8	DW Racing Enterprises	5	-									
			Total	14	6	-	-	1	-	-	1	5	-	-
ARUNDELL, Peter (GB) b. 8.11.33														
1964	Lotus 25	Climax V8	Team Lotus	4	3	-	-	2	1	-	-	11	-	-
ASHMORE, Gerry (GB) b. 25.7.36														
1961	Lotus 18	Climax 4	Gerry Ashmore	3	1									
1962	Lotus 18	Climax 4	Gerry Ashmore	-										
ATTWOOD, Richard (GB) b. 4.4.40														
1965	Lotus 25	BRM V8	Reg Parnell (Racing)	8	4	-	-	-	-	-	2	2	-	-

Year	Chassis	Engine	Entrant	Starts	Finishes	Wins	2nd	3rd	4th	5th	6th	Points	PP	FL
BAGHETTI, Giancarlo (I) 25.3.34 – 27.11.95														
1961	Ferrari 156	Ferrari V6	FISA/ Scud Sant Ambroeus	3	1	1	-	-	-	-	-	9	-	1
1962	Ferrari 156	Ferrari V6	Ferrari SpA SEFAC	4	3	-	-	-	1	1	-	5	-	-
1963	ATS T100	ATS V8	Automobili Tourismo e Sport	5	-									
1964	BRM P578	BRM V8	Scuderia Centro Sud	6	5	-	-	-	-	-	-	-	-	-
1965	Brabham BT7	Climax V8	Brabham Racing Organisation	1	-									
			Total	19	9	1	-	-	1	1	-	14	-	1
BANDINI, Lorenzo (I) 21.12.35 – 10.5.67														
1961	Cooper T53	Maserati 4	Scuderia Centro Sud	4	2	-	-	-	-	-	-	-	-	-
1962	Ferrari 156	Ferrari V6	Ferrari SpA SEFAC	3	2	-	-	1	-	-	-	4	-	-
1963	BRM P578	BRM V8	Scuderia Centro Sud	3	2	-	-	-	-	1	-	2	-	-
	Ferrari 156	Ferrari V6	Ferrari SpA SEFAC	2	1	-	-	-	-	1	-	2	-	-
	Ferrari Aero	Ferrari V6	Ferrari SpA SEFAC	2	1	-	-	-	-	1	-	2	-	-
1964	Ferrari Aero	Ferrari V6	Ferrari SpA SEFAC	4	3	1	-	1	-	1	-	15	-	-
	Ferrari 158	Ferrari V8	Ferrari SpA SEFAC	4	2	-	-	1	-	-	-	4	-	-
	Ferrari 1512	Ferrari F12	Ferrari SpA SEFAC	2	1	-	-	1	-	-	-	4	-	-
1965	Ferrari 158	Ferrari V8	Ferrari SpA SEFAC	3	2	-	-	-	-	-	1	1	-	-
	Ferrari 1512	Ferrari F12	Ferrari SpA SEFAC	7	6	-	1	-	2	-	-	12	-	-
			Total	34	22	1	1	4	2	4	1	46	-	-
BARTH, Edgar (D) 26.11.17 – 20.5.65														
1964	Cooper T66	Climax V8	RRC Walker Racing Team	1	-									
BASSI, Giorgio (I) b. 20.1.34														
1965	BRM P578	BRM V8	Scuderia Centro Sud	1	-									
de BEAUFORT, Carel Godin (NL) 10.4.34 – 3.8.64														
1961	Porsche 718	Porsche F4	Ecurie Maarsbergen	6	5	-	-	-	-	-	-	-	-	-
1962	Porsche 718	Porsche F4	Ecurie Maarsbergen	8	6	-	-	-	-	-	2	2	-	-
1963	Porsche 718	Porsche F4	Ecurie Maarsbergen	7	6	-	-	-	-	-	2	2	-	-
1964	Porsche 718	Porsche F4	Ecurie Maarsbergen	1	-									
			Total	22	17	-	-	-	-	-	4	4	-	-
BIANCHI, Lucien (B) 10.11.34 – 30.3.69														
1961	Lotus 18	Climax 4	Equipe National Belge	1	-									
	Emeryson	Maserati 4	Equipe National Belge	-										
	Lotus 18/21	Climax 4	UDT-Laystall Racing Team	2	-									
1962	ENB	Maserati 4	Equipe National Belge	1	1									
	Lotus 18	Climax 4	Equipe National Belge	1	1									
1963	Lola Mk 4	Climax V8	Reg Parnell (Racing)	1	-									
1965	BRM P578	BRM V8	Scuderia Centro Sud	1	1									
			Total	7	3									
BLOKDYK, Trevor (ZA) b. 30.11.35														
1963	Cooper T51	Maserati 4	Trevor Blokdyk	1	1									
1965	Cooper T59	Ford 4	Trevor Blokdyk	-										

Year	Chassis	Engine	Entrant	Starts	Finishes	Wins	2nd	3rd	4th	5th	6th	Points	PP	FL
BONDURANT, Bob (USA) b. 27.4.33														
1965	Ferrari 158	Ferrari V8	North American Racing Team	1	1									
	Lotus 33	BRM V8	Reg Parnell (Racing)	1	-									
BONNIER, Joakim (S) 30.11.30 – 11.6.72														
1961	Porsche 787	Porsche F4	Dr Ing hc F Porsche KG	2	1	-	-	-	-	-	-	-	-	-
	Porsche 718	Porsche F4	Dr Ing hc F Porsche KG	6	4	-	-	-	-	1	1	3	-	-
1962	Porsche 804	Porsche F8	Porsche System Engineering	6	3	-	-	-	-	-	1	1	-	-
	Porsche 718	Porsche F4	Porsche System Engineering	1	1	-	-	-	-	1	-	2	-	-
1963	Cooper T60	Climax V8	RRC Walker Racing Team	4	2	-	-	-	-	1	-	2	-	-
	Cooper T66	Climax V8	RRC Walker Racing Team	6	4	-	-	-	-	1	2	4	-	-
1964	Cooper T66	Climax V8	RRC Walker Racing Team	1	1	-	-	-	-	1	-	2	-	-
	Brabham BT11	BRM V8	RRC Walker Racing Team	4	1	-	-	-	-	-	-	-	-	-
	Brabham BT7	Climax V8	RRC Walker Racing Team	4	2	-	-	-	-	-	1	1	-	-
1965	Brabham BT7	Climax V8	RRC Walker Racing Team	10	5	-	-	-	-	-	-	-	-	-
			Total	44	24	-	-	-	-	5	5	15	-	-
BRABHAM, Jack (AUS) b. 2.4.26														
1961	Cooper T55	Climax 4	Cooper Car Co	5	2	-	-	-	1	-	1	4	-	-
	Cooper T58	Climax V8	Cooper Car Co	3	-	-	-	-	-	-	-	-	1	1
1962	Lotus 24	Climax V8	Brabham Racing Organisation	5	2	-	-	-	-	1	1	3	-	-
	Brabham BT3	Climax V8	Brabham Racing Organisation	3	2	-	-	-	2	-	-	6	-	-
1963	Brabham BT3	Climax V8	Brabham Racing Organisation	2	1	-	-	-	-	1	-	2	-	-
	Lotus 25	Climax V8	Brabham Racing Organisation	1	-									
	Brabham BT7	Climax V8	Brabham Racing Organisation	7	4	-	1	-	2	-	-	12	-	-
1964	Brabham BT7	Climax V8	Brabham Racing Organisation	6	3	-	-	2	1	-	-	11	-	1
	Brabham BT11	Climax V8	Brabham Racing Organisation	4	-									
1965	Brabham BT11	Climax V8	Brabham Racing Organisation	6	4	-	-	1	1	1	-	9	-	-
			Total	42	18	-	1	3	7	3	2	47	1	2
BROEKER, Peter (CDN) b. 15.5.29														
1963	Stebro Mk 4	Ford 4	Canadian Stebro Racing	1	-									
BROOKS, Tony (GB) b. 25.2.32														
1961	BRM P57	Climax 4	Owen Racing Organisation	8	4	-	-	1	-	1	-	6	-	1
BUCKNUM, Ronnie (USA) 5.4.36 – Apr. 92														
1964	Honda RA271	Honda V12	Honda R&D Co	3	-									
1965	Honda RA272	Honda V12	Honda R&D Co	6	1	-	-	-	-	1	-	2	-	-
BURGESS, Ian (GB) b. 6.7.30														
1961	Lotus 18	Climax 4	Camoradi International	2	2									
	Cooper T53	Climax 4	Camoradi International	1	1									
1962	Cooper T59 Sp	Climax 4	Anglo American Equipe	2	2									
1963	Scirocco	BRM V8	Scirocco-Powell Racing	2	-									
			Total	7	5									

Year	Chassis	Engine	Entrant	Starts	Finishes	Wins	2nd	3rd	4th	5th	6th	Points	PP	FL
BUSINELLO, Roberto (I) b. 4.10.27														
1961	de Tomaso	Alfa Romeo 4	Scuderia de Tomaso	1	-									
1965	BRM P578	BRM V8	Scuderia Centro Sud	1	-									
CABRAL, Mario (P) b. 15.1.34														
1963	Cooper T60	Climax V8	Scuderia Centro Sud	1	-									
1964	ATS T100	ATS V8	Derrington-Francis Racing Team	1	-									
CAMPBELL-JONES, John (GB) b. 21.1.30														
1962	Lotus 18	Climax 4	Emeryson Cars	1	-									
1963	Lola Mk 4	Climax V8	Reg Parnell (Racing)	1	1									
CHAMBERLAIN, Jay (USA)														
1962	Lotus 18/21	Climax 4	Ecurie Excelsior	1	-									
CLARK, Jim (GB) 4.3.36 – 7.4.68				**World Champion 1963 and 1965**										
1961	Lotus 21	Climax 4	Team Lotus	8	5	-	-	2	1	-	-	11	-	1
1962	Lotus 25	Climax V8	Team Lotus	9	4	3	-	-	1	-	-	30	6	5
1963	Lotus 25	Climax V8	Team Lotus	10	9	7	1	1	-	-	-	73	7	6
1964	Lotus 25	Climax V8	Team Lotus	7	4	3	-	-	1	-	-	30	4	3
	Lotus 33	Climax V8	Team Lotus	3	1	-	-	-	-	1	-	2	1	1
1965	Lotus 25	Climax V8	Team Lotus	1	1	1	-	-	-	-	-	9	1	1
	Lotus 33	Climax V8	Team Lotus	8	5	5	-	-	-	-	-	45	5	5
			Total	46	29	19	1	3	3	1	-	200	24	22
COLLOMB, Bernard (F) b. 7.10.30														
1961	Cooper T53	Climax 4	Bernard Collomb	2	-									
1962	Cooper T53	Climax 4	Bernard Collomb	1	-									
1963	Lotus 24	Climax V8	Bernard Collomb	1	-									
FAIRMAN, Jack (GB) 15.3.13 – Fe02														
1961	Ferguson P99	Climax 4	RRC Walker Racing Team	1	-									
	Cooper T45	Climax 4	Fred Tuck Cars Ltd	1	-									
GARDNER, Frank (AUS) b. 1.10.30														
1964	Brabham BT10	Ford 4	John Willment (Automobiles)	1	-									
1965	Brabham BT11	BRM V8	John Willment (Automobiles)	7	2									
'GEKI' (Russo, Giacomo) (I) 23.10.37 – 18.6.67														
1964	Brabham BT11	BRM V8	RRC Walker Racing Team	-										
1965	Lotus 25	Climax V8	Team Lotus	1	-									
GENDEBIEN, Olivier (B) 12.1.24 – 2.10.98														
1961	Emeryson	Maserati 4	Equipe National Belge	-										
	Ferrari 156	Ferrari V6		1	1	-	-	-	1	-	-	3	-	-

Year	Chassis	Engine	Entrant	Starts	Finishes	Wins	2nd	3rd	4th	5th	6th	Points	PP	FL
GINTHER, Ritchie (USA) 5.8.30 – 28.9.89														
1961	Ferrari 156	Ferrari V6	Ferrari Spa SEFAC	7	5	-	1	2	-	1	-	16	-	2
1962	BRM P57	BRM V8	Owen Racing Organisation	2	-	-	-	-	-	-	-	-	-	-
	BRM P578	BRM V8	Owen Racing Organisation	7	5	-	1	1	-	-	-	10	-	-
1963	BRM P578	BRM V8	Owen Racing Organisation	10	8	-	3	2	2	1	-	34	-	-
1964	BRM P261	BRM V8	Owen Racing Organisation	10	9	-	2	-	3	1	-	23	-	-
1965	Honda RA272	Honda V12	Honda R&D Co	8	4	1	-	-	-	-	2	11	-	-
			Total	44	31	1	7	5	5	3	2	94	-	2
GREENE, Keith (GB) b. 5.1.38														
1961	Gilby	Climax 4	Gilby Engineering Co	1	1									
1962	Gilby	BRM V8	Gilby Engineering Co	1	-									
GREGORY, Masten (USA) 29.2.32 – 8.11.85														
1961	Cooper T53	Climax 4	Camoradi International	3	3	-	-	-	-	-	-	-	-	-
	Lotus 18/21	Climax 4	UDT-Laystall Racing Team	2	-									
1962	Lotus 18/21	Climax 4	UDT-Laystall Racing Team	1	-									
	Lotus 24	BRM V8	UDT-Laystall Racing Team	4	2	-	-	-	-	-	1	1	-	-
	Lotus 24	Climax V8	UDT-Laystall Racing Team	1	1	-	-	-	-	-	-	-	-	-
1963	Lola Mk 4	Climax V8	Reg Parnell (Racing)	2	-									
	Lotus 24	BRM V8	Reg Parnell (Racing)	3	1									
1965	BRM P578	BRM V8	Scuderia Centro Sud	4	1	-	-	-	-	-	-	-	-	-
			Total	20	8	-	-	-	-	-	1	1	-	-

Year	Chassis	Engine	Entrant	Starts	Finishes	Wins	2nd	3rd	4th	5th	6th	Points	PP	FL
GURNEY, Dan (USA) b. 13.4.31														
1961	Porsche 718	Porsche F4	Dr Ing hc F Porsche KG	7	7	-	3	-	-	1	1	21	-	-
	Porsche 787	Porsche F4	Dr Ing hc F Porsche KG	1	1	-	-	-	-	-	-	-	-	-
1962	Porsche 804	Porsche F8	Porsche System Engineering	7	4	1	-	1	-	1	-	15	1	-
	Lotus 24	BRM V8	Autosport Team Wolf. Seidel	-										
1963	Brabham BT7	Climax V8	Brabham Racing Organisation	10	5	-	2	1	-	1	1	19	-	1
1964	Brabham BT7	Climax V8	Brabham Racing Organisation	10	5	2	-	-	-	-	1	19	2	2
1965	Brabham BT11	Climax V8	Brabham Racing Organisation	9	7	-	2	3	-	-	1	25	-	1
			Total	44	29	3	7	5	-	3	4	99	3	4
HAILWOOD, Mike (GB) 2.4.40 – 23.3.81														
1963	Lotus 24	Climax V8	Reg Parnell (Racing)	1	1	-	-	-	-	-	-	-	-	-
	Lola Mk 4	Climax V8	Reg Parnell (Racing)	1	1	-	-	-	-	-	-	-	-	-
1964	Lotus 25	BRM V8	Reg Parnell (Racing)	9	4	-	-	-	-	-	1	1	-	-
1965	Lotus 25	BRM V8	Reg Parnell (Racing)	1	-									
			Total	12	6	-	-	-	-	-	1	1	-	-
HALL, Jim (USA) b. 23.7.35														
1961	Lotus 18	Climax 4	Jim Hall	1	-									
1962	Lotus 21	Climax 4	Jim Hall	-										
1963	Lotus 24	BRM V8	British Racing Partnership	9	6	-	-	-	-	1	1	3	-	-
			Total	10	6	-	-	-	-	1	1	3	-	-

Year	Chassis	Engine	Entrant	Starts	Finishes	Wins	2nd	3rd	4th	5th	6th	Points	PP	FL
HANSGEN, Walt (USA) 28.10.19 – 7.4.66														
1961	Cooper T53	Climax 4	Momo Corporation	1	-									
1964	Lotus 33	Climax V8	Team Lotus	1	1	-	-	-	-	1	-	2	-	-
HARRIS, Mike (ZA) b. 25.5.39														
1962	Cooper T53	Alfa Romeo 4	Mike Harris	1	-									
HAWKINS, Paul (AUS) 12.10.37 – 26.5.69														
1965	Brabham BT10	Ford 4	John Willment (Automobiles)	1	1									
	Lotus 33	Climax V8	DW Racing Enterprises	2	-									
HERRMAN, Hans (D) b. 23.2.38														
1961	Porsche 718	Porsche F4	Dr Ing hc F Porsche KG	2	2									
	Porsche 718	Porsche F4	Ecurie Maarsbergen	1	1									
HILL, Graham (GB) 15.2.29 – 29.11.75				**World Champion 1962**										
1961	BRM P57	Climax 4	Owen Racing Organisation	8	3	-	-	-	-	1	1	3	-	-
1962	BRM P578	BRM V8	Owen Racing Organisation	9	8	4	2	-	1	-	1	52	1	3
1963	BRM P578	BRM V8	Owen Racing Organisation	8	5	2	-	2	1	-	-	29	2	-
	BRM P61	BRM V8	Owen Racing Organisation	2	1	-	-	1	-	-	-	-	-	-
1964	BRM P261	BRM V8	Owen Racing Organisation	10	8	2	3	-	1	1	-	41	1	1
1965	BRM P261	BRM V8	Owen Racing Organisation	10	9	2	3	1	1	2	-	47	4	3
			Total	47	34	10	8	4	4	4	2	172	8	7

Year	Chassis	Engine	Entrant	Starts	Finishes	Wins	2nd	3rd	4th	5th	6th	Points	PP	FL
HILL, Phil (USA) b. 20.4.27				**World Champion 1961**										
1961	Ferrari 156	Ferrari V6	Ferrari SpA SEFAC	7	7	2	2	2	-	-	-	38	5	2
1962	Ferrari 156	Ferrari V6	Ferrari SpA SEFAC	6	4	-	1	2	-	-	-	14	-	-
1963	ATS T100	ATS V8	Automobili Tourismo e Sport	5	1	-	-	-	-	-	-	-	-	-
	Lotus 24	BRM V8	Ecurie Filipinetti	1	-									
1964	Cooper T66	Climax V8	Cooper Car Co	1	-									
	Cooper T73	Climax V8	Cooper Car Co	8	3	-	-	-	-	-	1	1	-	-
			Total	28	15	2	3	4	-	-	1	53	5	2
HULME, Dennis (NZ) 18.6.36 – 4.10.92														
1965	Brabham BT7	Climax V8	Brabham Racing Organisation	3	1	-	-	-	-	-	-	-	-	-
	Brabham BT11	Climax V8	Brabham Racing Organisation	3	2	-	-	-	1	1	-	5	-	-
IRELAND, Innes (GB) 12.6.30 – 22.10.93														
1961	Lotus 21	Climax 4	Team Lotus	5	3	1	-	-	1	-	-	12	-	-
	Lotus 18/21	Climax 4	Team Lotus	1	-									
1962	Lotus 24	Climax V8	UDT-Laystall Racing Team	8	2	-	-	-	-	1	-	2	-	-
1963	Lotus 24	BRM V8	British Racing Partnership	2	-									
	BRP	BRM V8	British Racing Partnership	5	3	-	-	-	2	-	-	6	-	-
1964	BRP	BRM V8	British Racing Partnership	7	5	-	-	-	-	2	-	4	-	-
1965	Lotus 25	BRM V8	Reg Parnell (Racing)	4	1	-	-	-	-	-	-	-	-	-
	Lotus 33	BRM V8	Reg Parnell (Racing)	2	1	-	-	-	-	-	-	-	-	-
			Total	34	15	1	-	-	3	3	-	24	-	-

Year	Chassis	Engine	Entrant	Starts	Finishes	Wins	2nd	3rd	4th	5th	6th	Points	PP	FL
JOHNSTONE, Bruce (ZA) b. 30.1.37														
1962	BRM P57	BRM V8	Owen Racing Organisation	1	1									
de KLERK, Peter (ZA) b. 16.3.36														
1963	Alfa Special	Alfa Romeo 4	Otelle Nucci	1	-									
1965	Alfa Special	Alfa Romeo 4	Otelle Nucci	1	1									
LEDERLE, Neville (ZA) b. 25.9.39														
1962	Lotus 21	Climax 4	NA Lederle	1	1	-	-	-	-	-	1	1	-	-
1965	Lotus 21	Climax 4	Scuderia Scribante	-	-									
LEWIS, Jack (GB) b. 1.11.36														
1961	Cooper T53	Climax 4	H&L Motors	5	3	-	-	-	1	-	-	3	-	-
1962	BRM P57	BRM V8	Ecurie Galloise	-										
	Cooper T53	Climax 4	Ecurie Galloise	4	1	-	-	-	-	-	-	-	-	-
LIPPI, Roberto (I) b. 17.10.26														
1961	de Tomaso	OSCA 4	Scuderia Settecolli	1	-									
1962	de Tomaso	OSCA 4	Scuderia Settecolli	-										
1963	de Tomaso	Ferrari V6	Scuderia Settecolli	-										
LOVE, John (RSR) 7.12.24 – Apr 05														
1962	Cooper T55	Climax 4	John Love	1	1									
1963	Cooper T55	Climax 4	John Love	1	1									
1964	Cooper T73	Climax V8	Cooper Car Co	-										
1965	Cooper T55	Climax 4	John Love	1	-									
McLAREN, Bruce (NZ) 30.8.37 – 2.7.70														
1961	Cooper T55	Climax 4	Cooper Car Co	8	7	-	-	1	1	1	2	11	-	-
1962	Cooper T60	Climax V8	Cooper Car Co	9	7	1	1	3	1	1	-	32	-	1
1963	Cooper T66	Climax V8	Cooper Car Co	10	4	-	1	2	1	-	-	17	-	-
1964	Cooper T66	Climax V8	Cooper Car Co	1	-								-	-
	Cooper T73	Climax V8	Cooper Car Co	9	5	-	2	-	-	-	1	13	-	-
1965	Cooper T73	Climax V8	Cooper Car Co	1	1	-	-	-	-	1	-	2	-	-
	Cooper T77	Climax V8	Cooper Car Co	9	4	-	-	1	-	2	-	8	-	-
			Total	47	28	1	4	7	3	5	3	83	-	1
MAGGS, Tony (ZA) b. 9.2.37														
1961	Lotus 18	Climax 4	Mrs Louise Bryden Brown	2	2	-	-	-	-	-	-	-	-	-
1962	Cooper T55	Climax 4	Cooper Car Co	3	2	-	-	-	-	1	-	2	-	-
	Cooper T60	Climax V8	Cooper Car Co	6	5	-	1	1	-	-	1	11	-	-
1963	Cooper T66	Climax V8	Cooper Car Co	10	5	-	1	-	-	1	1	9	-	-
1964	BRM P578	BRM V8	Scuderia Centro Sud	3	2	-	-	-	1	-	1	4	-	-
1965	Lotus 25	BRM V8	Reg Parnell (Racing)	1	1	-	-	-	-	-	-	-	-	-
			Total	25	17	-	2	1	1	2	3	26	-	-

Year	Chassis	Engine	Entrant	Starts	Finishes	Wins	2nd	3rd	4th	5th	6th	Points	PP	FL
MAIRESSE, Willy (B) 1.10.28 – 2.9.69														
1961	Emeryson	Maserati 4	Equipe National Belge	-	-									
	Lotus 18	Climax 4	Equipe National Belge	1	-									
	Lotus 21	Climax 4	Equipe National Belge	1	-									
	Ferrari 156	Ferrari V6	Ferrari SpA SEFAC	1	-									
1962	Ferrari 156	Ferrari V6	Ferrari SpA SEFAC	3	2	-	-	-	1	-	-	3		
1963	Ferrari 156	Ferrari V6	Ferrari SpA SEFAC	3	-									
1965	BRM P578	BRM V8	Scuderia Centro Sud	-										
			Total	9	2	-	-	-	1	-	-	3	-	-
MARSH, Tony (GB) b. 20.7.31														
1961	Lotus 18	Climax 4	AE Marsh	2	1									
MAY, Michael (CH) b. 18.8.34														
1961	Lotus 18	Climax 4	Scuderia Colonia	2	1									
MAYER, Tim (USA) 22.2.38 – 28.2.64														
1962	Cooper T53	Climax 4	Cooper Car Co	1	-									
MITTER, Gerhard (D) 30.8.35 – 1.8.69														
1963	Porsche 718	Porsche F4	Ecurie Maarsbergen	2	1	-	-	-	1	-	-	3	-	-
1964	Lotus 25	Climax V8	Team Lotus	1	1	-	-	-	-	-	-	-	-	-
1965	Lotus 25	Climax V8	Team Lotus	1	-									
MOSS, Stirling (GB) b. 17.9.29														
1961	Lotus 18	Climax 4	RRC Walker Racing Team	2	2	1	-	-	1	-	-	12	1	1
	Lotus 18/21	Climax 4	RRC Walker Racing Team	5	2	1	-	-	-	-	-	9	-	-
	Lotus 21	Climax 4	RRC Walker Racing Team	1	-									
			Total	8	4	2	-	-	1	-	-	21	1	1
NATILI, Massimo (I) b. 28.7.35														
1961	Cooper T51	Maserati 4	Scuderia Centro Sud	1	-									
NAYLOR, Brian (GB) 24.3.39 – Aug. 89														
1961	JBW	Climax 4	JBW Car Co	1	-									
NIEMANN, Brausch (ZA) b. 7.1.39														
1963	Lotus 22	Ford 4	Ted Lanfear	1	-									
1965	Lotus 22	Ford 4	Ted Lanfear	-										
PARNELL, Tim (GB) b. 25.6.32														
1961	Lotus 18	Climax 4	RHH Parnell	2	1									
1962	Lotus 18/21	Climax 4	RHH Parnell	-										
PENSKE, Roger (USA) b. 27.2.37														
1961	Cooper T53	Climax 4	John M Wyatt III	1	1									
1962	Lotus 24	Climax V8	Team Zerex	1	1									

Year	Chassis	Engine	Entrant	Starts	Finishes	Wins	2nd	3rd	4th	5th	6th	Points	PP	FL
PIETERSE, Ernest (ZA) b. 4.7.38														
1962	Lotus 21	Climax 4	Ernest Pieterse	1	-									
1963	Lotus 21	Climax 4	Lawson Organisation	1	-									
1965	Lotus 21	Climax 4	Lawson Organisation	-										
PILETTE, André (B) b. 6.10.18														
1961	Emeryson	Climax 4	A Pilette	-										
1963	Lotus 18/21	Climax 4	A Pilette	-										
1964	Scirocco	Climax V8	Equipe Scirocco Belge	1	-									
PIROCCHI, Renato (I) b. 26.3.33														
1961	Cooper T51	Maserati 4	Pescara Racing Club	1	1									
PON, Ben (NL) b. 9.12.36														
1962	Porsche 787	Porsche F4	Ecurie Maarsbergen	1	-									
PROPHET, David (GB) 9.10.37 – 29.3.81														
1963	Brabham BT6	Ford 4	David Prophet (Racing)	1	-									
1965	Brabham BT10	Ford 4	David Prophet (Racing)	1	-									
RABY, Ian (GB) 22.9.21 – 7.11.67														
1963	Gilby	BRM V8	Ian Raby (Racing)	1	-									
1964	Brabham BT3	BRM V8	Ian Raby (Racing)	1	-									
1965	Brabham BT3	BRM V8	Ian Raby (Racing)	1	1									
REVSON, Peter (USA) 27.2.39 – 22.3.74														
1964	Lotus 24	BRM V8	Revson Racing (America)	4	1									
RHODES, John (GB) b. 18.8.27														
1965	Cooper T60	Climax V8	Gerard Racing	1	-									
RINDT, Jochen (A) 18.4.42 – 5.9.70														
1964	Brabham BT11	BRM V8	RRC Walker Racing Team	1	-									
1965	Cooper T73	Climax V8	Cooper Car Co	2	1	-	-	-	-	-	-	-	-	-
	Cooper T77	Climax V8	Cooper Car Co	7	3	-	-	-	1	-	1	4	-	-
			Total	10	4	-	-	-	1	-	1	4	-	-
RODRIGUEZ, Pedro (MEX) 18.1.40 – 11.7.71														
1963	Lotus 25	Climax V8	Team Lotus	2	-									
1964	Ferrari Aero	Ferrari 156	North American Racing Team	1	1	-	-	-	-	-	1	1	-	-
1965	Ferrari 158	Ferrari V8	North American Racing Team	1	1	-	-	-	-	-	-	-	-	-
	Ferrari 1512	Ferrari F12	North American Racing Team	1	1	-	-	-	-	1	-	2	-	-
			Total	5	3	-	-	-	-	1	1	3	-	-
RODRIGUEZ, Ricardo (MEX) 14.2.42 – 1.11.62														
1961	Ferrari 156	Ferrari V6	Ferrari SpA SEFAC	1	-									
1962	Ferrari 156	Ferrari V6	Ferrari SpA SEFAC	4	2	-	-	-	1	-	1	4	-	-

Year	Chassis	Engine	Entrant	Starts	Finishes	Wins	2nd	3rd	4th	5th	6th	Points	PP	FL
RUBY, Lloyd (USA) b. 12.1.28														
1961	Lotus 18	Climax 4	J Frank Harrison	1	-									
RYAN, Peter (CDN) 10.6.42 – 2.7.62														
1961	Lotus 18	Climax 4	J Wheeler Motorsport	1	1									
SALVADORI, Roy (GB) b. 12.5.22														
1961	Cooper T53	Climax 4	Yeoman Credit Racing Team	5	4	-	-	-	-	-	2	2	-	-
1962	Lola Mk 4	Climax V8	Bowmaker Racing Team	7	-									
SCARFIOTTI, Lodovico (I) 18.10.33 – 8.6.68														
1963	Ferrari 156	Ferrari V6	Ferrari SpA SEFAC	1	1	-	-	-	-	-	1	1	-	-
1964	Ferrari Aero	Ferrari V6	Ferrari SpA SEFAC	1	1	-	-	-	-	-	-	-	-	-
1965	Ferrari 1512	Ferrari F12	Ferrari SpA SEFAC	-										
SCARLATTI, Giorgio (I) b. 2.10.21														
1961	de Tomaso	OSCA 4	Scuderia Serenissima	1	-									
SCHILLER, Heinz (CH) b. 25.1.30														
1962	Lotus 24	BRM V8	Ecurie Filipinetti	1	-									
SCHROEDER, Bob (USA) b. 11.5.26														
1962	Lotus 24	Climax V8	John Mecom	1	1									
SEIDEL, Wolfgang (D) 4.7.26 – 1.3.87														
1961	Lotus 18	Climax 4	Scuderia Colonia	3	-									
1962	Emeryson	Climax 4	Ecurie Maarsbergen	1	-									
	Lotus 24	BRM V8	Autosport Team Wolf. Seidel	1	-									
SERRURIER, Doug (ZA) b. 9.12.20														
1962	LDS 07	Alfa Romeo 4	Otelle Nucci	1	-									
1963	LDS 06	Alfa Romeo 4	Otelle Nucci	1	1									
1965	LDS 07	Alfa Romeo 4	Otelle Nucci	-										
SETTEMBER, Tony (USA) b. 1930														
1962	Emeryson	Climax 4	Emeryson Cars	2	1									
1963	Scirocco	BRM V8	Scirocco-Powell Racing	4	-									
SHARP, Hap (USA) 1.1.28 – May 93														
1961	Cooper T53	Climax 4	Hap Sharp	1	1									
1962	Cooper T53	Climax 4	Hap Sharp	1	1									
1963	Lotus 24	BRM V8	Reg Parnell (Racing)	2	1									
1964	Brabham BT11	BRM V8	RRC Walker Racing Team	2	1									
			Total	6	4									
SHELLY, Tony (NZ) b. 2.2.37														
1962	Lotus 18/21	Climax 4	John Dalton	1	-									
	Lotus 24	BRM V8	Autosport Team Wolf. Seidel	-										

Year	Chassis	Engine	Entrant	Starts	Finishes	Wins	2nd	3rd	4th	5th	6th	Points	PP	FL
SIFFERT, Jo (CH) 7.7.36 – 24.10.71														
1962	Lotus 21	Climax 4	Ecurie Filipinetti	2	2	-	-	-	-	-	-	-	-	-
	Lotus 24	BRM V8	Ecurie Filipinetti	1	-									
1963	Lotus 24	BRM V8	Siffert Racing Team	9	3	-	-	-	-	-	1	1	-	-
1964	Lotus 24	BRM V8	Siffert Racing Team	1	-									
	Brabham BT11	BRM V8	Siffert Racing Team	7	3	-	-	-	1	-	-	3	-	-
	Brabham BT11	BRM V8	RRC Walker Racing Team	2	1	-	-	1	-	-	-	4	-	-
1965	Brabham BT11	BRM V8	RRC Walker Racing Team	10	7	-	-	-	1	-	2	5	-	-
			Total	32	16	-	-	1	2	-	3	13	-	-
SOLANA, Moises (MEX) 1936 – 27.7.69														
1963	BRM P578	BRM V8	Scuderia Centro Sud	1	-									
1964	Lotus 33	Climax V8	Team Lotus	1	1									
1965	Lotus 25	Climax V8	Team Lotus	2	-									
SPENCE, Mike (GB) 30.12.36 – 7.5.68														
1963	Lotus 25	Climax V8	Team Lotus	1	-									
1964	Lotus 25	Climax V8	Team Lotus	2	2	-	-	-	1	-	-	3	-	-
	Lotus 33	Climax V8	Team Lotus	4	2	-	-	-	-	-	1	1	-	-
1965	Lotus 25	Climax V8	Team Lotus	1	1									
	Lotus 33	Climax V8	Team Lotus	8	5	-	-	1	2	-	-	10	-	-
			Total	16	10	-	-	1	3	-	1	14	-	-
STARRABBA, Prince Gaetano (I) b. 3.12.32														
1961	Lotus 18	Maserati 4	Prince G Starrabba	1	-									
STEWART, Jackie (GB) b. 11.6.39														
1965	BRM P261	BRM V8	Owen Racing Organisation	10	7	1	3	1	-	1	1	34	-	-
SURTEES, John (GB) b. 11.2.34				**World Champion 1964**										
1961	Cooper T53	Climax 4	Yeoman Credit Racing Team	8	3	-	-	-	-	2	-	4	-	-
1962	Lola Mk 4	Climax V8	Bowmaker Racing Team	9	5	-	2	-	1	2	-	19	1	-
1963	Ferrari 156	Ferrari V6	Ferrari SpA SEFAC	7	4	1	1	1	1	-	-	22	-	3
	Ferrari Aero	Ferrari V6	Ferrari SpA SEFAC	3	-	-	-	-	-	-	-	-	1	-
1964	Ferrari 158	Ferrari V8	Ferrari SpA SEFAC	10	6	2	3	1	-	-	-	40	2	2
1965	Ferrari 158	Ferrari V8	Ferrari SpA SEFAC	4	3	-	1	1	1	-	-	13	-	-
	Ferrari 1512	Ferrari F12	Ferrari SpA SEFAC	4	2	-	-	1	-	-	-	4	-	-
			Total	45	23	3	7	4	3	4	-	102	4	5
TAYLOR, Henry (GB) b. 16.12.32														
1961	Lotus 18	Climax 4	UDT-Laystall Racing Team	3	2									
TAYLOR, John (GB) 23.3.33 – 8.9.66														
1964	Cooper T73	Ford 4	Gerard Racing	1	-									
TAYLOR, Trevor (GB) b. 26.12.36														
1961	Lotus 18	Climax 4	Team Lotus	1	1	-	-	-	-	-	-	-	-	-
1962	Lotus 24	Climax V8	Team Lotus	5	2	-	1	-	-	-	-	6	-	-
	Lotus 25	Climax V8	Team Lotus	4	2	-	-	-	-	-	-	-	-	-
1963	Lotus 25	Climax V8	Team Lotus	9	3	-	-	-	-	-	1	1	-	-

Year	Chassis	Engine	Entrant	Starts	Finishes	Wins	2nd	3rd	4th	5th	6th	Points	PP	FL
TAYLOR, Trevor (GB) b. 26.12.36 (continued)														
1964	Lotus 24	BRM V8	British Racing Partnership	1	-									
	BRP	BRM V8	British Racing Partnership	6	2	-	-	-	-	-	1	1	-	-
			Total	26	10	-	1	-	-	-	2	8	-	-
TINGLE, Sam (RSR) b. 24.8.21														
1963	LDS 02	Alfa Romeo 4	SA Tingle	1	-									
1965	LDS 02	Climax 4	SA Tingle	1	-									
TRINTIGNANT, Maurice (F) 30.10.17 – 12.2.05														
1961	Cooper T51	Maserati 4	Scuderia Serenissima	5	3	-	-	-	-	-	-	-	-	-
1962	Lotus 24	Climax V8	RRC Walker Racing Team	6	2	-	-	-	-	-	-	-	-	-
1963	Lola Mk 4	Climax V8	Reg Parnell (Racing)	1	-									
	Lotus 24	Climax V8	Reg Parnell (Racing)	1	1	-	-	-	-	-	-	-	-	-
	BRM P578	BRM V8	Scuderia Centro Sud	1	1	-	-	-	-	-	-	-	-	-
1964	BRM P578	BRM V8	M Trintignant	4	2	-	-	-	-	1	-	2	-	-
			Total	18	9	-	-	-	-	1	-	2	-	-
von TRIPS, Wolfgang (D) 4.5.28 – 10.9.61														
1961	Ferrari 156	Ferrari V6	Ferrari SpA SEFAC	7	5	2	2	-	1	-	-	33	1	-
VACCARELLA, Nino (I) b. 4.3.33														
1961	de Tomaso	Alfa Romeo 4	Scuderia Serenissima	1	-									
1962	Lotus 18/21	Climax 4	Scud SSS Republica di Venezia	-										
	Porsche 718	Porsche F4	Scud SSS Republica di Venezia	1	1									
	Lotus 24	Climax V8	Scud SSS Republica di Venezia	1	1									
1965	Ferrari 158	Ferrari V8	Ferrari SpA SEFAC	1	-									
			Total	4	2									
WALTER, Heini (CH) b. 28.7.27														
1962	Porsche 718	Porsche F4	Ecurie Filipinetti	1	1									
WARD, Rodger (USA) 10.1.21-5.7.04														
1963	Lotus 24	BRM V8	Reg Parnell (Racing)	1	-									

Drivers who attempted to qualify for a GP but failed to make a single start

Year	Chassis	Engine	Entrant
BRAMBILLA, Tino (I)			
1963	Cooper T53	Maserati 4	Scuderia Centro Sud
DRIVER, Paddy (ZA) b. 19.5.34			
1963	Lotus 24	BRM V8	E Driver
GUBBY, Brian (GB)			
1965	Lotus 24	Climax V8	Brian Gubby
KUHNKE, Kurt (D)			
1963	Lotus 18	Borgward 4	Kurt Kuhnke

Year	Chassis	Engine	Entrant
NASIF, Estafano (RA) 18.11.32 – 21.10.73			
1962	de Tomaso 801	de Tomaso F8	Scuderia de Tomaso
PRINOTH, Ernesto (I)			
1962	Lotus 18	Climax 4	Jolly Club
ROLLINSON, Alan (GB) b. 1943			
1965	Cooper T73	Ford 4	Gerard Racing
RUDAZ, Jean-Claude (CH)			
1964	Cooper T60	Climax V8	Fabre Urbain

8 Circuits

Over the course of the 1½-litre F1, forty-seven Grands Prix were held on fifteen circuits in eleven countries spread over three continents. Of the circuits, eight were purpose-built, six utilised public roads, and one was an operational airfield. The characters of the circuits varied from the wide-open cornfields of Reims to the suburbs of Liverpool, and the confined streets of Monte Carlo to the pine forests of the Ardennes. The circuits contrasted in both length and lap speed. Monte Carlo was the shortest at 1.94 miles, while the 14.2 miles of the mighty Nürburgring made it the longest. The fastest circuit was Spa, lapped at over 137mph in 1964, while Monte Carlo was slowest with a lap record set at 76.7mph in 1965.

Facilities

Circuit facilities varied from venue to venue. The European road circuits, made-up of public roads closed during practice and the GP, invariably featured a permanent pits structure and start line grandstand, other temporary facilities were erected for GP weekends. Permanent circuits were not necessarily better equipped. Common to both, the pits were little more than brick or concrete structures, usually allocated on the basis of one per car, in which team personnel could shelter and store tools and spare parts, etc. Pit frontage was of approximately a car's length with a waist-high counter at the front on which the team's timekeeper, usually someone's wife or girlfriend, would locate herself. Only at the new Mexico City circuit did the pits incorporate a lock-up garage area, seen as essential to modern GP teams. In 1963 this was a rare luxury for the mechanics. The paddock, probably backing on to the pits, was where car preparation was undertaken, usually in the open air or under an awning if lucky. It did not necessarily feature a hard standing, more likely a grassy meadow, its underlying surface dependent upon the weather. It was not unusual for preparation to be undertaken away from the circuit, such as at Spa where teams hired space in local garages, while at Watkins Glen, a communal, covered garage area was provided.

Medical facilities were similarly varied, some more professional and better equipped than others. At Monte Carlo you were never too far away from hospital facilities but it was obviously difficult to provide adequate medical cover around the 14 miles of the Nürburgring.

In the days before corporate hospitality and commercial sponsorship, the availability of luxury hotel accommodation and helicopter parking was not a priority. It mattered little if the circuit was miles from anywhere. While most circuits had a permanent start line grandstand as a minimum, the bulk of the spectators lined the course at suitable vantage points protected by simple fencing, straw bales or a length of rope strung between posts. There was no sign of corporate hospitality.

Safety

Circuit safety was not yet at the forefront of thinking in the 1960s. Typically, GPs run on public roads were lined with trees, hedges, telegraph poles, stone walls and buildings, limiting the potential to provide safety measures, had there been a desire to do so. Strategically placed sandbags or straw bales protected solid obstacles such as telegraph poles, generally to protect the obstacle rather than the drivers. Straw bales were the most popular form of safety measure, being easily obtainable, but were not popular with drivers as contact with them could pitch a car into a roll. Some steel barriers or guardrails were in evidence, notably at Monte Carlo, to protect the buildings, but their use was by no means widespread. Permanent circuits were not without their danger points, although not usually as unrelenting as the solid obstacles lining a road circuit.

Driving flat out around the sweeping curves of Spa with perhaps the forest on one side and an embankment dropping down to oblivion on the other certainly concentrated a driver's mind. Added to this was the threat of a change in the fickle Ardennes weather that could suddenly present a driver with a waterlogged stretch of road while the remainder of the circuit was dry. By contrast, the streets of Monte Carlo were much slower yet no less hazardous. Any momentary lapse in concentration or component breakage could pitch a car into a substantial kerbstone, stone wall, steel barrier or, if you were very unlucky, the clear blue waters of the harbour.

Racing on potentially dangerous circuits was routine and regarded as an occupational hazard by the GP driver, who had to make sure that he did not put a wheel wrong – to do so was to court disaster. To many the challenge of driving at circuits such as Spa, Rouen or the Nürburgring might have been a frightening

proposition, yet a quick, near-perfect lap not only demonstrated the driver's mastery of car and course but also provided a satisfaction like nothing else. They simply did not consider the dangers – when it came right down to it, they either went out and raced or they went home and stayed there. They all felt that they were on the same side, doing something that they loved – the drivers respected each other and formed real friendships with each other out of their cars. There were unwritten rules and standards of etiquette by which they played, as racing was quite dangerous enough without some drivers behaving recklessly. As far as accidents were concerned, they convinced themselves that those only happened to the other guy – it could not happen to them.

Starting grids were normally formed up on a 3-2-3 basis while at Silverstone and the Nürburgring a 4-3-4 format was used which was fine on the wide start line area but the field still had to negotiate the first corner. Both Watkins Glen and Mexico City featured 2-by-2 grids, anticipating modern day regulations, and Monaco adopted this from 1963. In 1964, the 'dummy' grid was introduced to eliminate the hazard of a stalled car, the field moving forward to the starting grid proper once engines had been started.

Despite the dubious attention to safety, only two fatalities occurred during GPs of the period – Wolfgang von Trips died at Monza in 1961 and Godin de Beaufort succumbed to injuries received during practice at the Nürburgring in 1964. Von Trips' accident unfortunately claimed the lives of 14 spectators, highlighting the potential danger faced by spectators at the GP circuits.

Lap speeds

The overall intention of the 1½-litre F1 regulations had been to contain speeds, presumably to levels lower than those seen under the then current 2½-litre regulations. As with all regulations introduced in the name of speed containment, it was only a matter of time before speeds were first equalled and then beaten. This proved to be true under the new regulations despite the 40% decrease in engine capacity. The 1½-litre cars were immediately quicker around Monte Carlo than their 2½-litre equivalents, reflecting the suitability of the smaller capacity GP cars to this circuit. Similarly, they were immediately quicker at the Nürburgring, although 2½-litre cars had not run there for two years. By the end of 1964, all the circuits on the GP calendar had been lapped faster by 1½-litre cars (bar Reims that did not run an F1 event after 1963), reflecting the advances made in chassis, suspension, engine and, in particular, tyre technology. At the conclusion of the formula, nine circuits had been lapped at over 100mph, three of them at over 130mph, the fastest at over 137mph. The increase in lap record speeds can be seen in the following table:

Lap record speeds (mph)

Circuit	2½-litre lap records (year)		1961	1962	1963	1964	1965
Aintree	92.31	(1959)	91.68	93.91	*96.60*	*96.26*	-
Brands Hatch	*94.82*	*(1960)*	*93.52*	-	-	96.56	*97.20*
East London	N/a		94.20	96.35	98.41	-	100.33
Mexico City	N/a		-	-	*94.71*	95.14	96.59
Monte Carlo	72.87	(1960)	73.13	73.70	74.45	74.92	76.72
Monza – road	128.13	(1959)	-	125.74	130.05	130.12	133.43
Nürburgring	92.90	(1957)	94.88	*	96.88	98.30	101.23
Reims	134.69	(1960)	126.25	*128.96*	*131.15*	-	-
Rouen	102.87	(1957)	-	106.90	-	111.40	-
Silverstone	111.86	(1960)	-	*109.31*	109.76	*112.58*	114.29
Spa	136.02	(1960)	131.56	133.87	*	137.60	*
Watkins Glen	N/a		106.14	110.40	111.14	113.11	115.16
Zandvoort	99.98	(1960)	98.23	99.36	99.89	100.07	103.91

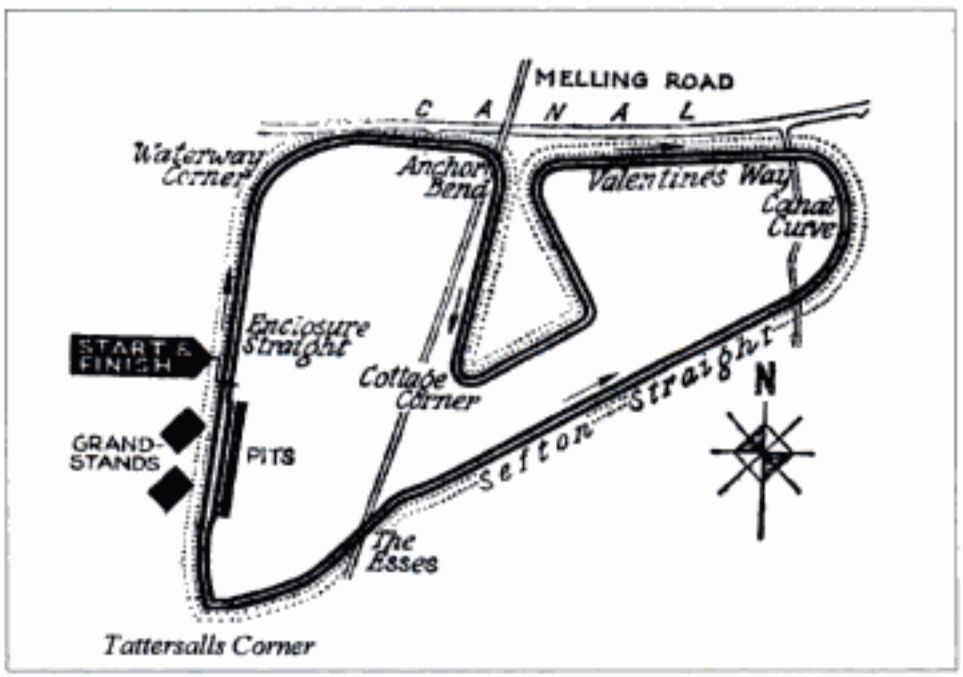
Key:

Italics:	Fastest lap from non-Championship event – GP not held at circuit that year.
Shaded area:	Fastest lap speed lower than 2½ -litre lap record.
*:	Slower speed due to wet race.

The circuits

Aintree

Lap distance: 3.0 miles (4.828km)
Event: British GP (1961 &1962)
Lap record: 1m 55.0s (1962), 93.91mph/151.14km/h (1962)
Location: Liverpool, England.



Aintree.

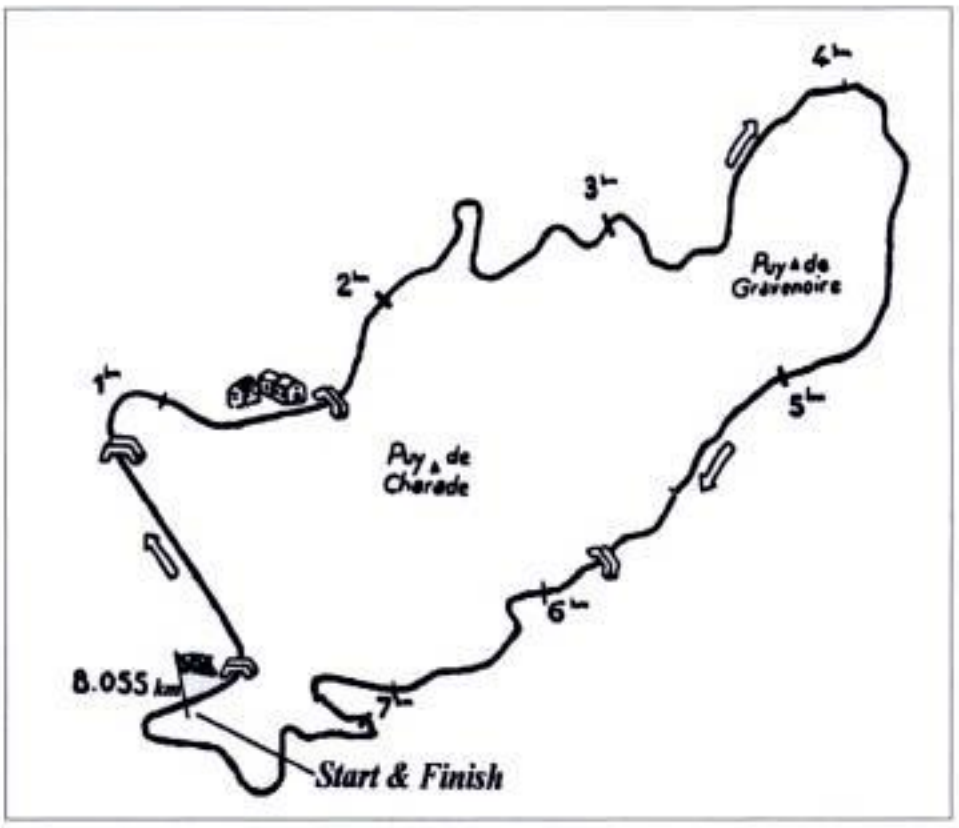
Built in 1954, partly inside and partly outside the famous Grand National steeplechasing course, spectators were able to benefit from the vast permanent grandstands and other facilities already in place. The British GP was first held there in 1955, when it was won by Stirling Moss in a Mercedes. He repeated his victory two years later in a Vanwall to become the first British driver to win a GP in a British car for 35 years.

The circuit was flat and featureless with the Liverpool skyline forming a backdrop. From a driver's view point it comprised too many slow-to-medium-fast corners. Aintree alternated with Silverstone as host of the British GP until running the event in consecutive years in 1961 and 1962. Thereafter, Brands Hatch took its place and the circuit's fortunes dwindled under the ever-present threat of change of ownership and closure.

Phil Hill (Ferrari 156) splashes his way towards Tattersalls during the 1961 British GP at Aintree.

Auvergne

Lap distance:	5.01 miles (8.055km)
Event:	GP de l'ACF (1965)
Lap record:	3m 18.9s, 90.59mph/145.791km/h
Location:	3 miles west of Clermont-Ferrand, central France.



Auvergne.

The Circuit de Montagne d'Auvergne – sometimes 'Clermont-Ferrand' or 'Charade' – was a spectacular road circuit that undulated through the town of Charade and around the tree clad slopes of two extinct volcanoes, Puy de Grave Noire and Puy de Charade, reaching 2600 feet above sea level at its highest point.

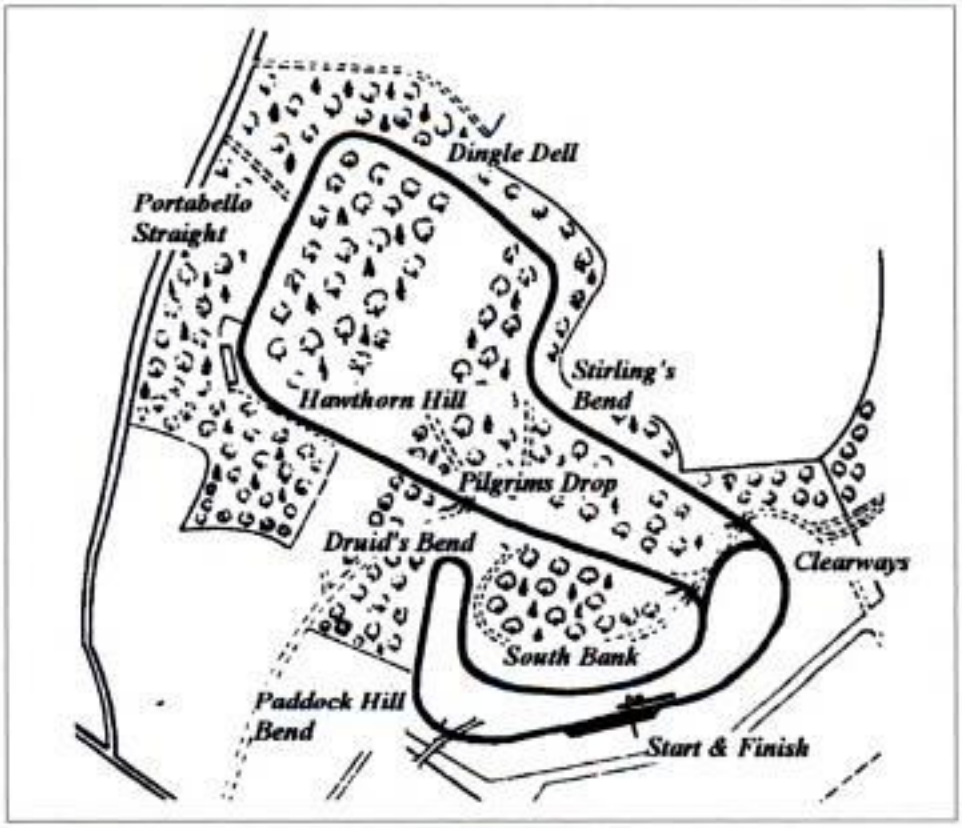
It was something of a miniature Nürburgring with some 51 corners per lap, of which 24 were hairpins. It had a first class surface that was diligently maintained by the local authority that effected repairs every spring once the snow had thawed. A permanent pits complex had been built with only one grandstand, located opposite the start/finish line.

Opened in 1958, it had previously hosted F2 and sports car events before being awarded the French GP in 1965.

Brands Hatch

Lap distance:	2.65 miles (4.265km)
Event:	British GP (1964)
Lap record:	1m 38.8s, 96.56mph/155.398km/h (1964)
Location:	Near West Kingsdown, Kent, 20 miles SE of London, England.

In use since 1928 as a motorcycle grass track, it was not surfaced until 1950 when it became the centre for 500cc F3 racing. Originally a 1 mile kidney-shaped circuit, the Druids Hill loop was added in 1954, and a further extension to bring it up to



Brands Hatch.

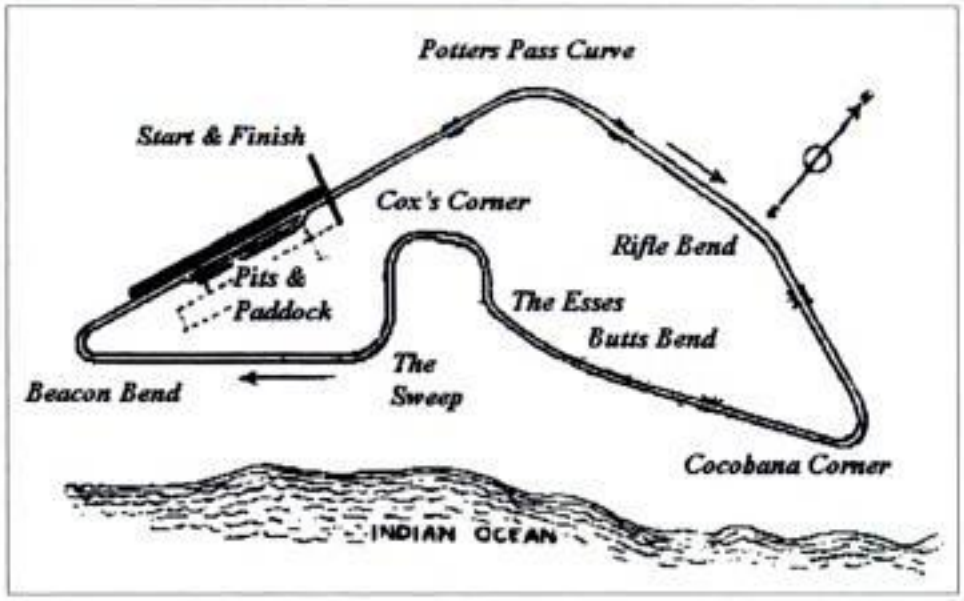
GP length was opened in 1960. The 1964 event was the first GP to be held at the circuit.

Its undulating terrain was popular with spectators as most of the circuit could be seen from the enclosures on the hillsides overlooking it. Paddock Hill bend, just after the start, was interesting for drivers as the road dropped away downhill, making it a semi-blind corner before the run up to Druids, a double apex hairpin.

East London

Lap distance:	2.44 miles (3.920km)
Event:	South African GP (1962-63 & 1965)
Lap record:	1m 27.6s, 100.10mph/161.091km/h (1965)
Location:	Coastal, 150 miles NE of Port Elizabeth, S. Africa

Situated on the coast 1/3mile from the sea and 4 miles out of town, the East London circuit was completed in 1959. It was made up of public roads with chamfered curbs on corners and permanent pits. Initially it was the scene of a round of the South African Gold Star Championship, a series of races for 4-cylinder, 1 1/2-litre single-seaters. At the end of 1961, the RAC of South Africa organised a series of four races to which European teams were invited. Suitably encouraged by the success of this 'Springbok'



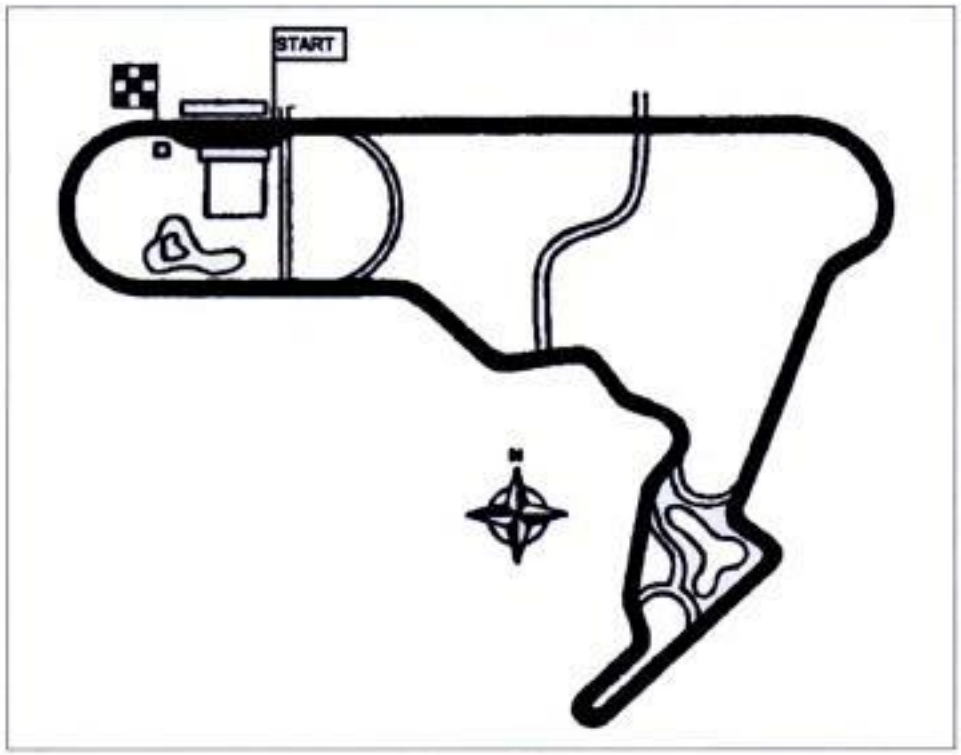
East London.

series, the RAC of South Africa applied for a round of the World Championship to be held in December 1962. This proved to be that year's Championship decider but, basically, the event was held too late in the year. From 1965 it became the first GP of the season by moving its date forward a few days into January. Now it was too early in the year ...

The track itself vaguely resembled Aintree in shape, with a similar lap speed, but had the advantage of the Indian Ocean as a backdrop.

Local man, local car. Doug Serrurier at East London in his LDS-Alfa during the 1963 South African GP.

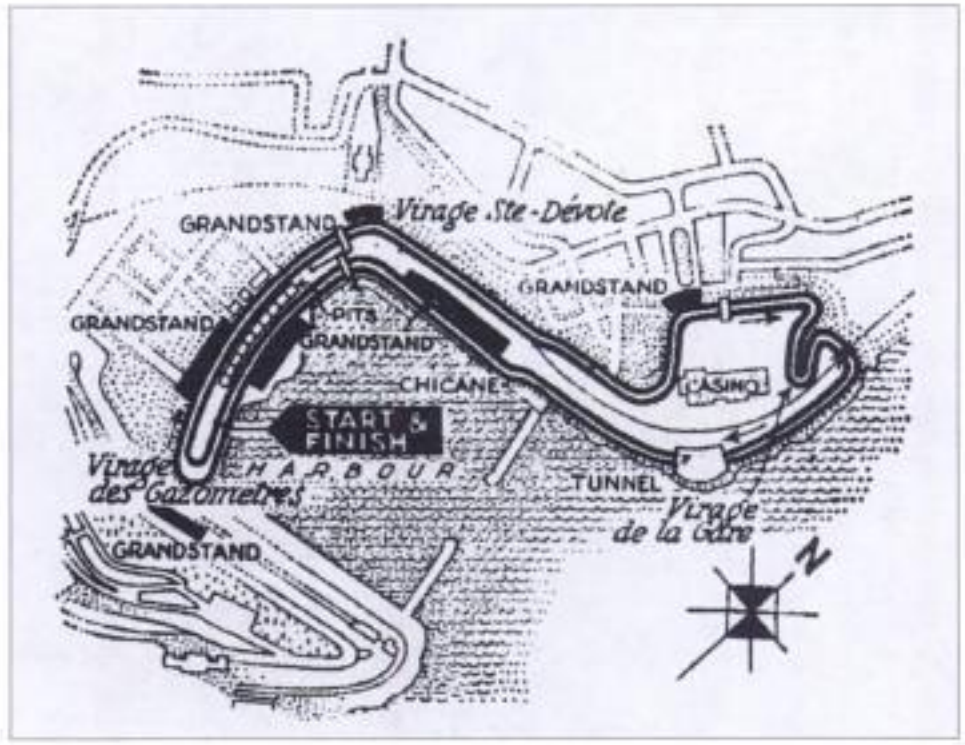
Mexico City
Lap distance: 3.107 miles (5.00km)
Event: Mexican GP (1963-65)
Lap record: 1m 55.84s, 96.59mph/155.387km/h (1965)
Location: East of Mexico City, a few miles south of the International Airport, Mexico.



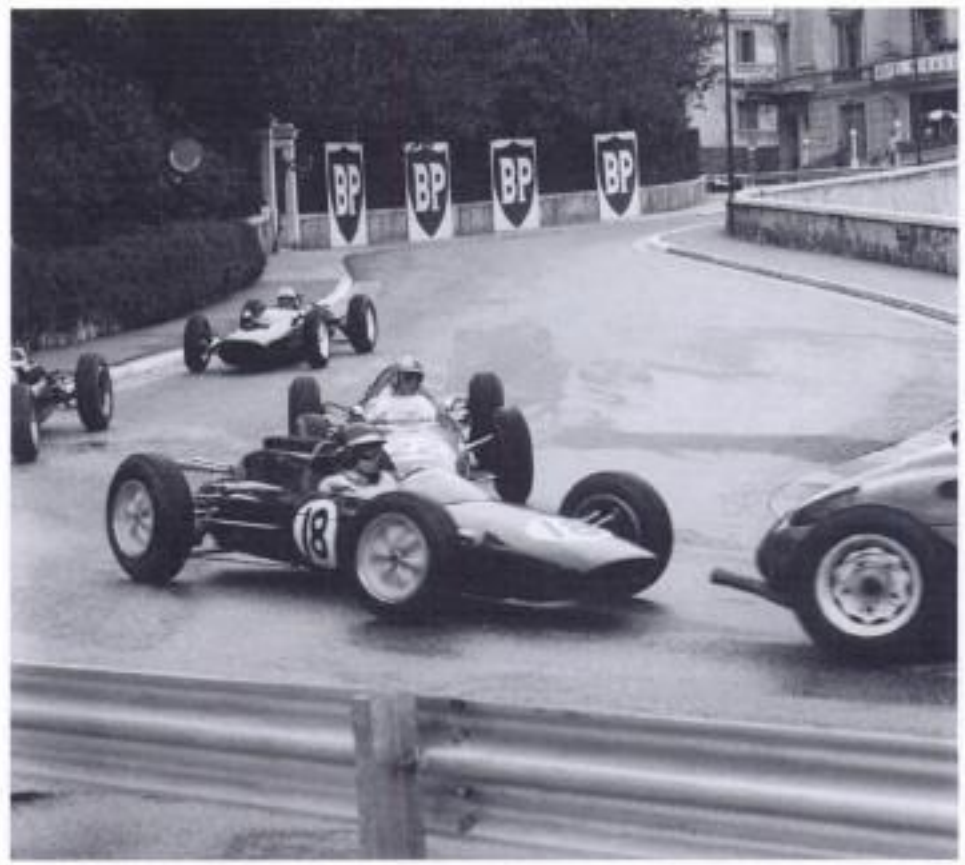
Mexico City.

The Mexico City Autodrome, also known as the Magdalena Mixhuca circuit and, from 1962, the Autodromo Ricardo Rodriguez, hosted its first F1 race in 1962 as a precursor to being upgraded to World Championship status for 1963. The track was laid out in a large sports park with grass covered embankments for spectator viewing. Facilities were excellent for the time with each pit comprising a permanent lock-up workshop with power and light. The track included a first gear hairpin and a long, semi-banked, 180° right-hand turn leading on to the 700 yard pit straight. The surface was mainly good but a few curves, noticeably the 180° turn, had surface ripples making it somewhat bumpy. The main feature of the circuit, however, was its 7400ft altitude that called for adjustments to fuel-injection systems to compensate for the lack of oxygen.

Monte Carlo
Lap distance: 1.94 miles (3.145km)
Event: Monaco GP (1961-65)
Lap record: 1m 31.7s, 76.72mph/123.467km/h (1965)
Location: City centre Monte Carlo, Principality of Monaco, 15 miles east of Nice.



Monte Carlo.



Traffic at the Monte Carlo Station hairpin in 1962. Jim Clark (Lotus 25 number 18) and Jack Brabham (Lotus 24 number 22) are caught between Bonnier (Porsche 718 exiting right) and Maggs, (Cooper T58 entering left) while Surtees (Lola Mk 4) follows.

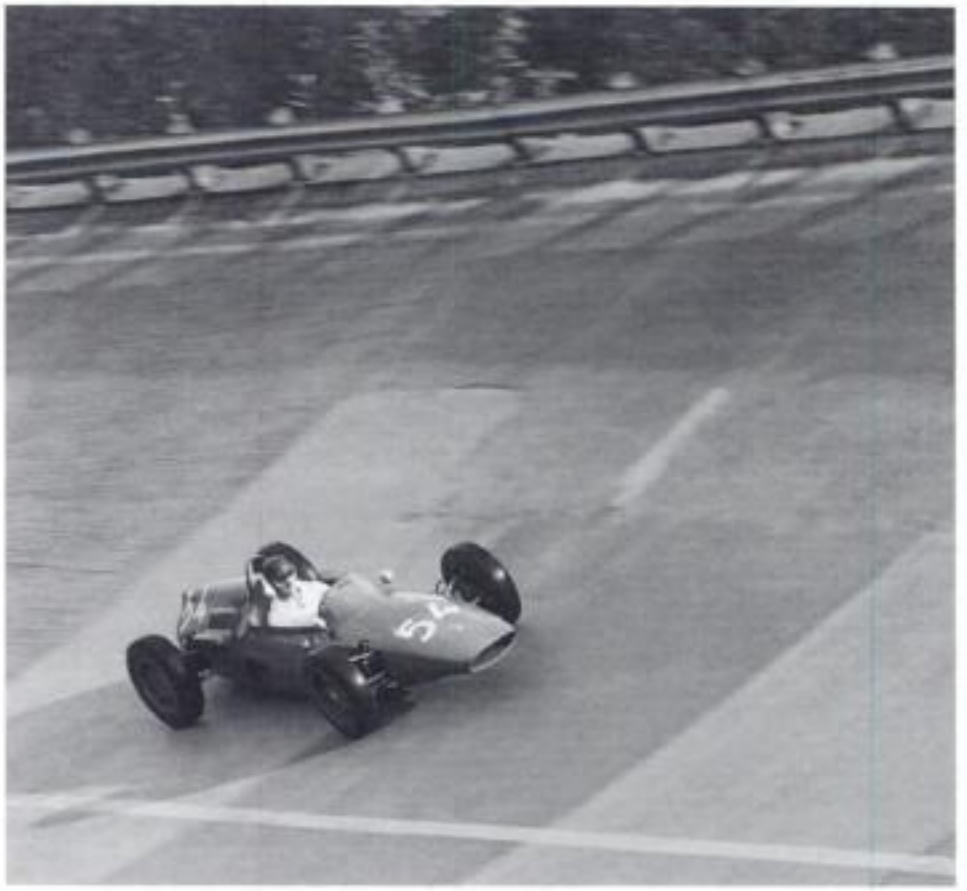
The original round-the-houses circuit, the event was first held in 1929. Despite being an unlikely location for a World Championship GP, the event became the most glamorous of them all by way of its Principality location on the shores of the Mediterranean, playground of the rich and famous. The circuit wound around the narrow, hilly and twisting streets of the town before descending through hairpin bends to the seafront, through a 400 yard tunnel and around the harbour. The start/finish line was situated on the promenade only a short dash away from the Gasometer hairpin until a multiple accident there on the first lap of the 1962 GP prompted its relocation inland to the other side of the hairpin.

It was a very demanding circuit, its endless succession of corners calling for approximately 20 gear changes per lap and was consequently very hard on transmissions. Limited to 16 starters, the finishers never amounted to more than half a dozen. While Jim Clark never won the Monaco GP, Graham Hill scored a hat trick of victories from 1963 to earn the accolade 'master of Monaco'.

Monza

Lap distance: Road circuit 3.56 miles (5.75km); combined road/banked circuit 6.21 miles (10.00km).
Event: Italian GP (combined circuit 1961; road circuit 1962-65)
Lap record: Combined: 2m 48.4s, 132.84mph/213.776km/h (1961); Road: 1m 36.4s, 133.43mph/214.730km/h (1965).
Location: 12 miles from central Milan, northern Italy.

Monza.



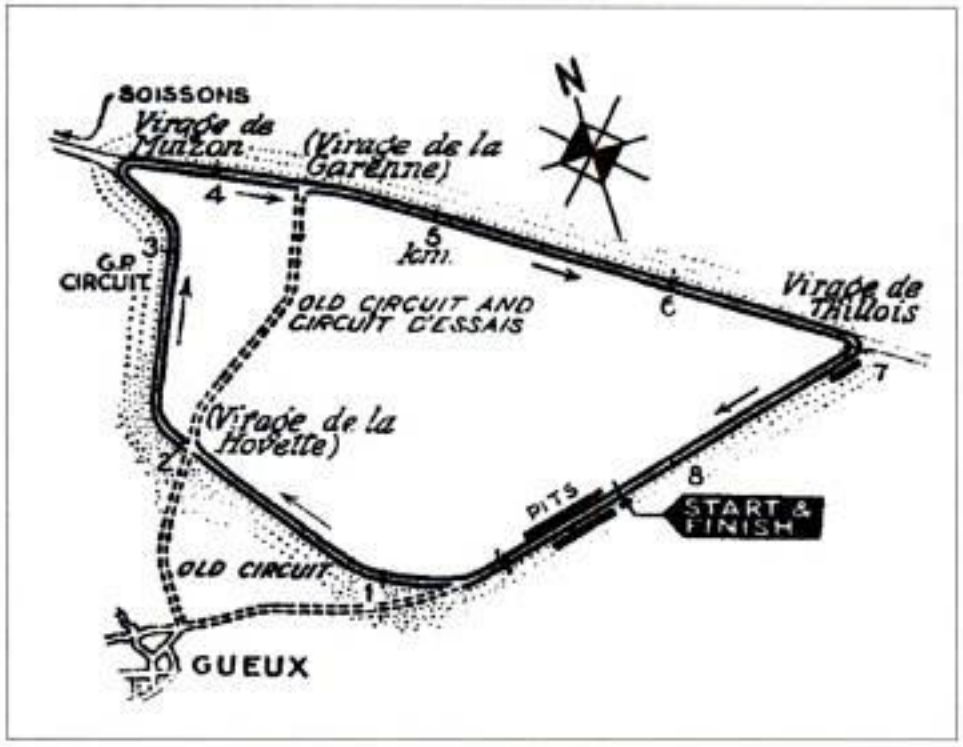
Roberto Bussinello (de Tomaso-Alfa Romeo) rides the Monza banking early in the 1961 Italian GP.

One of the 'classic' European circuits, this artificial road course was laid out in wooded parkland outside Milan in 1922 and was traditionally the home of the Italian GP. The event had an atmosphere of its own, mainly due to the enthusiasm of the partisan crowd, the tifosi, and their fanatical support for the Ferrari team. With long straights and flat, sweeping curves, the circuit was ideal for slipstreaming. This became a feature of the GPs of the 1960s, the lead changing hands all around the circuit. Entrants and drivers alike disliked the inclusion of the banked section, as the concrete banking was notoriously bumpy. Running at maximum speed, drivers were pummelled by the surface in a chassis subjected to shocks and stresses for which it was never designed.

In 1961, the circuit claimed the lives of Wolfgang von Trips and 14 spectators when his Ferrari and Jim Clark's Lotus touched approaching the Parabolica (Curva Sud) on the road section.

Nürburgring

Lap distance: 14.17 miles (22.81km)
Event: German GP (1961-65)
Lap record: 8m 24.1s, 101.23mph/162.896km/h (1965)
Location: Eifel mountains, south of Cologne near Koblenz, western Germany.

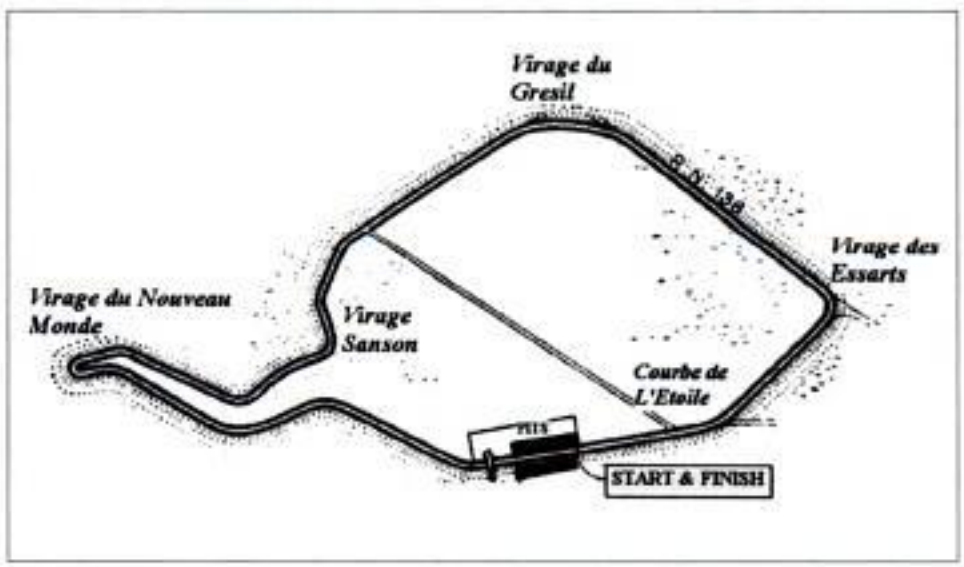


Reims.

In a memorable 1961 GP, Giancarlo Baghetti, running in his first GP, fought a thrilling slipstreamer duel over the last 12 laps with the Porsches of Jo Bonnier and Dan Gurney. On the final dash to the flag, he slipped his Ferrari ahead of Gurney to win the race by 0.1sec.

Rouen-les-Essarts

Lap distance: 4.065 miles (6.542km)
Event: GP de l'ACF (1962 &1964)
Lap record: 2m 11.4 s, 111.40mph/179.232km/h (1964)
Location: South of Rouen, northern France.



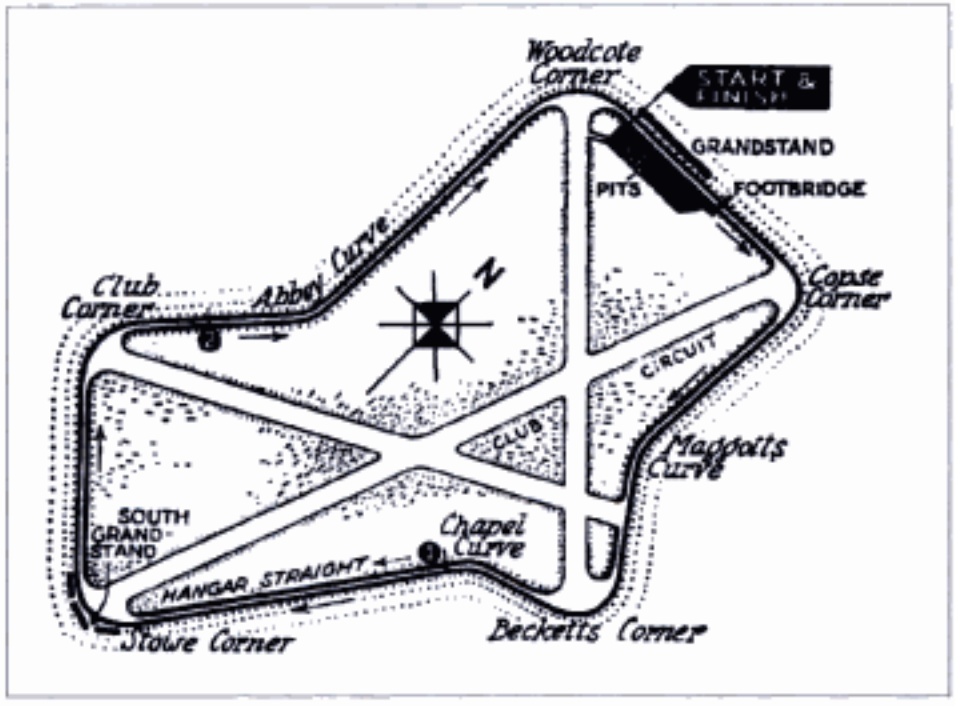
Rouen-les-Essarts.

Another French circuit utilising public roads but a much more interesting and challenging rival to Reims as a venue for the French GP. Despite having been conceived as a GP circuit from the outset, it had only hosted the GP twice, in 1952 and 1957, prior to the introduction of the 1½-litre F1. The circuit was roughly v-shaped and ran up and down forest-clad hillsides near the village of Les Essarts, south of Rouen. Though on a smaller scale than those at Reims, there were permanent pits and a grandstand at the start/finish line. Vantage points for spectators were provided on embankments above road level. The most challenging part of the circuit began just after the start line where the road dropped downhill into a succession of right-left-right-left fast, swooping curves taken only without lifting by the most skilful and brave of drivers. A small error in line at the beginning of this section would compound itself all the way downhill as there were no straight bits on which to make corrections. Once at the bottom of the hill, drivers were faced with the Virage du Nouveau Monde, a right-handed hairpin surfaced with cobbles.

The circuit proved lucky for Dan Gurney who won there in both 1962 and 1964, driving Porsche and Brabham respectively, giving the two marques their first GP victories.

Dan Gurney (Porsche 804) leads Masten Gregory (Lotus 24) out of the swooping, downhill curves towards Nouveau Monde hairpin in the 1962 French GP on the way to his first GP win.

Silverstone
Lap distance: 2.927 miles (4.711km)
Event: British GP (1963 & 1965)
Lap record: 1m 32.2s, 114.29mph183.925km/h (1965)
Location: 14 miles south of Northampton near Towcester, Northants, England.

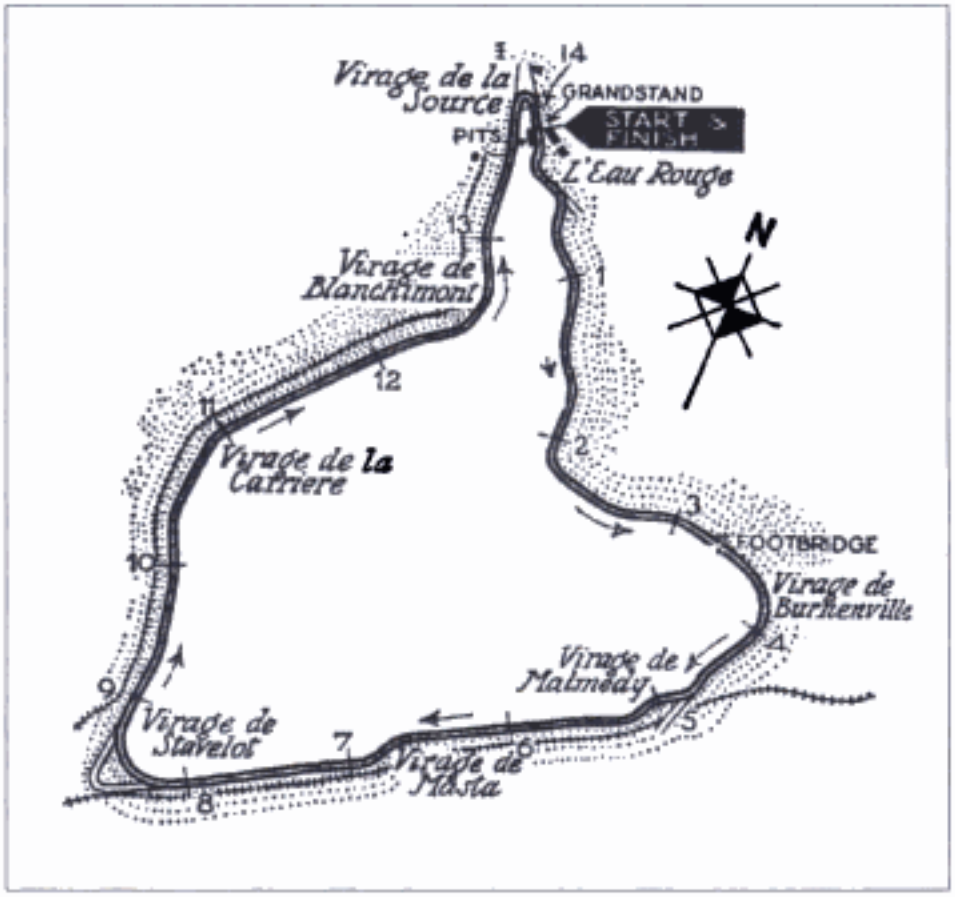


Silverstone.

Following World War II, Britain found itself without any racing circuits as both Brooklands and Donington Park had been taken over by the War Department and not returned. There were, however, a large number of wartime airfields in lesser inhabited areas of the country with perimeter roads that would make perfectly adequate race circuits. One such was Silverstone, for which the Royal Automobile Club gained responsibility, holding its first race in 1948. Initially a combination of runway and perimeter was used but this soon gave way to the perimeter only. From 1949, Silverstone became the home of the British GP until the mid 1950s when the honour was shared with Aintree. By this time the British Racing Drivers Club was running the circuit and had improved facilities with permanent pits and grandstands, although the latter were constructed from steel scaffolding.

Being an ex-airfield, Silverstone was somewhat flat and featureless but did provide good viewing for spectators from the southern end of the circuit. Woodcote was the most challenging corner for drivers and immensely satisfying when taken on the limit to slingshot onto the finishing straight.

Spa-Francorchamps
Lap distance: 8.76 miles (14.10km)
Event: Belgian GP (1961-1965)
Lap record: 3m 49.2s, 137.60mph/221.465km/h (1964).
Location: 22 miles SE of Liege, Belgium.



Spa-Francorchamps.

Another of the classic European circuits and one of the greatest of all road circuits. It ran through the hilly, wooded countryside of the Ardennes along both sides of the Eau Rouge valley. It was used first in 1921 for motorcycles while the first Belgian GP (for GP cars) took place in 1925. Uniquely, the start/finish line was situated on a fairly steep downhill slope flanked by the pits and grandstands. Originally, the road was narrow, rough and slow but continual improvements over the years widened and smoothed out the surface and the corners were cambered and eased in several places to make it Europe's fastest circuit.

Spa was spectacular for drivers and spectators alike. It was a real driver's circuit, requiring much skill and courage to take the long sweeping curves and dramatically fast corners at speeds approaching 150 mph. Added to this was the unpredictability of the Ardennes weather.

It was not uncommon for one side of the circuit to be dry while the opposite side could be engulfed in heavy rain. The sudden arrival of a car on to a waterlogged section of road was particularly hazardous.

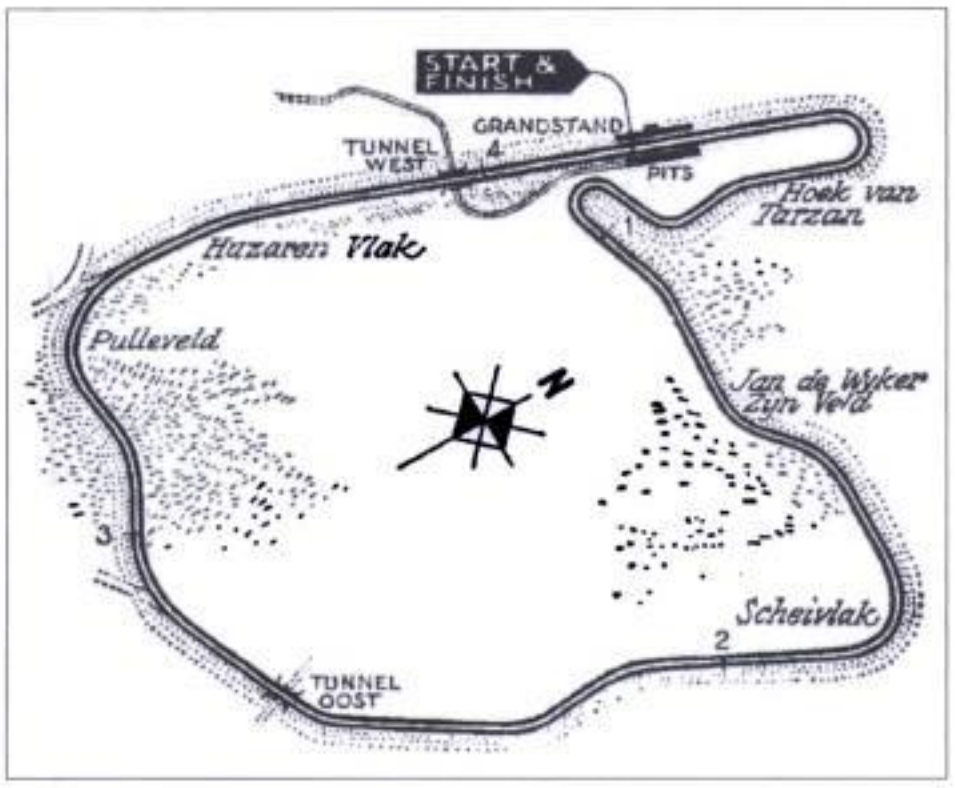
Jim Clark never liked the circuit but this did not prevent

was provided for all the teams to work on their cars out of the elements. The US GP had made a faltering start at Sebring in 1959 and then Riverside the following year before finding a permanent, reasonably popular home at the Glen from 1961.

The track itself was narrow and not truly challenging. The surface deteriorated over the years due to the ravages of hard winters. The antics of race starter Tex Hopkins were something of a tradition at the Glen – clad in a lilac coloured suit with a large cigar jutting from his mouth, he would signal the grid away at the start by leaping in the air and waving the flag.

Zandvoort

Lap distance: 2.6 miles (4.193km)
Event: Dutch GP (1961-1965)
Lap record: 1m 30.6s, 103.91mph/103.525km/h (1965)
Location: On North Sea coast near Haarlem, 17 miles west of Amsterdam, Netherlands.



Zandvoort.

Prior to World War II there had been no racing circuit in Holland. The war brought destruction from which the seaside town of Zandvoort did not escape but, in clearing the debris, the town Burgomaster had the inspired idea of using it as a hardcore base for a racing circuit. This, it was hoped, would attract business and bring prosperity to the area when the war was over. The circuit was designed by John Hugenholtz, who became something of an expert in this field, being involved in the design of other circuits including Hockenheim, Zolder and Suzuka. The first race

Graham Hill (BRM P261) cuts inside Ritchie Ginther's Honda on the approach to Tarzan on lap 3 of the 1965 Dutch GP. Note the spectators using the rolling sand dunes as natural viewing points.

meeting was held in 1948, co-organised by the BRDC, and the first Championship qualifying Dutch GP took place in 1952.

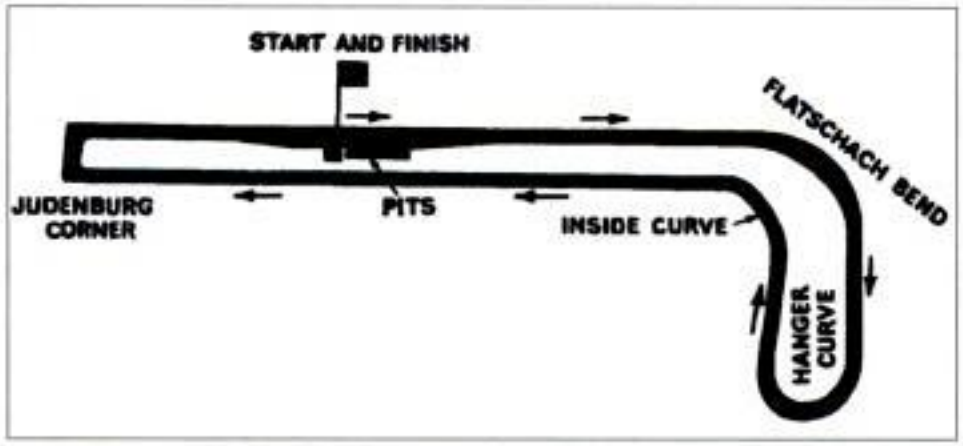
The track included a number of fast bends undulating through the sand dunes and leading on to a long start/finish straight that terminated in a hairpin at Tarzan, providing an excellent point for overtaking. The surface was excellent, although prone to becoming slippery with wind blown, drifting sand.

The 1961 GP was notable for being the only GP (at the time of writing) in which there were no retirements and not a single pit stop in two hours of racing.

Zeltweg

Lap distance: 1.99 miles (3.2km)
Event: Austrian GP (1964)
Lap record: 1m 10.56s, 101.57mph/163.462km/h (1964)
Location: Near Knittelfeld, between Salzburg and Graz, central Austria.

In 1960, Austria held an international race at Zeltweg for the then 1½-litre F2. In 1961 and 1963, the events were well supported



Zeltweg.

as non-Championship F1 races and the organisers were granted World Championship status in 1964 for the first F1 Austrian GP. The circuit was laid out on the runway of an active airfield that would, of necessity, close down for the GP. The track comprised two parallel straights on the runway, linked by a hairpin bend at one end and an L-shaped extension at the other. The surface was very rough and bumpy, especially over the seams between concrete sections of the runway, resulting in many transmission and suspension failures. The temporary nature of the circuit was demonstrated by the use of a converted London double decker bus for the Omega timing equipment and Dunlop scoreboard. **The GP circus did not visit Zeltweg airfield circuit again.**

State of the art: the timing centre at Zeltweg.

9 Chassis directory

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Note regarding chassis numbers

In the 1960s, single seat racing cars required registration with the appropriate government department and motor sport authority (in the UK the Board of Trade and the RAC). Once registered it was possible to obtain a customs carnet identifying the car and exempting its owner from paying import duty whenever it travelled across international borders. To avoid delay, it was not uncommon for chassis number identification plates and the relative customs carnets to be swapped from crashed or damaged chassis to replacements when, in actual fact, the replacement was a new car requiring new registration and certification. The chassis numbers quoted in the following directory have to be viewed against this background and so, in some cases, they may not necessarily refer to the actual car raced.

Alfa Special

In 1958, Pieter de Klerk arrived in England from South Africa and was able to persuade Colin Chapman to employ him as a mechanic. The experience he gained at Lotus gave him an insight into race car chassis design and construction, and, when he returned home a few years later, he set about building his own single-seater for the South African Gold Star Series.

With the help of Doug Serrurier (of LDS fame q.v.) and fellow driver Ernest Pieterse, he built a space frame chassis with wishbone suspension, powered by an enlarged and tuned 4-cylinder Alfa Romeo Guilietta engine. De Klerk was no mean driver and in later years he would drive for Porsche at Le Mans. For the moment, however, he debuted his simply named 'Alfa Special' in the 1962 South African Series and carefully improved and developed the car over that and subsequent seasons. The car made its GP debut in the 1963 South African GP and also ran in the 1965 event.

ATS (Automobili Tourismo e Sport)

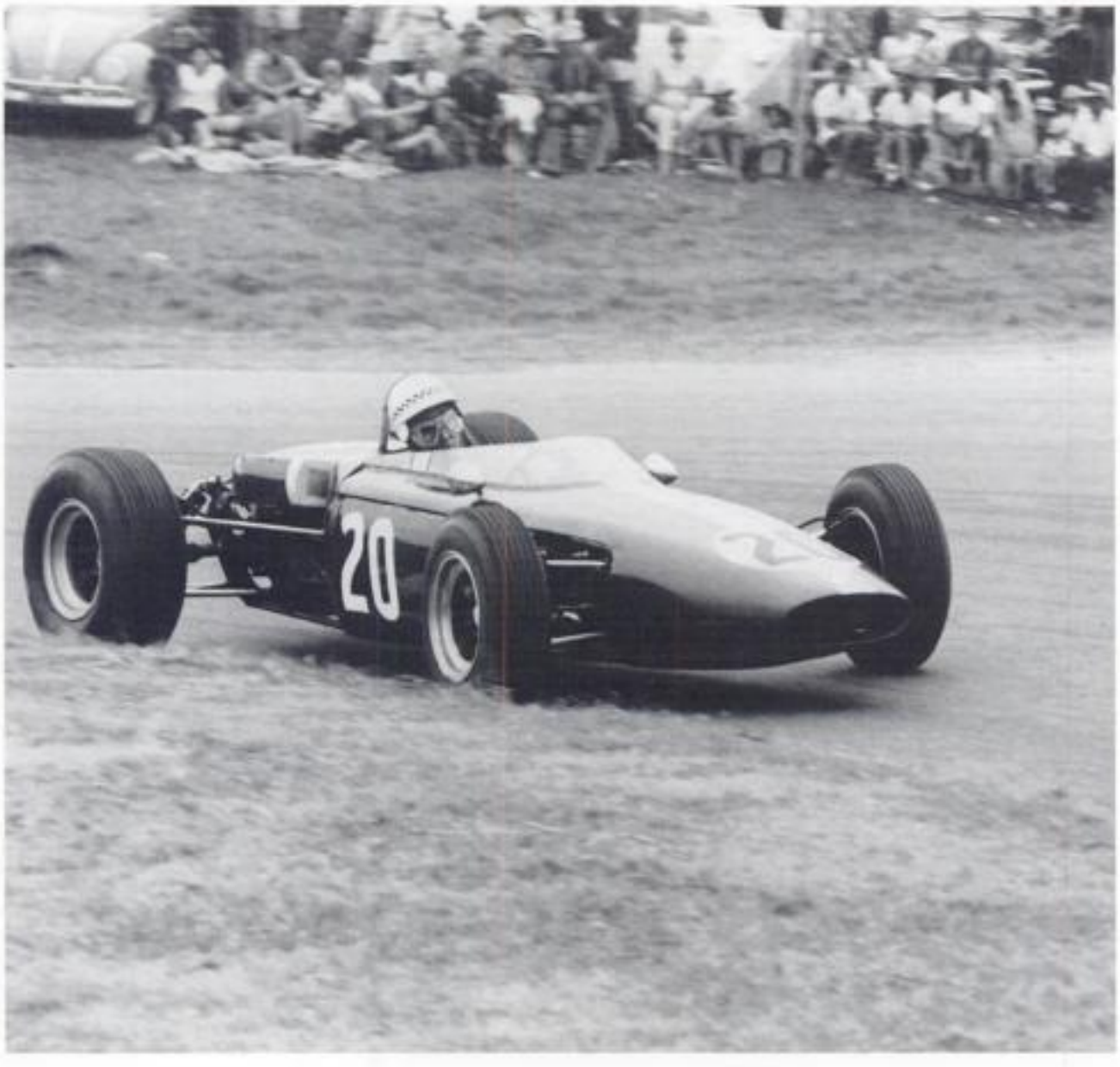
In 1960, Count Giovanni Volpi di Misurata was 24, had recently inherited his father's title and fortune, and was something of a motor racing enthusiast. He decided to form his own racing

Opposite: Alfa Special: Pieter de Klerk finished 10th, 6 laps down in the 1965 South African GP.

Alfa Special chassis record (1963-65)							
Chassis no.	**Engine**	**Entrant**	**GP**	**Driver**	**No.**	**Grid**	**Result**
1963							
-	Alfa Romeo 4	Otelle Nucci	S Africa	P de Klerk	18	Q16	Gearbox – lap 53/85
1965							
-	Alfa Romeo 4	Otelle Nucci	S Africa	P de Klerk	20	Q17	10th – 6 laps down.

team, Scuderia Serenissima, that ran Maseratis and Porsches in sports car and endurance racing and made the odd foray into GP racing with Cooper and de Tomaso chassis during 1961. Volpi also had ambitions to become a constructor in his own right and he sought out additional backing from two wealthy men who had similar ambitions, Jaime Ortiz Patiño, a Bolivian tin billionaire, and Italian industrialist Giorgio Billi.

At about the same time, in the autumn of 1961, the resignation of key personnel had taken place at Ferrari, and Volpi was quick to contact the dissidents and recruit them for his new company.



On 11 February 1962, Automobili Serenissima SpA Bologna was established at Pontecchio Marconi near Bologna. The former Ferrari personnel took on their previous roles in the new company, including Ing Carlo Chiti as chief engineer and Romolo Tavoni as team manager. The company was well funded, had an experienced designer and management structure and seemed well able to achieve its ultimate ambition of beating Ferrari at its own game. In the meantime, Volpi continued to operate his racing team but, having lent the name 'Serenissima' to the car company, ran it as 'Scuderia SSS Republica di Venezia'.

During 1962 relations between Volpi, Billi and Patiño deteriorated. Volpi had hoped that Ricardo Rodriguez would lead the new F1 team but he was killed in October during practice for the non-Championship Mexican GP. His death prompted Volpi to withdraw from the project, taking the name Serenissima with him. The company continued without him and on 30 November 1962 was re-named Automobili Tourismo e Sport SpA or 'ATS'.

ATS T100

The brand new F1 car made its public debut on 15 December, 1962, at the Grand Hotel Majestic Baglioni in Bologna. In a remarkably short space of time, Chiti had produced a completely new GP car and V8 engine. In general conception the chassis was an orthodox multi-tubular space frame, one move away from the relatively crude multi-tubular frame of Chiti's Ferrari 156. It was unusually shallow, the top chassis side-members being only 17in above ground level without fuel or driver, the top of the scuttle bulkhead a further 5in above this. The frame was 20in wide at the cockpit, narrowing to 16in through the scuttle hoop. A rather deep windscreen kept the driver out of the airstream, offsetting any reduction in frontal area due to the shallower frame. Front suspension was of the rocker arm type, as introduced on the Lotus 21, with a double wishbone rear suspension. Unusually, the GSD type 34-based 6-speed gearbox was mounted

ATS T100 specification

Engine:	ATS 90° V8
Chassis:	Multi-tubular space frame constructed in 30mm (c.1.2in) steel tubing with fabricated perforated hoop type scuttle bulkhead. Not fully triangulated but many joints gusseted for strength. Oil tank mounted in tail with oil cooler below.
Transmission:	GSD type 34 6-speed in ATS casing located between engine and final drive.
Fuel tanks:	Twin fabricated aluminium side tanks and single scuttle tank. Capacity approximately 30 gallons.
Suspension:	Front: fabricated narrow-based tubular rocker arm acting on inboard mounted coil spring/damper unit. Wide based tubular lower wishbone 'X' braced for rigidity. Anti-roll bar. Rear: fabricated tubular wishbones; conventional upper with reversed lower located by single radius arm picking up at seat-back bulkhead. Combined coil spring/damper unit. Anti-roll bar.
Brakes:	Dunlop discs mounted outboard front, inboard rear.
Wheels:	Dunlop cast magnesium alloy, centre lock, 15in diameter.
Dimensions:	Wheelbase 2320mm (7ft 7.3in); track 1348mm (4ft 5.1in) front, 1320mm (4ft 4in) rear.
Weight:	460kg (1014lb)

between the ATS V8 engine and final drive, a position favoured by Chiti for the 1962 Ferrari but one that had not demonstrated any benefits in handling.

Development and performance

Team manager Tavoni had recruited two more Ferrari refugees for his driving force, 1961 World Champion Phil Hill and Giancarlo Baghetti. Hill had always had a good relationship with Chiti, the new team seemed sound and adequately funded, and he saw no reason not to give them a go. He could not have imagined how the season would progress.

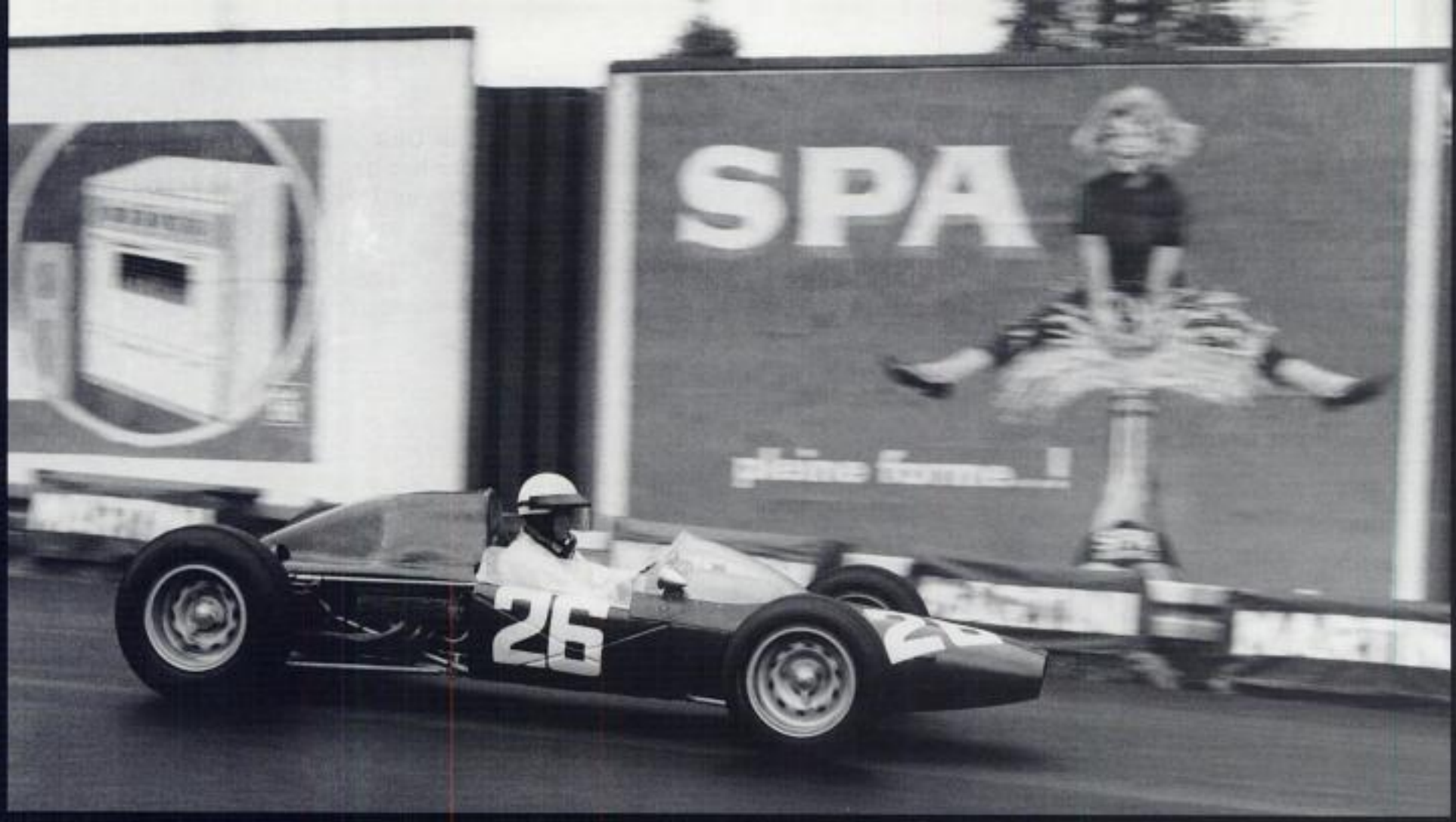
At the instigation of Dick Jeffrey of Dunlop, the veteran British driver Jack Fairman had been nominated to carry out pre-season test and development. In the event, this did not amount to much and Phil Hill put in the only effective development work with Chiti but this was also minimal. One problem was a delay in completing the new factory well into 1963, the first chassis having been constructed in a farmhouse on the same site. The team was expected to make its debut at the 1963 Syracuse GP in April. This date passed, as did that of the Silverstone International in May, then the Championship opener at Monaco. Finally, Giorgio Billi insisted that ATS should debut at Spa. Two cars were entered but in a shocking state of preparation. The bodywork was ill fitting, unfinished and only roughly painted, not even up to the standard of an amateur. The chassis was worse, as a lack of stiffness in the engine bay had been overcome by welding cross-bracing tubing over the engine after its installation. Had an engine change been necessary, the bracing would have had to be sawn through and then re-welded into place. Hill qualified 17th, nearly 12sec off the pace and both cars failed to finish.

Two weeks later at Zandvoort, the cars were tidier and had been modified to make the engine bay bracing detachable. The French and British GPs were missed to try to get the team's act together but the scheduled return at the German GP was thwarted by a transporter accident at the Brenner Pass, delaying arrival at the circuit until race morning, too late to take part. Both cars finished the Italian GP, Hill 7 laps down while Baghetti was unclassified, 23 laps in arrears. For this race the cars were fitted with drag-reducing wheel fairings and were now better prepared. The team travelled to North America but to no avail.

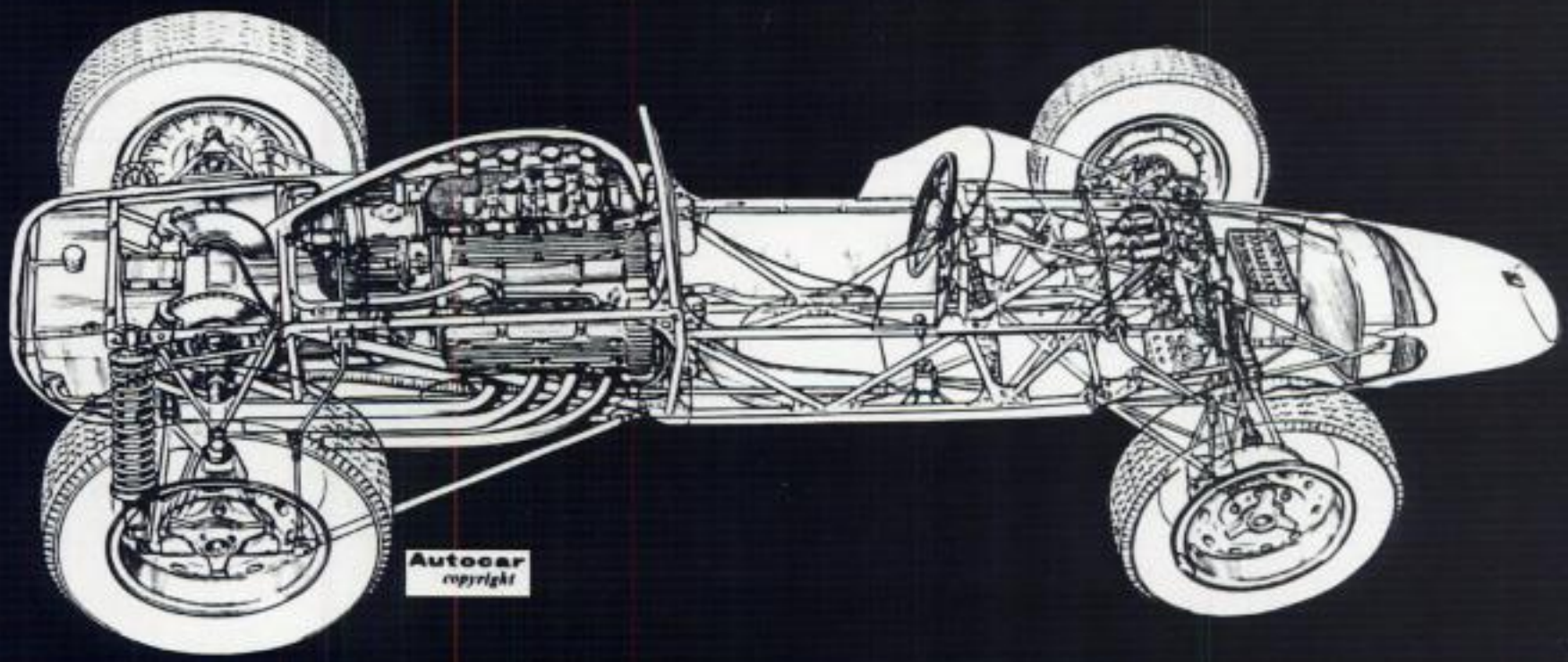
Chiti designed a new car for 1964 but it was not to be built as ATS had begun to collapse. Billi and Patiño had decided to close down the operation and amidst financial confusion the company folded. Count Volpi returned to take over the remaining assets and established his short-lived Serenissima marque at the Pontecchio Marconi premises.

ATS T100 chassis record – 1963

Chassis no.	Engine	Entrant	GP	Driver	No.	Grid	Result
100-01	ATS V8	Automobili Tourismo e Sport	Belgium	P Hill	26	Q17	Gearbox – lap 13/32
			Holland	P Hill	24	Q13	Stub axle lap 15/80
			Italy	P Hill	16	Q14	11th – 7 laps down
			USA	P Hill	25	Q15	Oil pipe lap 4/110
			Mexico	P Hill	25	Q17	Rear suspension – lap 40/65
100-02	ATS V8	Automobili Tourismo e Sport	Belgium	G Baghetti	27	Q20	Transmission lap 7/32
			Holland	G Baghetti	26	Q15	Engine – lap 17/80
			Italy	G Baghetti	14	Q20	N/C 63 laps/86
			USA	G Baghetti	26	Q20	Oil pump lap 0/110
			Mexico	G Baghetti	26	Q21	Engine – lap 10/65



ATS T100: Phil Hill, looking uncomfortable (as does the girl on the advertisement hoarding), trundles around for 13 laps on the car's debut at Spa in 1963.



ATS T100 on its debut in December 1962 with cut down windscreen and individual exhaust pipes per cylinder. It has yet to receive the infamous 'bracing' over the engine bay.

Brabham

Jack Brabham arrived in England in 1955 to further a driving career that had begun in Australia some nine years earlier. He based himself at the Cooper premises in Surbiton and developed a useful working relationship with the father and son team as he progressed to become lead driver for the F1 team. This was put to good effect in winning the World Driver's and Constructor's Championships in both 1959 and 1960 as Cooper pioneered the rear-engine revolution.

Brabham was a shrewd engineer in his own right but would often bounce technical problems encountered at Cooper off Ron Tauranac, his friend and former race rival back in Australia. Tauranac and his brother Austin had constructed a number of racing cars under the Ralt name. Suggestions made by Tauranac were carefully fed into the Cooper design process.

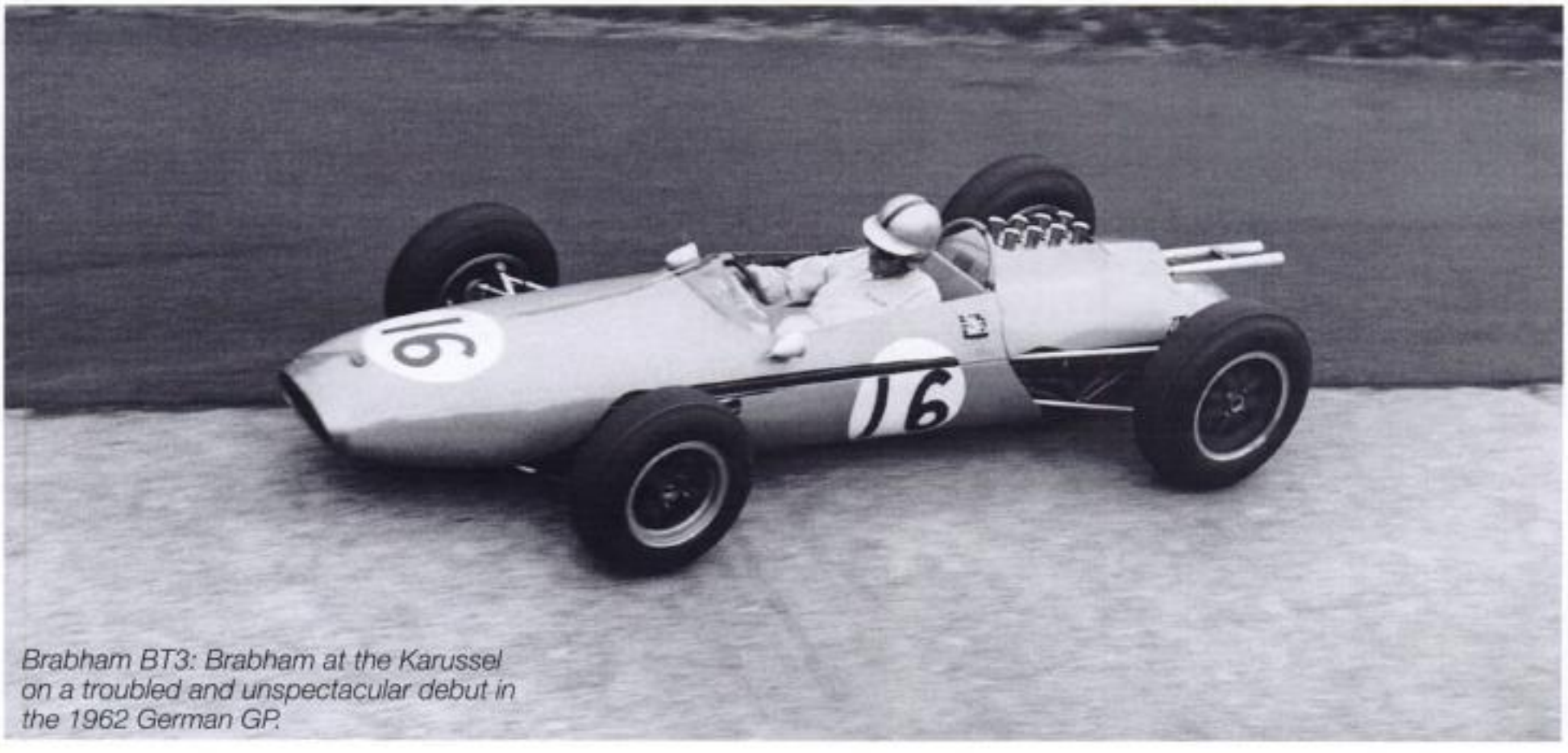
Having ambitions to set up his own race car manufacturing business, it was a natural step for Brabham to invite Tauranac to join him in England. The two of them formed Motor Racing Developments Ltd. (MRD) and Tauranac designed an FJ single-seater, the prototype chassis being completed in 1961. The FJ MRD attracted considerable interest, and plans were made to manufacture replicas for sale. Brabham had to tread carefully, however, as he was still under contract to Cooper which was a major player in the production racing car market and whose business MRD would inevitably cut into.

During 1961, it was clear to Brabham that there was little chance of long term technical progress being made at Cooper. It might have pioneered the rear-engine concept but was now being eclipsed by Colin Chapman's Lotus. Not wishing to be left behind in the technology stakes, Brabham decided to leave Cooper. He could now come clean about MRD, whose products were re-named Brabhams, primarily in response to the discovery that the pronunciation of 'MRD' in French had unfortunate connotations.

As part of his plan to go it alone, Brabham had decided that MRD should build him an F1 car. He would, therefore, be the first driver to manufacture his own car, a situation that would become more common in F1 in later years. As the project had started late, the new F1 car would not appear until late in the 1962 season, and in the interim he purchased and raced a customer Lotus 24.

BRABHAM BT3

In a season in which Colin Chapman's monocoque Lotus 25 had set a new trend in chassis design, the BT3 (Brabham/Tauranac type 3) was essentially conservative but built for reliability and safety. The fully triangulated space frame chassis was simple in design yet highly efficient. Outboard double wishbone suspension units were employed and anti-roll bars fitted front and rear supported the Brabham/Tauranac design philosophy of relatively high roll centres (approximately 4in above the road) and low spring rates



Brabham BT3: Brabham at the Karussel on a troubled and unspectacular debut in the 1962 German GP.

Brabham BT3 specification

Engine:	Coventry Climax FWMV V8
Chassis:	Fully triangulated multi-tubular space frame constructed from mainly 1in diameter 18swg mild steel tubing duplicated around cockpit opening for additional strength. Engine bay braced with detachable frame to facilitate removal of engine. Separate water pipes running outside bodywork between front-mounted radiator and engine.
Transmission:	GSD type 34 6-speed
Fuel tanks:	Fabricated aluminium tanks either side of cockpit, behind seat and above driver's legs. Capacity 28 gallons
Suspension:	Front: wide-based tubular wishbones, lower forward link picking up from behind radiator mounting, upper braced 'A' link feeding loads into scuttle bulkhead providing extremely positive location for modified Standard-Triumph uprights. Combined coil spring damper unit, anti-roll bar. Rear: reversed upper wishbone, single lower link. Cast magnesium upright located by twin parallel radius arms picking up from engine bulkhead. Combined coil spring damper unit, anti-roll bar.
Brakes:	Girling discs mounted outboard, 9.75in diameter front and rear.
Wheels:	Brabham cast magnesium alloy, bolt on, 13in diameter front, 15in rear. Rim widths 6in front, 7in rear.
Dimensions:	Wheelbase 7ft 7in; track 4ft 5in front, 4ft 2½in rear.
Weight:	1105lb

allied to a stiff chassis. The whole car was clothed in neat glass fibre bodywork finished in a striking shade of turquoise.

Development and performance 1962-65

The BT3 made an unimpressive debut at the Nürburgring for the 1962 German GP. Despite brief testing at Brands Hatch, race preparation was only completed on the Friday morning prior to practice. Unfortunately the engine lost oil pressure and ran its bearings on Brabham's first timed lap. Not having a spare, a repair was cobbled together using parts from a blown Team Lotus engine. Despite running out of fuel, he qualified 24th, some 1m 34.4sec slower than Gurney's Porsche on pole. Having been able to secure a replacement engine, Brabham ran mid-field in the GP until retiring on lap 9 with a deranged throttle linkage.

The Italian GP was missed due to a disagreement over starting money but the BT3 showed potential in the US GP. The front discs had been increased in size to 10.25in to provide increased pad area and improvements made to the springing. Brabham had qualified fifth, 1.1sec slower than Clark's pole, and finished fourth following it up with another fourth in South Africa, to become the first driver to score World Championship points in a car of his own construction.

Brabham continued to use the BT3 into 1963, pending completion of a new BT7 chassis, running it in three GPs and finishing fifth in Italy to prove that it remained competitive.

Brabham BT3 chassis record – 1962-65

Chassis no.	Engine	Entrant	GP	Driver	No.	Grid	Result
1962							
F1-1-62	Climax FWMV	Brabham Racing Organisation	Germany	J Brabham	16	Q24	Throttle linkage lap 9/15
			USA	J Brabham	17	Q5	4th
			S Africa	J Brabham	10	Q3	4th
1963							
F1-1-62	Climax FWMV	Brabham Racing Organisation	Monaco	J Brabham	3		DNS – engine shortage
			Belgium	J Brabham	17	Q6	Fuel pump short circuit lap 12/32
			Italy	J Brabham	22	Q7	5th
1964							
F1-1-62	BRM P56	Ian Raby (Racing)	Britain	I Raby	23	Q17	Accident – lap 37/80
			Italy	I Raby	56	-	DNQ
1965							
F1-1-62	BRM P56	Ian Raby (Racing)	Britain	I Raby	24	Q20	11th – 7 laps behind
			Germany	I Raby	23	-	DNQ

Brabham BT6 chassis record – 1963							
Chassis no.	**Engine**	**Entrant**	**GP**	**Driver**	**No.**	**Grid**	**Result**
1963							
FJ-5-63	Lotus-Ford 4	David Prophet (Racing)	S Africa	D Prophet	22	Q14	Oil pressure lap 49/85

Brabham BT3 Performance and chassis record – 1964-65
In 1964 the chassis was sold to Brighton garage owner Ian Raby who fitted it with a BRM V8. He ran it in a number of non-Championship F1 races and qualified for the British GP in both 1964 and 1965.

BRABHAM BT6
The BT6 was the successful 1963 FJ chassis from the Brabham/Tauranac partnership. It was a typically well-executed space frame design with the standard unequal length wishbone and coil spring suspension front and rear. David Prophet, a British privateer in FJ, fitted his chassis with a twin cam Lotus-Ford engine and took it to South Africa in the winter of 1963 to compete in the 'Springbok' series of races. While there, he also took in the South African GP.

BRABHAM BT7
The performance of the BT3 had encouraged Jack Brabham and Ron Tauranac to proceed with a two-car team for 1963. The popular and highly talented Californian Dan Gurney was approached to join the team as number 1, Jack having decided to take more of a managerial and development role. The F1 team was to be operated by the Brabham Racing Organisation (BRO) from premises in Guildford, separate from the production race car side of the business run by Tauranac at New Haw. Tauranac designed and built the F1 cars at New Haw at

Brabham BT7 specification as for BT3 except:

Chassis:	Fully triangulated multi-tubular space frame, shallower in engine bay to allow upper main tubular members to pass beneath exhaust cam boxes of Climax engine.
Transmission:	Hewland HD 5-speed.
Suspension:	Rear: single transverse upper link and reversed lower wishbone.
Brakes:	Girling discs mounted outboard, 10 1/4in diameter front, 9 1/2in rear.
Wheels:	Brabham cast magnesium alloy, bolt on, 15in diameter, 6in rims front, 7in rear.
Dimensions:	Wheelbase 7ft 7in; track 4ft 6in front, 4ft 3in rear.
Weight:	1050lb

Brabham BT7: Dan Gurney's first of 20 drives in chassis F1-1-63, Monaco 1963.

a cost to BRO of £3000 per chassis, after which the factory had no further involvement, other than to supply spares or development parts.

Detail changes only were made to the basic BT3 design concept in creating the BT7. These included a shallower frame in the engine bay to allow the upper main tubular members to pass beneath the exhaust cam boxes of the Climax engine, obviating the need for a detachable frame to facilitate engine installation. More cockpit space was provided for Gurney's lanky frame, and the front suspension layout included a new upper wishbone. Rear suspension now featured a single transverse upper link and reversed lower wishbone, the reverse of the layout on the BT3.

A significant development was the first application of a Hewland transmission in F1 as an alternative to the customer GSD units. Hewland had been building FJ and sports car gearboxes since 1960 based on VW casings with Hewland internals. The HD was a purpose-built 5-speed unit under development at the time and supplied to Brabham on that basis.

The bodywork had been tidied-up and now looked much sleeker than the slightly portly BT3. The pannier fuel tanks doubled as the outer body panels and an overall weight saving of 55lb had been achieved. A much more attractive colour scheme replaced the BT3's turquoise, this comprising a dark shade of green with a gold central stripe and noseband. Wheelbase was as for the BT3 but the track had been widened front and rear by 1in and ½in respectively.

Development and performance – 1963

Two BT7 chassis were built for the 1963 season, although the second was not ready until the Dutch GP. BRO enjoyed a promising season, Gurney and Brabham being the only drivers able to offer a challenge to Jim Clark's Lotus in terms of pace. All too often, however, the BT7s were struck down by annoying reliability problems or misfortunes. Typically, a promising performance at the British GP came to nought when both cars suffered engine failures. Nevertheless, the team was placed third in the Manufacturers Championship behind Lotus and BRM. A first GP victory required, it seemed, only a little bit of luck.

Development and performance – 1964-65

The two BT7 chassis continued in service in 1964. Modifications were made to the suspension layout and geometry compatible with new cast magnesium alloy 13in diameter wheels to take the new wider tread Dunlop R6 tyres. The Brabhams took easily to the new tyres and were more competitive than they had been in 1963, especially in the hands of Dan Gurney who was particularly at home on circuits where good handling and straightline speed were of the essence. At Spa, Dan totally dominated both practice and the race until running out of fuel on the final lap. This performance was put down to Tauranac's decision to run the cars close to the ground, restricting the airflow under the car and its tendency to generate aerodynamic lift. Despite being more competitive, leading or being up with the leaders in nearly every GP, Gurney's efforts were continually thwarted by trivial problems. Dan's maiden victory for the marque in the French GP was popularly received but a sixth, a couple of pole positions, a fastest lap and a second win in the final round were poor rewards for one of the top four drivers of the season.

Brabham BT7 chassis record – 1963

Chassis no.	Engine	Entrant	GP	Driver	No.	Grid	Result
F1-1-63	Climax FWMV	Brabham Racing Organisation	Monaco	D Gurney	4	Q6	Final drive on lap 25/100
			Belgium	D Gurney	18	Q2	3rd
			Holland	D Gurney	18	Q14	2nd
			France	D Gurney	8	Q3	5th
			Britain	D Gurney	9	Q2	Engine – lap 59/82
			Germany	D Gurney	10	Q13	Gearbox – lap 6/15
			Italy	D Gurney	24	Q5	Fuel feed lap 64/86
			USA	D Gurney	6	Q6	Chassis lap 42/110
			Mexico	D Gurney	6	Q4	6th
			S Africa	D Gurney	9	Q3	2nd (FL)
F1-2-63	Climax FWMV	Brabham Racing Organisation	Holland	J Brabham	16	Q4	Throttle lap 68/80
			France	J Brabham	6	Q5	4th
			Britain	J Brabham	8	Q4	Engine – lap 27/82
			Germany	J Brabham	9	Q8	7th
			USA	J Brabham	5	Q5	4th
			Mexico	J Brabham	5	Q10	2nd
			S Africa	J Brabham	8	Q2	N/C – spin, fuel tank – 70 laps/85

Brabham BT10 chassis record							
Chassis no.	**Engine**	**Entrant**	**GP**	**Driver**	**No.**	**Grid**	**Result**
1964							
F2-4-64	Lotus-Ford 4	John Willment (Automobiles)	Britain	F Gardner	26	Q19	Accident on grid at start
1965							
F2-4-64	Lotus-Ford 4	John Willment (Automobiles)	S Africa	P Hawkins	18	Q16	9th – 4 laps behind
F2-10-64	Cosworth SCA	David Prophet (Racing)	S Africa	D Prophet	19	Q19	N/C – 71 laps/85

Africa in 1963, ran his BT10 in the 1965 South African GP, retaining the Ford-based Cosworth SCA engine.

BRABHAM BT11

The Brabham/Tauranac partnership remained faithful to the conventional tubular space frame when producing the BT11 for 1964. The chassis was not significantly different from the BT7 but reflected the continuous development and refinement of the original concept. Whereas the top main tubular members of the BT7 had run below the exhaust camshaft covers of the Climax V8, on the BT11 they ran above them, cleared by overlapping butt joints on each side behind the cockpit. The right-hand joint was welded but the left-hand bolted into place to allow it to be removed for engine installation. None of the frame tubes were used to convey oil or water between the engine and radiators. Separate pipes, round for oil and rectangular for water, ran along the sides of the car in the airstream, together with fuel lines to and from the Lucas fuel pump mounted ahead of the radiator. Wheelbase was as for the BT7, while front and rear track were increased by 2in and 3in respectively.

Performance – 1964

Four BT11 chassis were built in 1964, the first three chassis being supplied to customers for whom Brabham was now the sole source of a competitive chassis, following the virtual withdrawal of Lotus from this market and the failure of Cooper to remain competitive. While Dan Gurney was happy to continue with his BT7, BRO produced BT11 F1-1-64 for Jack Brabham in time for the Austrian GP. He failed to finish any of the remaining GPs due to a variety of engine problems.

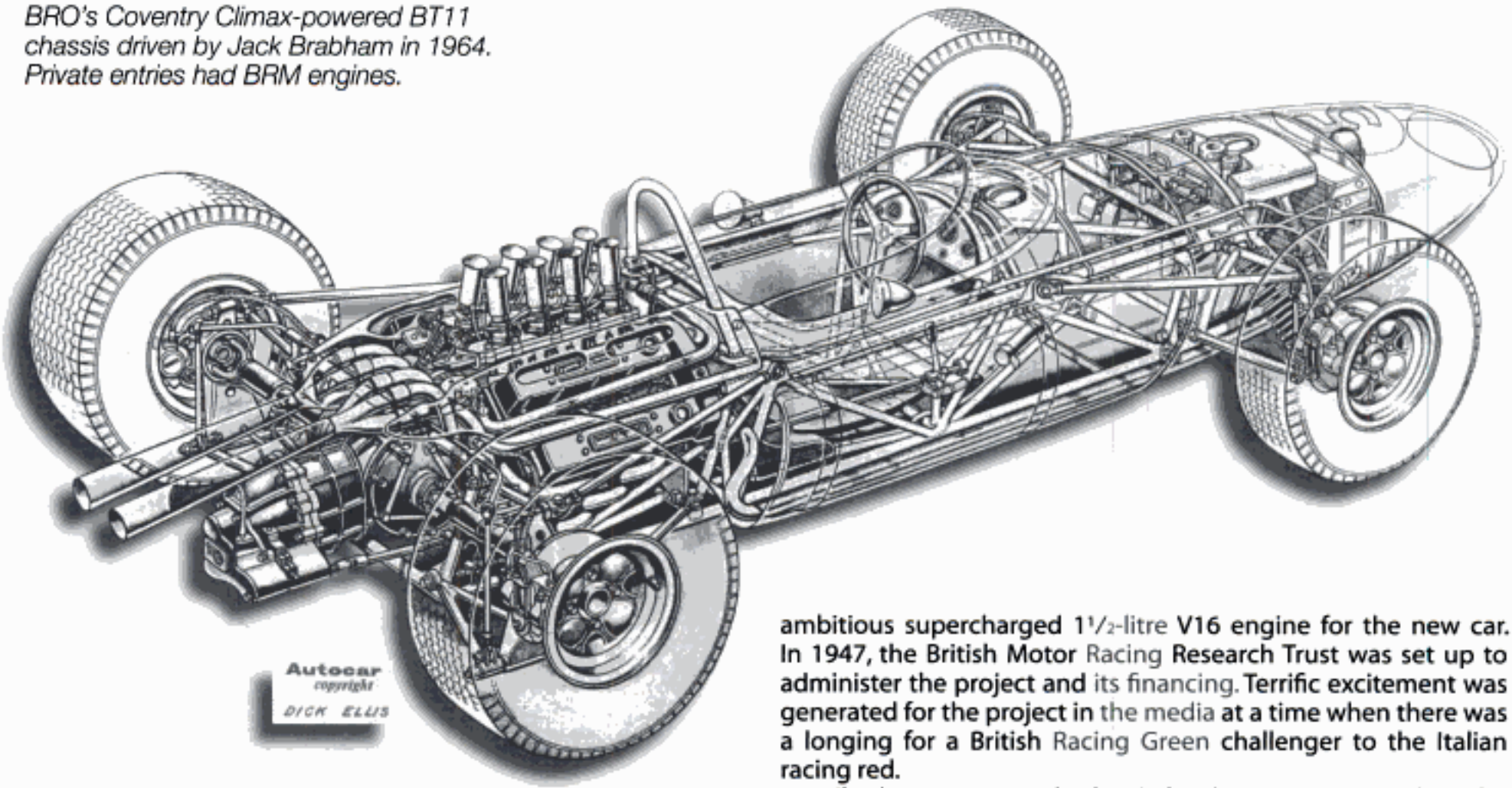
Of the customer chassis, Rob Walker purchased F1-4-64 for a BRM V8 engine for Jo Bonnier, while DW Racing Enterprises purchased F1-5-64, installing a 1962 carburettor Climax engine for Bob Anderson. Anderson ran all the European GPs, finishing in the points in both Holland and Austria, an impressive performance in an underpowered car. DW Racing Enterprises was the epitome of a private team; prepared in a garden shed by Anderson, the car was transported on a second-hand VW Combi, the remainder of the team comprising his French wife, who did the admin, and a mechanic. Although Anderson was awarded the GPDA Wolfgang von Trips Memorial Trophy for the best private entrant of 1964, Jo Siffert was marginally more successful with his Siffert Racing Team BRM engined F1-6-64, scoring points finishes in Germany and the USA, and also gaining the distinction of beating Jim Clark to win the non-Championship Mediterranean GP at Enna-Pergusa. In North America the car was entered by Rob Walker, for whom Siffert would drive in 1965.

Development and performance – 1965

A fifth BT11 chassis was built for the 1965 season, this to replace Dan Gurney's BT7 in the BRO team. At the instigation of Gurney, BRO became the first team to be contracted to Goodyear tyres and these had an effect on the competitiveness of the team early in the season. BRO chassis featured detail modifications over the 1964 versions, including a new upper wishbone for the front suspension. An articulated unit comprising, effectively,

Brabham BT11 specification	
Engine:	Coventry Climax FWMV V8
Chassis:	Fully triangulated multi-tubular space frame constructed from 1in diameter, 18swg steel tubes braced with tubular crossmembers and fully triangulated in 1in or $^{7}/_{8}$in diameter tubing. Heavily stressed joints strengthened with metal gusseting plates brazed into position to spread loading. Cockpit opening reinforced and corners triangulated with secondary $^{5}/_{8}$in diameter tubing.
Transmission:	Hewland HD 5-speed.
Fuel tanks:	Twin fabricated aluminium pannier tanks fitting between chassis tubes and alongside the driver's legs, small seat tank and supplementary tank above driver's legs. Capacity 31 gallons (approx.).
Suspension:	Front: wide-based tubular wishbones; top braced to form 'A' with rearward arm feeding loads into scuttle bulkhead. Forward arm of lower wishbone picking up from point behind radiator mounting. Standard Triumph uprights. Outboard mounted coil spring/damper unit, anti-roll bar. Rear: single upper link and reversed lower wishbone located by twin forward facing radius rods. Combined coil spring/damper unit, anti-roll bar.
Brakes:	Girling discs mounted outboard, 10$^{3}/_{4}$in diameter front, 9$^{3}/_{4}$in rear.
Wheels:	Brabham cast magnesium alloy, bolt on, 13in diameter.
Dimensions:	Wheelbase 7ft 7in; track 4ft 8in front and rear.
Weight:	1010lb

BRO's Coventry Climax-powered BT11 chassis driven by Jack Brabham in 1964. Private entries had BRM engines.



to short-stroke specification with fuel-injection. The chassis was badly damaged in a practice accident at the Nürburgring and not seen again in 1965.

Over the winter of 1964, Twickenham-based Ford dealer John Willment acquired the former Rob Walker team chassis F1-4-64 and ran it on Goodyear tyres for Australian F3/F2 driver Frank Gardner.

Chassis number F1-3-64 was never built.

BRM (British Racing Motors)

The original BRM (British Racing Motors) project was intended to provide Britain with a Grand Prix challenger at a time when it had none and GPs were dominated by continental, mainly Italian, marques such as Alfa Romeo and Maserati. It was conceived while World War II was still in progress, by Raymond Mays, a well-known driver, and Peter Berthon, a self-taught engineer. Mays and Berthon had instigated the pre-war ERA marque that had proved very successful in competition though it had not been a commercial success. Once the war was over, Mays set out to promote the BRM project around British industry, seeking either financial support or donations by way of component manufacture. Berthon, meanwhile, was designing an overly ambitious supercharged 1½-litre V16 engine for the new car. In 1947, the British Motor Racing Research Trust was set up to administer the project and its financing. Terrific excitement was generated for the project in the media at a time when there was a longing for a British Racing Green challenger to the Italian racing red.

The hype was matched only by disappointment when the new car continually failed to appear for a race. When it finally did so, at the last moment at Silverstone in 1950, it failed on the start line with a sheared drive shaft. In a moment BRM had degenerated into a laughing stock. It continued to break down or failed to perform on its fleeting appearances, its V16 engine proving to be fatally flawed. By the time it produced a useful power output, the car was obsolete as regards GP racing, being eligible only for British Club racing. The project had been a disaster, a victim of its own hype, plagued by internal squabbles, delays in the supply of components and a lack of adequate finance. On the positive side, however, the V16 had an unforgettable exhaust note..

At the end of 1952 the project had been on the verge of collapse and had been bought out by Sir Alfred Owen, one of its staunchest supporters. BRM became a small subsidiary of the Owen Organisation, a Midlands-based manufacturer of components for the motor industry. The organisation encompassed a variety of subsidiaries in the UK, South Africa and Australia, and BRM would contribute technical input and, hopefully, act as a promotional tool for the group, race entries being made in the name of 'Owen Racing Organisation'. BRM remained under the direction of Mays and Berthon at its base in Bourne, Lincolnshire.

BRM P578: Graham Hill on his way to the World Championship in lightweight chassis 5785, East London 1962.

BRM P578

While BRM raced the Coventry Climax engined P57 throughout 1961, design and construction proceeded on a new chassis to take the new P56 V8 power unit being developed concurrently. The first complete P578 appeared in practice for the Italian GP in September 1961, its slimlines (for the time) and good looks attracting much attention. The 1962 season would be critical for BRM as Sir Alfred Owen was becoming frustrated by the lack of success despite the amount of financial support the Owen Organisation was providing. He made a decree to the effect that if the team did not produce some concrete results in the year, it faced the threat of closure. The P578 had to be a winner.

Chief Engineer Tony Rudd was looking for a chassis with torsional rigidity in the region of 2000lb/ft per degree to provide adequate handling and came up with a well triangulated space frame. The frame was deep for beam strength and well strutted with diagonal stiffeners to resist lozenging loads. In concentrating time and resources on the design and development of a new engine and chassis, a new transmission was not on the agenda for 1962. Accordingly, the 5-speed unit used in the 1961 P57 BRM was retained and, although suitably reliable, was unnecessarily sturdy, having been designed to accept torque from a larger capacity engine, and consequently heavier than need be. The whole car was constructed to BRM's usual high standard, not least in the finish of the hand-formed electron body panels sprayed in the traditional BRM dark green metallic colour scheme.

however, and after failing to qualify for the Dutch GP, he returned the car to Bourne amidst threats of legal action against BRM. Chassis 573 was acquired by British hill climb champion Tony Marsh for non-Championship F1 races and occasional runs on the 'hills'.

BRM P578 chassis record – 1962

Chassis no.	Engine	Entrant	GP	Driver	No.	Grid	Result
5781	BRM P56	Owen Racing Organisation	Holland	G Hill	17	Q2	1st
			Monaco	G Hill	10	Q2	6th
			Belgium	G Hill	1	Q1	2nd
			France	G Hill	8	Q2	N/C 44 laps/54 (FL)
			Britain	G Hill	12	Q5	4th
			Germany	G Hill	11	Q2	1st (FL)
			Italy	G Hill	14	Q2	1st (FL)
			USA	G Hill	4	Q3	2nd
5783	BRM P56	Owen Racing Organisation	Belgium	R Ginther	2	Q9	Transmission lap 22/32
			France	R Ginther	10	Q10	3rd
			Britain	R Ginther	14	Q8	13th
			Germany	R Ginther	12	Q6	8th
			USA	R Ginther	5	Q2	Engine – lap 35/100
			S Africa	R Ginther	4	Q7	7th
5785	BRM P56	Owen Racing Organisation	Italy	R Ginther	12	Q3	2nd
			S Africa	G Hill	3	Q2	1st

BRM P578 chassis record – 1964-65

Chassis no.	Engine	Entrant	GP	Driver	No.	Grid	Result
1964							
5781	BRM P56	M Trintignant	Monaco	M Trintignant	4	Q13	Overheating lap 53/100
			France	M Trintignant	28	Q16	11th
			Britain	M Trintignant	25		DNQ
			Germany	M Trintignant	22	Q14	5th
			Italy	M Trintignant	48	Q20	Fuel-injection – lap 22/78
5783	BRM P56	Scuderia Centro Sud	Holland	G Baghetti	32	Q16	10th
			Belgium	G Baghetti	6	Q17	8th
			Britain	G Baghetti	18	Q21	12th
			Germany	G Baghetti	18	Q21	Throttle linkage – lap 2/15
			Austria	G Baghetti	18	Q15	7th
5785	BRM P56	Scuderia Centro Sud	Holland	A Maggs	30		DNS – accident in practice
			Belgium	A Maggs	7		DNS – engine in practice
			Britain	A Maggs	17	Q23	Gearbox – lap 38/80
			Germany	A Maggs	26	Q16	6th
			Austria	A Maggs	19	Q19	4th
			Italy	G Baghetti	30	Q15	8th
1965							
5781	BRM P56	Scuderia Centro Sud	Italy	G Bassi	52	Q22	Engine – lap 8/76
5783	BRM P56	Scuderia Centro Sud	Belgium	M Gregory	29	Q20	Fuel pump lap 12/32
			Britain	M Gregory	12	Q19	N/C 70 laps/80
			Germany	M Gregory	24	Q18	8th
			Italy	M Gregory	48	Q23	Gearbox – lap 22/76
5785	BRM P56	Scuderia Centro Sud	Belgium	L Bianchi	27	Q17	12th
			Germany	R Bussinello	25		DNQ
			Italy	R Bussinello	50	Q21	Oil pressure – lap 58/76

that BRM could not rest on its laurels as the Lotus would inevitably overcome its problems and prove to be a consistent winner. He reacted quickly to the challenge and the P61 monocoque was on the drawing board by the summer of 1962, with construction of the first chassis underway in September as the P578 was scoring an historic 1-2 finish at Monza.

The monocoque comprised a single, large diameter duralumin outer tube section doubling as the body skin into which a fabricated sheet structure was riveted forming the driver's seat pan,

BRM P61: Hill raced this chassis only twice during 1963, the second occasion was at Monza where the nose appears to be generating aerodynamic lift.

BRM P61 chassis record – 1963							
Chassis no.	**Engine**	**Entrant**	**GP**	**Driver**	**No.**	**Grid**	**Result**
611	BRM P56	Owen Racing Organisation	France	G Hill	2	Q2	3rd (penalised 1 min for push-start. No points awarded)
			Italy	G Hill	12	Q2	Clutch – lap 59/86

BRM P61 specification

Engine: BRM P56 V8

Chassis: Full '360°' monocoque centre section constructed from 16swg duralumin with internal fabricated structure riveted into place to form driver's seat pan, cockpit floor and sides. Sheet steel bulkheads at front and rear. Light tubular framework riveted to front bulkhead provided suspension, steering and radiator mounting points. Tubular sub-frame comprising two 1¼in diameter, 18swg steel tubes welded to lower part of rear bulkhead with four 1in tubes bolted to lugs on upper part of bulkhead to support rear of engine, transmission and rear suspension. Upper tubes and combined diagonal stiffeners detachable for engine installation.
Twin flexible rubber engine oil tanks mounted in rear of side sections of monocoque, either side of engine with oil radiator between, total capacity 3½ gallons.

Transmission: BRM P62 6-speed.

Fuel tanks: Flexible rubber bag fuel tanks in hollow D-shaped areas between inner and outer sections of monocoque on either side of the cockpit, capacity 26 gallons. 6 gallon auxiliary tank mounted above driver's legs in case of need.

Suspension: Front: fabricated steel top wishbone forming rocker arm and acting on inboard coil spring/damper unit via complex series of links. Wide-based tubular lower wishbone. Aluminium forged upright. Anti-roll bar.
Rear: upper and lower fabricated tubular wishbones with short upper radius rod running forward to point level with clutch bell housing. Longer lower radius rod anchored at seat-back bulkhead. Hollow cast aluminium upright. Combined coil spring/damper unit mounted above top wishbone and operated via articulated link and pushrod. Anti-roll bar.

Brakes: Dunlop discs mounted outboard, 10½in diameter front, 9½in rear (inboard of the uprights).

Wheels: Dunlop cast magnesium alloy, bolt on front, centre lock rear, 15in diameter, 5in rims front, 6in rear.

Dimensions: Wheelbase 7ft 6in; track 4ft 5in front, 4ft 4.7in rear.

Weight: 1010lb

development miles at Snetterton on 13 June 1963, in the hands of Graham Hill, somewhat later than planned due to GP team resources being diverted to the Rover-BRM gas turbine Le Mans project. Nine days later it made its public debut in practice for the Dutch GP where it was plagued by locking rear brakes, but the team stayed on at Zandvoort and completed further development mileage. It was entered for the French GP at Reims the following weekend where, despite reservations about its handling, Hill qualified second to Clark and finished third after a 1 minute penalty for the infamous push-start on the grid.

Further testing was carried out at Silverstone and Snetterton to improve the handling, as the car was lifting its inside front wheel on cornering. The pivot point of the top front suspension wishbone was raised slightly and the car appeared in this form in practice for the German GP. Problems were experienced with oil frothing, thought to be due to it overheating, and the oil cooler was relocated ahead of the water radiator in the nose. It later transpired that the fault lay in the oil pipe layout and partial collapse of the bag type tanks. The P61 next raced at Monza, Hill once again qualifying in second and disputing the lead with first Surtees and then Clark, until falling away with clutch slip and retiring.

The car had appeared to be fast in a straight line but its cornering and roadholding remained suspect due to a weakness in the chassis. The tubular rear frame supporting the engine and suspension was proving to be insufficiently rigid compared to the monocoque centre section, distorting under cornering loads and allowing the rear suspension to take up attitudes for which it was not designed, compromising the handling. In addition, the chassis had taken too long to build and was difficult to service. The P61 was set aside and the lessons learned were carried forward to a second series monocoque on which Rudd was already working.

BRM P261

Having analysed the shortcomings of the P61, Tony Rudd started design work on a Mk 2 version in August 1963. This became familiarly known around the factory as the '2-61', and the type number P261 was adopted as the official designation as a result. The new chassis was built to the same basic wheelbase and track dimensions as the P61 and on the same jigs as the earlier chassis. The structure was constructed from mainly 18swg duralumin rather than the 16swg of the P61. The main difference from the P61 was in the engine bay, where the tubular sub-frame had been deleted in favour of two stressed skin extensions of the main structure, running either side of the engine, below the exhaust camshaft covers. The engine was bolted rigidly to the structure via four points at the seat-back bulkhead – two low down and two on the cam covers – and four points on the rear bulkhead, one on each cam cover. The resultant structure had a claimed

BRM P261 specification

Engine:	BRM P56 V8
Chassis:	Full '360°' monocoque centre section constructed from mainly 18swg duralumin with internal fabricated structure riveted into place to form driver's seat pan, cockpit floor and sides. Stressed skin extensions either side of engine terminating in sheet steel bulkhead providing engine and suspension mounting points. Sheet steel bulkhead at front with light tubular framework providing front suspension, steering, oil tank and radiator mounting points.
Transmission:	BRM P62 6-speed.
Fuel tanks:	Flexible rubber bag fuel tanks in D-shaped areas between inner and outer sections of monocoque either side of cockpit, capacity 26 gallons. Auxiliary 6 gallon tank mounted above driver's legs in case of need.
Suspension:	Front: fabricated steel rocker arm acting on inboard coil spring/damper unit. Wide-based tubular lower wishbone. Aluminium forged upright. Anti-roll bar. Rear: single upper link and reversed lower wishbone located by twin parallel radius rods picking up from points adjacent to the seat-back bulkhead. Hollow cast aluminium upright. Combined coil spring/damper unit, anti-roll bar.
Brakes:	Dunlop discs mounted outboard, 10½in diameter front, 9½in rear (inboard of the uprights).
Wheels:	Dunlop/BRM cast magnesium alloy, bolt on, 13in diameter, 5in rims front, 6in rear.
Dimensions:	Wheelbase 7ft 6½in; track 4ft 5in front, 4ft 4.7in rear.
Weight:	1010lb

torsional stiffness of 8000lb/ft per degree – four times greater than the space frame P578 and over three times greater than the Lotus 25.

The variable rate geometry of the P61 had been abandoned but the front suspension retained the inboard mounted spring/damper units, actuated by a plated wishbone pivoting on the chassis. The rear suspension now featured conventional single upper links and reversed lower wishbones located by twin parallel radius rods picking up from points adjacent to the seat-back bulkhead. The 6-speed P62 gearbox that first appeared at Spa in 1963 was retained until a new P72 version became available during the 1964 season. This version had a magnesium alloy case, instead of aluminium, saving 8lb in weight. As before, all the ratios of this non-synchromesh unit could be changed individually.

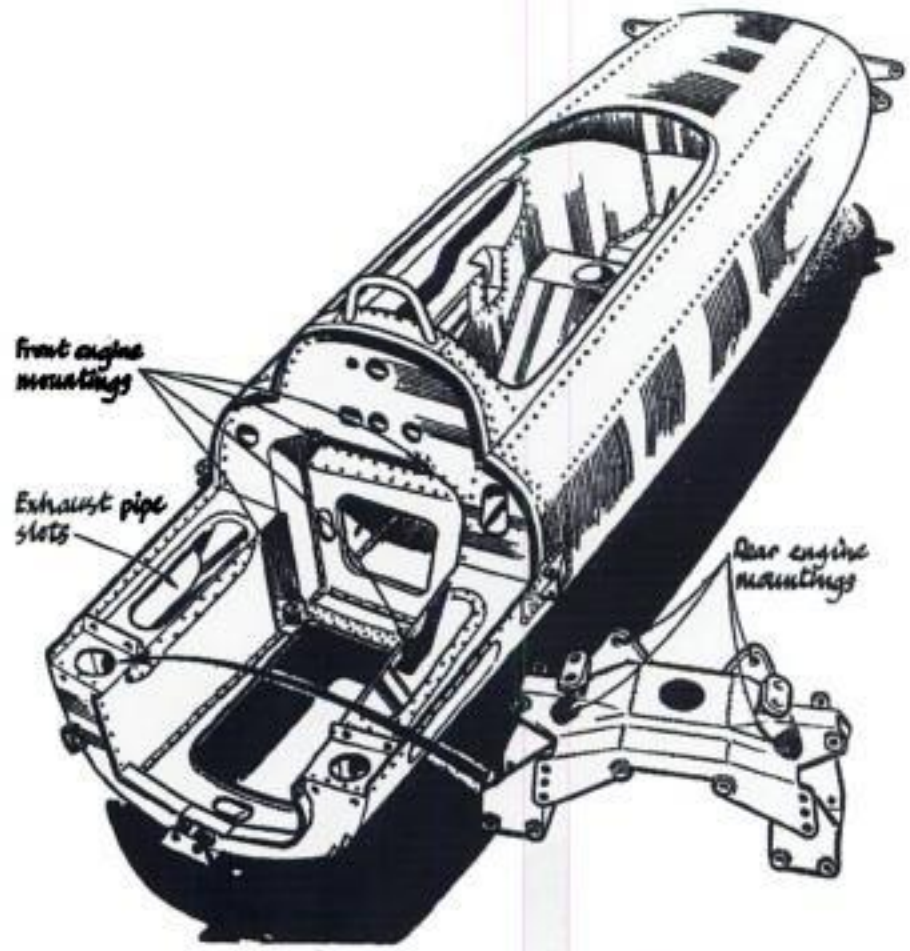
The chassis was intended to take a new version of the P56 V8 featuring reversed intake and exhaust ports in which the exhaust pipes emerged from the centre of the vee instead of at each side. This engine was not ready at the beginning of the season making it necessary to revert to the 1963 type engines with side exhausts. This required passing the exhausts through sheet steel reinforced slots specially cut into the rear chassis extensions.

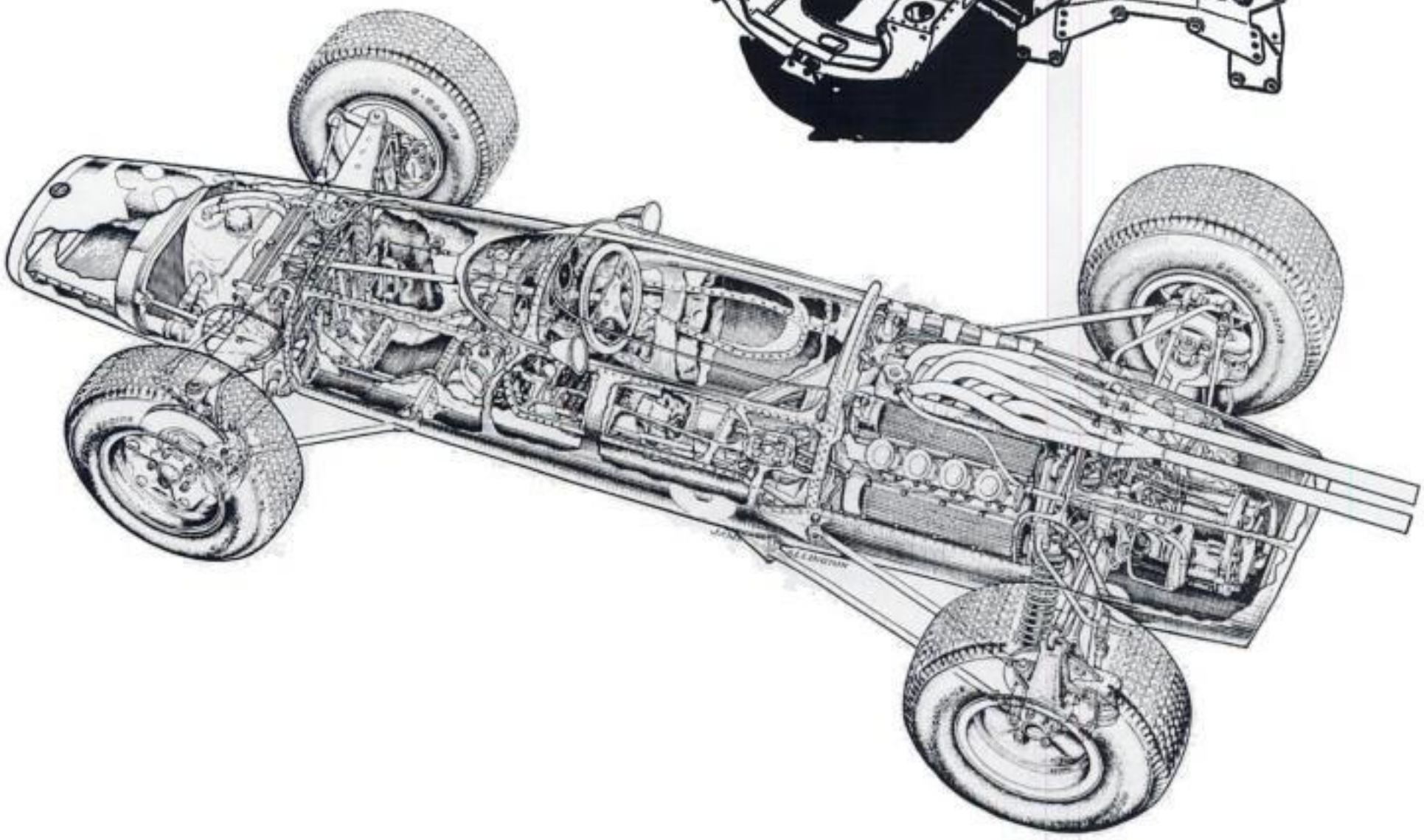
The first chassis (2612) was tested at Silverstone on 7 February 1964, and proved to be impressively fast and handle well on 15in wheels. Graham Hill found the cockpit to be a bit of a close fit and set about it with a hammer to give himself more elbow room, much to the consternation of Tony Rudd. On 14 March, the chassis was written-off at a very wet non-Championship F1 race at Snetterton when the car aquaplaned off the track. By this time, Dunlop had announced its new wider tread tyres on 13in wheels and the suspension had to be modified, as the smaller wheels would not fit over it. A new chassis (2613) was built with 13in wheels, now all of the bolt-on type, but its handling was found to be compromised compared to the 15in wheel original. It took some time to master the different characteristics of the new tyres, this

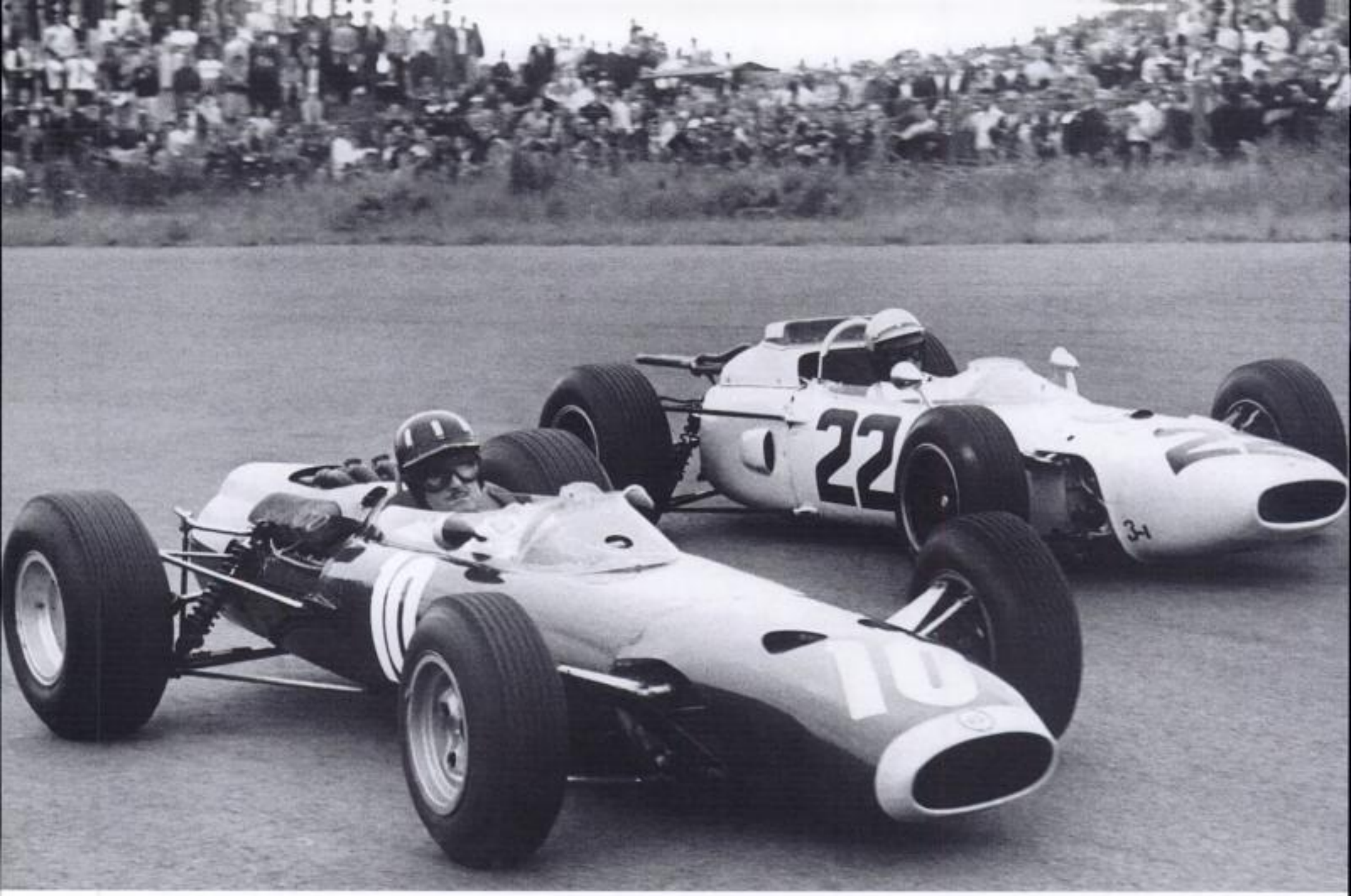
BRM P261 chassis record – 1964

Chassis no.	Engine	Entrant	GP	Driver	No.	Grid	Result
2613	BRM P56	Owen Racing Organisation	Monaco	R Ginther	7	Q8	2nd – 1 lap down
			Holland	R Ginther	8	Q8	N/C 64 laps/80
			Belgium	R Ginther	2	Q8	4th
			France	R Ginther	10	Q9	5th
			Britain	R Ginther	4	Q14	8th
			Germany	R Ginther	4	Q11	7th
			Austria	R Ginther	4	Q5	2nd
			Italy	R Ginther	20	Q9	4th
2614	BRM P56	Owen Racing Organisation	Monaco	G Hill	8	Q3	1st (FL)
			Holland	G Hill	6	Q3	4th
			Britain	G Hill	3	Q2	2nd
			Germany	G Hill	3	Q5	2nd
2615	BRM P56	Owen Racing Organisation	Belgium	G Hill	1	Q2	5th
			France	G Hill	8	Q6	2nd
			Austria	G Hill	3	Q1	Distributor drive – lap 5/105
			USA	R Ginther	4	Q13	4th
			Mexico	R Ginther	4	Q11	8th
2616	BRM P56	Owen Racing Organisation	Italy	G Hill	18	Q3	Clutch – lap 0/78
			USA	G Hill	3	Q3	1st
			Mexico	G Hill	3	Q6	11th – collision with Bandini

Right: *BRM P261 monocoque hull in 1964 form with exhaust slots in rear chassis members.* ***Below:*** *BRM P261 with central exhaust V8 (chassis 2616) first raced at Monza – and for the remainder of the 1964 season – by Graham Hill.*







BRM P261: Graham Hill slips inside Ginther's Honda on the approach to Tarzan at Zandvoort, 1965.

being achieved by careful but continuous adjustments to camber angles, castor, roll centres and spring and roll bar stiffness, all of which were fully adjustable. Early season front brake fade problems were rectified by replacing solid discs with hollow, ventilated discs, something that BRM had first used back in 1957. As on previous versions, rear discs were mounted inboard of the uprights.

The reverse port head engine eventually appeared at Monza in September in a new chassis (2616) purpose-built for it that was used by Hill for the final three GPs of the season. On this chassis, the exhaust slots were omitted from the rear monocoque chassis extensions, allowing them to be built 2in deeper to provide additional fuel capacity This was the fifth chassis built, the numbering sequence having begun with 611, the P61 of 1963.

Development and performance – 1964

The P261 was fully competitive by the beginning of the GP season, the highlight of which was the team's second successive 1-2 finish at Monaco, Hill in 2614 leading Ginther in 2613 by a lap. Once again, Ginther had an enviable reliability record, finishing in every GP bar one. In fact, BRM had only three non-finishes from twenty starts, an 85 per cent finishing record. Ginther was not as successful as he had been in 1963, however, his car clearly slower than Hill's. On occasion his practice times were slower in the P261 than in the P578 the preceding year. Overall, BRM was runner-up in the Constructors' Championship once again.

Development and performance – 1965

Chassis 2613 and 2614 were retired after the 1964 season

BRM P261 chassis record – 1965							
Chassis no.	**Engine**	**Entrant**	**GP**	**Driver**	**No.**	**Grid**	**Result**
2615	BRM P56	Owen Racing Organisation	Belgium	G Hill	7	Q1	5th
			Mexico	J Stewart	4	Q8	Clutch lap 35/65
2616	BRM P56	Owen Racing Organisation	S Africa	G Hill	3	Q5	3rd
			Monaco	G Hill	3	Q1	1st (FL)
			France	G Hill	10	Q13	5th
			Britain	G Hill	3	Q2	2nd (FL)
			Holland	G Hill	10	Q1	4th
			Germany	G Hill	9	Q3	2nd
			Italy	G Hill	30	Q4	2nd
			USA	G Hill	3	Q1	1st (FL)
			Mexico	G Hill	3	Q5	Engine – lap 56/65
2617	BRM P56	Owen Racing Organisation	S Africa	J Stewart	4	Q11	6th
			Monaco	J Stewart	4	Q3	3rd
			Belgium	J Stewart	8	Q3	2nd
			France	J Stewart	12	Q2	2nd
			Britain	J Stewart	4	Q4	5th
			Holland	J Stewart	12	Q6	2nd
			Germany	J Stewart	10	Q2	Suspension – lap 2/15
			Italy	J Stewart	32	Q3	1st
			USA	J Stewart	4	Q6	Suspension – lap 12/110

while new chassis 2617 was built for Jackie Stewart (who had replaced Ritchie Ginther). The reverse port cylinder head V8 was standardised and numerous detail modifications were tried, including reversing the lower front suspension wishbone to provide a forward rather than rearward-facing arm. The forward pickup point was located just aft of the radiator on a tubular extension to the monocoque. At the rear, the upper radius rod mounting point was raised from hub height to the level of the top transverse link. The radius rod and upper link formed a very wide-based wishbone and provided more even distribution of braking and acceleration loads between the radius rods, and minimised rear-wheel toe-in under suspension movement.

The 1965 season was another in which BRM demonstrated outstanding reliability with sixteen finishes from twenty starts, all of them being in the points. Graham Hill scored his third consecutive wins for BRM at Monaco and Watkins, while Jackie Stewart scored his maiden GP win at Monza having previously scored three second places, all behind Jim Clark. As a result, BRM finished runner-up in the Constructors' Championship for the third year running.

BRM P67

The BRM P67 was a four-wheel-drive F1 research project looking ahead to the change in regulations that would double engine capacity to 3-litres from 1966. The design work was the responsibility of Mike Pilbeam (who would become a designer/manufacturer of racing cars in his own right in later years), having been briefed by Tony Rudd.

Design and development

The car was based around a multi-tubular space frame chassis, very much on the lines of the P578 of 1962. It was mainly constructed from 16 gauge round steel tubing with some 18 and 20 gauge in lower stressed areas. The front suspension was a conventional double wishbone set up with outboard spring/damper units, while the rear wishbones and single radius rod were lifted straight from the P578, complete with 'old' type 15in diameter wheels.

The BRM P56 V8 engine was installed in the chassis back-to-front, putting the clutch immediately behind the driver. The engine was angled in the frame 2° to the left of the front/rear axis of the car, and, with the drivers seat positioned 2in to the right, space was provided for the 4WD mechanicals along the left-hand side of the car. Power was transmitted forward from the engine and clutch via a short shaft to the rear of a combined BRM 6-speed gearbox and Ferguson 4WD centre differential. Drive then

BRM chassis performance summary											
Chassis	**Year**	**Starts**	**Finishes**	**1st**	**2nd**	**3rd**	**4th**	**5th**	**6th**	**PP**	**FL**
P57	1961-62	19	8	-	-	1	-	2	1	-	1
P578	1962-65	59	40	6	6	5	5	3	2	3	3
P61	1963	2	1			1					
P261	1964-65	40	33	5	11	2	5	5	1	5	4
Total		120	82	11	17	9	10	10	4	8	8

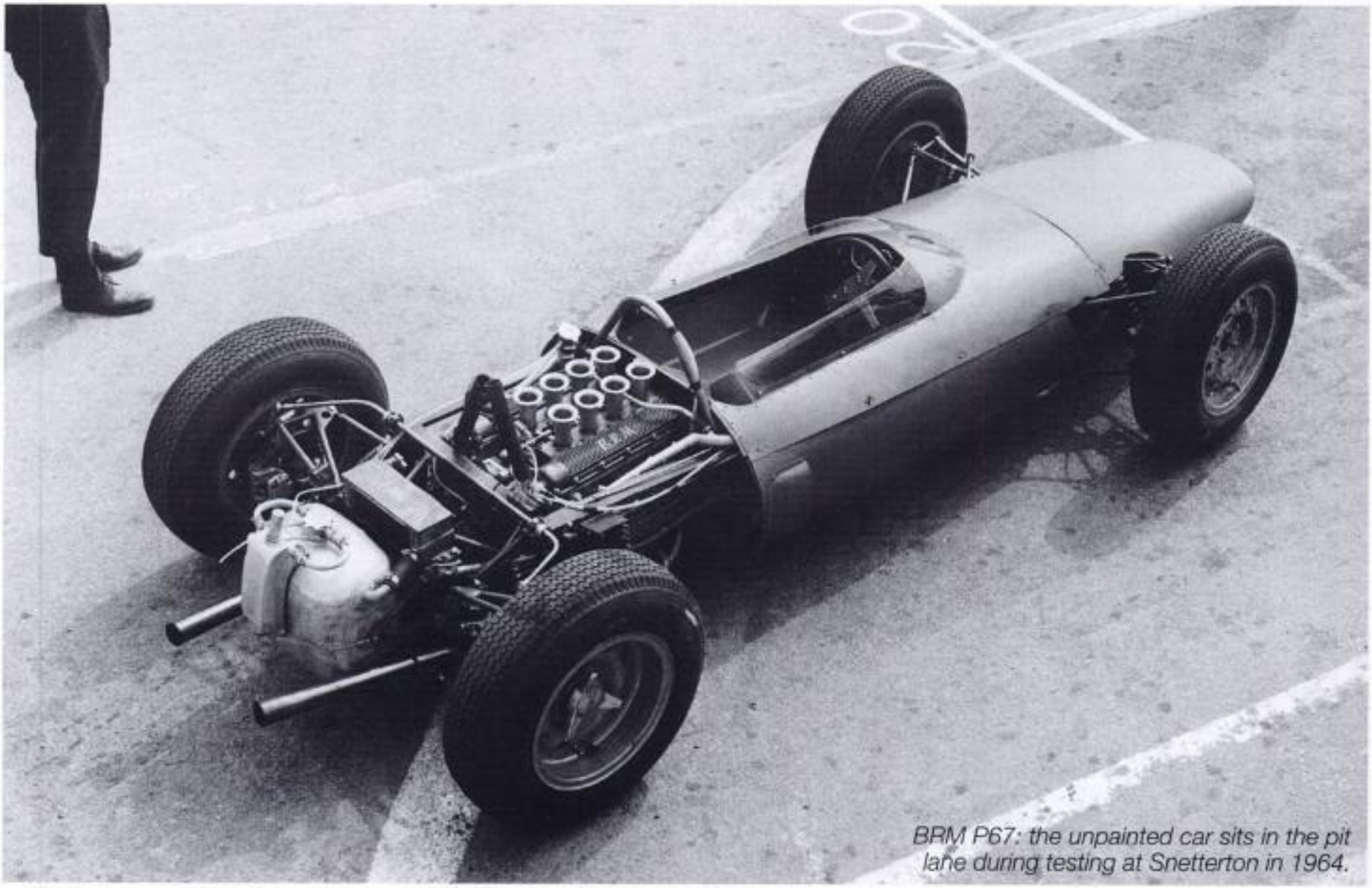
Constructors' Championship placings		
Year	**Points**	**Position**
1961	7	5th
1962	56	1st
1963	45	2nd
1964	51	2nd
1965	61	2nd

passed forward to the front final drive and back to the rear unit via a shaft running along the left side of the engine.

Ritchie Ginther and Richard Attwood, newly recruited from F2, carried out extensive testing at Snetterton, Silverstone and Brands Hatch. Torque split between the front and rear wheels, although adjustable, was fixed at 40:60 for testing. An entry was made for the 1964 British GP, and Attwood practised the one-off chassis numbered '671'. Having lapped 7sec off the pace, the car was withdrawn. After due consideration, the project was set aside as being inappropriate for F1 – the car was overweight by at least 150lb and the handling required considerably more development work as it was being compromised by the characteristics of the 4WD system. The P67 was not seen again until purchased by Peter Lawson, who dominated the 1968 British Hill Climb Championship with it, winning eleven out of thirteen rounds.

BRP (British Racing Partnership)

The British Racing Partnership (BRP) was formed in 1958 by Alfred Moss and Ken Gregory, respectively the father and manager of Stirling Moss. Stirling himself was involved only as an occasional driver but, following his retirement, would become a shareholder and director. Initially, the team ran Coopers in F2 powered by the German Borgward 4-cylinder, 16-valve, fuel-injected engines. The team's first involvement with F1 came in 1959 when Sir Alfred Owen loaned it a BRM for Stirling Moss to drive. Later that year, Ken Gregory was approached by the Samengo-Turner brothers who ran the Yeoman Credit finance company. In what amounted to the first instance of commercial sponsorship in F1, they offered to finance an entire F1 team in 1960 to be managed by BRP. This arrangement put BRP in a very strong financial position but was terminated after the first year as relations between Gregory and the Samengo-Turners broke down. The Yeoman Credit finance



BRM P67: the unpainted car sits in the pit lane during testing at Snetterton in 1964.

BRP: a neat-looking, well-engineered little car. Innes Ireland here at Reims in 1963.

agreement. BRP was termed an assembler of other constructors' components as it did not manufacture enough of its own. Colin Chapman was convinced that the BRP was a Lotus 25 copy. The truth of the matter was that BRP built its own chassis but used Lotus suspension parts – hardly grounds for exclusion. Ken Gregory and Tony Robinson offered the BRP cars to the other constructors for inspection after the 1964 Mexican GP to enable them to judge for themselves but none of them bothered to take up the offer.

The real origin of the problem lay in professional jealousy, stemming from when BRP was substantially funded by Yeoman Credit and then by UDT-Laystall. This posed a distinct threat to the other teams who would not be able to compete with BRP had it lured top class drivers away from them with better financial terms. In the event, BRP did not follow this strategy but the threat remained.

BRP had been unfairly ejected from F1; without starting money it could not survive. At any other time Gregory would have fought on but by now he had lost interest and was looking to other business opportunities. In December 1964, BRP announced that it would not compete in F1 in 1965. A couple of chassis were purpose-built for the Indianapolis 500, after which the team folded.

Cooper

The Cooper Car Company Ltd. was incorporated in December 1947 by the father and son team of Charles and John Cooper to manufacture a run of 500cc single seat racing cars. Charles had become an experienced and capable racing mechanic between the two world wars, and had eventually opened a small garage in Surbiton, south London. After WWII, son John had joined him in the business. John's interest in motor sport prompted him to build a single-seater racing car, the 500cc motorcycle engine installed behind the driver in the chassis to simplify the chain drive to the rear axle. This 'Cooper Mk 1' proved to be very successful in competition, to the extent that rival drivers sought to obtain replicas. The first production run of twelve was manufactured over the winter of 1947/48 and the 500cc Coopers began to dominate what became the internationally recognised F3 racing category. The company soon developed into the largest manufacturer of production racing cars in the 1950s, and John persuaded his ever-cautious father that they should branch out into other categories. Some sports cars were built as were the now legendary Cooper-Bristol 2-litre F2 cars, all conventionally front-engined.

The availability, from mid-1954, of the 1100cc Coventry Climax FWA engine for racing, encouraged Cooper to build a new sports car. A return was made to the simple rear-engined concept derived from the 500cc F3 cars with a central seat and all-enveloping bodywork. These cars, known as the 'bob-tail' Coopers due to their abbreviated tails, were very effective in their class in the mid-1950s until trumped by Colin Chapman's rather more sophisticated Lotus 11. In 1957, the FIA introduced a new 1½-litre F2 category for which Cooper produced an exposed-wheel version of its bob-tail sports car. Coventry Climax provided suitable engines in the form of the FWB and, subsequently, the twin-overhead camshaft FPF, and the early performances of the new Cooper generated numerous orders for production versions. Coopers dominated F2 from its inception through to its demise in 1960, by which time its position was being challenged by the new rear-engined Lotus 18 and Porsche 718.

In early season testing in 1957, driver Roy Salvadori had been very impressed by the nimble handling of the F2 Cooper compared to a front-engined F1 Connaught. He commented that, with an enlarged engine, the Cooper would make an effective F1 car on twisty circuits such as Monaco where its handling and lighter weight would offset the superior power of the contemporary front-engined F1 cars. Private owner Rob Walker took up the challenge and financed the enlargement of a Climax engine to 1960cc and an entry was made for the 1957 Monaco GP. Driven by Jack Brabham and running in third place in the closing stages, the outing was thwarted by a broken fuel pump mounting. From then on, Coopers made regular GP appearances culminating in wins in both the Argentine and Monaco GPs of 1958. Suitably encouraged and pressed by its customers, Coventry Climax produced a full 2½-litre version of the FPF for 1959, and Cooper chassis went on to win five GPs that year and six in 1960 to claim consecutive World Constructors' Championships.

Cooper, with its policy of simplicity and steady evolution, had instigated, perhaps inadvertently, the rear-engined revolution in F1, leaving other constructors no option but to follow suit.

COOPER T45

The T45 had been the 1958 production F2 Cooper, and, like many F2 cars of the period, was updated without difficulty to 1961 F1 specification, albeit with little hope for success. The chassis followed Cooper's multi-tubular principles being constructed from 1½in diameter, 18 gauge steel tubing. The seat-back bulkhead was formed from a curved tube that also acted as a body former, and welded-on brackets provided suspension pick-up points. There was little bracing in the frame save for three tubes welded up into an inverted Y-shape in the engine bay sides. A major change had been made in the front suspension where coil springs and wishbones replaced the previous transverse leaf

Cooper T45 chassis record – 1961

Chassis no.	Engine	Entrant	GP	Driver	No.	Grid	Result
F2-23-58	Climax FPF	Fred Tuck Cars Ltd.	Italy	J Fairman	30	Q26	Engine – lap 5/43

Cooper T45: the 1958 F2 chassis in action during that year's German GP.

spring. The latter was retained at the rear where it doubled as the upper location of the uprights. Girling drum type brakes were fitted as standard front and rear of 10in diameter and 1¾in width, although disc brakes were offered as an option. The engine was inclined 18° to the right in the chassis to bring the carburettors within the rear bodywork, and was mated to a Cooper modified Citroën-ERSA 4-speed transmission.

Cooper T45 chassis record – 1961

A number of T45s appeared in non-Championship F1 races during 1961 but only one chassis ran in a GP when West Country garage owner Fred Tuck took F1-23-58 to the Italian GP.

COOPER T51

The 1958 T45 underwent only detail modifications to become the T51 production F1/F2 Cooper for 1959. The main changes were different engine mountings and the provision on the chassis for mounting upper wishbones for the rear suspension. These relieved the leaf spring of some of the loadings imposed upon it and, together with screw thread adjusters at the inner ends of the wishbones, enabled small variations to be made to the handling, including more controllable oversteer. Girling disc brakes were now the norm, mounted outboard and of 10¼in diameter at the front and 9¾in at the rear. Dimensions were: wheelbase 7ft 7in, track 3ft 10½in front and 4ft rear.

Development and performance – 1961 and 1963

Three T51 chassis appeared in GPs, two in 1961 and one in 1963. Count Volpi's Scuderia Serenissma fitted F2-01-59 with a Maserati engine and GSD gearbox for Maurice Trintignant, who managed a highest placing of seventh from five starts. During the season the car appeared with Serenissma modified body panels. Another Maserati-engined chassis (F2-13-59) prepared by Scuderia Centro Sud appeared in the British and Italian GPs.

A 1960-built Maserati-engined T51 regular from the South African Gold Star Series (F2-16-60) made a single appearance in the 1963 South African GP.

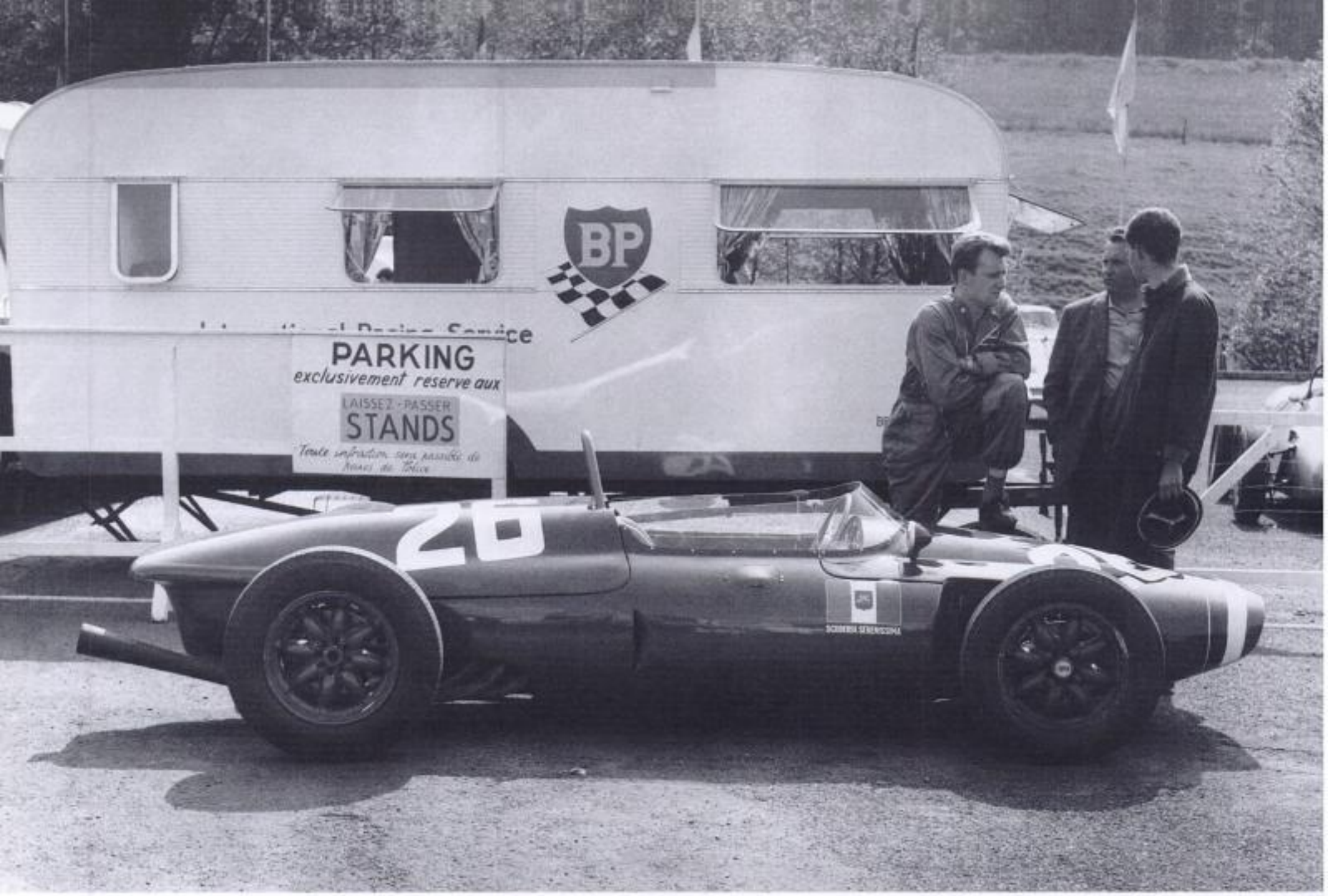
Cooper T51 chassis record – 1961/63

Chassis no.	Engine	Entrant	GP	Driver	No.	Grid	Result
1961							
F2-01-59	Maserati 150S	Scuderia Serenissima	Monaco	M Trintignant	42	Q15	7th
			Belgium	M Trintignant	26	Q19	Gearbox – lap 22/30
			France	M Trintignant	32	Q23	13th
			Germany	M Trintignant	20	Q21	Engine – lap 12/15
			Italy	M Trintignant	48	Q22	9th
F2-13-59	Maserati 150S	Scuderia Centro Sud	Britain	M Natili	62	Q28	Gearbox – lap 0/75
		Pescara Racing Club	Italy	R Pirocchi	58	Q29	12th
1963							
F2-16-60	Maserati 150S	T Blokdyk	S Africa	T Blokdyk	23	Q19	12th

COOPER T53

The origins of the T53 go back to February 1960 when the new rear-engined Lotus 18 made its GP debut in Argentina and proved to be much faster than the Cooper T51. Jack Brabham and John Cooper realised that they would need a completely new car for the 1960 season and began planning it on the flight home. Once back in England, the design 'committee' of Cooper, Brabham and the bearded Owen Maddock, Cooper's popular and highly respected draughtsman/designer, set to work. The result was the T53, known as the 'Lowline' that took Brabham to five GP wins in the season and won Cooper its second consecutive Constructors' Championship. Come 1961, replicas of the T53 would become the customer chassis for the new 1½-litre F1.

The chassis followed normal Cooper practice of employing four main tubular steel members but these were straight at each side between the front and rear suspension mounting points rather than the curved tubes seen on previous chassis. Torsional stiffness was up by 25 per cent compared



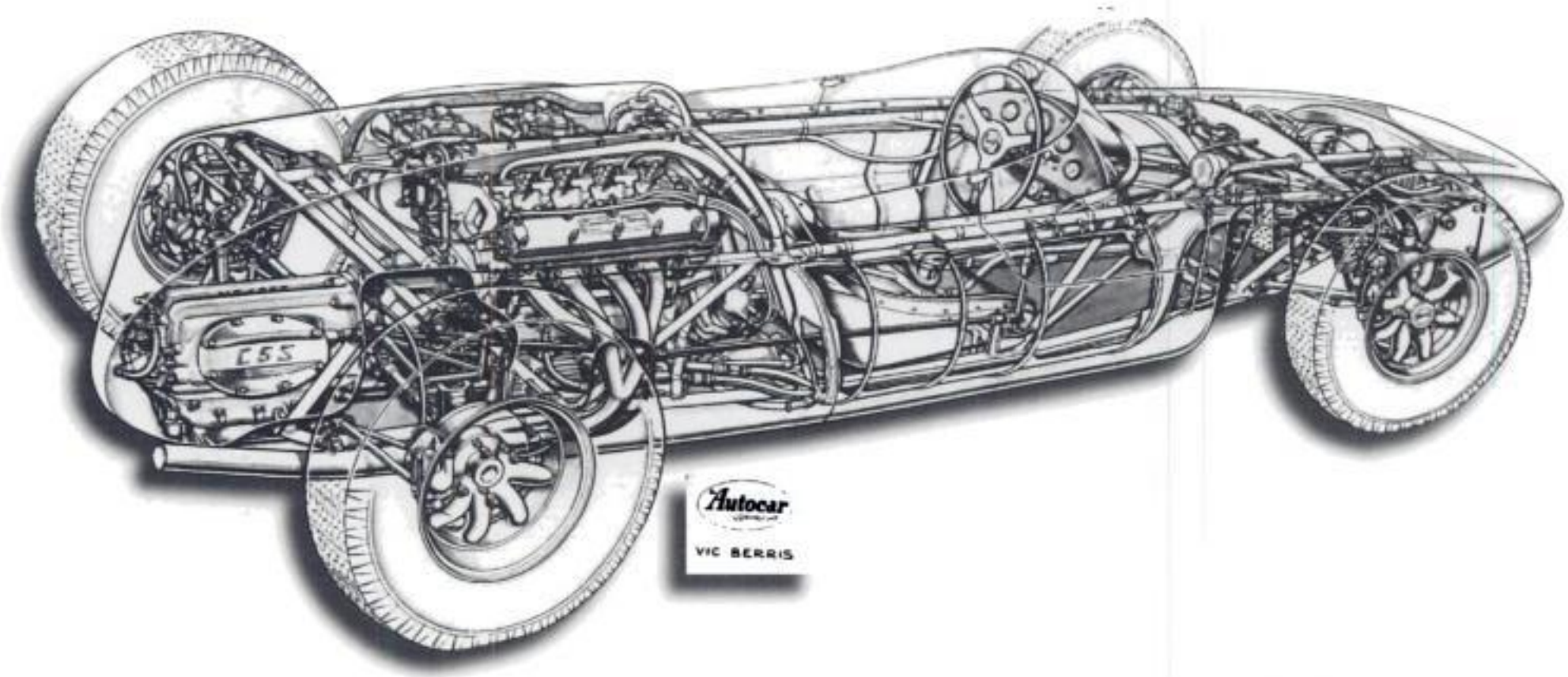
Cooper T51: the Serenissma modified, Maserati-engined chassis driven by Maurice Trintignant in a handful of GPs during 1961, seen here at Spa. The engine cover has been lowered and re-styled somewhat.

to the T51 thanks to diagonal stiffeners in the section between the scuttle and front suspension bulkhead, triangulation of the corners of the cockpit opening and more rigid, five point mounting of the engine and gearbox in the chassis. A great deal of detail work had been undertaken to achieve a reduction in frontal area. This included lowering the engine in the chassis by 1in, repositioning the steering box, lowering and widening the oil tank and locating the radiators further forward. This lengthened the available cockpit space, providing room for the driver to adopt a more reclining driving position, lowering him in the car and his shoulders within the cockpit sides. A desire to increase roll stiffness in the rear suspension was achieved by replacing Cooper's traditional transverse leaf spring with coil springs controlled by an anti-roll bar. Front suspension pivot points had been widened to increase resistance to braking loads. The wheelbase remained as for the T51 with ½in increases in front and rear track.

Development and performance – 1961

A total of fourteen of the chassis, known as T53P to differentiate them from the 1960 Championship cars, were built, of which ten took part in one or more GPs. One chassis that did not, went to Japan where it was used by the Honda motor company as part of its investigative process prior to entering F1 in 1964.

The most significant customer for the T53P was the Reg Parnell-run Yeoman Credit Racing Team with drivers John Surtees



Cooper T53 shown in 1960 World Championship-winning form. 1961 customer cars were little changed save for a 1½-litre Coventry Climax engine, roll bar, self-starter, etc, to comply with the new F1 regulations.

Cooper T53: John Surtees in the Yeoman Credit car during the 1961 German GP.

Cooper T53 specification (applicable also to T55 and T58)

Engine:	Coventry Climax FPF 4IL
Chassis:	Multi-tubular frame constructed from 1 1/2in diameter steel tubing, upper tubes 18swg with lower of 16swg. Diagonal stiffeners in section between the scuttle and front suspension bulkhead plus triangulation of corners of cockpit opening.
Transmission:	Cooper C5S 5-speed.
Fuel tanks:	Twin fabricated aluminium tanks mounted pannier fashion along either side of chassis, capacity 30 gallons (approximately).
Suspension:	Front: fabricated tubular wishbones with combined coil spring/damper unit and anti-roll bar. Standard-Triumph upright. Rear: fabricated tubular wishbones with cross-bracing. Combined coil spring/damper unit, anti-roll bar.
Brakes:	Girling discs mounted outboard, 10 1/4in diameter front, 9 3/4in rear.
Wheels:	Cooper cast magnesium alloy, bolt on, 15in diameter.
Dimensions:	Wheelbase 7ft 7in; track 3ft 11in front, 4ft 1/2in rear.
Weight::	1148 lb (approximately)

Cooper T55 chassis record – 1961-65

Chassis no.	Engine	Entrant	GP	Driver	No.	Grid	Result
1961							
F1-10-61	Climax FPF	Cooper Car Co.	Monaco	J Brabham	24	Q16	Ignition – lap 38/100
			Holland	J Brabham	10	Q7	6th
			Belgium	J Brabham	28	Q11	Engine – lap 12/30
			France	J Brabham	2	Q14	Oil pressure – lap 14/52
			Britain	J Brabham	12	Q9	4th
F1-11-61	Climax FPF	Cooper Car Co.	Monaco	B McLaren	26	Q7	6th
			Holland	B McLaren	11	Q13	12th
			Belgium	B McLaren	30	Q15	Ignition – lap 8/30
			France	B McLaren	4	Q8	5th
			Britain	B McLaren	14	Q14	8th
			Germany	B McLaren	2	Q12	6th
			Italy	B McLaren	12	Q14	3rd
			USA	B McLaren	2	Q4	4th
1962							
F1-11-61	Climax FPF	Cooper Car Co.	Holland	A Maggs	7	Q15	5th
			Monaco	A Maggs	16	Q16	Gearbox – lap 43/100
			Germany	A Maggs	10	Q23	9th
		J Love	S Africa	J Love	18	Q12	8th
1963							
F1-11-61	Climax FPF	J Love	S Africa	J Love	19	Q13	9th
1965							
F1-11-61	Climax FPF	J Love	S Africa	J Love	17	Q18	Half-shaft – lap 20/85

the pannier fuel tanks enabled the front half of the car to be lowered and slimmed down, the overall impression enhanced by a multi-curvature Perspex cockpit surround. Dry weight was approximately 464kg (1023lb).

Cooper had been producing its own 'C5S' 5-speed gearbox, designed by Owen Maddock, since 1960, and it was now converted to 6-speeds. Achieved by slimming down the gears and fitting six in the space previously occupied by 5-speeds, it would not have been possible but for the lower power and torque of the 1½-litre engines compared to that of the 2½-litre engines for which the gearbox had originally been designed. The addition of a sixth gear was not publicised, as it was hoped that it would assist the drivers in making better use of the narrower torque bands of the 1½-litre engines. It may well have done so but the T55 was still no match for Lotus in the Climax-engined 'class'.

Performance – 1961-65

Only two T55 chassis were completed. Initially, problems were experienced with misfiring and running on less than four cylinders. This was traced to imperfections in the float chambers of the Weber DCOE9 carburettors. Jack Brabham ran his chassis until the arrival of the new Coventry Climax V8, while Bruce McLaren ran his all season.

The 'works' team retained the ex-McLaren chassis F1-11-61 in early 1962 until a second T60 was ready for Tony Maggs. Thereafter it became a spare, Maggs driving it in Germany following a practice accident to his T60. It was then purchased by Rhodesian driver John Love who ran it in the South African Gold Star Series and the South African GPs of 1962, 1963 and 1965.

COOPER T58

Development and performance

By the beginning of July 1961, Coventry Climax had its new FWMV V8 engine running on the test bed and giving sufficiently encouraging performance for it to be chassis tested. Cooper was to be the first recipient of the new engine by virtue of its position as the reigning World Champion and, on 28 July, an engine was delivered to the Cooper premises in Surbiton. Four days later it had been installed in a chassis officially type numbered 'T58' but actually a third T55 (F1-12-61), suitably modified to accommodate the wider engine. This entailed re-routing the bracing tubes in the engine bay sides and making a section of the top left side frame tube detachable for engine installation and removal. Additional triangulating members running forward from just ahead of the upper rear suspension mounts to a point some 6in above the top frame tube on the seat-back bulkhead strengthened the engine bay.

The car was tested at Silverstone on 1 August where it proved encouraging, despite the wrong size anti-roll bars, and

Cooper T58 chassis record – 1961

Chassis no.	Engine	Entrant	GP	Driver	No.	Grid	Result
F1-12-61	Climax FWMV	Cooper Car Co.	Germany	J Brabham	1	Q2	Accident – lap 0/15
			Italy	J Brabham	10	Q10	Overheating – lap 7/43
			USA	J Brabham	1	Q1	Overheating – lap 57/100 (FL)

Cooper T59 chassis record – 1962							
Chassis no.	**Engine**	**Entrant**	**GP**	**Driver**	**No.**	**Grid**	**Result**
-	Climax FPF	Anglo-American Equipe	Britain	I Burgess	36	Q16	12th
			Germany	I Burgess	25	Q16	11th
			Italy	I Burgess	62		DNQ – 13sec off pace

Working on a 1962 Cooper T59 FJ rolling chassis, Aiden-Jones installed a Coventry Climax FPF Mk II 4-cylinder engine and a Cooper 5-speed gearbox. Twin water radiators were mounted in pods on either side of the engine bay, and this enabled him to neatly taper the nose cone down to a point, as it no longer had to provide an air inlet. These innovations placed a greater percentage of the weight distribution on the rear wheels and were anticipated to improve frontal aerodynamics. Unfortunately, the side radiators proved impracticable, possibly because the size and shape of the pods did not allow sufficient airflow to them. After a few races they were deleted and replaced by an orthodox front-mounted radiator fed with air from a rectangular hole formed by cutting off the front of the nose cone.

The team, now known as the Anglo-American Equipe, undertook a series of non-Championship F1 races and three GPs in 1962, with Ian Burgess doing the driving. The car was always going to be underpowered and proved to be well off the pace. The Cooper chassis was not the best starting point, Burgess not the most talented of drivers, and the car was not seen again after the Italian GP that year. It would be another eight years before Colin Chapman produced the definitive hip-radiator layout for the Lotus 72 but Aiden-Jones was working along the right lines. Maybe, with a little development, the problems could have been overcome.

In 1965, another 1962 Cooper T59 FJ chassis (number unknown) complete with 1100cc Ford 105E FJ engine failed to qualify for the South African GP.

COOPER T60

Jack Brabham had left Cooper at the end of the 1961 season to run his own production race car business and to build and race his own F1 car. He had played an important role in the development of Cooper's cars, always ready with input for both the design and development processes. He would be missed but a lot of his experience had rubbed off on team-mate Bruce McLaren, who now inherited both his position as team leader and his role in the design team with John Cooper and Owen Maddock.

Cooper's first proper V8-engined chassis did not feature any technical innovations, rather it continued the steady process of evolution from the T51/55 of the Cooper multi-tubular theme although more triangulation made it torsionally stiffer than previous chassis, largely the input of Bruce McLaren. A contemporary report described how the Cooper chassis "which used to be a series of mounting brackets connected by tubes, can now be described as a series of mounting brackets connected by water and oil pipes". Coolant was conveyed between the engine and radiator via the top left main longitudinal chassis member, returning via the bottom right; the other two chassis members conveyed oil for the same purpose.

The suspension was fully adjustable for roll centre heights, camber and castor angles, wheel toe-in and spring, damper and anti-roll bar rates. Roll centres at 5in were higher than under Brabham's influence and spring rates were soft, some of the loading being taken up by Aeon bump rubbers. With relatively slender anti-roll bars, as well, the nose of the car would dip noticeably under braking, promoting negative camber at the front wheels and having an adverse effect on handling and braking efficiency.

Owen Maddock had designed a new two shaft, constant mesh 6-speed gearbox. Ratios on this 'C6S' gearbox could be

Cooper T60: Bruce McLaren heading for a win in the 1962 Monaco GP, the nose of the car dipping under braking on the descent to the Station hairpin.

changed in a matter of minutes by removing the rear cover and sliding the gears in or out. It had been intended to locate the rear brakes in-board on either side of the gearbox but, due to an error, insufficient space was allowed and they ended up being mounted at the wheels.

The bodywork was hand beaten in aluminium with the pannier mounted fuel tanks doubling as body sides. Neatly finished in Cooper's dark green with two longitudinal white stripes running from the nose to cockpit, it had a dumpier appearance than its slimline Lotus and Lola rivals. In South Africa for the final GP of the season, a strange modification instigated by the normally reserved Charles Cooper, comprising a v-shaped radiator in an abbreviated nosecone, proved to be both inefficient and drag inducing and was not raced.

Performance – 1962

The two T60 chassis enjoyed reliable seasons finishing in the top six on most outings, they were fast and efficient but were lacking the pace of the BRM, Lotus 25 or Lola. A win at Monaco was inherited from BRM five laps short of the finish, and a convincing win was scored in the non-Championship Reims GP later in the season. This would, in fact, be the last Cooper victory of the 1½-litre F1.

Cooper T60 specification

Engine:	Coventry Climax FWMV V8
Chassis:	Multi-tubular frame constructed from 1½in and 1⅜in 18 gauge steel tubing with smaller diameter transverse and diagonal members plus triangulation of corners of cockpit opening. Water and oil conveyed between the engine and radiators via main frame tubes – top left and bottom right for water, opposites for oil.
Transmission:	Cooper C6S 6-speed.
Fuel tanks:	Twin fabricated aluminium tanks mounted pannier fashion along either side of chassis, capacity 30 gallons (approximately).
Suspension:	Front: narrow-based fabricated tubular wishbones with combined coil spring/damper unit and anti-roll bar. Standard-Triumph upright. Rear: fabricated tubular upper and longer, wider based lower wishbones with cross-bracing. Cast magnesium upright. Combined coil spring/damper unit, anti-roll bar.
Brakes:	Girling discs mounted outboard, 10¼in diameter front, 9¾in rear.
Wheels:	Cooper cast magnesium alloy, bolt on, 13in diameter front, 15in rear. Rim widths 6in front, 7in rear.
Dimensions:	Wheelbase 7ft 7in; track 4ft 3½in front, 4ft 2½in rear.

Cooper T60 chassis record – 1962-65

Chassis no.	Engine	Entrant	GP	Driver	No.	Grid	Result
1962							
F1-17-61	Climax FWMV	Cooper Car Co.	Holland	B McLaren	6	Q5	Gearbox – lap 21/80 (FL)
			Monaco	B McLaren	14	Q3	1st
			Belgium	B McLaren	25	Q2	Engine – lap 19/32
			France	B McLaren	22	Q3	4th
			Britain	B McLaren	16	Q4	3rd
			Germany	B McLaren	9	Q5	5th
			Italy	A Maggs	28	Q12	7th
			USA	B McLaren	21	Q6	3rd
			S Africa	B McLaren	8	Q8	2nd
F1-18-61	Climax FWMV	Cooper Car Co.	Belgium	A Maggs	26	Q10	Gearbox – lap 21/32
			France	A Maggs	24	Q11	2nd
			Britain	A Maggs	18	Q13	6th
			Germany	A Maggs	10		DNS – accident in practice
			Italy	B McLaren	30	Q4	3rd
			USA	A Maggs	22	Q10	7th
			S Africa	A Maggs	9	Q6	3rd
1963							
F1-17-61	Climax FWMV	Scuderia Centro Sud	Germany	M Cabral	22	Q20	Gearbox – lap 6/15
			Italy	M Cabral	64		WDN in favour of Baghetti's ATS
F1-18-61	Climax FWMV	RRC Walker Racing Team	Monaco	J Bonnier	11	Q11	7th
			Belgium	J Bonnier	12	Q13	5th
			Holland	J Bonnier	28	Q8	N/C 56 laps/80
			France	J Bonnier	44	Q11	N/C 32 laps/53
1964							
F1-18-61	Climax FWMV	Fabre Urbain	Italy	J-C Rudaz	60		DNQ
1965							
F1-17-61	Climax FWMV	Gerard Racing	Britain	J Rhodes	20	Q21	Ignition – lap 38/80

Cooper T60 chassis record – 1962-65

Two T60 chassis were built, numbered F1-17-61 and F1-18-61 in Cooper records, although neither was completed until early in the 1962 season. In fact, Tony Maggs' chassis was not ready until the third GP of the season at Spa.

Scuderia Centro Sud acquired F1-17-61 for 1963 and entered it for two GPs, including the Italian GP where it actually qualified only for the organisers to persuade the team to give up its grid position in favour of the slow ATS of Baghetti. Meanwhile, Rob Walker hired F1-18-61 for Jo Bonnier for the first four GPs of the season, pending delivery of a new T66. Retained as the team spare for the remainder of the season, it was not raced.

Into 1964 and F1-18-61 had been acquired by Fabre Urbain and entered in the Italian GP for the Swiss Jean-Claude Rudaz who failed to qualify. F1-17-61 re-appeared in mid-1964 in the ownership of Gerard Racing in non-Championship F1 races and the 1965 British GP.

COOPER T66

The T66 continued the Cooper policy of steady evolution, the chassis retaining the relatively large diameter straight tubing of the T60 but with mild sheet steel reinforcement welded to the floor section between the front and rear bulkheads. The main frame tubes continued to act as conduits for oil and water between the engine and radiators, while the rear of the bottom left tube doubled as an oil catch tank from the engine and transmission breathers. The car had been slimmed down both in the chassis and by the use of a smaller front-mounted oil tank and oil and coolant radiators. Slimmer pannier fuel tanks doubled as the outer bodywork and were supplemented by a tank behind and around the driver's seat, shaped to give a more reclining driving position than the T60. The three fuel tanks had separate fillers with breathers incorporated in the roll over bar behind the driver's head.

The main change for 1963 was in the suspension geometry. The T60 had been prone to marked nosedive under braking, causing the front wheels to adopt negative camber and run on the edges of its tyres, a phenomenon that could not be tolerated by modern tyre technology with its squarer crown profiles. The axes of the front wishbones suspension were, therefore, inclined by 5° (when viewed from the side) down towards the nose to reduce nose dive under braking while the upper rear wishbones were inclined 11° downwards to the rear to reduce tail sit under acceleration. In addition, the upper wishbones were of shorter length and more steeply inclined in response to Bruce McLaren's desire for a reduction in roll centre height.

Dimensions remained as for the T60. Despite the changes, the Cooper was still some 70-80lb heavier than the Lotus 25, equivalent to carrying a driver some 5 stone heavier than the diminutive Jim Clark.

Cooper T66 specification

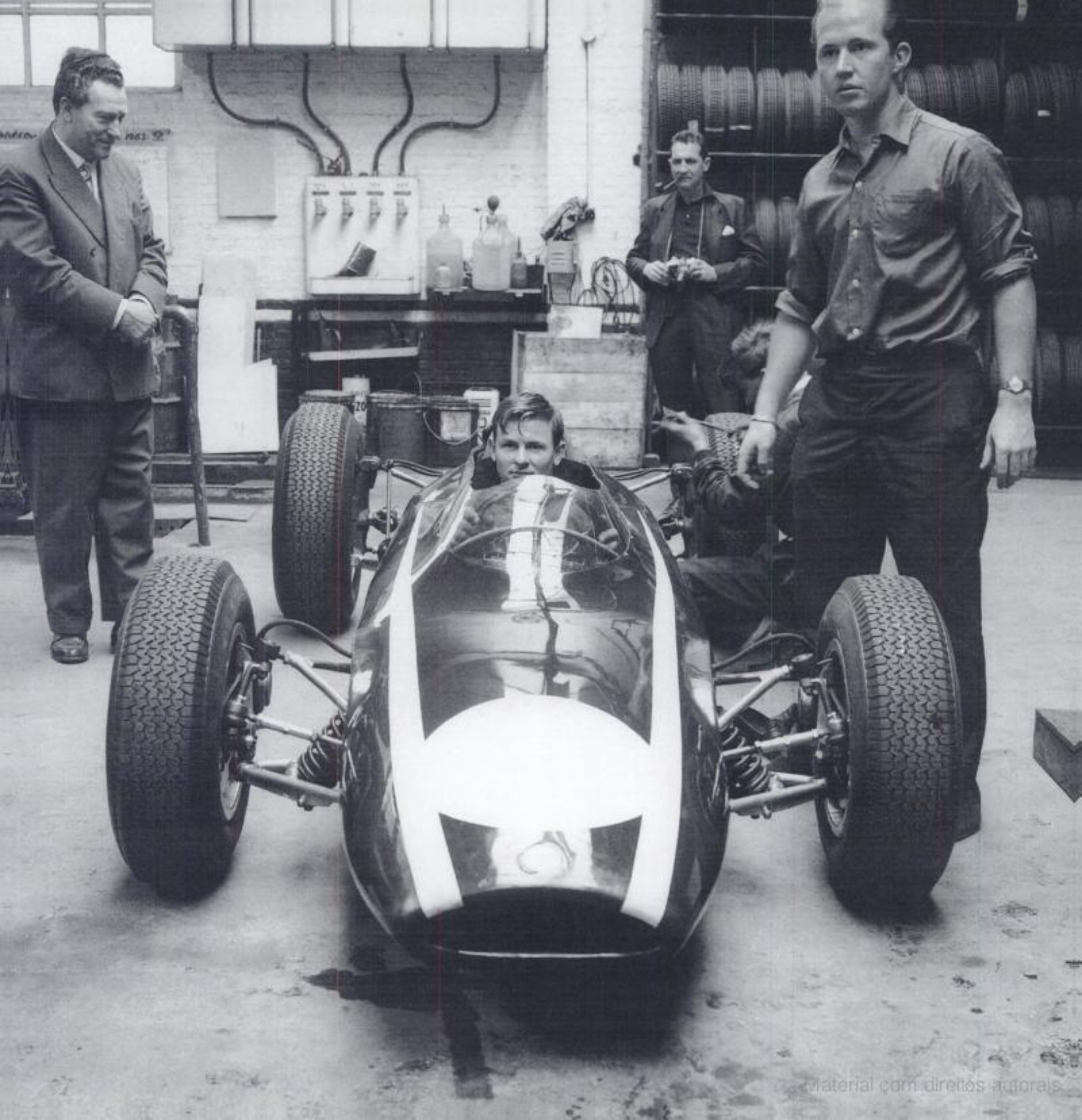
Engine:	Coventry Climax FWMV V8
Chassis:	Multi-tubular frame constructed from $1^1/_2$in and $1^3/_8$in, 18 gauge steel tubing with smaller diameter transverse and diagonal members plus triangulation of corners of cockpit opening. Mild sheet steel reinforcement welded to floor section between front and rear bulkheads.
Transmission:	Cooper C6S 6-speed.
Fuel tanks:	Twin fabricated aluminium pannier tanks, capacity 20 gallons, supplemented by 8 gallon tank behind and around the driver's seat.
Suspension:	Front: narrow-based, unequal length fabricated tubular wishbones with combined coil spring/damper unit and anti-roll bar. Standard-Triumph upright. Rear: fabricated tubular upper and longer, wider based lower wishbones with cross-bracing. Cast magnesium upright. Combined coil spring/damper unit, anti-roll bar.
Brakes:	Girling discs mounted outboard, $10^1/_4$in diameter front, $9^3/_4$in rear.
Wheels:	Cooper cast magnesium alloy, bolt on, 13in diameter front, 15in rear. Rim widths: 6in front, 7in rear.
Dimensions:	Wheelbase 7ft 7in; track 4ft $3^1/_2$in front, 4ft $2^1/_2$in rear.
Weight:	1075lb

Development and performance – 1963-64

Cooper was failing to keep pace with chassis technology and was gradually declining in competitiveness, as evidenced by 5th place in the 1963 Constructors' Championship, ahead of only the singleton BRP and a privately entered Porsche. The team suffered a setback before the GP season had begun when John Cooper was badly injured in a road accident with an experimental twin-engined Mini. He would be out of action for some months and Ken Tyrrell, who ran Coopers in FJ through his Tyrrell Racing Organisation, deputised for him as team manager in the meantime.

At Spa the team debuted a new high-penetration nose cone with smaller radiator air inlet and narrower cockpit opening. It made little difference as unreliability took its toll, the team being particularly prone to engine failures that accounted for eight of eleven retirements. At the Nürburgring, McLaren uncharacteristically suffered a heavy accident, the result of a breakage in a right rear wishbone, writing off chassis F1-4-63. This was replaced at Monza by a new chassis, F1-6-63, on which a long upper radius arm was tried on the rear suspension but not used in the race.

Opposite: Cooper T66: Bruce McLaren tries the narrow cockpit opening for size in the workshop.



Cooper T66 chassis record – 1963-64

Chassis no.	Engine	Entrant	GP	Driver	No.	Grid	Result
1963							
F1-2-63	Climax FWMV	RRC Walker Racing Team	Britain	J Bonnier	14	Q12	Engine – lap 65/82
			Germany	J Bonnier	16	Q12	6th
			Italy	J Bonnier	58	Q11	7th
			USA	J Bonnier	11	Q12	N/C 85 laps/110
			Mexico	J Bonnier	11	Q8	5th
			S Africa	J Bonnier	12	Q11	6th
F1-4-63	Climax FWMV	Cooper Car Co.	Monaco	B McLaren	7	Q8	3rd
			Belgium	B McLaren	14	Q5	2nd
			Holland	B McLaren	20	Q3	Gearbox – lap 7/80
			France	B McLaren	10	Q6	Ignition – lap 42/53
			Britain	B McLaren	6	Q6	Engine – lap 6/82
			Germany	B McLaren	5	Q5	Accident – lap 3/15 – chassis written-off
F1-5-63	Climax FWMV	Cooper Car Co.	Monaco	A Maggs	8	Q10	5th
			Belgium	A Maggs	15	Q4	Accident – lap 27/32
			Holland	A Maggs	22	Q9	Overheating – lap 14/80
			France	A Maggs	12	Q8	2nd
			Britain	A Maggs	7	Q7	9th
			Germany	A Maggs	6	Q10	Engine – lap 7/15
			Italy	A Maggs	20	Q13	6th
			USA	A Maggs	4	Q10	Engine – lap 44/110
			Mexico	A Maggs	4	Q13	Engine – lap 7/65
			S Africa	A Maggs	11	Q10	7th
F1-6-63	Climax FWMV	Cooper Car Co.	Italy	B McLaren	18	Q8	3rd
			USA	B McLaren	3	Q11	Fuel pump – lap 74/110
			Mexico	B McLaren	3	Q6	Engine – lap 29/65
			S Africa	B McLaren	10	Q9	4th
1964							
F1-2-63	Climax FWMV	RRC Walker Racing Team	Monaco	J Bonnier	19	Q11	5th
			Germany	E Barth	12	Q20	Clutch – lap 3/15
F1-6-63	Climax FWMV	Cooper Car Co.	Monaco	B McLaren	10	Q10	Engine – lap 17/100
			Austria	P Hill	10	Q20	Accident – lap 58/105

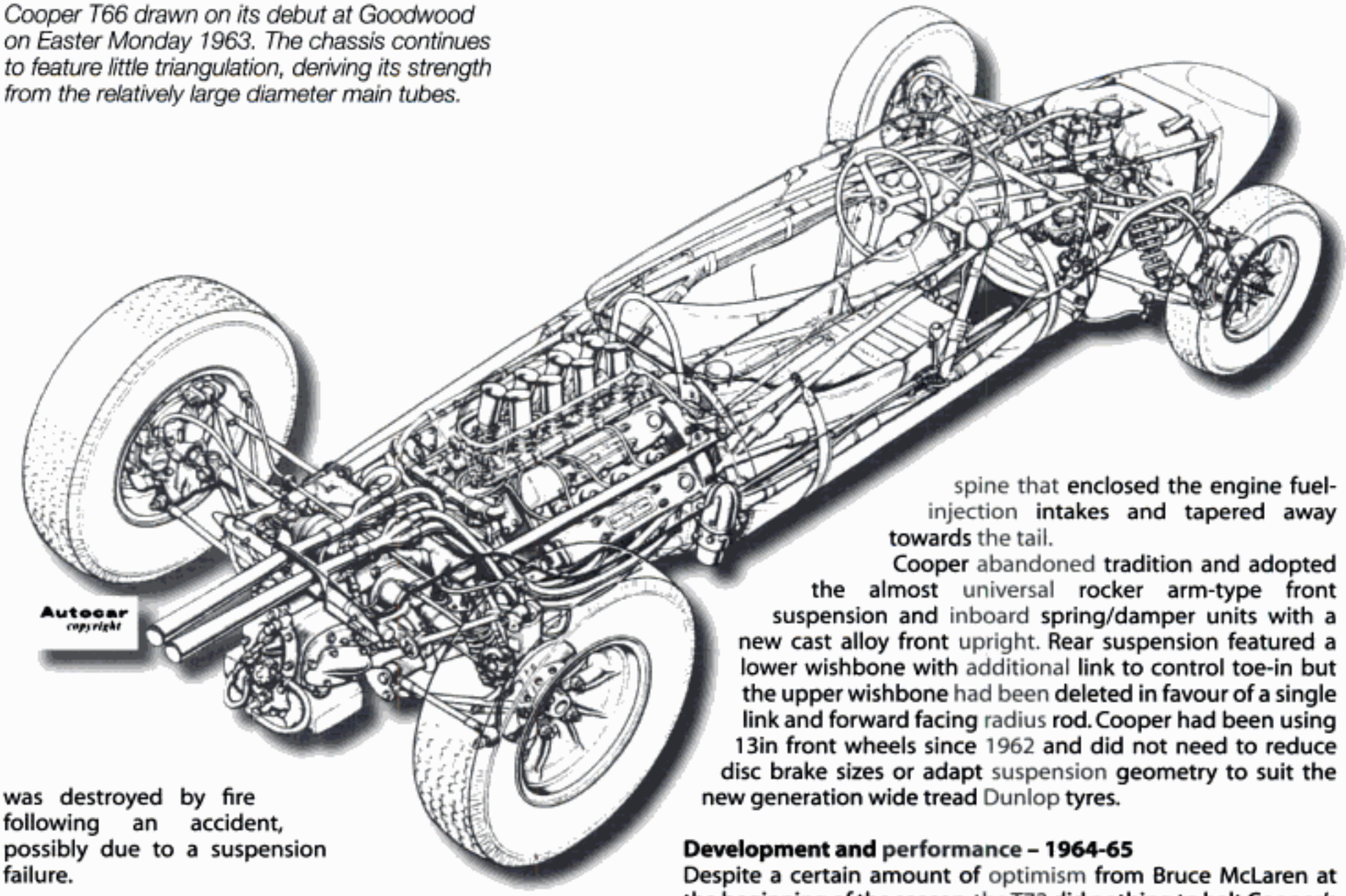
Cooper T66 chassis record – 1963-64

Four chassis were built, including one supplied to long time former customer Rob Walker (F1-2-63) for Jo Bonnier to drive. Fitted by the Walker mechanics with a GSD type 34 6-speed gearbox, it was not completed until the Belgian GP and not raced until the British GP. Some confusion exists in Cooper records in that F1-2-63 was reserved for the Walker car but F1-3-63 applied to it when built. Nevertheless, F1-2-63 is recorded as having raced, F1-3-63 seeming not to have existed.

Rob Walker retained F1-2-63 into 1964 as a spare for Jo Bonnier who drove it into fifth at Monaco after his new Brabham BT11 had been damaged by fire in practice for the Silverstone International Trophy. It was run as a second team entry for local expert Edgar Barth at the Nürburgring. The Cooper works team retained F1-6-63 as a spare, McLaren running it at Monaco following a steering arm breakage on his T73. Phil Hill drove it in Austria where it

The simple Cooper tubular chassis for 1964 with minimal triangulation to which a stressed undertray was spot welded to enhance stiffness (drawing actually depicts the T72 F3 frame that followed the same principle).

Cooper T66 drawn on its debut at Goodwood on Easter Monday 1963. The chassis continues to feature little triangulation, deriving its strength from the relatively large diameter main tubes.



was destroyed by fire following an accident, possibly due to a suspension failure.

COOPER T73

Over the winter of 1963/64, Bruce McLaren had run two special 'slimline' Coopers in the Tasman series in Australia and New Zealand. Several of the design features and experience gained on these T70s were incorporated in the design of the 1964 T73.

The basic chassis frame followed Cooper tradition, being based on four large diameter 16swg steel tubes. As usual there was only minimal triangulation, stiffness now being derived from a stressed, 24swg sheet steel undertray wrapped under and around the frame, and spot-welded to the upper frame tubes. The engine was bolted solidly to this structure to improve torsional rigidity.

The elimination of pannier tanks had reduced the overall width to 26in and the slim shape was accentuated by neat, close fitting body panels. The engine cover incorporated a central spine that enclosed the engine fuel-injection intakes and tapered away towards the tail.

Cooper abandoned tradition and adopted the almost universal rocker arm-type front suspension and inboard spring/damper units with a new cast alloy front upright. Rear suspension featured a lower wishbone with additional link to control toe-in but the upper wishbone had been deleted in favour of a single link and forward facing radius rod. Cooper had been using 13in front wheels since 1962 and did not need to reduce disc brake sizes or adapt suspension geometry to suit the new generation wide tread Dunlop tyres.

Development and performance – 1964-65

Despite a certain amount of optimism from Bruce McLaren at the beginning of the season, the T73 did nothing to halt Cooper's decline in competitiveness. At Monaco, McLaren suffered a steering arm breakage in practice and was forced to race the spare T66. Stiffening brackets were added for the Dutch GP as a temporary measure and a radius rod linked the rocker arm to the scuttle bulkhead to spread loads and counter suspected flexing under braking. By the Belgian GP new, beefier front uprights had been produced with stronger steering arms. Changes were also made to the inboard location of the rear suspension radius rod to reduce bump steer, and the spring/damper units were repositioned nearer the vertical. This improved handling and both cars were so modified by the French GP.

Like Dan Gurney and Graham Hill, McLaren had been unlucky to miss out on a win in the Belgian GP when an electrical problem cut the engine only yards from the finish line. He finished second, and second again at Monza, a just reward for running with the

Cooper T73 specification

Engine:	Coventry Climax FWMV V8
Chassis:	Multi-tubular frame comprising four large diameter 16swg steel tubes. Upper tubes 1 1/2in diameter and angled upwards from front bulkhead to scuttle before running in horizontal plane as far as seat back. Vertical height reduced between seat back and rear bulkheads to allow frame to run below engine exhaust camshaft covers. Lower tubes 1 3/8in diameter running length of car. Front bulkhead stiffened with sheet steel, by perforated hoope type fabrications. Minimal triangulation, stiffness derived from stressed, 24swg sheet steel undertray wrapped under and around frame and spot-welded to upper frame tubes. Engine bolted solidly to structure. Oil and water conveyed between the engine and radiators via main frame tubes – top right and bottom left for water, opposites for oil.
Transmission:	Cooper C6S 6-speed.
Fuel tanks:	Fabricated aluminium tanks, seat 12 gallons capacity, scuttle 7 gallons above the driver's knees and two 9 gallon tanks on either side of legs.
Suspension:	Front: narrow-based, fabricated upper wishbone pivoting on the upper frame tube to act on combined coil spring/ telescopic damper unit mounted within the bodywork. Cooper cast alloy front uprights. Fabricated wide-based lower wishbone picked up from just aft of the radiator. Anti-dive characteristics included in geometry. Anti-roll bar. Rear: lower wishbone with additional link to control toe-in. Single upper link and forward facing radius rod, anchored to the seat-back bulkhead.
Brakes:	Girling discs mounted outboard, 10in diameter front, 9 1/2in rear.
Wheels:	Cooper cast magnesium alloy, bolt on, 13in diameter.
Dimensions:	Wheelbase 7ft 7in; track 4ft 3 1/2in front, 4ft 2 1/2in rear.
Weight:	1012lb

leading slipstreaming group in the early stages. These were the only highlights in an otherwise lacklustre season. Team-mate Phil Hill fared badly, finishing only once in the points, his car suffering from poor preparation.

T73 chassis record – 1964-65

Two chassis were built for the works team, while a third chassis, F1-3-64, was listed in Cooper records but was not a true F1 chassis, rather a T71/73 (F1/F2) hybrid supplied to Gerard Racing. Fitted with a 4-cylinder Lotus Ford twin cam engine, it was run mostly in British Formula Libre races for John Taylor but was also entered for the British GP.

F1-1-64 and F1-2-64 were turned out for the first GP of the 1965 season for McLaren and Jochen Rindt, as the new T77 team

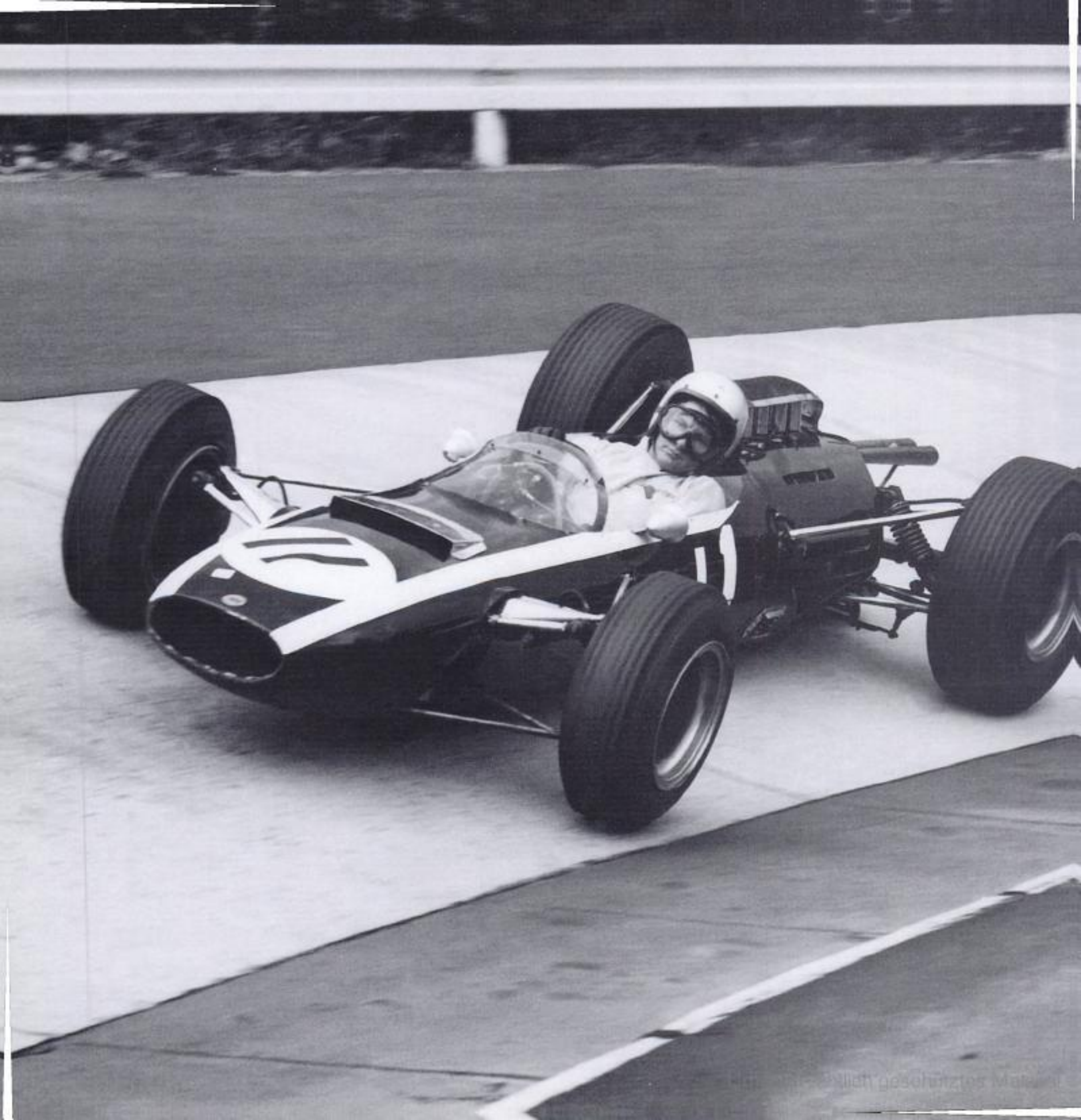
Cooper T73: Bruce McLaren short of the engine cover at Spa in 1964.

cars were not yet ready. Only McLaren finished in the points. F1-1-64 became the team spare and was fitted, experimentally, with a Hewland transmission in place of the heavier Cooper C6S unit. Rindt drove the car at Monza following engine failure in his regular T77. Gerard Racing entered its F1-3-64 hybrid for the British GP once again but it failed to qualify in the hands of F3 driver Alan Rollinson.

COOPER T77

With only one season of 1 1/2-litre F1 racing remaining, Cooper thinking was that there was little to be gained from investing resource in new chassis development. In any event, the design team was at less than full strength following the decision of long time Cooper designer Owen Maddock to move on to pastures new. In addition, John Cooper announced in April 1965 that he had sold the company to the Chipstead Motor Group.

The 1964 T73 was, therefore, modified only slightly but re-numbered T77 all the same. The chassis, comprising the simple multi-tubular frame stiffened by a stressed sheet steel undertray, was identical to the T73. The suspension was also identical save for a slightly wider front track. The car's fuel capacity had proved to be marginal on fast, thirsty circuits such as Spa, and



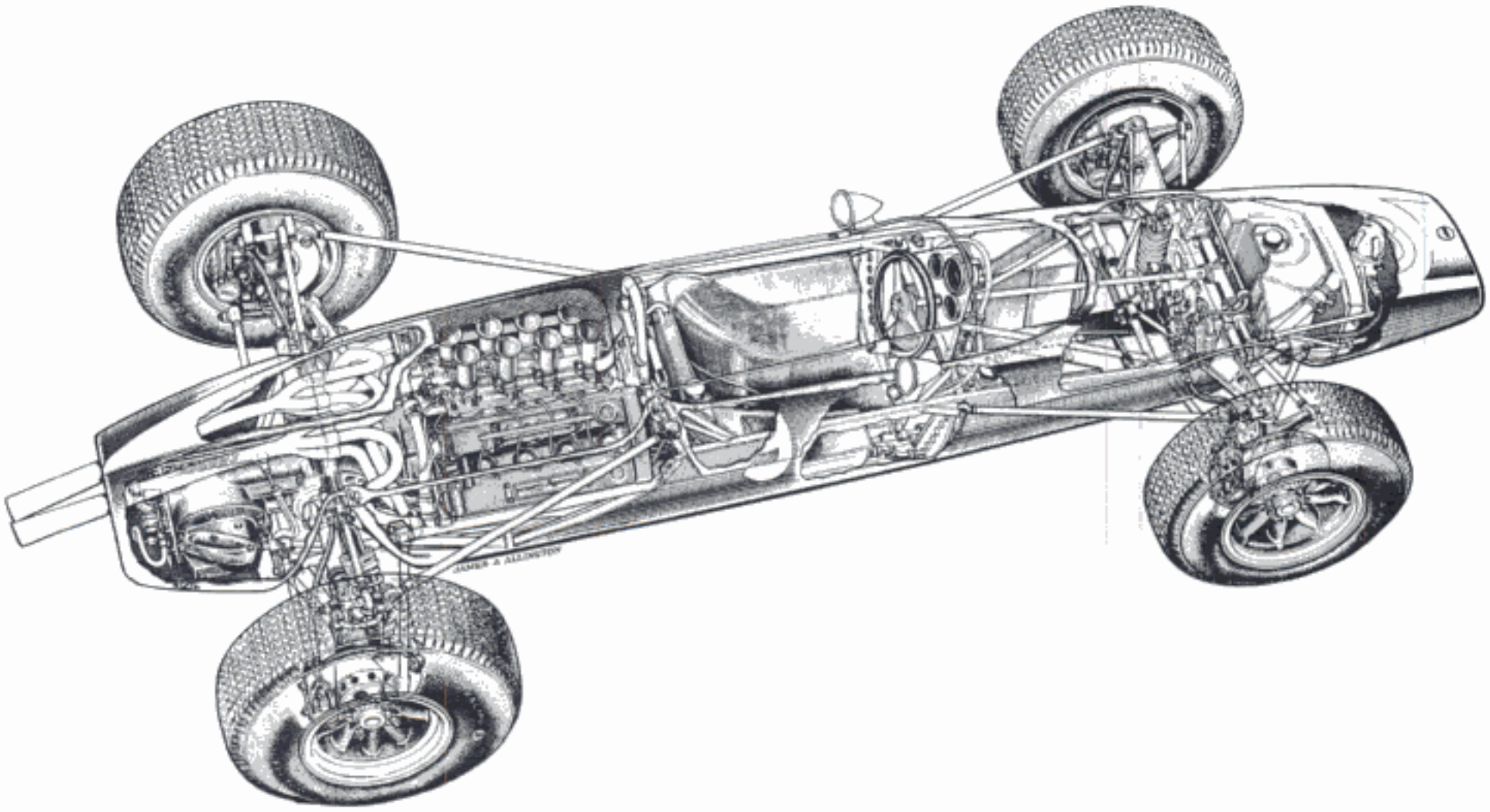
Cooper chassis performance summary

Chassis	Year	Starts	Finishes	1st	2nd	3rd	4th	5th	6th	PP	FL
T45	1961	1	-								
T51	1961/63	8	5								
T53	1961-62	39	20	-	-	-	1	2	2	-	-
T55	1961-65	19	13	-	-	1	2	2	3	-	-
T58	1961	3	-							1	1
T59	1962	3	2								
T60	1962-65	21	14	1	2	4	1	2	1	-	1
T66	1963-64	30	14	-	2	2	1	3	3	-	-
T73	1964-65	21	10	-	2	-	-	1	2	-	-
T77	1965	16	7	-	-	1	1	2	1	-	-
Total		161	85	1	6	8	6	12	12	1	2

Constructors' Championship placings

Year	Points	Position
1961	18	4th
1962	37	3rd
1963	26	5th
1964	16	5th
1965	14	5th

Below: *By mid-season 1964 the Cooper T73 had gained a radius rod linking the front suspension rocker arm to the scuttle to spread braking loads. A slim, tidy chassis but still unable to keep up with the competition.*



Opposite: *Cooper T77: Bruce McLaren rounds the Karussel during the 1965 German GP.*

Derrington-Francis

An attempt was made in 1964 to do something constructive with the remains of the failed ATS F1 equipment by Vic Derrington and Alf Francis. Derrington was well-known in the British performance equipment and exhaust system trade, with premises in Kingston-upon-Thames, Surrey, while Francis was the famous racing mechanic who had tended Stirling Moss' cars both when he had driven for Rob Walker between 1959 and 1961 and before. Francis was an extremely talented engineer/mechanic who could turn his hand to any type of fabrication problem and, by 1964, was working in Italy, as a partner to Valerio Colotti in Gear Speed Developments SpA, manufacturers of the GSD range of gearboxes. Derrington backed Francis in the construction of a new space frame chassis to be powered by the ATS V8 engine, now equipped with Lucas fuel-injection and claimed to produce 200bhp at 11,000rpm. The chassis was a neat and more substantial looking effort than ATS had produced and was said to be some 6in shorter in wheelbase than the original. It was fitted with squarish yet purposeful looking aluminium bodywork and adopted ATS chassis number '100-02'.

Well-financed Portuguese racing driver Mario Cabral agreed to put some money into the project in a return for a drive, and the car was entered in the 1964 Italian GP. Cabral qualified 19th in a field of 20 and retired from the tail of the field with ignition problems before half distance. The car was not seen again.

Derrington-Francis T100: the car sits in the pits during practice for the 1964 Italian GP. Note Goodyear tyres.

Derrington-Francis ATS T100 chassis record – 1964

Chassis no.	Engine	Entrant	GP	Driver	No.	Grid	Result
100-02	ATS T100 V8	Derrington-Francis Racing Team	Italy	M Cabral	50	Q19	Ignition – lap 25/78

de Tomaso

In the early 1960s, Alejandro de Tomaso, an Argentine-born engineer and sometime racing driver, had aspirations to become a racing car constructor and road car manufacturer. In the latter he would be more successful as owner of Maserati, Innocenti and his own marque de Tomaso. As regards race car construction, however, his ambitions would outweigh any actual achievement.

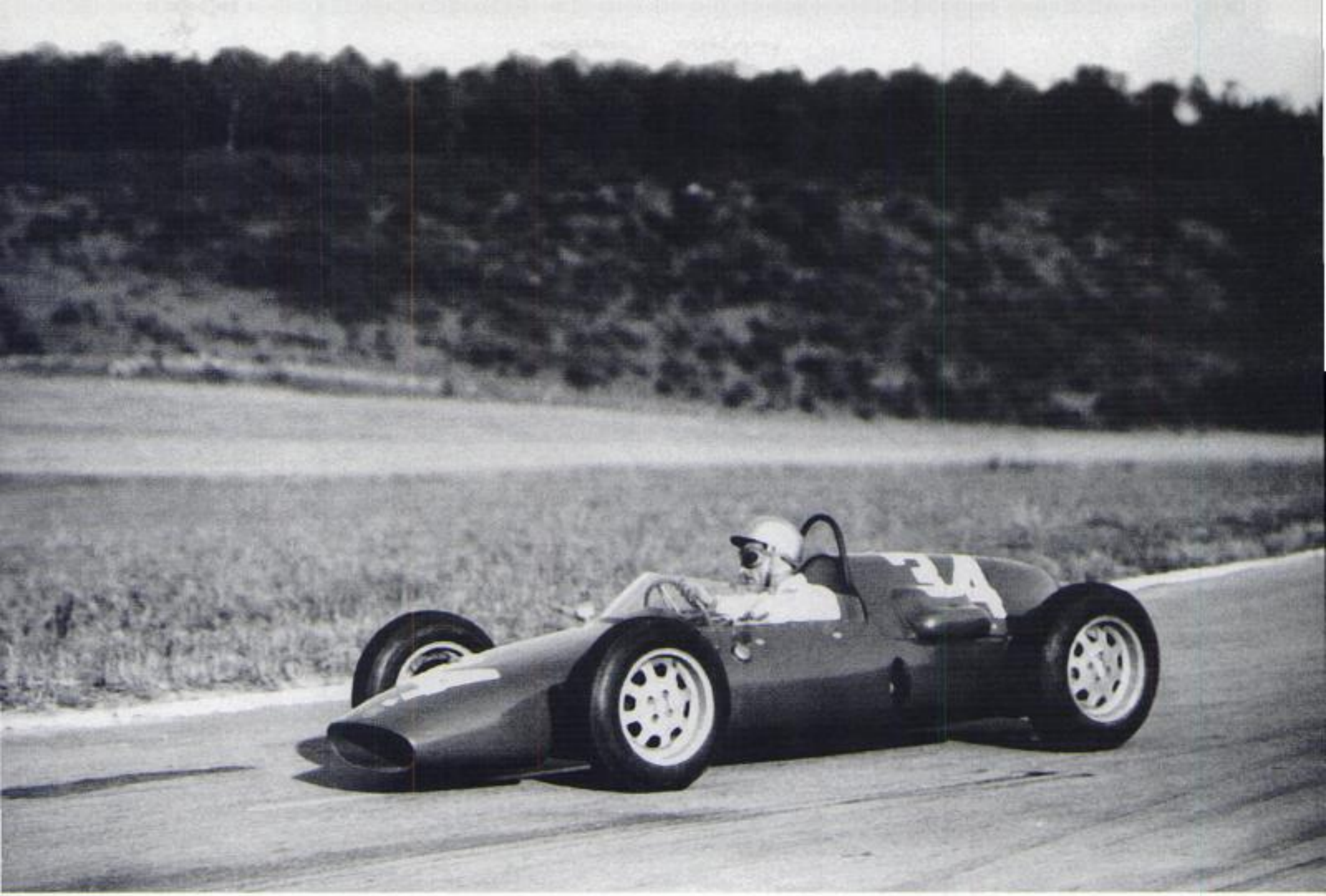
He terminated his driving career in 1959 and settled in Italy with his wealthy American wife. His first project was to construct a Formula Junior car, this turned out to be a copy of a contemporary Cooper under the name Isis. In late 1960, he constructed an OSCA engined F2 car but it was not raced. In 1961, this design became eligible for F1 and six chassis were built, now in the name of their creator, and sold to Italian amateur drivers to compete in local non-Championship F1 races.

1961 F1 Car

Design and performance

The de Tomaso chassis was of space frame construction with double wishbone and coil spring suspension front and rear, running on distinctive specially cast alloy wheels. Engines fitted were either the 4-cylinder twin overhead camshaft OSCA or the production based Alfa Romeo Guilietta unit, enlarged and modified by Italian tuner Conrero with a twin plug cylinder head. Both engines were mated to a de Tomaso-produced 5-speed transmission.

Given the choice of engines, the de Tomaso was never likely to be more than a tail-end runner, and even this proved difficult to achieve. The marque made its GP debut in the 1961 French GP where OSCA-engined example 001 retired with engine problems having qualified 26th and last, over 22sec off the pace. Three different chassis appeared at Monza for the Italian GP but all retired with engine problems, two of them after the first lap. The third, Alfa-powered chassis 003, had managed to qualify 20th out of 32, driven by Sicilian lawyer Nino Vaccarella who would make his name later as a Targa Florio expert and Le Mans winner.



de Tomaso: Giorgio Scarlatti corners the OSCA-engined chassis 001 at Reims in 1961.

A de Tomaso did not appear in a GP again until, predictably, the 1962 Italian GP, when Roberto Lippi failed to qualify 002, his best lap being some 18sec off the pole time. Lippi re-appeared at Monza in 1963 with 002 now fitted with a Ferrari 156/65° V6 engine, but once again failed to qualify, recording an even slower time than in 1962.

de Tomaso F1 (1961) chassis record – 1961-63

Chassis no.	Engine	Entrant	GP	Driver	No.	Grid	Result
1961							
001	OSCA 4	Scuderia Serenissima	France	G Scarlatti	34	Q26	Engine – lap 15/52
002	OSCA 4	Scuderia Settecolli	Italy	R Lippi	52	Q32	Engine – lap 1/43
003	Alfa Romeo 4	Scuderia Serenissima	Italy	N Vaccarella	50	Q20	Engine – lap 13/43
004	Alfa Romeo 4	Scuderia de Tomaso	Italy	R Bussinello	54	Q24	Engine – lap 1/43
1962							
002	OSCA 4	Scuderia Settecolli	Italy	R Lippi	50		DNQ
1963							
002	Ferrari 156/65°	Scuderia Settecolli	Italy	R Lippi	44		DNQ

de TOMASO 801

Undeterred by his lack of success with the 4-cylinder engined F1 cars, de Tomaso set about a more ambitious project: the design and construction of an F1 car in its entirety, inclusive of

de Tomaso 801: the unraced car in the paddock at Monza 1962.

engine and transmission, and so join the elite ranks of Ferrari, BRM and Porsche. He employed Alberto Massimino to carry out the design work. Massimino was a very experienced engineer who had worked for both Maserati and Ferrari before taking up a consultancy role in semi-retirement.

Design and construction

The 801 featured a space frame chassis and a flat-8, water-cooled engine with a 5-speed transmission. The rear of the chassis was easily detachable to give access to the engine, the low build of which made it possible to brace the top of the engine bay with a detachable 'X' frame. Suspension was very similar in layout to that of the Lotus 24 and 25. At the front the fabricated lower wishbone was wide-based, while the upper was narrow-based, forming a rocking arm pivoting on the top main frame tube and acting on an inboard mounted coil spring/damper unit. Initial reaction was that Colin Chapman's design had been copied, until it was pointed out that Massimino had used a similar layout for Maserati in 1948. Unlike Chapman, however, the rocking arm principle was carried over to the rear suspension as well. The top link comprised a machined, double-tapered, diamond-section solid aluminium casting, pivoting on the chassis just ahead of the half-shafts. There was a fabricated tubular reversed lower wishbone with twin parallel trailing radius arms providing fore and aft location. No anti-roll bars were fitted. Braking was by Girling discs at the front with inboard Amadori units at the rear. Wheels were cast magnesium alloy

The body was reasonably slim, given the width of the engine, with an ungainly looking tail section through which the carburettors protruded, unprotected, on either side. Photographs of the car indicated that the driver sat rather upright, spoiling the aerodynamics. The overall impression of the car was of a high level of finish and detail craftsmanship.

Performance – 1962/63

The de Tomaso 801 made its debut in practice for the 1962 Italian GP driven by Argentine stock car driver Estafano Nasif, a well-regarded driver in his own country with but a single GP start in 1960 to his name. The engine would not run properly and the car failed to qualify, having lapped some 4½ minutes slower than Jim Clark's pole position time.

The car did not appear again until May 1963 in the non-Championship Rome GP in which it expired on the opening lap with a clutch problem. It was entered for the British GP that year but failed to show and was not seen again. de Tomaso's dream of becoming an F1 constructor was over, although he continued to build a number of ambitious one-off single-seater and sports cars.

de Tomaso 801 chassis record – 1962							
Chassis no.	**Engine**	**Entrant**	**GP**	**Driver**	**No.**	**Grid**	**Result**
F1-801	de Tomaso 801	Scuderia de Tomaso	Italy	E Nasif	34		DNQ

Emeryson

Paul Emery was a talented engineer who designed, built and sometimes raced a variety of home-built specials in F1, F2 and the 500cc F3 during the 1940s and 50s. Never short of an ambitious idea, he unfortunately lacked the business ability to make them economically viable. In 1960, he was on the brink of becoming an established constructor when he attracted the backing of Alan Brown to form a new company, Emeryson Cars Ltd. Brown was a regular Cooper racer who had taken over

the former Connaught Engineering works at Send in Surrey and he installed Emery there to design and build a range of customer F1 and FJ cars.

1961 Emeryson F1

The prototype was produced in late 1960 as an F2 car and debuted unspectacularly in the Kentish 100 at Brands Hatch, retiring after 4 laps with a broken fuel pipe. It next appeared at Monthléry in the hands of little known amateur John Turner. Having lost time after a spin, Turner appeared to make a dramatic comeback drive through the field. In reality his performance had been enhanced by consistently missing out one of the chicanes at the back of the circuit, for which he was disqualified. On the strength of this performance, but seemingly unaware of the reasons for it, Equipe National Belge (ENB) approached Emeryson with a view to running a team of cars in the new F1 in 1961. ENB was a respected Belgian Ferrari sports car team run by Jacques Swaters, the Brussels-based Ferrari concessionaire for Belgium. Quite why ENB should have been impressed by the performance of an amateur in a race with only ten starters and no established 'stars' is difficult to imagine.

Design and construction

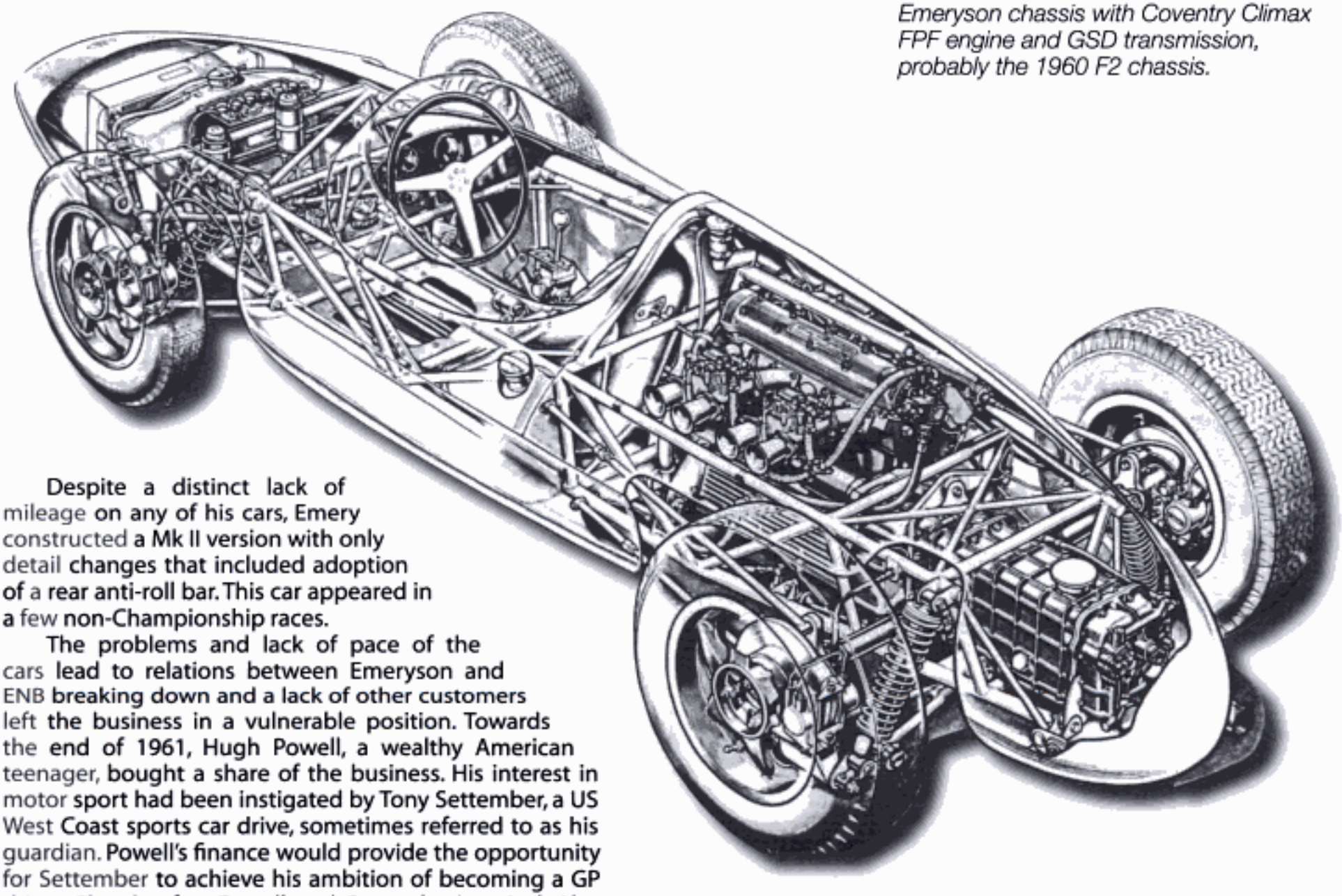
Emery based his first customer chassis on well-proven features. The multi-tubular space frame was constructed from 1¼in and 1in diameter, 16swg steel tubing, braced and strutted for torsional rigidity. Front suspension comprised fabricated tubular wishbones with combined coil spring/damper units and an anti-roll bar. Rear suspension was derived from Colin Chapman's Lotus 18 with a reversed lower wishbone and the fixed-length drive shaft doubling as the upper member, located by twin radius arms picking up from the seat-back bulkhead. Girling disc brakes of 11in diameter were mounted outboard, within the Emeryson magnesium alloy, bolt-on wheels. Fuel was carried in twin pannier tanks mounted on either side of the chassis and unusually constructed from glass fibre.

ENB chose to fit the Maserati 150S 4-cylinder engine to its chassis while other examples were equipped with the Coventry Climax FPF 4-cylinger. The latter was canted over in the chassis by 18° to the right to bring the Weber carburettors within the bodywork. Either engine transmitted its power through a GSD type 32 5-speed gearbox.

Development and performance – 1961

On the face of it the Emeryson should have been reasonably competitive. Chassis manufacture had been sub-contracted out to Brian Lister at Cambridge, the former sports racing car constructor, and the motoring press was of the opinion that the car appeared to be a well conceived and solidly constructed and might offer serious competition to Lotus and Cooper. Unfortunately, this failed to be the case. The ENB Emeryson-Maseratis debuted in the early non-Championship F1 races but either crashed or proved to be off the pace. Two cars failed to qualify for their GP debut at Monaco, being over 3sec off Moss' pole position time. Entries were made for ENB's home GP at Spa but neither started due to chassis breakages in practice. Finally, an entry for the Italian GP, this time Coventry Climax powered, failed to qualify.

Emeryson: John Campbell-Jones locks a front brake during the 1962 non-Championship Brussels GP. This is chassis 1004 which Tony Settember would run in the British and Italian GPs that year.



Emeryson chassis with Coventry Climax FPF engine and GSD transmission, probably the 1960 F2 chassis.

Despite a distinct lack of mileage on any of his cars, Emery constructed a Mk II version with only detail changes that included adoption of a rear anti-roll bar. This car appeared in a few non-Championship races.

The problems and lack of pace of the cars lead to relations between Emeryson and ENB breaking down and a lack of other customers left the business in a vulnerable position. Towards the end of 1961, Hugh Powell, a wealthy American teenager, bought a share of the business. His interest in motor sport had been instigated by Tony Settember, a US West Coast sports car drive, sometimes referred to as his guardian. Powell's finance would provide the opportunity for Settember to achieve his ambition of becoming a GP driver. Shortly after Powell and Settember's arrival, Alan Brown and the other directors resigned, leaving Emery to stay on as designer.

Development and performance – 1962

A Mk III version of the car was constructed with a semi-monocoque chassis in so far as the pannier fuel tanks formed a stressed section of the chassis. It was both slimmer and lighter than its predecessors and featured an almost horizontally-mounted radiator in the nose through

Emeryson F1 chassis record – 1961-62

Chassis no.	Engine	Entrant	GP	Driver	No.	Grid	Result
1961							
1001	Maserati 150S	Equipe National Belge	Monaco	L Bianchi	10		DNQ
			Belgium	L Bianchi	12		DNS – broken chassis
1002	Maserati 150S	Equipe National Belge	Belgium	W Mairesse	10		DNS – broken chassis
1003	Maserati 150S	Equipe National Belge	Monaco	O Gendebien	12		DNQ
1005	Climax FPF	Equipe National Belge	Italy	A Pilette	68		DNQ
1962							
1004	Climax FPF	Emeryson Cars Ltd	Britain	A Settember	40	Q19	11th
			Italy	A Settember	48	Q21	Head gasket – lap 18/86
1006	Climax FPF	Ecurie Maarsbergen	Holland	W Seidel	16	Q20	N/C 52 laps/80

which air was ducted from below. Powell's intention was to back a two-car team for 1962 but only single entries were made for Settember to drive in the British and Italian GPs, recording one finish only. The Mk III was an improvement over the earlier cars but it was not run as Settember could not fit into it. An entry was made for the Dutch GP in the name of Godin de Beaufort's Ecurie Maarsbergen for Wolfgang Seidel who was unclassified.

Before the end of the year, Emery left but Powell's backing continued, creating the Scirocco marque out of the remains of Emeryson for 1963 (q.v.).

ENB Maserati

In 1962, Equipe National Belge reviewed the remnants of its F1 team and decided to rebuild Emeryson chassis 1001. The underpowered Maserati engine was retained and the chassis re-bodied by a Brussels coachbuilder with a twin-nostril nose section on the lines of the 1961 'Sharknose' Ferrari. The result was entered as an 'ENB Maserati' in a couple of early season non-Championship F1 races in the hands of Lucien Bianchi but not finishing in either. The car was entered for the German GP in which Bianchi qualified last, nearly 2 minutes away from Gurney's Porsche on pole, and finished last.

ENB Maserati chassis record

Chassis no.	Engine	Entrant	GP	Driver	No.	Grid	Result
1001	Maserati 150S	Equipe National Belge	Germany	L Bianchi	21	Q25	16th

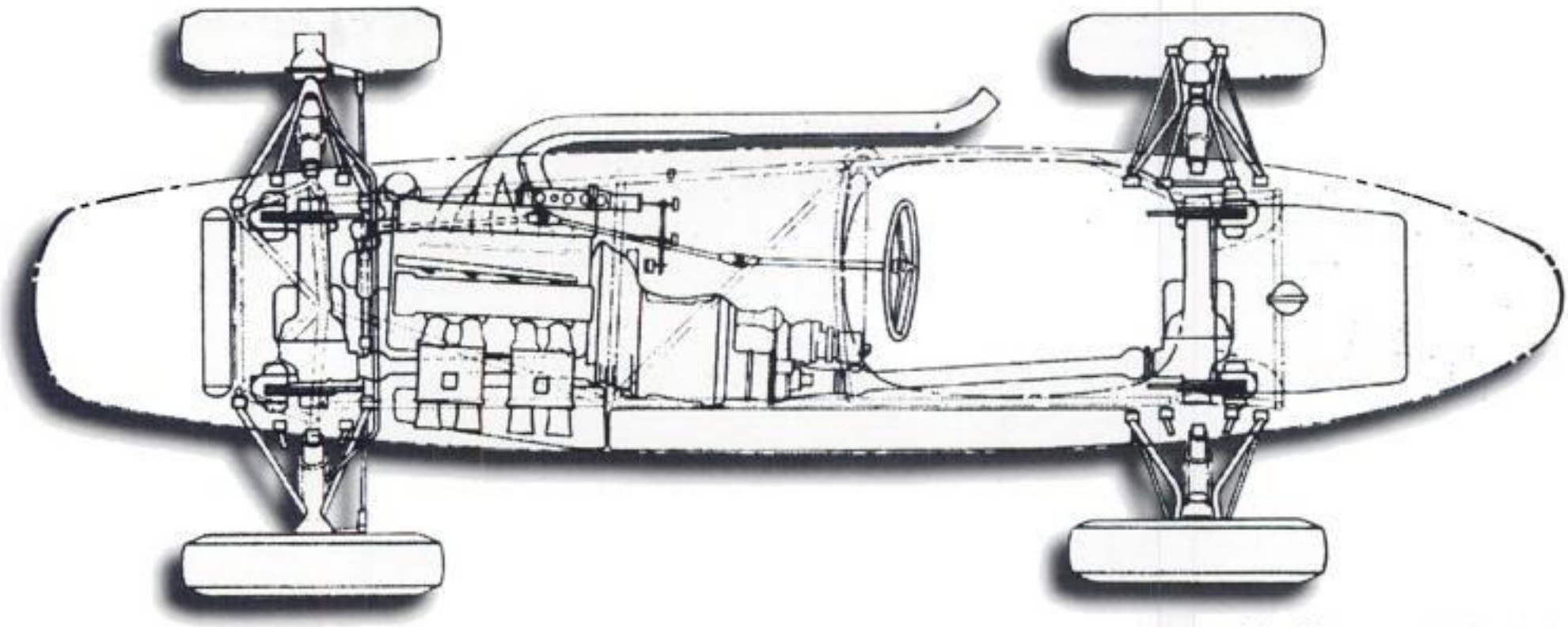
Ferguson

Harry Ferguson had made his name as a manufacturer of agricultural tractors and was fascinated by four-wheel drive (4WD). In the 1950s he founded Harry Ferguson Research Ltd. to research 4WD and its possible application for an advanced passenger car design. Prototypes were built and shown to the Press but the motor industry failed to show any interest in the developments. It was decided, therefore, to develop a racing application to act as both a research vehicle and demonstrate to a wider audience that 4WD was a viable concept that need not incur a weight penalty or absorb engine power.

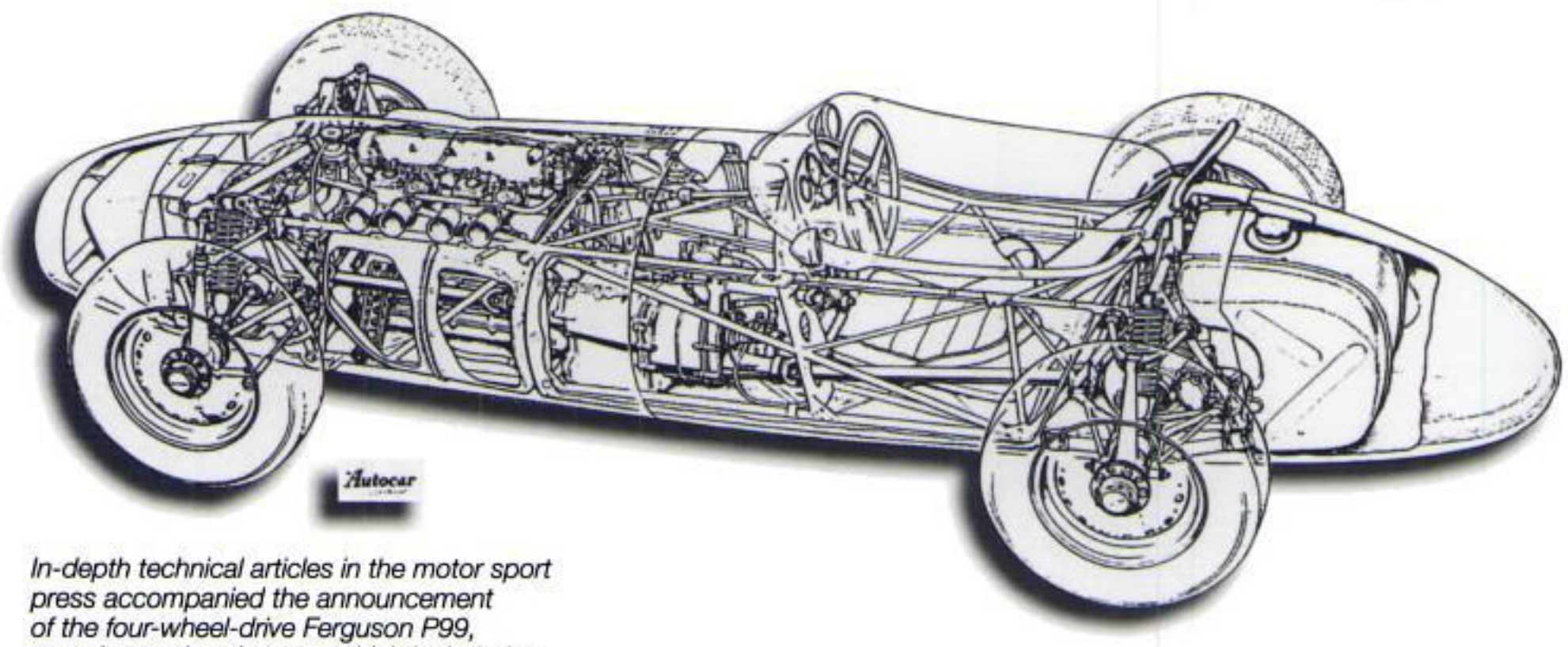
At irregular intervals over the years, race car designers had been attracted to the concept of 4WD and the opportunity it provided to maximise traction. There had been many examples of 4WD racing cars, including the Bugatti type 53 in 1932 and the Gulf-Millers built for the 1939 Indianapolis 500. Up to 1961, however, no one had been able to overcome the complexities associated with it, including additional weight, power loss and the ability to maintain drive to all four wheels all of the time. Consequently, 4WD had never reached the point where it could effectively challenge two-wheel-drive cars. In addition, there were implications for the driver in handling a 4WD car. In the 1960s, drivers would use the 'four wheel drift' technique for cornering, holding the car at a yaw angle through the corner, balanced either by the steering or use of the throttle, enabling the corner to be taken in a shorter time than running through it at a constant radius. 4WD required a completely different technique in that the car had to be consciously steered into the corner and adhesion previously used to prevent the wheels from slipping sideways was made available to provide additional forward motion. Put simply, with adhesion divided equally between all four wheels rather than two, more power could be fed into them resulting in faster cornering.

The key personnel behind the development were technical director Tony Rolt, a former racing driver and winner of the 1953 Le Mans 24 Hours for Jaguar, and Claude Hill, a former technical director of Aston Martin.

ENB-Maserati: Lucien Bianchi on his lonely run to 16th in the 1962 German GP.



Layout of the Ferguson mechanicals showing the front and rear differentials, angled Climax engine and identical suspension units at each corner.



In-depth technical articles in the motor sport press accompanied the announcement of the four-wheel-drive Ferguson P99, none better than Autocar *which included a cutaway drawn (appropriately) by staff artist John Ferguson.*

Ferguson P99 specification

Engine:	Coventry Climax FPF 4IL (front-mounted)
Chassis:	Fully triangulated multi-tubular space frame constructed from mainly 1in diameter steel tubing supplemented by fabricated perforated hoop section at scuttle. Driver offset to right, alongside transmission. Radiator located in nose.
Transmission:	Ferguson 5-speed with patented 4-WD master differential and control unit.
Fuel tanks:	Fabricated aluminium tanks in tail and sides, capacity of 25 gallons.
Suspension:	Front and rear: unequal length double wishbones with combined coil spring/damper units mounted above drive shafts.
Brakes:	Dunlop disc brakes 10in diameter front and rear installed inboard on either side of the final drive units.
Wheels:	Dunlop light alloy, centre-lock 16in diameter with 5in rim width front and rear.
Dimensions:	Wheelbase 7ft 6in; track 4ft 4in front, 4ft 2in rear.
Weight:	1456lb.

it was not actually used in a race. This was a forerunner of the current ABS system used in production cars.

Aided by the extensive use of magnesium alloy for differential casings and by smaller, lighter loaded driveshafts, etc., than a conventional rear-wheel-drive car, the claimed weight of the P99 at 1456lb was comparable to the contemporary BRM and Cooper equivalents.

Performance – 1961

Tony Rolt arranged for the race proving exercise to be handled by his friend and entrant of Stirling Moss, Rob Walker. The car was finished in the Walker team colours of dark blue with a white noseband. It made its only GP appearance in the 1961 British GP at Aintree driven by Jack Fairman, a second division driver who was unlikely to be able to demonstrate its true capabilities. Fairman qualified 20th on the grid and, in wet race conditions that should have suited it admirably, got it no higher than 13th before pitting with an electrical fault. He restarted but was then called in to hand the car over to Stirling Moss who had retired his Lotus from the race. Moss had experienced the car in a streaming wet practice session the previous day and now engaged in some competitive driving until the P99 was disqualified for having been push-started following Fairman's earlier stop.

Ferguson P99 chassis record – 1961

Chassis no.	Engine	Entrant	GP	Driver	No.	Grid	Result
P99-01	Climax FPF	RRC Walker Racing Team	Britain	J Fairman	26	Q20	DSQ – push-start after pit stop lap 56/75

Ferguson P99 chassis record – 1961

The project might have remained inconclusive had Stirling Moss not taken an interest in the P99 and, after some extensive testing, taught himself the correct technique for handling a 4WD car. Sufficiently confident, he drove it in the non-Championship Oulton Park Gold Cup in September 1961, scoring a resounding win in damp conditions.

Ferguson Research continued to run the car as a research vehicle but it never again ran in a GP. Plans were made to update the chassis to take a V8 engine, and Coventry Climax actually built a flat crank V8 with low level exhaust system to suit its front-engine layout, but these plans did not reach fruition. It had originally been designed for the 2½-litre F1 when there had been a degree of surplus power available. In 1½-litre form there was no such surplus and there is no doubt that the power absorbed by the additional differential unit, gearing, etc., was proportionately greater in this form, putting it at a distinct disadvantage to its rivals.

Rob Walker subsequently ran the car again in the 1963 Tasman series in Australia and New Zealand with minor success in the hands of Graham Hill and Innes Ireland. In 1964, it found its true home when Peter Westbury drove it to dominate the British Hill Climb Championship after which it was retired from active service.

Ferrari

No name in motor sport conjures up more emotion in the hearts and minds of enthusiasts worldwide than that of Ferrari. It may be the sight of the stunning Italian racing scarlet colour scheme of the race cars – without which no GP grid is complete – or the sight and sound of an exquisitely engineered V12 engine in a classically styled Grand Touring car. Or maybe it is the awe in which the name is held, arising from the years of experience and success on the race track and charisma that other marques have not come close to achieving. Whatever, constructors may come and go but Ferrari is forever.

Enzo Ferrari began working for Alfa Romeo as an ordinary employee in 1920; before he had finished he had been a race driver, salesman, consultant, organiser and racing manager. In 1929, he formed Scuderia Ferrari as a quasi-works operation to sell, service, prepare and maintain Alfas for competition-minded customers. When Alfa Romeo closed its competition department, its racing activities were effectively transferred to Scuderia Ferrari, which became a semi-works team through the 1930s. In 1938, Alfa decided to run its own racing activities as Alfa Corse, and Ferrari was retained to manage it. Before long, however, a disagreement lead him to leave and set up his own organisation in the former Scuderia

premises. Under the terms of severance he was prohibited from any involvement in racing, other than with Alfa, for four years. Nevertheless, he soon began to design and construct his own cars, the first of which ran in the 1940 Mille Miglia, simply referred to by its type number '815', not as a Ferrari.

World War II interrupted further development but, as early as 1945, Ferrari made moves to resume car manufacture with the emphasis on competition. A Ferrari first appeared in a GP in 1948 and has been represented in GPs every season since, the only manufacturer to do so. Some seasons have been successful, some have not, there may have been internal conflict with key personnel and drivers, decisions may have appeared to lack logic, but the cars have always been more important than the personalities.

The first GP win for a Ferrari was scored by Alberto Ascari in Switzerland in 1949, and in 1952/53 he won back-to-back Drivers' Championships. In 1954 and 1955, Ferrari lost its way with cars that proved difficult to handle, slow and unreliable. Lancia had entered GP racing in 1954 but the costs of this extravagance had contributed to the financial collapse of the company in 1955 and the business was taken over by Fiat. The fledgling GP team was handed over in its entirety to Ferrari to ensure a continued Italian representation in GP racing. Ferrari was back in business and the Lancia-Ferrari powered Fangio to his fourth World Championship in 1956. A new V6 'Dino' engine gave Mike Hawthorn the Championship in 1958 but, in 1959/60, the rear-engine revolution took hold. Ferrari had traditionally put more emphasis on engine power than chassis sophistication and the more nimble Coopers became the cars to beat, even whittling away Ferrari's power advantage on the fast circuits. The time for change was at hand.

FERRARI 156/61

Background

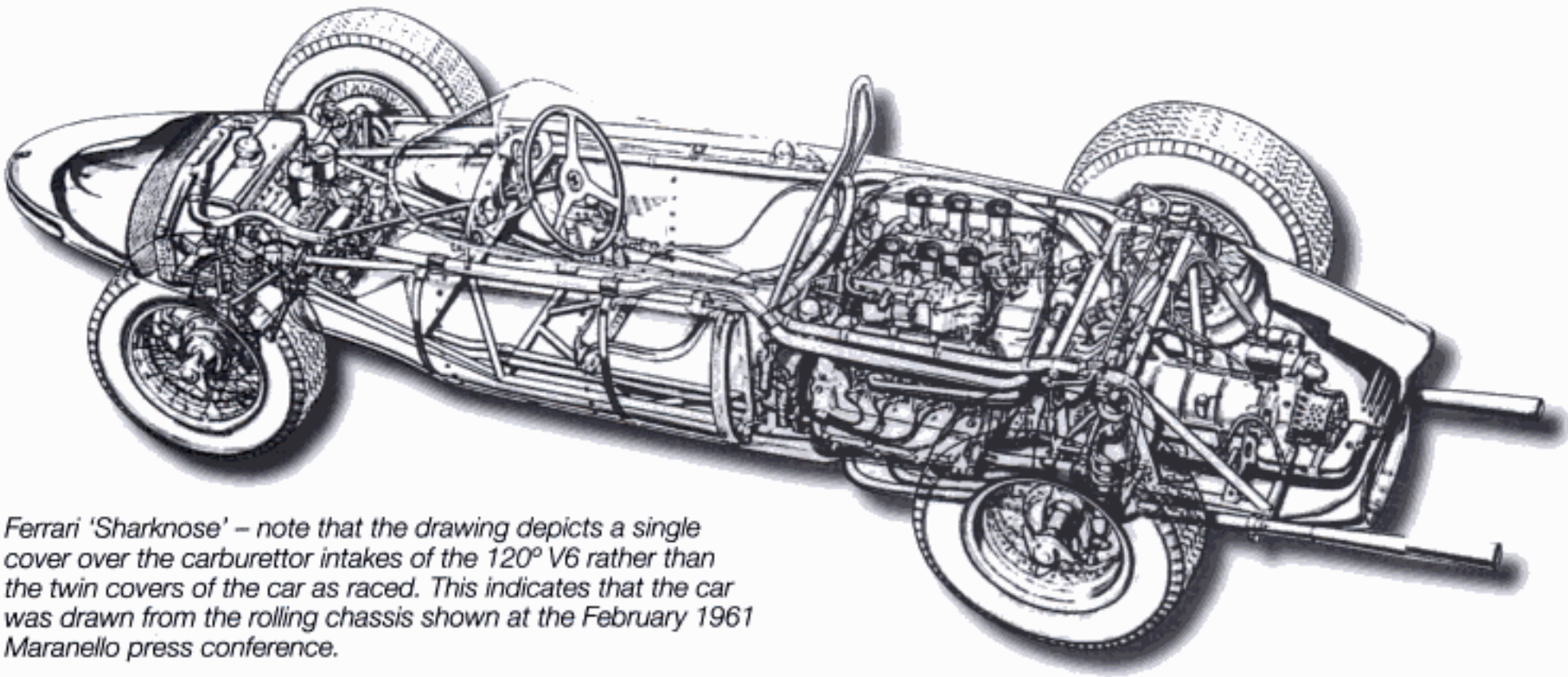
The 1960 Monaco GP was significant for Ferrari in that it marked the debut of its first rear-engined F1 chassis. Despite considerable internal opposition, chief engineer Carlo Chiti had pushed through the construction of an experimental car based on a multi-tubular chassis with double wishbone and coil spring suspension, similar to that seen on the then current front-engined cars. It was powered by the 2½-litre Dino 246 V6 installed in unit with a new 5-speed transmission. With a high engine cowl and Borrani wire wheels, it looked remarkably similar to, and only slightly less bulky than, the front-engined cars. Test and development driver Ritchie Ginther was pleased with the handling of the car, qualified ninth and was classified sixth although retiring with transmission problems before three-quarter distance. The car appeared again in practice for the Dutch GP the following weekend but did not race.

On its return to Ferrari's Maranello base, the chassis was converted to 1½-litre F2 specification with a Dino 156 V6 engine. The suspension was reworked with new wishbones, and the clutch operating mechanism mounted on the gearbox rather than on a chassis crossmember. The high engine cover was replaced with a flat one incorporating a perspex carburettor intake and a wraparound windscreen fitted. In this form, the car was entered for the F2 Solitude GP where, in the hands of Wolfgang von Trips, it won convincingly against a competitive field. Development continued on suspension layout and geometry, and the inclination of the wishbones between chassis and wheel upright. It was clear that this chassis would form the basis of the new 1½-litre Ferrari for 1961.

The definitive 1961 Ferrari was shown to the world at a press conference in February of that year, the first constructor to reveal details of its cars for the new F1. Everyone present was struck by the appearance of the new single-seater, altogether lower and tidier than the 1960 prototype, dominated by a longer nose with twin 'nostril' shaped inlets to the radiator that would see it go down in history as the 'Sharknose' Ferrari. Over the winter Chiti had produced a new version of the Dino 156 V6, opening up the angle of the vee from 65° to a wide 120°. This made the engine both wider and lower, and its lower centre of gravity would improve the handling of the chassis. This engine was also lighter and slightly more powerful than the 65° V6, although both

Ferrari 156/61 specification

Engine:	Ferrari 156 65° or 120° V6
Chassis:	Multi-tubular frame constructed from c.40mm (1½in) diameter steel tubing. Vertical spacing of 15in at cockpit, with 23in width at the top narrowing to 20in at bottom. Upper tubes curved outwards slightly in engine bay to provide clearance for installation of wider 120° V6. No triangulation, strength of main tubes relied upon to prevent lozenging. Rectangular oil tank mounted immediately behind radiator in nose with battery behind.
Transmission:	Ferrari 5-speed, 3-shaft transmission with clutch mounted on rear of casing and driven off second motion shaft.
Fuel tanks:	Twin aluminium tanks with riveted joints, mounted pannier fashion on either side of chassis, capacity approximately 30 gallons.
Suspension:	Front: fabricated, unequal length tubular wishbones with forged aluminium uprights and combined coil spring/Koni damper units. Anti-roll bar. Rear: fabricated, unequal length tubular wishbones with diagonal strutting for additional stiffness. Forged aluminium uprights and combined coil spring/Koni damper units. Anti-roll bar.
Brakes:	Dunlop discs, outboard front, inboard rear.
Wheels:	Borrani wire, centre lock, 15in diameter.
Dimensions:	Wheelbase 2300mm (7ft 6.6in); track 1860mm (3ft 11.2in) front and rear.
Weight:	460kg (1014lb).



Ferrari 'Sharknose' – note that the drawing depicts a single cover over the carburettor intakes of the 120° V6 rather than the twin covers of the car as raced. This indicates that the car was drawn from the rolling chassis shown at the February 1961 Maranello press conference.

versions would be raced over the next two seasons. The 120° V6 was distinguished by twin gauze or perspex covers over the wider spaced carburettor inlets as opposed to the single, central cover of the 65° V6. A developed version of the experimental car's 5-speed, 3-shaft transmission was retained with the clutch mounted on the rear of the casing and driven off the second motion shaft. The transmission casing provided a spacer between engine and final drive so as to place the engine forward in the chassis for better weight distribution.

Chassis construction was similar to the 1960 car and closely followed the multi-tubular layout used by Cooper. It was, however, relatively crude with a poor standard of welding. Ferrari hung on to its traditional Borrani wire wheels, the last F1 constructor to do so. These undoubtedly flexed and added nothing to the car's roadholding capabilities. Claimed weight for the car was an unlikely 420kg, some 30kg (66lb) under the regulation minimum weight.

Development and performance – 1961

The Ferrari V6 enjoyed a power advantage of circa 30bhp over its rivals, enough to compensate for its relatively unsophisticated chassis design except when faced by the skill of Stirling Moss on the 'handling' circuits of Monte Carlo and the Nürburgring. Good handling was never a Ferrari strongpoint and the 156 suffered from Chiti's reliance on a negative camber-inducing suspension geometry. In practice at Spa, Vic Barlow of Dunlop persuaded Chiti to reduce the camber as the cars were showing excessive wear on the inner edges of their tyres. To Chiti's surprise, the drivers found the handling improved, while tyre wear and temperature reduced to more acceptable levels. An interesting experiment at Reims was the fitting of a large carburettor air intake box behind the driver's head. Although demonstrating no advantage and thus never raced, it foreshadowed the adoption of such intakes a decade later.

Despite its shortcomings, five wins, five seconds, four thirds, six pole positions, five fastest laps and a 1-2-3-4 finish in Belgium were more than enough to demonstrate Ferrari's superiority over the season and enable it to scoop both the Drivers' and Constructors' World Championships. Such dominance had not been seen since the Mercedes-Benz Championship years of 1954/55. Three works cars were run on a regular basis, expanded to four for guest drivers at four GPs, while five entries were fielded for Ferrari's home GP at Monza.

Ferrari 156/61 chassis record – 1961

Five chassis were built for the 1961 season, numbered 0001 to 0006 – although Ferrari records do not record 0005. In addition, the 1960 experimental chassis 0008 was updated with 'Sharknose' body panels as the Federazione Italiana Scuderie Automobilistiche (FISA) entry for Giancarlo Baghetti. Chassis 0002 and 0003 started life at Monaco with 65° V6 engines and were subsequently converted to 120° V6s. 0008 remained a 65° V6 chassis throughout its life, as did 0006, a new chassis at Monza.

Ferrari 156/61 120° V6: von Trips shows off the lines of the 'Sharknose' at the Nürburgring, where he was no match for Stirling Moss.

Ferrari 156/63: John Surtees at the wheel of the last tube frame F1 Ferrari during the 1963 British GP.

at the Nürburgring, his favourite circuit, honing the car's handling to perfection to suit the circuit's humps and bumps. Additional engine performance had been released and the car now featured the lighter bolt-on fixing for the wheels – the deletion of another traditional feature. The package paid-off magnificently as he headed Jim Clark in a misfiring Lotus over most of the race to score his first GP win and the first for Ferrari since September 1961. The new monocoque Aero chassis appeared at Monza and the tube frame 156/63 then filled a support role for the remainder of the season.

Ferrari 156/63 chassis record – 1963

Three 156/63 were built, commencing a new run of chassis numbers from 0001. Surtees drove all three chassis during the season, following which they were not seen again.

FERRARI AERO CHASSIS – 156, 158 AND 1512

Design and development

Mauro Forghieri's design team had been briefed towards the end of 1962 to produce a new range of Ferrari F1 engines, including a 90° V8 and a longer term, high revving flat-12 cylinder unit. The intention was to push through the V8 for 1963 and introduce the flat-12 at the beginning of 1965. Both engines would require a new up-to-date chassis, an area in which Ferrari lacked sophistication but was making up ground with the interim 156/63 space frame chassis. Colin Chapman had proved that

Ferrari 156/63 chassis record – 1963

Chassis no.	Engine	Entrant	GP	Driver	No.	Grid	Result
0001	Ferrari 156/120° V6	Ferrari SpA SEFAC	Monaco	J Surtees	21	Q3	4th (FL)
			Britain	J Surtees	10	Q5	2nd (FL)
0002	Ferrari 156/120° V6	Ferrari SpA SEFAC	Belgium	W Mairesse	10	Q3	Gearbox – lap 7/32
			Holland	L Scarfiotti	4	Q11	6th
			France	L Scarfiotti	14		DNS practice accident
			Germany	J Surtees	7	Q2	1st (FL)
			Italy	L Bandini	2	Q6	Gearbox – lap 37/86
			USA	L Bandini	24	Q9	5th
0003	Ferrari 156/120° V6	Ferrari SpA SEFAC	Monaco	W Mairesse	20	Q7	Engine – lap 37/100
			Belgium	J Surtees	9	Q10	Fuel-injection – lap 19/32
			Holland	J Surtees	2	Q5	3rd
			France	J Surtees	16	Q4	Fuel pump – lap 12/53
			Germany	W Mairesse	8	Q7	Accident – lap 1/15
			USA	J Surtees	23	Q3	Engine – lap 82/110

monocoque construction was the way to go and this had already been taken up by BRP and BRM. Forghieri studied the work of his rivals closely before committing his new design to paper, the result being the first Ferrari monocoque chassis.

The new chassis followed the trend set by Colin Chapman, although under the skin there were a number of significant differences from the Lotus 25. The monocoque was based around a simple tubular frame to which was riveted a duralumin skin, a method of construction used in the aircraft industry. This feature prompted the chassis to become known as the 'Aero' in its early days and when powered by the 120º V6 it was referred to as the 'Aero 156' to differentiate it from the tube frame 156/63.

The chassis comprised two upper and two lower longitudinal steel tubes welded to three fabricated sheet steel bulkheads. The tubes doubled as conduits for oil and coolant between the engine and radiators, the left-hand side being for oil, the right for coolant. A double bulkhead at the front supported the front suspension and steering, while an intermediate, scuttle bulkhead formed the instrument panel and steering column support. The third bulkhead was located behind the driver's seat and was rather more substantial as the chassis terminated at this point, the engine being attached directly to it by means of small triangular brackets.

Sheet duralumin was riveted around and to the structure to form longitudinal D-section side-members, with a double skinned cockpit floor and reclining seat back riveted into place between them. Each side-member was divided into two sections by the scuttle bulkhead and was braced internally with U-section ribs, also riveted into place. The driver sat between the side-members, those forward of the scuttle being wider, allowing just sufficient space for his outstretched legs to pass between them. They were also taller, extending up and partially over his legs, while the height of those alongside him was governed by the need to provide elbow room. Each of the four sections contained interconnected bag-type fuel tanks with an auxiliary tank located behind the driver's seat. This helped to reduce fuel surge compared to the single tank per side of the Lotus 25. Also, the larger capacity of the front tanks allowed the cockpit to be roomier than it might otherwise have been, a factor supported by the drivers over the designers who were aiming for a minimal frontal area. An additional inch of internal width was found, compared to the Lotus, at the expense of only a 1cm increase in overall width to 70cm.

The front suspension copied the layout of the Lotus 25 with a narrow-based, one-piece upper wishbone pivoting on the chassis to operate an inboard-mounted combined coil spring/damper unit. The rear arm of the wide-based lower wishbone anchored on the lower member of the tubular chassis structure. Both the upper wishbone and the upright were steel forgings, beautifully finished in typical Ferrari fashion. The rear suspension was lifted from the 156/63 space frame car with the upper link and lower wishbone mounting points on the engine and transmission and the twin parallel radius arms picking up from the rear chassis bulkhead.

The transmission had been completely redesigned from the central gearbox/exposed clutch of the 156/63. The clutch was now located in the conventional position between the engine and final drive, with a two shaft, 6-speed gearbox overhung behind the latter. Ferrari retained allegiance to inboard rear brakes, these being mounted on either side of the final drive unit. Wheelbase was as for the 156 with slightly wider tracks, front and rear. As first tested, the car was some 30lb over the minimum weight limit of 991lb. The chassis was finished off with a tight-fitting nose cone and cockpit surround, the outer skin of the monocoque forming the lower bodywork. The upper part of the engine cover above the induction system was formed in fine mesh gauze. The resultant appearance was much slimmer and more compact than the 156/63 but not yet on a par with the Lotus 25. The debut of the new chassis was scheduled for June but continually postponed due to delays with the new V8 engine for which it had been designed. It finally began testing on 25 August 1963 at Modena where John Surtees found it better than the 156/63 even at such an early stage in its development.

A number of modifications were made to the Aero chassis for 1964, including the strengthening of the double front bulkhead with a sheet steel cover plate welded across its upper surfaces. Three rectangular holes let into the plate allowed inspection of the clutch and brake pedal linkages. The suspension geometry was modified to accept the new generation, wider tread Dunlop tyres, and the forged steel uprights were replaced by hollow, cast alloy units incorporating additional offset. New 13in diameter cast alloy, 5-spoke wheels from Campagnolo were fitted, those at the front having 6in wide rims with 7in at the rear.

A weight saving exercise on the Aero chassis was undertaken for 1965 by drilling non-stressed metal components and running glass fibre body panels for the first time, the latter being introduced to Ferrari by John Surtees. This saved 80lb but it

Technical innovation

Ferrari had moved one step ahead of Lotus to utilise the engine as a structural member, through which all rear suspension and transmission loads were taken. In the event, early testing of the 158 indicated that the V8 engine's crankcase was not sufficiently stressed to act as a structural member. A simple tubular sub-frame had been added to the rear of the chassis when it was adapted to take the V6 and this was continued for the V8. It was not until the introduction of the flat-12 1512 engine that the cylinder block/crankcase proved to be sufficiently stressed and able to act as a structural member. This engine was attached to the chassis via a cast alloy mounting plate to spread loadings.

remained some 20lb over the limit. The battery was relocated alongside the gearbox, standing on end, part of an effort to put more weight over the rear wheels. The rear suspension was modified with raised chassis anchorage points for the upper radius rod to promote oversteer. The original anchorage points were retained in case of need.

The basic Aero chassis remained in service from September 1963 through to the end of the formula in 1965. Its performance is reviewed by reference to each of the three power units with which it was equipped over this period – the 120° V6 (Aero 156), the 90° V8 (type 158) and flat-12 (type 1512). The power units are described more fully in the 'Engines' section.

FERRARI AERO 156

Development and performance – 1963-64

While John Surtees had found the new V8 engined chassis to be promising in initial testing, it was decided not to debut the car in the 1963 Italian GP due to uncertainty over the reliability of the engine. It was decided, however, to debut the new chassis but with the familiar V6 replacing the new V8.

The V6 engine was not sufficiently stressed to act as a structural member and the modifications required to mate the engine to the chassis were not the work of a moment. The rear bulkhead had to be modified and a new tubular sub-frame installed beneath the engine to relieve it of some of the transmission and suspension loadings. Modifications to the engine were more extensive and involved the casting of a new crankcase, something that only a manufacturer such as Ferrari had the capacity to undertake, let alone at short notice.

The hybrid Aero 156 chassis duly made its debut at Monza where Surtees put it on pole by 1.2sec from Hill's BRM. He lead the GP from lap 4 until 17 when the engine dropped a valve. It was not raced in the USA as the right rear wishbone mount pulled out of the chassis in practice and in Mexico the front suspension began to collapse while Surtees was holding second place. Unable to restart after a pit stop to investigate, he was disqualified for a push-start. Bandini recorded the first finish for an Aero with fifth in South Africa, slightly disappointing in view of the initial promise shown.

Slower development and problems with the V8 engine prompted use of the Aero 156 well into the 1964 season in which it provided able support for Ferrari's late season charge for the Constructors' Championship.

The chassis were in modified form, as described above,

Ferrari Aero 156: Surtees debuted the Aero at Monza in 1963 with pole position, and led for 12 laps before the engine expired.

Ferrari tipo 158: the 1964 Championship winner, here in 1965 form at Auvergne.

Ferrari 1512 specification – as for Aero 156 except:

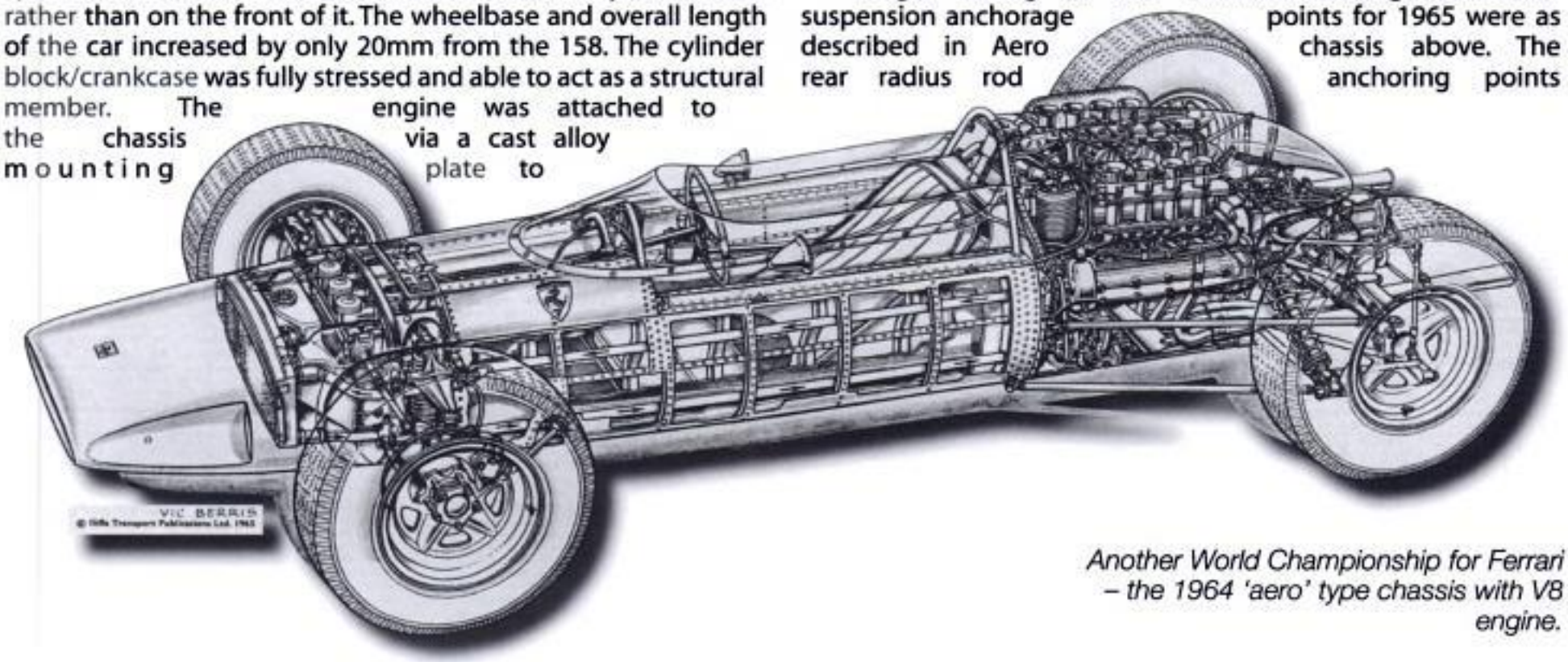
Engine:	Ferrari 1512 flat-12
Chassis:	Engine acts as fully stressed structural member.
Suspension:	Front: Cast alloy upright.
Wheels:	Campagnolo cast alloy, 5-spoke, bolt on, 13in diameter. Rim widths 6in front, 7in rear.
Dimensions:	Wheelbase 2400mm (7ft 10^{1}/$_{2}$in).
Weight:	465kg (1025lb).

spread loadings, removing the need for the tubular sub-frame of the 158. The clutch and 6-speed gearbox were identical to that seen on the 158. At this stage, the complete car weighed about 25lb more than the 158 but this, and possibly more, would be shaved off during further development.

Lorenzo Bandini debuted the first flat-12 engined chassis during the wet Saturday practice session at Monza. Despite some reasonable lap times, it was decided not to race the car due to the uncertainties over its fuel consumption and high speed endurance. The car subsequently made its race debut in the US GP only to retire with a deranged engine. It was competitive in the thin air of Mexico, Bandini qualifying and finishing third. The car had inadvertently contributed to John Surtees 1964 World Championship 0007 by punting Graham Hill's BRM off into the guardrails.

chassis for the first time in practice on 5 September for the Italian GP. Although longer than the V8, the flat-12 took up no more space as its accessories were mounted over the cylinder block rather than on the front of it. The wheelbase and overall length of the car increased by only 20mm from the 158. The cylinder block/crankcase was fully stressed and able to act as a structural member. The engine was attached to the chassis via a cast alloy mounting plate to

Weight saving in the chassis and changes to the rear suspension anchorage points for 1965 were as described in Aero chassis above. The rear radius rod anchoring points



Another World Championship for Ferrari – the 1964 'aero' type chassis with V8 engine.

Gilby

Gilby Engineering Ltd. was a small business owned and run by Sid Greene. Despite losing his left arm in a road accident at the age of 16, he had been an amateur racing driver both before and after World War II and a Spitfire pilot with the RAF during it. He retired from racing in 1953 and became an entrant, fielding cars in the name of his business, including a Maserati 250F for Roy Salvadori and, later, Lotus sports racers for his son Keith. In 1959, he commissioned the then ex-Lotus design engineer Len Terry to sort the handling problems of his Lotus 17 and this led to the design and construction of a Gilby Climax sports racer that achieved some success in Keith's hands during 1960.

Sid had ambitions for Keith to become a successful F1 driver although he would have more success as a very capable team manager in the 1970s and 80s. Nevertheless, in pursuit of his ambitions, Sid commissioned Len Terry to design a Coventry Climax engined F1 car for Keith to drive in 1961.

GILBY F1

Design and construction

Len Terry specified a conventional multi-tubular space frame constructed from 1in and 3/4in diameter steel tubing, suitably braced and triangulated to prevent lozenging. A detachable Y-shaped frame around the 4-cylinder Coventry Climax FPF engine enhanced stiffness in the engine bay. The engine drove through a 5-speed GSD type 32 gearbox and was installed in the chassis at an angle of 18° to the right to bring the carburettors within the bodywork and lower the centre of gravity.

Front suspension comprised fabricated unequal length tubular wishbones with combined coil spring/damper units. At the rear there was a single upper link, reversed lower wishbone and twin radius arms picking up from the seat-back bulkhead. With its combined coil spring/damper units, this layout was remarkably similar to the yet-to-be-announced Lotus 21. Anti-roll bars were fitted front and rear. Girling disc brakes of 10 1/4in diameter front and 9 1/2in rear were fitted outboard at each Cooper cast electron wheel. For a one-off this was an extremely workmanlike chassis and actually better conceived than a number of works team efforts. It was clothed in an attractive aluminium body with a wide, sharp, whale-like nose profile.

Performance – 1961

Bruce McLaren was invited to try the Gilby during a test session at Goodwood and managed to lap 6 seconds faster than Keith Greene, indicating what potential the car might have had with a more talented driver. The team had only limited resources, having built the car for a mere £5,000, and was able to contest only non-Championship races plus the British GP at Aintree. In the latter, Greene finished 15th, six laps down on the winning Ferrari.

Development and performance – 1962-63

Over the winter of 1961/62 the transmission was updated to a GSD type 34 6-speed unit, and in this format the car achieved moderate success in non-Championship F1 races. Meanwhile, a second chassis had been constructed to accept a customer BRM V8 engine. This combination made its debut in the German GP but Greene retired with a broken suspension wishbone and failed to qualify at Monza, some 12 seconds off Jim Clark's pole position time.

By the end of 1962, Gilby Engineering had been taken over and the lack of success in F1 led to the demise of the team.

Gilby: Keith Greene takes the distinctively styled, Climax-engined chassis through Goodwood's Lavant Corner on Easter Monday, 1962.

Gilby chassis record – 1961-63

Chassis no.	Engine	Entrant	GP	Driver	No.	Grid	Result
1961							
'1'	Climax FPF	Gilby Engineering Ltd.	Britain	K Greene	54	Q23	15th
1962							
'2'	BRM P56	Gilby Engineering Ltd.	Germany	K Greene	27	Q19	Suspension – lap 7/15
			Italy	K Greene	56		DNQ
1963							
'2'	BRM P56	Ian Raby (Racing)	Britain	I Raby	26	Q19	Gearbox – lap 59/82
			Germany	I Raby	25		DNQ
			Italy	I Raby	50		WDN

The BRM-engined car was sold to Ian Raby, a veteran private owner/driver who ran Empire Cars Ltd. in Brighton. He raced on a shoestring, running his cars in dark blue livery, each one under the name 'Puddle Jumper'. He entered the Gilby in three 1963 GPs, qualifying only once. Having qualified at Monza, he was persuaded to withdraw by the organisers to let Giancarlo Baghetti into the race in his ATS. On this note the GP career of the Gilby ended.

Honda

The arrival of Honda in F1 added Japan to the select number of nations (France, Germany, Italy, Britain and the USA) that had produced GP cars since the inauguration of the World Championship in 1950. More significantly, it generated a huge amount of interest and gave GP racing a welcome boost in the final years of the 1½-litre F1.

In 1948, Soichiro Honda founded the company that would become the largest motorcycle manufacturer in the world. As a motor sport enthusiast, he recognised the promotional value of the sport as a means of establishing an export market for his products. In 1961, Honda motorcycles won the 125cc and 250cc World Championships, and added the 350cc title in 1962. By this time, Honda was looking to expand from two wheels into four, initially with a small capacity sports car, the S600. Once again, motor sport would play a key role in supporting the sales programme, one of Honda's declared aims being to participate successfully in FIA World Championship GP races.

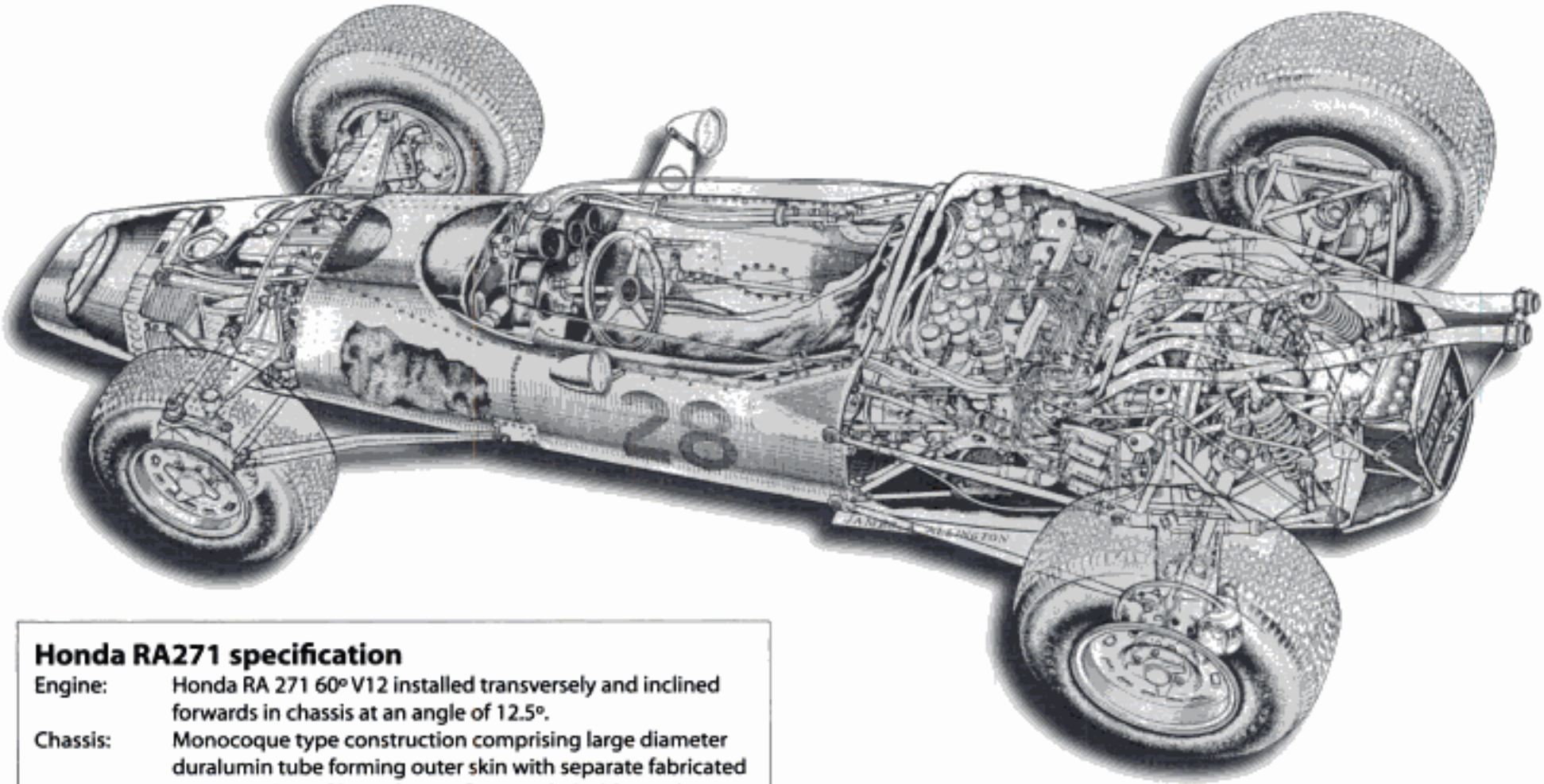
A group of Honda technicians attended the 1961 Italian GP, studying and photographing all the machinery and Soichiro Honda himself examined the prototype Coventry Climax FWMV V8 in the Cooper chassis. Back in Japan, the Honda Research & Development Co. initiated an F1 project under the direction of Yoshio Nakamura. A number of engine configurations were considered before a 135° V8 was built and tested in a Cooper T53 chassis purchased from Cooper in 1961. This engine did not provide the desired level of superiority over the competition (30+bhp) and, in late 1962, work commenced on a V12 engine for transverse chassis installation. The engine was running and producing a consistent 230bhp by November 1963 and was tested successfully in a Honda-built tubular chassis. Honda had little confidence in this chassis and approaches were made to Brabham, Lotus and Cooper with a view to obtaining British chassis expertise. The transverse engine installation was a stumbling block, however, and although Brabham was interested in building a one-off chassis, in the event it did not have the time to do so. Colin Chapman then hustled in and expressed an interest in running a Honda engined Lotus but used this only as a ploy to ensure that Coventry Climax continued development of the FWMV. In January 1964, Honda decided to go it alone and produce its own chassis in line with the latest GP technology.

At the same time, Honda had been looking at the driver market and approaches were made to Phil Hill, Ritchie Ginther and Dennis Hulme – none of whom were free to be signed up. Eventually, a contract was signed with American Ronnie Bucknum who had co-driven a Porsche with Ginther in the Sebring 12 Hours. Bucknum was a 28-year-old US West Coast sports car driver whose family ran a Honda dealership. Being unknown outside the USA, he was considered to be the perfect choice for a low-key entry into F1 – if the car proved successful it would be down to Honda but, if not, it would be the fault of the driver.

HONDA RA271

The chassis owed a great deal to British technology of the time, being a monocoque, very much on the lines of the BRM P61 of 1963. It comprised a large diameter duralumin tube outer skin into which was riveted a separate fabricated structure forming the cockpit sides and driver's seat back. The structure terminated behind the driver's seat in a fabricated sheet steel bulkhead to which a tubular sub-frame was bolted, as on the BRM, to support the engine and transmission, and provided mounting points for the rear suspension.

The suspension followed British practice, that at the front being of the familiar rocker arm type. At the rear, the coil spring/damper units were also mounted inboard, operated by an additional semi-trailing, reversed wishbone via a thin pull-rod connected to the rear, upper end of the hub carrier. A short link to an anti-roll bar also connected to the spring mounting point, the springs themselves being inclined towards their top ends.



Honda RA271 specification

Engine:	Honda RA 271 60º V12 installed transversely and inclined forwards in chassis at an angle of 12.5º.
Chassis:	Monocoque type construction comprising large diameter duralumin tube forming outer skin with separate fabricated structure riveted into place to form cockpit sides and driver's seat back. Fabricated sheet steel bulkheads riveted to each end with further bulkhead strengthening scuttle area. Tubular sub-frame bolted to rear bulkhead supporting engine and transmission, and providing mounting points for rear suspension.
Transmission:	Honda 6-speed in unit with engine.
Fuel tanks:	Flexible rubber bag type tanks housed in D-section cavities between outer skin and cockpit sides. Capacity 30 gallons approximately.
Suspension:	Front: fabricated sheet steel rocker arm operating inboard mounted coil spring/damper units. Wide-based lower wishbone comprising transverse tubular link and a cranked fabricated sheet steel radius arm, feeding loads back into scuttle area. Forged steel upright. Anti-roll bar. Rear: cast alloy upright located by reversed upper wishbone, single lower link and twin, non-parallel radius arms picking up at the seat-back bulkhead. Inboard mounted coil spring/damper units operated by additional semi-trailing, reversed wishbone via thin pull-rod connected to rear, upper end of hub carrier. Anti-roll bar.
Brakes:	Dunlop discs mounted outboard, 9.875in diameter front, 9.687in rear.
Wheels:	Dunlop cast alloy, bolt on, 13in diameter.
Dimensions:	Wheelbase 7ft 6.6in; track 4ft 5in front and rear.
Weight:	1200lb (approx.)

The Honda RA271 ran three GPs in 1964, twice with fuel-injected V12 in chassis 002, as here. Note 'spindly' exhaust system and complex rear suspension linkage.

to Honda's European headquarters in Amsterdam. A private test session was booked at the Zandvoort circuit between 21 and 23 July 1964. The motoring press was allowed in to observe the new F1 car and found it to be pretty much a motorised test bed, not especially well finished and devoid of such necessities as rear view mirrors and oil catch tanks, etc. Nevertheless, Bucknum put some mileage on the car with a fastest lap 3.2sec slower than the lap record established two months earlier. The team then moved on to the Nürburgring for a further four days of testing during which handling, braking and overheating problems restricted Bucknum to no more than three full laps. Despite this, Honda's GP debut was set for the German GP on 2 August.

Bucknum qualified 22nd and last, some 20sec slower than the next man up and 56sec off Surtees' pole position time. The Nürburgring was a challenging proposition for any driver, let alone an American on his first trip to Europe, in his first single-seater race and making his GP debut. It must have been a daunting proposition. Nevertheless, he drove sensibly before the steering broke and put him off the road.

The Austrian GP was missed while a new, fuel-injected engine was awaited from Japan. This was installed in a new chassis 002, and Bucknum qualified a respectable tenth for the Italian GP. After a slow start he was able to demonstrate the Honda's straight line speed to move his way up the order, reaching fifth momentarily before retiring with rear brake failure. He drove 002 again in the US GP but was plagued with overheating problems in both practice and the race. Following this, the team returned to Japan to prepare for 1965.

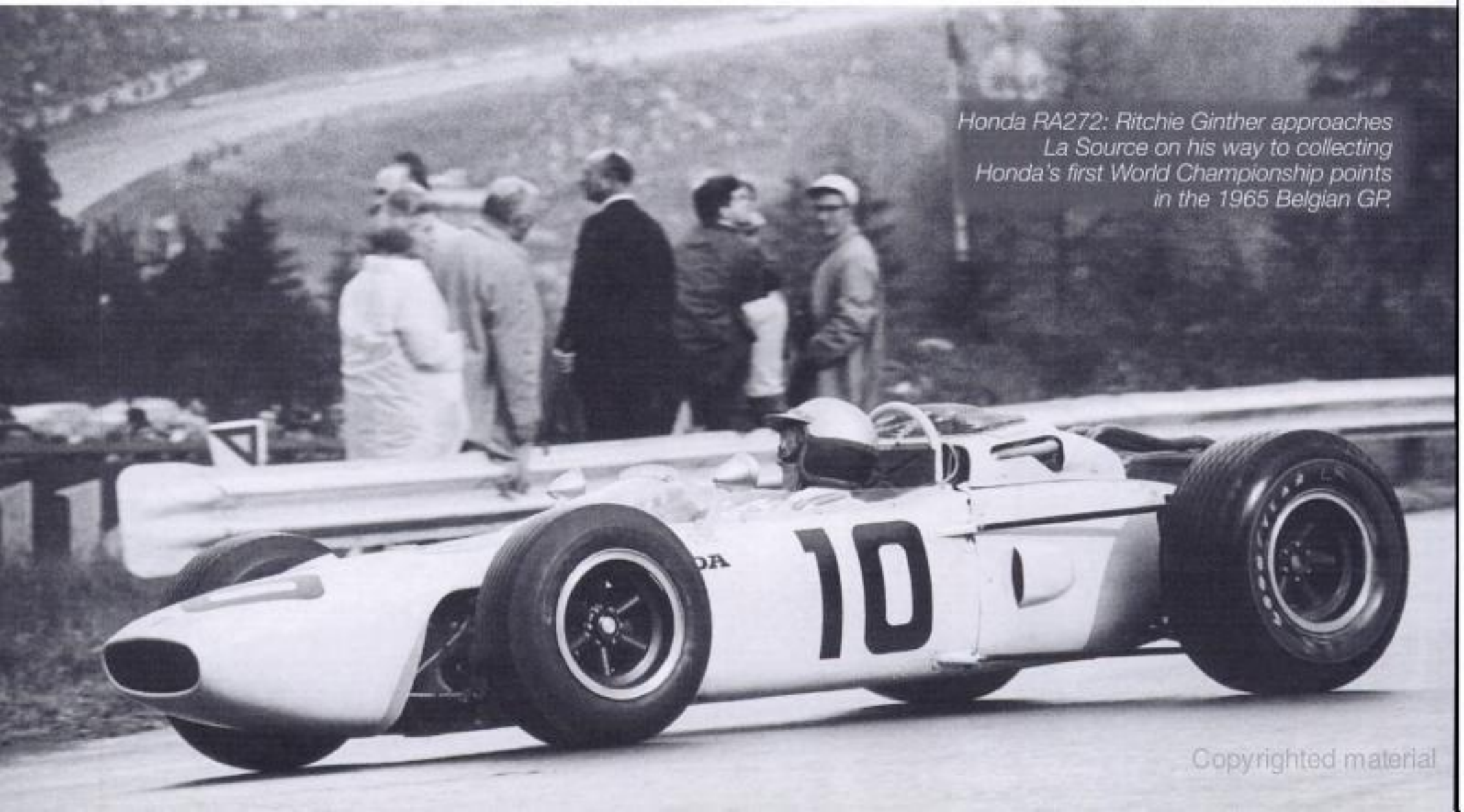
HONDA RA272

The RA272 was created from a detailed redesign of the RA271 monocoque both to reduce weight and tidy it up. Approximately 60lb was saved – some through the use of titanium steel bolts and pins – to bring it down to within 100lb of the regulation minimum. The monocoque retained duralumin construction with sheet steel reinforcements at bulkheads and suspension mounting points. Changes were made to the plumbing, including the relocation of the water pipes from within the chassis side-members to a recess running the length of the chassis below the cockpit. Square section aluminium piping with ribbed floors for additional cooling, conveyed both water and oil between the engine and front-mounted radiators, the latter increased in size to combat the overheating problems of 1964. The tubular sub-frame of the RA271 supporting the engine and rear suspension was retained, the engine now being inclined forward in the chassis by 15° rather than the previous 12.5° and featuring a more substantial looking exhaust system.

The front suspension retained the rocker arm layout of the RA271, with the rearward facing lower radius arm now of tubular steel and straight rather than kinked. The rear suspension had been redesigned to eliminate the inboard mounted spring/damper units and associated linkage. The wheelbase was unchanged, while track measurements had been modified to 4ft 4in and 4ft 6in, front and rear respectively. Honda had defected from Dunlop as supplier of brakes, wheels and tyres. Brakes were now by Girling, wheels by US manufacturer Halibrand and Honda had become the second major team to contract for tyres from Goodyear in its debut season in F1. Bodywork was now in Hizex polyester plastic and was noticeably tidier and more purposeful.

Development and performance – 1965

Honda had set up a serious two car entry for the 1965 World Championship series, having been able to recruit Ritchie Ginther



Honda RA272: Ritchie Ginther approaches La Source on his way to collecting Honda's first World Championship points in the 1965 Belgian GP.

Honda RA272 specification – as for RA271 except ...

Engine:	Honda RA272 60° V12 installed transversely and inclined forwards in chassis at an angle of 15°.
Suspension:	Front: fabricated sheet steel rocker arm operating inboard mounted coil spring/damper units. Wide-based tubular lower wishbone. Rear: single transverse upper link and reversed lower wishbone located by parallel radius rods anchored at the seat-back bulkhead. Combined coil spring/damper unit and anti-roll bar.
Brakes:	Girling discs mounted outboard.
Wheels:	Halibrand cast magnesium alloy, bolt on, 13in diameter.
Dimensions:	Wheelbase 7ft 6.6in; track 4ft 4in front, 4ft 6in rear.
Weight:	1091lb (approx.)

to lead the team with Ronnie Bucknum being retained as number 2. Ginther had been dropped by BRM but, well-known for his testing and development skills, would be an undoubted asset over the season ahead.

The South African GP was given a miss and Honda's season began at Monaco where the cars filled the back row of the grid and had retired by lap 33, Ginther breaking a drive-shaft on the first lap. Things improved with a points finish in Belgium but both cars failed in France. Single car entries were made in Britain and Holland as chief engineer Nakamura and his team worked away on development. By now, the car was qualifying in the top three and displaying race leading performance over the opening laps before heat build-up in the engine resulted in power loss and the car dropping back. The German GP was not contested at all.

The team was back to full strength for the Italian GP with modifications that increased the forward inclination of the engine to 30° and the whole engine was lowered nearly 4in in the chassis. This was achieved by routing the exhaust system from the forward cylinder bank around, rather than underneath, the engine. Alternative pick up points were provided for the rear suspension radius rods, lowering the upper and raising the lower such that, rather than run in parallel, their paths diverged between chassis and rear upright. Engine problems afflicted both entries but both cars finished for the first time in the USA, although off the pace.

It all came good in Mexico for the final GP of the season and of the 1½-litre F1 regulations. The team spent two days at the circuit prior to official practice tuning the fuel-injection set-up to compensate for the high-altitude. Ritchie Ginther qualified third and stormed away from the start never to be headed, recording Honda's first GP win.

Honda RA272 chassis record – 1965

Three chassis were built for the season, 001 being Ginther's regular car and the most successful. Bucknum began in 002 but it was badly damaged in a testing accident at Suzuka in mid-season. He resumed his season in Italy with a new chassis 003 that he used for the remainder of the season.

Honda RA272 chassis record – 1965

Chassis no.	Engine	Entrant	GP	Driver	No.	Grid	Result
001	Honda V12	Honda R&D Co.	Monaco	R Ginther	20	Q16	Drive shaft – lap 0/100
			Belgium	R Ginther	10	Q4	6th
			France	R Ginther	26	Q7	Ignition – lap 9/40
			Britain	R Ginther	11	Q3	Fuel-injection/ignition – lap 26/80
			Holland	R Ginther	22	Q3	6th
			Italy	R Ginther	20	Q17	Engine – lap 56/76
			USA	R Ginther	11	Q3	7th
			Mexico	R Ginther	11	Q3	1st
002	Honda V12	Honda R&D Co.	Monaco	R Bucknum	19	Q15	Gear linkage – lap 33/100
			Belgium	R Bucknum	11	Q11	Engine – lap 9/32
			France	R Bucknum	28	Q16	Ignition – lap 4/40
003	Honda V12	Honda R&D Co.	Italy	R Bucknum	22	Q6	Engine – lap 27/76
			USA	R Bucknum	12	Q12	N/C 92 laps/110
			Mexico	R Bucknum	12	Q10	5th

Honda chassis performance summary

Chassis	Year	Starts	Finishes	1st	2nd	3rd	4th	5th	6th	PP	FL
RA271	1964	3	-								
RA272	1965	14	5	1	-	-	-	1	2		
Total		17	5	1	-	-	-	1	2	-	-

Constructors' Championship placings

Year	Points	Position
1964	0	-
1965	11	6th

JBW

Brian Naylor was a Stockport motor dealer and amateur racing driver of mainly Lotus sports racing cars. His mechanic, Fred Wilkinson, modified his Lotus 11 to take a 2-litre Maserati engine and he enjoyed some success with this combination. This eventually evolved into construction of a purpose-built Maserati-engined sports racer known as the 'JBW' that was also raced with some success, both at home and abroad.

Naylor and Wilkinson became more ambitious in 1959 with the construction of a Cooper-influenced rear-engined 2½-litre F1 car, again Maserati-powered but with Cooper transmission. This car was raced throughout 1960 without success. In 1961, a new JBW was constructed for the 1½-litre F1 with a Maserati 150S engine and 5-speed GSD type 32 transmission. In this form the car retired from its debut, non-Championship race with overheating. The car was then entered for the 1961 Italian GP where Naylor qualified the now Climax FPF-engined car second from last, some 22sec off the pace. He retired from the GP after only 6 laps with engine trouble. Following a couple of non-Championship races at the end of the year, the JBW disappeared from the racing scene.

JBW: not the 1961 chassis but the 1960 version being lapped by John Surtees during the 1960 British GP at Silverstone.

JBW chassis record

Chassis no.	Engine	Entrant	GP	Driver	No.	Grid	Result
-	Climax FPF	JBW Car Co	Italy	B Naylor	14	Q31	Engine – lap 6/43

LDS

South Africa developed its own categories of racing in the late 1950s, the premier one being for 4-cylinder, 1½-litre engined single-seaters competing for the South African Gold Star championship. This was based on the European F2 category of the time and South African drivers would often buy British chassis into which they would fit their own engines, usually modified Alfa Romeo Guilietta units.

A number of the local drivers built their own chassis and one such was L D (Doug) Serrurier, a former speedway champion. Serrurier came the nearest of any South African special builder to being classified as a constructor. His first 'LDS' was front-engined but, thereafter, they were rear-engined, usually copies of Coopers with his own modifications. Three LDS chassis took part in the South African GPs of the period.

LDS 2 was pre-1960 Cooper based with even a Cooper transmission. LDS 6 and LDS 7 were based on the low-line Cooper T53 with Hewland 5-speed transmissions imported from the UK. These three chassis were initially Alfa Romeo-powered but, by the 1965 South African, GP LDS 2 and 7 had gained Climax FPF engines. The only finish for an LDS was, fittingly, Serrurier's 11th place in 1963.

Lola

In 1957, Eric Broadley was a quantity surveyor and the part-time constructor/driver of a 1172cc Ford engined 'special'. By 1962, he had become an F1 chassis designer, a remarkably swift advancement through the ranks by any standard.

Following some success with his Lola special, Broadley decided to move up to the 1100cc sports racing class, a class

LDS chassis record – 1962-65

Chassis no.	Engine	Entrant	GP	Driver	No.	Grid	Result
1962							
LDS-7	Alfa Romeo	Otelle Nucci	S Africa	D Serrurier	21	Q14	Radiator – lap 62/82
1963							
LDS-2	Alfa Romeo	SA Tingle	S Africa	S Tingle	20	Q17	Half-shaft – lap 2/85
LDS-6	Alfa Romeo	Otelle Nucci	S Africa	D Serrurier	16	Q18	11th (7 laps in arrears)
1965							
LDS-2	Climax FPF	SA Tingle	S Africa	S Tingle	25	Q20	N/C 73 laps/85
LDS-7	Climax FPF	Otelle Nucci	S Africa	D Serrurier	21		DNQ

LDS: Sam Tingle in his Alfa-engined LDS2 during the 1965 South African GP.

in which, at the time, a Lotus was the car to have. The new Lola Mk 1 was a neat and particularly attractive Coventry Climax-powered car, and, on its first outing at Brands Hatch in 1958, Broadley managed to break the lap record. This sparked a great deal of interest in the car and convinced Broadley that he should produce replicas for sale. He decided to give up his career to concentrate on establishing himself as a constructor, starting in a small garage workshop in Bromley, south east London. The production Lola Mk 1 dominated the 1100cc class in the UK in 1959 and 1960, and also did well on continental excursions.

Having established a reputation, he then built a front-engined single-seater, the Mk 2, for the newly established FJ class that would have been a great deal more successful had Colin Chapman not produced his all conquering rear-engined Lotus 18 at the same time. A rear-engined FJ followed in 1961 (the Mk 3) and although featuring a number of innovative ideas, it never achieved the necessary results.

At about this time, Reg Parnell, the highly experienced manager of the Yeoman Credit Racing Team, and his number one driver, John Surtees, were looking for a new F1 chassis. In 1961, the finance house-backed team had run Cooper T53 customer cars with little success, and Parnell and Surtees realised that to be competitive they needed a chassis for their exclusive use and one over which they could control development. Surtees thought highly of Broadley's ability with the Lola designs and it was decided to commission him to build an F1 chassis to take the new Coventry Climax V8 engine. In 1962, Yeoman Credit became Bowmaker, following a change in ownership of the sponsor, and the Bowmaker team effectively became the Lola 'works' team.

LOLA MK 4

The Lola Mk 4 was a simple, neat yet effective design as was expected from the drawing board of Eric Broadley. Like Colin Chapman, Broadley was a suspension specialist and he produced a double wishbone layout for the front wheels that differed in detail from his rivals. The wishbones were extremely wide-based, comprising short transverse links located by long, rearward leading radius rods, feeding loads into the scuttle bulkhead. This layout simplified the front of the chassis by eliminating the need for a double suspension bulkhead, the top transverse link and coil spring/damper unit being bolted to a common mounting. Roll centres were relatively low at about 2in front, 2½in rear with fairly stiff anti-roll bars.

Clothed in tight-fitting, high-sided glass-fibre body panels finished in the team colours of dark blue with a red noseband, the Lola was the most attractive looking F1 car of its time.

Development and performance – 1962

Testing of the first chassis began over the winter of 1961/62 with a 4-cylinder Climax FPF engine, and following delivery of an FWMV V8 in April, early season non-Championship F1 races proved that the package was competitive. The GP season itself began on a promising note when Surtees was credited with a suspect pole position at Zandvoort but suffered a broken front wishbone during the race. The car of team-mate Roy Salvadori was withdrawn as a precautionary measure. The wishbones were beefed-up for Monaco where Surtees scored Lola's first Constructors' points with a fourth place, the cars fitted with abbreviated 'Monaco' nose cones.

Surtees had some suspicions that the chassis might be flexing but, being a relative 'new boy' to F1, his remarks were not taken too seriously. Then, during practice at Spa, one corner of the car was jacked up to change a wheel and the other three wheels

Lola Mk 4: John Surtees shows off the attractive lines of his regular chassis BRGP-42 on the way to second behind Jim Clark during the 1962 British GP at Aintree.

remained firmly in contact with the road, the chassis having taken up the slack. Additional bracing was quickly added between the seat back and front bulkheads to rectify the situation. A new, stiffer Mk 4A chassis was ready for the British GP (though not raced) incorporating a stressed aluminium undertray. At the same time, purpose-made fabricated front uprights replaced the ubiquitous Standard-Triumph items.

Fifth placings were achieved in Belgium and France, although neither without problems. It all came right in the British GP at Aintree when Surtees qualified and finished second to Clark's Lotus 25. Another second followed at the epic German GP behind Hill's BRM but, thereafter, poor engine reliability prevented any further finishes. Salvadori, in the second car, failed to finish a single GP in a lacklustre end to his F1 career.

The Lola was undoubtedly a competitive proposition and it seemed only a matter of time before it achieved a GP win. A shortage of funds prevented the team from pursuing further development testing, but, at the end of the season, Bowmaker announced its withdrawal from motor sport and Lola's first GP foray was effectively at an end.

Lola Mk 4 chassis record – 1962

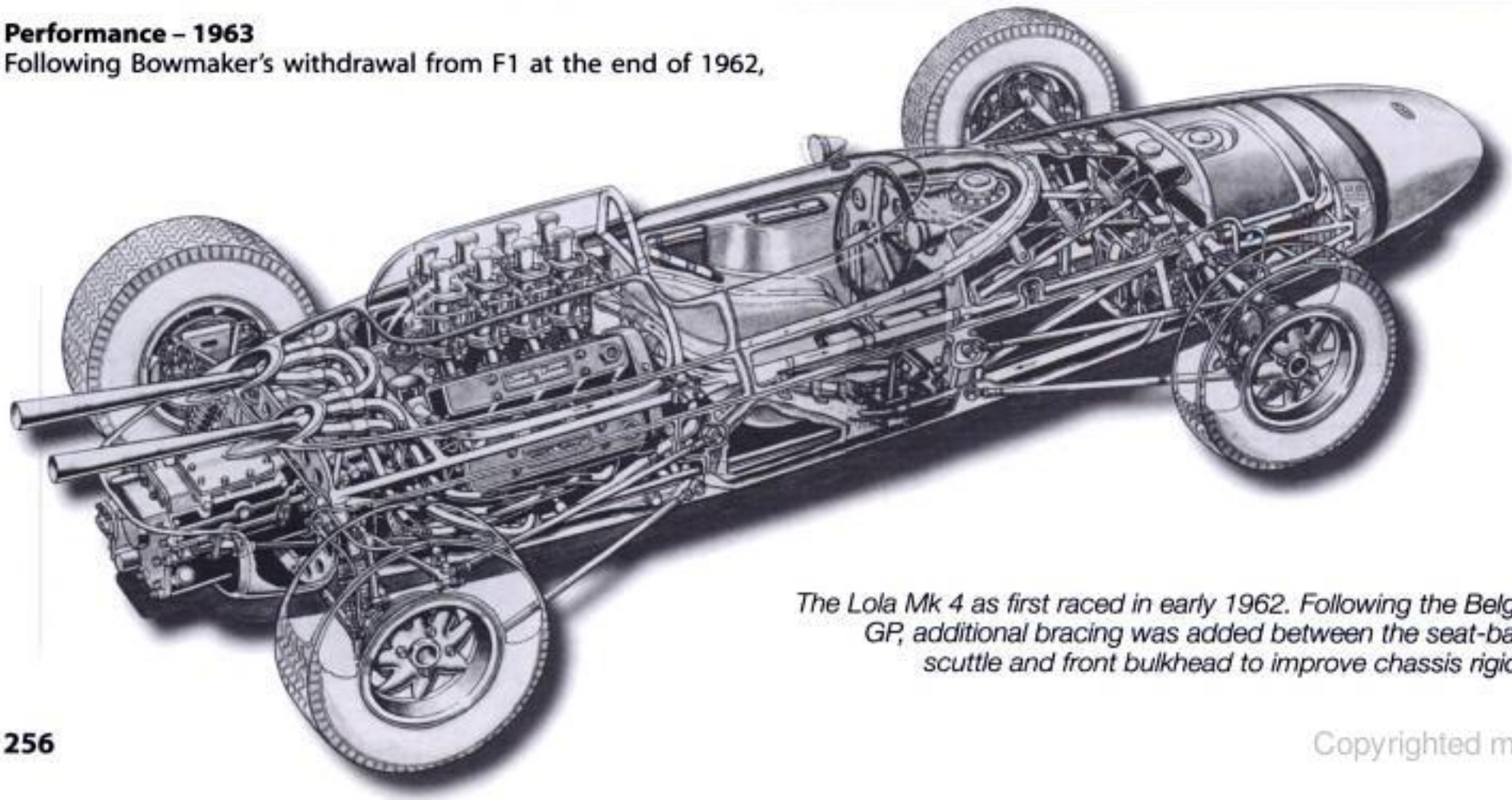
Four chassis were constructed; the first numbered BRGP-41 (for Bromley Grand Prix type 4 chassis 1) was built in late 1961 and fitted with a Climax FPF 4-cylinder engine for testing purposes due to the delayed delivery of the FWMV V8. Surtees drove the revised Mk 4A, chassis BRGP-44, in only the Italian GP.

Lola Mk 4 specification

Engine:	Coventry Climax FWMV V8
Chassis:	Fully triangulated multi-tubular space frame constructed from 1 1/4in, 1in and 3/4in diameter 16, 18 and 20 gauge steel tubing. Fabricated perforated hoop type bulkheads at scuttle and extreme rear. Main longitudinal chassis members used to convey oil and water between the engine and front-mounted radiators. 4 gallon fabricated aluminium oil tank mounted behind radiator.
Transmission:	GSD type 32 5-speed.
Fuel tanks:	Fireproof rubber bag type tanks behind and around seat and above driver's legs, total capacity 24 gallons.
Suspension:	Front: fabricated tubular wishbones comprising short transverse links located by long, rearward leading radius rods, feeding loads into scuttle bulkhead. Upper radius rod bolted to transverse link slightly inboard of the Standard-Triumph upright to provide adequate steering lock. Combined coil spring/damper, anti-roll bar operated by a bell crank arrangement. Rear: reversed upper wishbone and single lower link with long radius rods extending forward to pick up points on the seat-back bulkhead. Combined coil spring/damper unit, anti-roll bar.
Brakes:	Girling discs mounted outboard, 10in diameter front, 9 1/2in rear.
Wheels:	Lola cast magnesium alloy, bolt on, 15in diameter, 6in rims front, 7in rear.
Dimensions:	Wheelbase 7ft 6in; track 4ft 3in front and rear.
Weight:	1000lb

Performance – 1963

Following Bowmaker's withdrawal from F1 at the end of 1962,



The Lola Mk 4 as first raced in early 1962. Following the Belgian GP, additional bracing was added between the seat-back, scuttle and front bulkhead to improve chassis rigidity.

Lotus

Colin Chapman's first Lotus cars were Austin 7 specials but he soon progressed to building small capacity sports racing cars using advanced chassis and suspension technology. Lotus cars established themselves as the cars to beat in the categories in which they competed. While Cooper was building strong but relatively crude chassis at the same time, the Lotus was designed scientifically for performance through low weight, chassis members only being of sufficient strength to accept the loadings for which they were designed.

Chapman's talent for chassis and suspension technology were widely acknowledged in British motor racing circles and, in 1956, he had been commissioned to design the space frame chassis for the World Championship winning Vanwall and later to sort out the suspension of the BRM. The adoption of a 1½-litre F2 category in 1957 and the availability of a suitable Coventry Climax engine prompted Chapman to construct his first single-seater Lotus. The front-engined Lotus 12 featured a space frame chassis, independent suspension and a purpose-built gearbox and final drive unit that allowed the driver to sit reasonably low in the car. As larger capacity Climax engines became available, so Lotus followed Cooper's example and began making GP entries with what were basically F2 cars. Whereas the Cooper was capable of winning, the Lotus was no more than a mid-field runner.

In 1958, Chapman produced the Lotus 16, possibly the most technically advanced front-engined F1 car ever constructed. It was small, extremely light, its bodywork aerodynamically styled on the lines of a 'mini-Vanwall' and an offset drive line allowed the driver to sit alongside the transmission, lowering the car's overall height to the minimum. Unfortunately, its potential was never realised. The aluminium bodyshell was too thin and prone to cracking, the chassis suffered breakages with monotonous regularity, and the offset driveline was inefficient and absorbed too much power. Meanwhile, the ruggedly built rear-engined Coopers with identical power units were winning the 1959 Constructors' Championship.

Looking back more than forty years later, it is difficult to appreciate why Colin Chapman with all his technical foresight did not produce a rear-engined single-seater sooner. There was always some reluctance to follow arch rival Cooper's design principles but, by the end of 1959, with the rear-engined revolution in full swing, something radical had to be done. Starting with a clean sheet of paper, Chapman set out to reduce frontal area, maintain a low centre of gravity and minimise power losses. The result was the rear-engined Lotus 18 that may have followed Cooper principles but was designed and constructed using Lotus technology. Where the 16 had been complex, the 18 was simplicity itself. From its first F1 appearance in the 1960 Argentine GP, the 18 set new standards of performance, winning a number of non-Championship F1 races and several F2, many in the hands of Innes Ireland. In Championship GPs, Team Lotus entries were not so lucky, despite picking up many placings. Having been beaten by Ireland and the 18 twice on Easter Monday at Goodwood, Stirling Moss was sufficiently impressed to ask Rob Walker to order one for him. By the end of the year Moss had won two GPs for Lotus and its name had been made as a single-seater manufacturer, setting a standard that would be maintained throughout the 1960s and 70s.

LOTUS 18

By rights, the Lotus 18 should not have featured significantly in the new 1½-litre F1. It was, after all, a year old, too bulky and underpowered. That it did so was a tribute to the basic correctness of the design but more so to the superior driving skill of Stirling Moss who achieved two GP victories to beat the more powerful Ferraris on acknowledged 'drivers' circuits.

The chassis was a typical Lotus, well thought out space frame

Lotus 18: seventeen Lotus 18 chassis were seen in 1961 GPs; this was the Camoradi International-entered version, driven by Ian Burgess in the non-Championship Brussels GP.

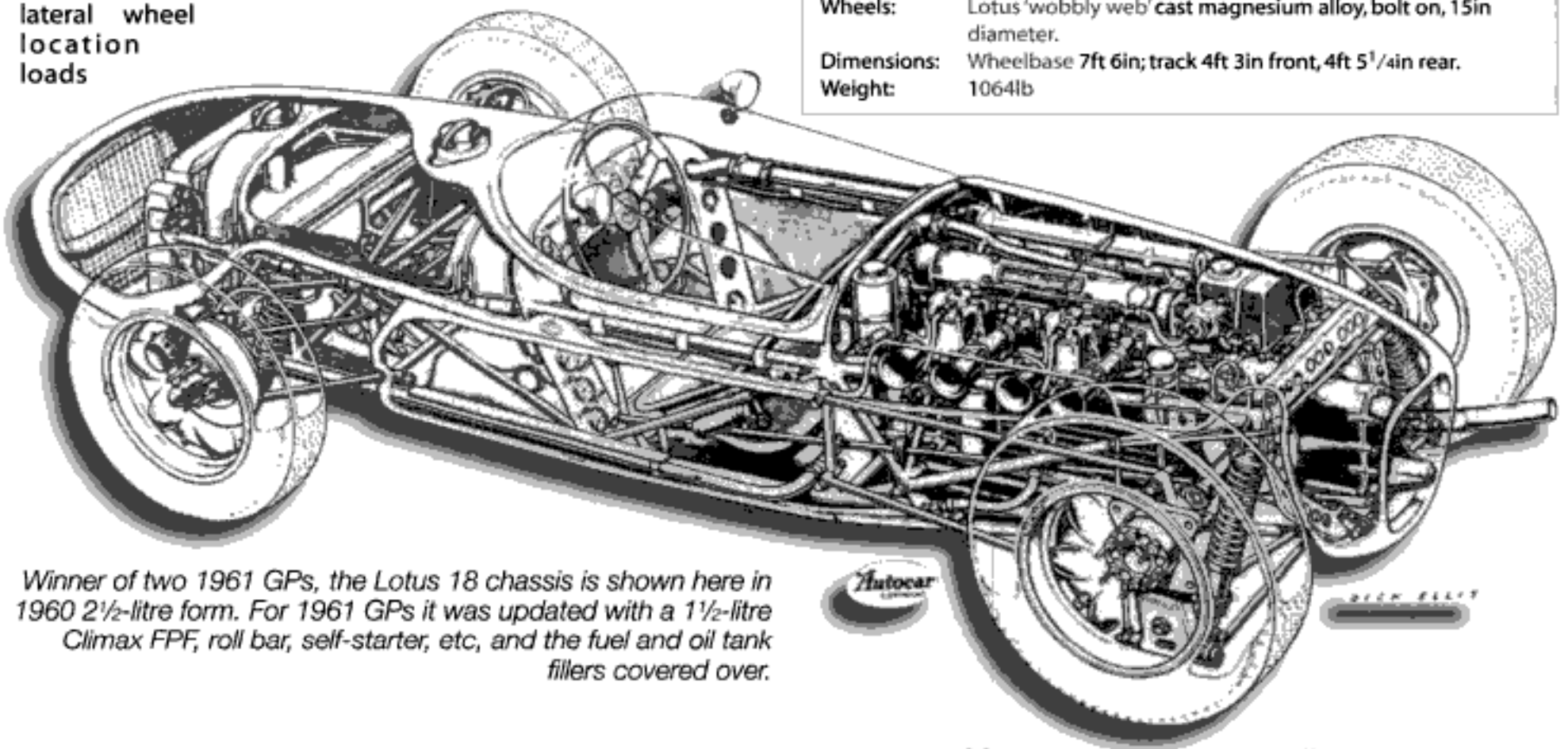
with fabricated perforated-hoop type bulkheads enhancing rigidity. The completed chassis was approximately 24in square in section, its glass-fibre body panels fitting closely to it and giving it a more functional than attractive 'brick' shape. For the rear suspension, Chapman had devised a trendsetting layout with long, low-mounted reversed wishbones pivoting almost on the chassis centre line beneath the gearbox. The outer ends of the wishbones were anchored to cast alloy hub carriers that extended down to approximately three inches above the road surface. Fixed-length driveshafts doubled as the upper suspension links and twin parallel radius arms picking up from the seat-back bulkhead provided longitudinal location.

Development – 1961

While most entrants raced their cars in standard form, the Walker and UDT-Laystall teams co-operated in updating and improving their chassis. The cars were updated to comply with the new F1 regulations and equipped with the Mk II version of the Coventry Climax FPF engine, where available. The square section chassis with its close fitting glass-fibre body panels had never been very fast in a straight line. More rounded body panels were devised on the style of the 21 to improve its speed, requiring some modifications to the frames including the scuttle bulkheads to accept the more elliptical profile. At the same time, UDT-Laystall chief mechanic Tony Robinson devised a rear suspension layout similar to the 21. This comprised shorter uprights with a single top link to relieve the half-shafts of lateral wheel location loads

Lotus 18 specification

Engine:	Coventry Climax FPF 4IL
Chassis:	Fully triangulated multi-tubular space frame constructed in 1in and 3/4in diameter mainly 18 with some 16 gauge steel tubing. Fabricated perforated hoop type bulkheads at scuttle and extreme rear where lower main frame members converged on inboard rear suspension pick up points. Engine bay braced by Y-shaped frame detachable with top section of rear bulkhead for installation and removal of engine and transmission. Additional light sub-frame on front of chassis to support radiator and oil tank.
Transmission:	Lotus 5-speed or GSD type 32 5-speed.
Fuel tanks:	Fabricated aluminium fuel tanks, 22 gallons above driver's legs, further 9 1/2 gallons behind seat.
Suspension:	Front: fabricated, unequal length tubular wishbones with proprietary Standard-Triumph upright. Combined coil spring/damper unit and anti-roll bar. Rear: long, low-mounted reversed wishbones pivoting almost on chassis centre line beneath gearbox. Outer ends of wishbone anchored to cast alloy hub carrier extending down to approximately three inches above road surface. Fixed-length driveshafts doubling as upper suspension links with twin parallel radius arms picking up from seat-back bulkhead providing longitudinal location. Combined coil spring/damper unit and anti-roll bar.
Brakes:	Girling discs, front 10 1/2in diameter installed outboard, rear 9 1/2in diameter either inboard, on either side of the transmission, or outboard.
Wheels:	Lotus 'wobbly web' cast magnesium alloy, bolt on, 15in diameter.
Dimensions:	Wheelbase 7ft 6in; track 4ft 3in front, 4ft 5 1/4in rear.
Weight:	1064lb



Winner of two 1961 GPs, the Lotus 18 chassis is shown here in 1960 2½-litre form. For 1961 GPs it was updated with a 1½-litre Climax FPF, roll bar, self-starter, etc, and the fuel and oil tank fillers covered over.

Lotus 18 chassis record – 1961

Chassis no.	Engine	Entrant	GP	Driver	No.	Grid	Result
371	Climax FPF	Team Lotus	Holland	T Taylor	16	Q14	13th
		Jim Hall	USA	J Hall	17	Q18	Fuel pipe – lap 76/100
372	Climax FPF	J Wheeler Autosport	USA	P Ryan	16	Q13	9th
373	Climax FPF	Scuderia Colonia *	Belgium	L Bianchi	12	Q21	Oil pipe – lap 9/30
			Britain	W Seidel	52	Q23	N/C 58 laps/75
			Germany	W Seidel	26	Q23	Steering – lap 3/15
			Italy	W Seidel	56	Q28	Engine – lap 1/43
902	Maserati 150S	Prince G Starrabba	Italy	G Starrabba	72	Q30	Engine – lap 19/43
903	Climax FPF	Mrs Louise Bryden-Brown	Britain	A Maggs	50	Q22	13th
			Germany	A Maggs	33	Q22	11th
904	Climax FPF	RHH Parnell	Britain	T Parnell	38	Q29	Clutch – lap 12/75
			Italy	T Parnell	16	Q27	10th
905	Climax FPF	Camoradi International	Belgium	I Burgess	50		DNQ
			France	I Burgess	38	Q24	14th
			Britain	I Burgess	44	Q25	14th
906	Climax FWMV	RRC Walker Racing Team	Italy	S Moss	28		DNS – overheating in practice
			USA	S Moss	7		DNS – overheating in practice
907	Climax FPF	J Frank Harrison	USA	L Ruby	26	Q19	Magneto – lap 76/100
909	Climax FPF	AE Marsh *	Belgium	W Mairesse	10	Q20	Engine – lap 7/30
			Britain	A Marsh	48	Q27	Ignition – lap 25/75
			Germany	A Marsh	37	Q20	16th
912	Climax FPF	RRC Walker Racing Team	Monaco	S Moss	20	Q1	1st (FL)
			Holland	S Moss	14	Q4	4th
			Belgium	S Moss	14	Q8	8th
			France	S Moss	26	Q4	Brake pipe – lap 31/52
			Britain	S Moss	28	Q5	Brake pipe – lap 44/75
			Germany	S Moss	7	Q3	1st
		(Swapped with Team Lotus)	Italy	I Ireland	38	Q9	Chassis – lap 5/43
			USA	S Moss	7	Q3	Engine – lap 58/100
914	Climax FPF	Scuderia Colonia	Monaco	M May	8	Q13	Oil leak – lap 42/100
			France	M May	46	Q22	11th
			Germany	M May	25		DNQ
915	Climax FPF	UDT-Laystall Racing Team	Monaco	H Taylor	34		DNQ
916	Climax FPF	UDT-Laystall Racing Team	Monaco	C Allison	32	Q14	8th
			France	H Taylor	30	Q25	10th
			Britain	H Taylor	30	Q17	Accident – lap 5/75
917	Climax FPF	UDT-Laystall Racing Team	France	L Bianchi	28	Q19	Clutch – lap 21/52
			Britain	L Bianchi	32	Q30	Gearbox – lap 45/75
			Italy	M Gregory	22	Q17	Rear suspension – lap 11/43
			USA	M Gregory	22	Q11	Gear selector – lap 23/100
918	Climax FPF	UDT-Laystall Racing Team	Belgium	C Allison	16		DNS – accident in practice
			Italy	H Taylor	20	Q23	11th
			USA	O Gendebien	21	Q15	11th
919	Climax FPF	G Ashmore	Britain	G Ashmore	40	Q25	Ignition – lap 7/75
			Germany	G Ashmore	27	Q25	17th
			Italy	G Ashmore	18	Q25	Accident – lap 0/43

* Note: entries hired by Equipe National Belge for Belgian GP from Scuderia Colonia and AE Marsh

the 1962 season, by which time both the engine and chassis had been sorted.

Performance – 1961

More Lotus 18s would be seen than any other chassis over the course of the season, but of the 17 chassis that practised for the eight GPs held in 1961, predictably only Stirling Moss in the RRC Walker Racing Team entry achieved any results. Memorably, he used chassis 912 to good effect to defeat the Ferrari team with GP wins at Monaco and the Nürburgring. In so doing, he scored 16 Constructors' Championship points for Lotus, as many as Team Lotus managed in total with the purpose-built Lotus 21 chassis.

Of the other 18 users, only 14 finishes were recorded from 33 starts, the highest being an eighth for Cliff Allison's UDT-Laystall entry at Monaco. The 18/21 V8 Special was not raced in 1961 – Moss practised the car at both Monza and Watkins Glen but declined to race it due to engine overheating problems. With the engine problems sorted, it was raced in the early 1962 season non-Championship F1 races, culminating in the accident at Goodwood in which it was written-off and Moss' career terminated.

There were two batches of chassis numbers; Team Lotus had built the first batch in the '370' range while the '900' series were production chassis built by Lotus Components. The most significant were the two RRC Walker Racing Team chassis, 906 (the spare chassis converted mid-season to take the second available Coventry Climax FWMV V8 engine) and 912 (the regular chassis used by Moss to defeat the Ferrari team at Monaco and the Nürburgring).

Performance – 1962-63

Despite being three years old, eight 18 chassis appeared for 1962 GPs. They were now completely outpaced and only one finish from five starts was recorded. A number of chassis changed hands into 1962, including 912, the ex-RRC Walker Racing Team chassis in which Stirling Moss had won two 1961 GPs, purchased by Count Volpi's Scuderia SSS Republica di Venezia. A new chassis numbered 'P1' was built up from spare parts by the Reg Parnell (Racing) team.

The 18 lingered on into the 1963 season, three chassis appearing for the German GP, although none managed to qualify for the race.

LOTUS 21

The Lotus 18 had been designed as an all-purpose racing car, equally suitable for the then 2½-litre F1, F2 and, in simplified form, for FJ. While Colin Chapman produced specific models in 1961 for F1 and FJ, they were very closely related. The London Racing Car Show in January 1961 had seen the debut of the new FJ Lotus 20 that re-introduced rounded, elliptical section body panels to Lotus single-seaters, replacing the highly successful but 'brick'-shaped type 18. It also shared a number of developments with the forthcoming F1 chassis, including the use of the main chassis tubes as oil and water conduits between the engine and radiators to save space in the cockpit, and a steeply reclining seating position. This latter feature lowered the driver by approximately 2in into the cockpit and reduced frontal area to an absolute minimum.

The 21 chassis was conceived around the new 1½-litre Coventry Climax V8 engine but, when it became clear that this would not become available until late-season at the very earliest, the engine bay had to be redesigned to take the Mk II version of the FPF 4-cylinder engine. Chapman had decided to set aside the oft troublesome Lotus-produced twin-shaft gearbox (known as the 'queerbox') in favour of a transmission that he had spotted on a visit to the ZF factory

Lotus 18 chassis record – 1962-63

Chassis no.	Engine	Entrant	GP	Driver	No.	Grid	Result
1962							
373	Climax FPF	Emeryson Cars	Belgium	J Campbell Jones	4	Q19	N/C 16 laps/32
905	Climax FPF	Ecurie Excelsior	Britain	J Chamberlain	46	Q20	N/C 64 laps/75
			Germany	J Chamberlain	30		DNQ
			Italy	J Chamberlain	26		DNQ
912	Climax FPF	Scud SSS Republica di Venezia	Monaco	N Vaccarella	42		DNQ
913	Climax FPF	Scuderia Jolly Club	Italy	E Prinoth	54		DNQ
917	Climax FPF	UDT-Laystall Racing Team	Holland	M Gregory	10	Q16	Gearbox – lap 54/80
918	Climax FPF	Equipe National Belge	Belgium	L Bianchi	19	Q18	9th
919	Climax FPF	G Ashmore	Italy	G Ashmore	52		DNQ
P1	Climax FPF	John Dalton	Britain	A Shelly	48	Q18	Overheating - lap 5.75
			Germany	A Shelly	29		DNQ
1963							
914	Borgward 30	K Kuhnke	Germany	K Kuhnke	27		DNQ
915	Climax FPF	RHH Parnell	Germany	T Parnell	30		DNQ
917	Climax FPF	A Pilette	Germany	A Pilette	29		DNQ
			Italy	A Pilette	46		DNQ

Lotus 24 chassis record – 1963-65

Chassis no.	Engine	Entrant	GP	Driver	No.	Grid	Result
1963							
941	BRM P56	Reg Parnell (Racing)	USA	H Sharp	22	Q18	Engine lap 6/110
			Mexico	H Sharp	22	Q16	7th
942	Climax FWMV	Reg Parnell (Racing)	France	M Trintignant	28	Q14	8th
			Britain	M Hailwood	20	Q17	8th
944	BRM P56	British Racing Partnership	Monaco	I Ireland	14	Q5	Accident lap 40/100
			Holland	J Hall	42	Q18	8th
			Germany	I Ireland	14	Q11	Accident lap 1/15
			USA	J Hall	16	Q16	Gearbox lap 76/110
			Mexico	J Hall	16	Q15	8th
945	BRM P56	British Racing Partnership	Monaco	J Hall	12	Q13	Gearbox lap 20/100
			Belgium	J Hall	5	Q12	Accident lap 16/32
			France	J Hall	34	Q16	11th
			Britain	J Hall	12	Q13	6th
			Germany	J Hall	20	Q16	5th
			Italy	J Hall	30	Q16	8th
946	BRM P56	E Driver	S Africa	P Driver	15		DNS – accident in practice
949	Climax FWMV	B Collomb	Monaco	B Collomb	24		DNQ
			Germany	B Collomb	28	Q21	N/C 10 laps/15
950	BRM P56	Siffert Racing Team	Monaco	J Siffert	25	Q12	Engine lap 3/100
			Belgium	J Siffert	28	Q14	Accident lap 16/32
			Holland	J Siffert	36	Q17	7th
			France	J Siffert	36	Q10	6th
			Britain	J Siffert	25	Q15	Gearbox lap 66/82
			Germany	J Siffert	18	Q9	Differential lap 10/15
			Italy	J Siffert	54	Q15	Oil pressure lap 40/86
			USA	J Siffert	14	Q14	Gearbox lap 56/110
			Mexico	J Siffert	14	Q9	9th
951	BRM P56	Scuderia Filipinetti	France	P Hill	42	Q13	N/C 34 laps/53
			Britain	M Gregory	21	Q22	11th
			Italy	M Gregory	42	Q12	Engine lap 26/86
		Reg Parnell (Racing)	USA	R Ward	18	Q17	Gearbox lap 44/110
			Mexico	C Amon	18	Q19	Gearbox lap 8/65
1964							
944	BRM P56	British Racing Partnership	Monaco	I Ireland	14		DNS – w/o in practice accident
945	BRM P56	British Racing Partnership	Britain	T Taylor	12	Q18	Driver ill lap 23/80
949	Climax FWMV	B Collomb	Monaco	B Collomb	3		DNQ
950	BRM P56	Siffert Racing Team	Monaco	J Siffert	24	Q16	N/C 78 laps/100
'P1'	BRM P56	Revson Racing (America)	Monaco	P Revson	2		DNQ
			Belgium	P Revson	29	Q10	DSQ – push start lap 28/32
			Britain	P Revson	24	Q22	Differential lap 43/80
			Germany	P Revson	27	Q18	Accident lap 10/15
			Italy	P Revson	38	Q18	13th
1965							
943	Climax FWMV	Brian Gubby	Britain	B Gubby	26		DNQ

Lotus 25 specification

Engine:	Coventry Climax FWMV V8
Chassis:	'Bathtub'/open type monocoque comprising two D-section side-members running length of wheelbase of car, bridged by stressed undertray panel. Constructed from mainly 16swg and some 18swg aluminium alloy sheet with fabricated steel bulkheads at front, rear and scuttle. Engine rigidly bolted into place as part of structure. 3 gallon oil tank, oil and coolant radiators mounted on light outrigger frame attached to front bulkhead with steering rack, anti-roll bar, brake and clutch master cylinders.
Transmission:	ZF 5DS10 5-speed.
Fuel tanks:	Aircraft type rubberised bag tanks within each side-member and wedge shaped cavity between engine and driver's reclining seat back, total capacity 26 gallons. Supplementary fabricated alloy tank of 5 1/2 gallons above driver's legs, as required.
Suspension:	Front: narrow-based, fabricated upper wishbone pivoting on front bulkhead acting on combined coil spring/damper unit mounted within bodywork. Lotus cast electron upright incorporating high-mounted track rods. Fabricated wide-based tubular lower wishbone. Anti-roll bar. Rear: single upper link and long, low-mounted reversed wishbones. Cast alloy hub carrier located by twin parallel radius arms picking up from seat-back bulkhead. Combined coil spring/damper unit and anti-roll bar.
Brakes:	Girling discs mounted outboard, 10 1/2in diameter front, 9 1/2in rear.
Wheels:	Lotus 'wobbly web' cast magnesium alloy, bolt on, 15in diameter, 6in rims front, 7in rear.
Dimensions:	Wheelbase 7ft 7in; track 4ft 4in front, 4ft 5 1/4in rear.
Weight:	995lb

Technical innovation

Although not a true 'monocoque' in the strict sense of the word, the new type chassis construction would be classified under this heading. Chapman himself described it as a 'twin-tube ladder frame, stressed-skin riveted structure'. The chassis was based on two D-section side-members, approximately 12in deep by 6in wide, running the length of the wheelbase of the car, bridged by a stressed undertray panel. It was constructed from mainly 16swg and some 18swg aluminium alloy sheet with fabricated steel bulkheads riveted into place to brace the structure at the front, rear and the scuttle. These provided front and rear suspension pick up points and supported the steering column and instrument panel respectively. At its rear, the side-members reduced in height to run below the exhaust camshaft boxes of the Coventry Climax FWMV V8 engine. This was rigidly bolted into place at six widely spaced mounting points, four at the front and two at the rear. The inner faces of the side-members alongside the engine were of sheet steel to withstand engine heat and rear suspension loadings. Initial rigidity tests were encouraging when the new chassis was found to have a torsional stiffness of 1000lb/ft per degree for a bare weight of 65lb; this improved to 2400lb/ft per degree with engine installed, and compared to a current 21 space frame with torsional stiffness of only 700lb/ft per degree and a bare weight of 82lb.

Fuel was contained in aircraft type rubberised bag tanks within each side-member, with a third installed in the wedge-shaped cavity between the engine and driver's reclining seat back. The tanks, inserted through openings in the side-members, were interconnected and filled through a common filler ahead of the scuttle bulkhead.

In such a compact chassis layout, space was difficult to find for the coolant and oil pipe runs and the gearchange linkage. The outward coolant pipe ran across the top of the left chassis side-member to the radiator while the return coolant, oil pipe runs, hydraulic lines and electrics were accommodated in two shallow, inverted v-shaped channels formed in the underside of the undertray adjacent to the inner edge of the side-members. The gearchange linkage ran through the right-hand side-member.

LOTUS 25

In 1961, Colin Chapman was working on the design and development of a backbone type chassis for the original road-going Lotus Elan sports car. Fabricated from sheet steel, this proved to be immensely rigid for its weight. Chapman's train of thought turned to other applications for the backbone chassis, including single-seaters. The story is well documented of how he sketched out the basic principles of what would become the Lotus 25 on a paper napkin during a planning lunch at a Waltham Abbey High Street restaurant. His idea was to space the sides of the backbone far enough apart for the driver to sit between them and box them in to hold rubberised fuel tanks, saving on the problems associated with the normal fabricated aluminium tanks hung on the side of a space frame chassis.

This was Colin Chapman at his best, establishing himself at the leading edge of race car design, a position that he would maintain through into the 1980s. This simple idea would change the course of chassis design for ever but, at a time when F1 chassis design had become fairly stabilised, the introduction of a new and completely radical form of construction required an immense amount of confidence in its potential.

The new chassis shared the suspension layout of the Lotus 24, being developed at the same time. The space frame construction of the 24 being a known quantity, proved a useful base for proving 25 components. The only difference between 24 and 25 suspension layouts was in the location of the rear coil spring/damper units, mounted behind the half-shafts of the 24 but ahead of them on the 25, thereby reducing the overall length of the frame. Rubber doughnut couplings were utilised at the inboard ends of the half-shafts in place of conventional sliding splines. The 25 also shared the brakes, wheels and basic dimensions with the 24.

problems. He led the first 11 laps of the GP before being delayed by a loose bolt in the clutch pedal.

At Monaco he was thwarted by clutch and engine problems, but in Belgium he worked his way to the front, after a troubled practice, to score an easy first win for himself and the 25. This set the pattern for the season: Clark and the 25 established themselves as the fastest combination on the track – when the 25 finished it invariably won. It failed in South Africa where Clark had his World Championship hopes drain away with an oil leak at three-quarter distance. The Lotus 25 scored 3 wins, 6 pole positions and 5 fastest laps, an impressive debut by any standard. Monocoque construction would be a concept that other constructors could not afford to ignore.

Lotus began a new run of chassis numbers for the 25, commencing at 'R1', of which five examples were built over the course of 1962. Little in the way of chassis modification was necessary over the season. Thanks to the unprecedented increase in rigidity of the chassis and the finely tuned suspension, it ran much softer springs than the opposition and made better use of Dunlop's race tyres, all of which contributed to superior handling. The second chassis built made its debut with 13in diameter front wheels but was soon switched to the 15in wheels for which the suspension had been designed, despite the small reductions in aerodynamic drag and unsprung weight. Subsequent chassis were built of thinner gauge aluminium to reduce weight, the material reduction being approximately 2swg all round. At the same time, the rear bulkhead was strengthened as was the lower rear suspension radius arm pick up point. Of the body panels, the gearbox cowling was shed after the Belgian GP to reduce heat build up in the gearbox.

Developments – 1963

Having amply proved itself over the 1962 season, Chapman wisely chose to refine the design for 1963. Many of the refinements were not visible but were significant none the less. They were carried through by Len Terry who had rejoined Lotus following a spell away designing the F1 Gilby (q.v.). The monocoque tubs were already being built in lighter gauge aluminium saving approximately 20lb in overall weight, and opportunity was taken to give the engine mounting brackets additional longitudinal stiffness as they were found to be flexing under acceleration and braking loads. A new roll-over bar was fabricated for attachment directly to the engine rather than to the chassis as previously.

A study of internal airflow revealed inefficiencies in engine cooling. Cooling air fed to the inboard coil spring/damper units via the radiator intake was found to impair radiator efficiency and the 1963 car featured separate ducts on either side of the nose specifically for this purpose. It was also found that the curved front of the oil tank, mounted behind the radiator, was impeding airflow through it. A new smaller capacity, v-shaped tank was fabricated, improving airflow and saving 12-15lb in weight. These modifications so improved cooling that a smaller radiator with six rows of tubes as opposed to ten proved adequate, saving another 15lb and bringing the car even closer to the regulation 990lb minimum weight.

The use of fuel-injection on the Mk III Climax engine highlighted a problem of air entering the system when the fuel tanks were nearly empty. Fuel sloshing around in the unbaffled tanks under acceleration, cornering and braking loads was momentarily uncovering the offtake. The easy answer was to carry additional fuel but the addition of weight was contrary to Chapman's philosophy. A rectangular fuel de-aerator was eventually devised and fitted in the cockpit where it served as a convenient rest for the driver's knee. The Lucas fuel pump for the injection system shared a tubular sub-frame beside the oil tank

Lotus 25: Monza 1963 and the first World Championship for Lotus and Jim Clark is around the next corner.

Lotus 25 chassis record – 1964-65 continued

Chassis no.	Engine	Entrant	GP	Driver	No.	Grid	Result
R4	Climax FWMV	Team Lotus	Monaco	P Arundell	11	Q6	3rd
			Holland	P Arundell	20	Q6	3rd
			Belgium	P Arundell	24	Q4	9th (overheating – lap 28/32)
			France	P Arundell	4	Q4	4th
			Britain	M Spence	2	Q13	9th
	Climax FWMV	Reg Parnell (Racing)	Austria	C Amon	16	Q17	Engine – lap 7/105
	BRM P56		Italy	M Hailwood	40	Q17	Engine – lap 5/78
			USA	C Amon	15	Q11	Starter motor – lap 47/110
			Mexico	C Amon	15	Q12	Gearbox – lap 46/65
R6	Climax FWMV	Team Lotus	Monaco	J Clark	12	Q1	4th – engine – lap 96/100
			Holland	J Clark	18	Q2	1st (FL)
			Belgium	J Clark	23	Q6	1st
			France	J Clark	2	Q1	Engine – lap 31/57
			Britain	J Clark	1	Q1	1st (FL)
			Germany	G Mitter	25	Q19	9th
			Italy	J Clark	8	Q4	Engine – lap 27/78
			USA	J Clark	1	Q1	Injection – lap 54/110 (FL)
			Mexico	M Spence	2	Q5	4th
R7	BRM P56	Reg Parnell (Racing)	Monaco	M Hailwood	18	Q15	6th
			Holland	M Hailwood	12	Q14	Transmission – lap 57/80
			France	M Hailwood	36	Q13	8th
			Britain	M Hailwood	14	Q12	Oil pipe – lap 17/80
			Germany	M Hailwood	15	Q13	Engine – lap 0/15
			USA	M Hailwood	14	Q16	8th – oil pipe – lap 101/110
			Mexico	M Hailwood	14	Q17	Overheating – lap 12/65
1965							
R3	BRM P56	Reg Parnell (Racing)	Monaco	R Attwood	15	Q6	Lost wheel – lap 43/100
			France	C Amon	24	Q8	Fuel feed – lap 20/40
			Britain	R Attwood	22	Q16	N/C 63 laps/80
			Holland	R Attwood	34	Q17	12th
			Germany	R Attwood	20	Q16	Engine – lap 8/15
			Italy	R Attwood	40	Q13	6th
			USA	R Attwood	21	Q16	10th
			Mexico	R Attwood	21	Q16	6th
R4	BRM P56	Reg Parnell (Racing)	S Africa	A Maggs	15	Q13	11th
			Belgium	R Attwood	23	Q13	Accident – lap 26/32
R6	Climax FWMV	Team Lotus	France	J Clark	6	Q1	1st (FL)
			Holland	M Spence	8	Q8	8th
			Germany	G Mitter	3	Q12	Water leak – lap 7/15
			Italy	'Geki'	28	Q20	Gearbox – lap 37/76
			USA	M Solana	18	Q17	N/C 95 laps/110
			Mexico	M Solana	18	Q9	Electrics – lap 55/65
R7	BRM P56	Reg Parnell (Racing)	Monaco	M Hailwood	16	Q12	Gearbox – lap 12/100
			Belgium	I Ireland	22	Q16	N/C 27 laps/32
			France	I Ireland	22	Q17	Gearbox – lap 18/40
			Britain	I Ireland	23	Q15	Engine – lap 41/80
			Holland	I Ireland	38	Q13	10th
			Germany	C Amon	19	Q15	Electrics – lap 2/15

monocoque chassis that would be stiffer, lighter and simpler to build. It was designed by Len Terry under Chapman's supervision and given the Lotus type number '33'.

The chassis continued the monocoque theme begun with the 25 by comprising two D-section boxed side-members linked by a stressed undertray forming the cockpit floor. The inner cockpit sides now converged from the seat-back all the way forward to the front bulkhead – on the 25 the cockpit sides had run parallel to each other between the seat back and scuttle, and were then kinked inwards towards the pedal area. This provided the 33 with a stiffer structure and more space for fuel tanks within the side-members. It was constructed in mainly 18swg aluminium sheet and lengthened by 3/4in within the wheelbase to take the latest flat-crank Climax FWMV engine.

The familiar rocker arm type front suspension was unchanged from the 25, and a higher geared steering rack was used to compensate for the smaller wheels. New rear uprights were manufactured with the top radius arm mounting point raised from hub height to the level of the upper transverse link. The lower radius arm chassis pick up point was located underneath the monocoque flank and the arm now formed part of an extremely wide-based wishbone with the lower reversed wishbone as the rearward element. This improved the distribution of braking and acceleration loads and minimised rear-wheel toe-in under suspension movement. These suspension modifications had been reflected in the 'B' version of the 25 prior to the 33 making its delayed GP debut.

On the transmission side, Chapman had persuaded ZF to revise the 5-speed gearbox with an internal selector gate, better lubrication and beefed-up output shafts. Modified Mercedes-Benz 220S sliding-spine drive shafts were adopted to transmit power to the wheels.

Lotus 33 specification

Engine:	Coventry Climax FWMV V8
Chassis:	'Bathtub'/open type monocoque comprising two D-section side-members running length of wheelbase of car, bridged by stressed undertray panel. Constructed from mainly 18swg aluminium alloy sheet, with fabricated steel bulkheads riveted into structure at front, rear and scuttle. Engine rigidly bolted into place as part of structure. 3 gallon oil tank, oil and coolant radiators mounted on light outrigger frame attached to front bulkhead with steering rack, anti-roll bar, brake and clutch master cylinders.
Transmission:	ZF 5DS10 5-speed.
Fuel tanks:	Aircraft type rubberised bag tanks within each side-member and in wedge shaped cavity between engine and driver's reclining seat back, capacity 28 gallons (approx.). Supplementary fabricated light alloy tank of 5 1/2 gallons above driver's legs, as required.
Suspension:	Front: narrow-based, fabricated upper wishbone pivoting front bulkhead and acting on combined coil spring/damper unit mounted within bodywork. Lotus cast electron front upright. Fabricated wide-based tubular lower wishbone. Anti-roll bar. Rear: single upper link and long, low-mounted reversed wishbone pivoting almost on chassis centre line beneath gearbox. Cast alloy hub carrier located by twin parallel radius arms picking up from seat-back bulkhead. Combined coil spring/damper units and anti-roll bar.
Brakes:	Girling discs mounted outboard, 11 1/2in diameter front and rear.
Wheels:	Lotus 6-spoke cast magnesium alloy, bolt on, 13in diameter.
Dimensions:	Wheelbase 7ft 7 3/4in; track 4ft 4in front, 4ft 5 1/4in rear.

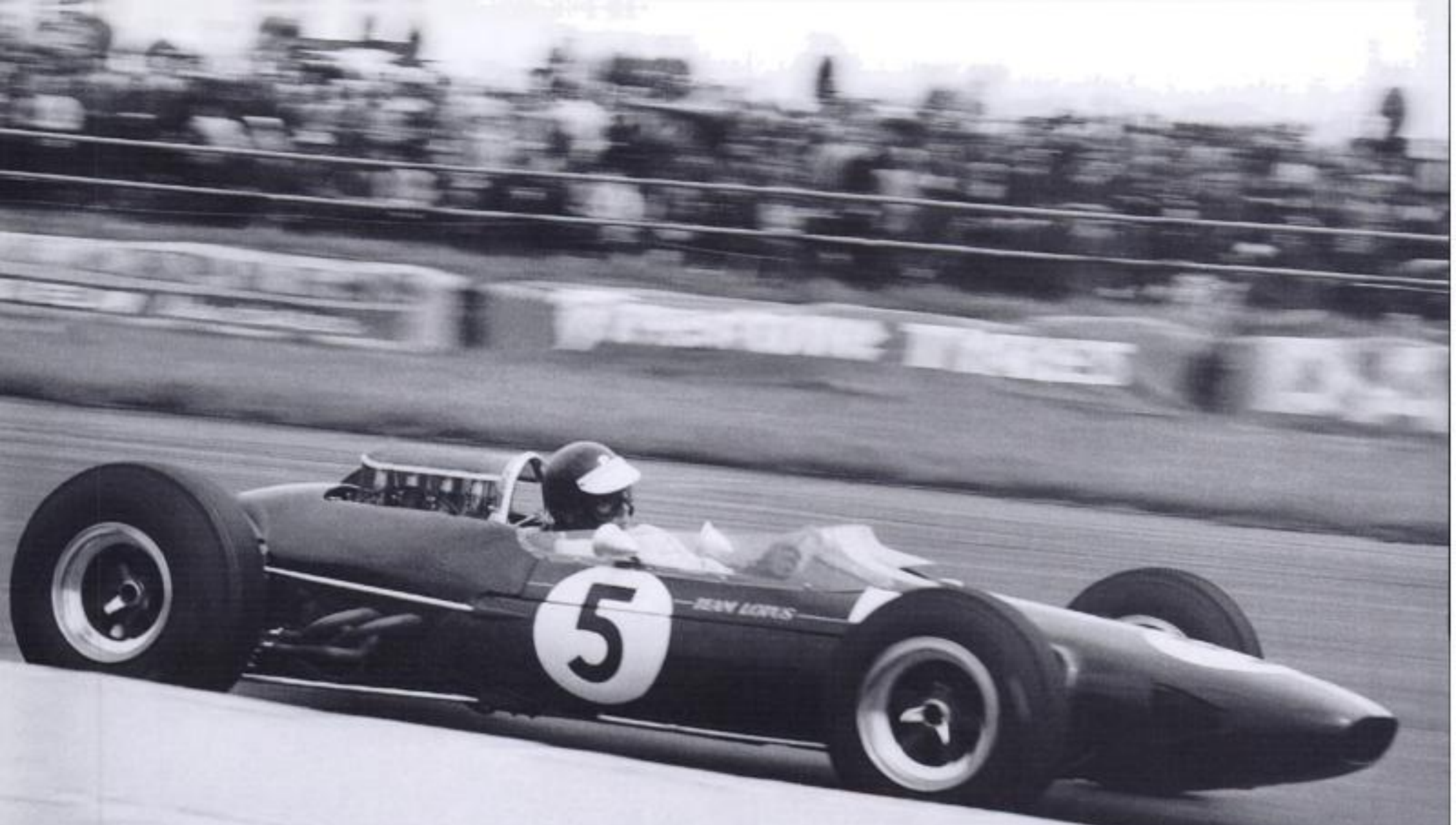
Performance – 1964

The new chassis debuted in the hands of Jim Clark in the non-Championship Aintree 200 in April 1964. While battling for the lead, Clark was tripped by a back marker being lapped and the chassis was extensively damaged in the ensuing accident. Clark tried it in rebuilt form in practice at Spa and a number of subsequent GPs but was never happy with it and did not race it again himself. A second 33 was ready in August and both chassis were campaigned over the remainder of the season. This coincided with a downturn in Team Lotus fortunes, a bout of reliability problems putting paid to both Lotus' and Clark's Championship hopes. Never more so than in Mexico where Clark had his Championship aspirations drain away in an engine oil leak on the last lap.

Development and performance – 1965

Only detail improvements were made to the Lotus 33 chassis for 1965. Problems had been encountered during the closing stages of a race when the fuel level was low enough to surge away from the pickups, letting air into the system and causing the engine to cut out. This was overcome with a collector pot fitted in the seat tank, into which the main side tanks drained. A one-way valve in the collector ensured that fuel remained in it, sufficient to maintain supply during surge situations. Occasional fuel vaporisation problems were eliminated by linking the fuel tank collector with the Lucas pump mounted ahead of the radiator and the engine via a large bore external fuel pipe. Another heat problem centred on the ingestion of hot air from the engine into its air intakes. A tighter fitting engine cover solved this, leaving the air intakes exposed above it in cool air and protected by a gauze cover.

Wheel rim widths increased progressively over the season as advantage was taken of the wide tread Dunlop tyres. The wheels were converted to knock-off hubs when Dunlop introduced wet



Lotus 33: Jim Clark wins again, this time the 1965 British GP.

and dry tyres that could not be used in the opposing conditions. This incurred a weight penalty of only ½lb per wheel. By the season end, rim widths were 8in at the front and 9½in at the rear. Improvements to aerodynamics for the fast Monza circuit gave an extra 4mph in straight-line speed. These included the covering of the external water pipes, hose clips, etc. on the underside of the chassis. The nose was shortened slightly with an increased radius on the air intake lip and the hot air outlet improved.

After a shaky start in 1964, the 33 exonerated itself fully in 1965 by accounting for 5 of the 6 GP wins achieved by Jim Clark and Lotus in this final season of 1½-litre F1 to clinch their second Drivers' and Constructors' Championships.

Lotus 33 chassis record – 1964-65

Such was the close relationship between the 25 and the 33 that the former's chassis numbering sequence was continued from R8 for the first of two chassis built during 1964. Five 33 chassis were built, together with one built up by the Parnell team, of which:

R8 – first chassis sold to Porsche privateer Dickie Stoop and entered in name of DW Racing Enterprises for 1965, running alongside its Brabham BT11. Paul Hawkins distinguished himself by putting this chassis into the harbour during the Monaco GP.

R10 – written-off in an uncharacteristic error by Jim Clark under pressure from Dan Gurney during the non-Championship 1965 Race of Champions at Brands Hatch.

R12 – a special one-off chassis built to take the flat-16 Coventry Climax FWMW engine that never materialised, hence it was unraced in 1965 GP season.

R13 – quasi-33 built up from the remains of 25 chassis R4 but taking Lotus chassis number R13. As with all the Parnell team cars, it was fitted with a BRM V8 engine and Hewland gearbox.

Porsche

In the period immediately following World War II, Europe suffered from a severe shortage of cars and any reasonable policy for a new manufacturer to the market would have been to produce a cheap and simple 4-door saloon. Not so for the recently formed Porsche company from its base in an old sawmill at Gmünd,

Austria where 'Ferry' Porsche had designed and built the type of car that he wanted. The result was the Porsche 356, a sporting car, the first prototype of which appeared in 1948. Even though this was the first car to carry the Porsche name, it was descended from a distinguished line of sporting and racing cars designed by Ferry's father, Dr Ferdinand Porsche, including the Mercedes-Benz SSK and the rear-engined V16 Auto Union GP cars of 1934-37. Immediately prior to the war, Dr Porsche had been developing the VolksWagen 'Beetle', and it was the basic running gear of this in production form that was used as the basis of the first Porsche.

Porsche was an ardent believer in the value of racing as a means of improving the breed of road cars, and it was inevitable that Porsches would be used in competition. Through the 1950s, the Porsche type 550 and then the 718 RSK sports racing cars became regular winners of their class at Le Mans and other endurance events, and were even in a position to challenge for overall wins in some events despite engine capacities of only 1600cc. In 1957, a new 1½-litre F2 category was introduced and aroused the interest of competitions director Huschke von Hanstein as another outlet for Porsche racing aspirations. He had a number of type 550 and 718 sports racers converted to centre-seat F2 form, retaining the fully enclosed sports car bodywork. In this form they achieved wins in the F2 section of the 1957 German GP and the 1958 French GP F2 support feature at Reims. Encouraged by this success, Ferry Porsche authorised a low-key development program to produce a purpose-built single-seater for 1959 with a longer term view of entering F1 when that formula adopted a 1½-litre engine capacity limit in 1961. It was important to Porsche that the new single-seater remained faithful to the original concept carried over from the 1948 prototype of a 4-cylinder, horizontally-opposed, air-cooled engine mounted in the rear of the chassis.

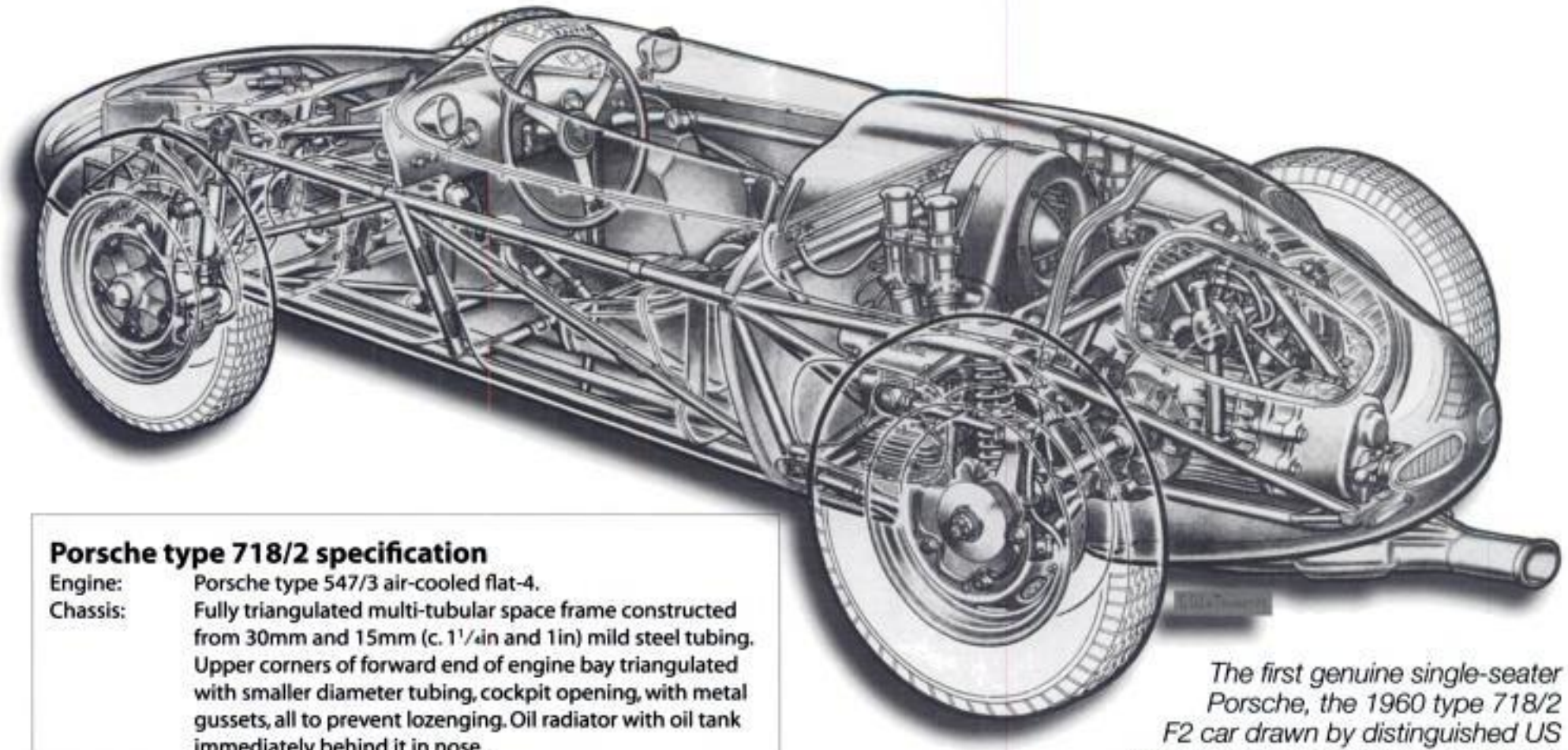
The car was constructed over the winter of 1958/59 but such was the nature of the development programme, that it was not allocated a unique project number, simply being recorded as type 718/2 – an extension of the 718 RSK sports racer project. The chassis was a well-triangulated space frame, necessarily wider than typical British chassis to allow the engine to slip down between the main chassis members. Track and wheelbase dimensions were identical to the type 718 RSK with the suspension also based on that model. Porsche's well tried, VW-derived trailing links with torsion bars featured at the front, while a double wishbone and coil spring layout at the rear achieved a wheel geometry in between a true wishbone and swing-axle type of layout. The engine was the familiar, well-proven air-cooled flat-4 mated to a new 6-speed transmission.

Porsche's new single-seater made its first public appearance in practice for the 1959 Monaco GP where Wolfgang von Trips easily qualified it for the race. An assessment of the full potential of the car could not be made, however, as von Trips spun out on the second lap, collecting the other two F2 entries and severely damaging the Porsche. Busy with its sports car programme, Porsche did not rebuild the chassis until after Le Mans in June. It was prepared for the Reims coupe de Vitesse F2 race where it finished third, somewhat disappointingly, due to an aerodynamic problem creating an unusually high-pressure area around the carburettor intakes and starving them of air. A re-profiled tail section and changes to the internal air flow rectified this and, at the same time, the pristine aluminium body panels received their first coat of paint. The car was then entered for the Kentish 100 at Brands Hatch to assess its competitiveness on a twisty circuit against the British F2 stalwarts. It came away with an aggregate fourth in the hands of Jo Bonnier. Stirling Moss was offered a test drive in the car at Goodwood where he was able to better his fastest time in a Cooper. As a result, von Hanstein offered Moss the loan of a works car for the 1960 F2 season to be prepared and entered by Rob Walker.

PORSCHE TYPE 718/2

Spurred on at having obtained the services of the leading driver of the time, the Porsche F2 programme attained the level of priority it deserved. An improved chassis design was developed over the winter, the first of which adopted the 1959 car's chassis number of 718/2-01. The front suspension trailing links had been straightened from the 1959 chassis to provide better clearance between the wheels and body, and the wheelbase was 4in longer than the prototype, allowing more cockpit space and larger fuel tanks. Over the course of 12 races entered during the 1960 season, Porsche scored six wins, five seconds and five thirds, jointly winning the F2 Constructors' Championship with Cooper. By mid-1960, Porsche had committed itself to its ambition of entering the new 1½-litre F1 in 1961 and work was underway on an all-new air-cooled flat-8 engine to be installed in a new chassis. While the engine was not expected to be seen until mid-season, the new chassis would be fitted with the familiar flat-4 engine to make Porsche's official GP debut. In the meantime, the 718/2 chassis would be updated to 1961 F1 specification.

Contrary to the norm for the time, Porsche retained drum brakes, these being mounted outboard, with finned magnesium alloy drums to reduce unsprung weight and assist cooling. The 6-speed gearbox was retained but with a redesigned linkage in response to complaints from drivers, including Stirling Moss, who had found it to be too imprecise. While the bodywork was much improved on the prototype, it was never described as being low and sleek, the popular description being 'podgy'. New for 1961 was the sealing off of the carburettor intakes from the engine bay to ensure that they drew in only cool air. Brought up to 1961 F1 specification with on-board starter and roll-over bar, the 718/2 weighed in at some 64lb over the minimum.



The first genuine single-seater Porsche, the 1960 type 718/2 F2 car drawn by distinguished US cutaway artist Clarence O LaTourette for Sports Cars Illustrated *(subsequently* Car & Driver*). Updated to 1961 F1 regulations, the 718 proved to be extremely reliable and would continue to race through into 1964 under the banner of Ecurie Maarsbergen.*

Porsche type 718/2 specification

Engine:	Porsche type 547/3 air-cooled flat-4.
Chassis:	Fully triangulated multi-tubular space frame constructed from 30mm and 15mm (c. 1¼in and 1in) mild steel tubing. Upper corners of forward end of engine bay triangulated with smaller diameter tubing, cockpit opening, with metal gussets, all to prevent lozenging. Oil radiator with oil tank immediately behind it in nose.
Transmission:	Porsche type 718 6-speed.
Fuel tanks:	Fabricated aluminium alloy fuel tanks fitted within chassis on either side of driver. Capacity approximately 30 gallons.
Suspension:	Front: VW-derived trailing links with torsion bars and telescopic dampers. Rear: wide-based and angle pivoted wishbones; lower wishbone reversed and located by radius arm picking up at seat-back bulkhead. Combined coil spring/damper units.
Brakes:	Porsche two leading shoe type drum brakes, 11in diameter, mounted outboard.
Wheels:	Porsche cast magnesium alloy, bolt on, 15in diameter.
Dimensions:	Wheelbase 2200mm (7ft 2.6in); track 1290mm (4ft 2.8in) front and rear.
Weight:	479kg (1056lb).

Development and performance – 1961

Porsche had built five chassis during 1960, and each of these would race at least once in a 1961 GP including chassis 01, the ex-Moss/Rob Walker chassis sold to Dutchman Count Carel Godin de Beaufort and entered in the name of his Ecurie Maarsbergen. Porsche made its GP debut at Monaco with two 718/2chassis and the first of the 1961, type 787 chassis. All three cars were powered by the flat-4 fitted with Kugelfischer fuel-injection in place of the traditional Weber carburettors. Dan Gurney took his car through to fifth place and Porsche's first Constructors' Championship points. Hans Herrmann finished ninth, driving a chassis modified over the winter to take a double wishbone and coil spring front suspension in place of the VW-derived trailing links. This layout gave a higher roll centre, the opportunity for better wheel control in cornering and a softer suspension.

The new 787 chassis were set aside following their poor performance and reliance was placed exclusively on the 718/2 for the remainder of the season. It was also apparent that the fuel-injected engine was no match for even the Climax FPF, and it too was set aside. Jo Bonnier and Dan Gurney faced the remainder of the season with out-of-date cars and yet Gurney managed to score three second places, including one at Reims where he had lost a magnificent slipstreaming duel to Baghetti's Ferrari. Bonnier did less well with only a fifth as his best placing. At the German GP, Gurney's chassis (03) was adapted to take Porsche-designed disc brakes being developed on the 787 chassis and in need of race mileage.

Despite the disappointing start, sufficient points were

Porsche 718/2: Dan Gurney on a reliable run to second in the 1961 Italian GP.

accumulated to place Porsche third in the Constructors' Championship behind Ferrari and Lotus. Above all, Porsche's reliability record was enviable with 19 finishes from 22 starts.

Performance – 1962-64

Porsche put its faith in the new flat-8 car for 1962 and the 718/2 cars were sold off. Godin de Beaufort sold 01 to Wolfgang Seidel but then re-purchased it in time to compete in the new season. He was rewarded with Championship points on two occasions, one of them being in his home GP. Later in the year he purchased 02 from Swiss Heinz Schiller, who had driven it in the German GP, as a source of spare parts but actually raced it in South Africa. Chassis 03 was purchased by Count Giovanni Volpi's Scuderia SSS Republica di Venezia and re-sprayed red. It was borrowed by

Porsche 718/2 chassis record – 1961-64

Chassis no.	Engine	Entrant	GP	Driver	No.	Grid	Result
1961							
01	Porsche 547/3	Ecurie Maarsbergen	Holland	G de Beaufort	8	Q15	14th
			Belgium	G de Beaufort	22	Q14	11th
			France	G de Beaufort	14	Q17	Engine – lap 23/52
			Britain	G de Beaufort	56	Q18	16th
			Germany	G de Beaufort	31	Q17	14th
			Italy	G de Beaufort	74	Q15	7th
02	Porsche 547/3	Dr Ing hc F Porsche KG	Germany	H Herrmann	11	Q11	13th
03	Porsche 547/3	Dr Ing hc F Porsche KG	Belgium	D Gurney	20	Q10	6th
			France	J Bonnier	10	Q13	7th
			Britain	J Bonnier	8	Q3	5th
			Germany	D Gurney	9	Q7	7th
			Italy	D Gurney	46	Q12	2nd
			USA	D Gurney	12	Q7	2nd
04	Porsche 547/3	Dr Ing hc F Porsche KG	Monaco	D Gurney	4	Q10	5th
			Belgium	J Bonnier	18	Q9	7th
			France	D Gurney	12	Q9	2nd
			Britain	D Gurney	10	Q12	7th
			Germany	J Bonnier	8	Q4	Engine – lap 5/15
			Italy	J Bonnier	44	Q8	Rear suspension – lap 15/43
			USA	J Bonnier	11	Q10	6th
05	Porsche 547/3	Dr Ing hc F Porsche KG	Monaco	H Herrmann	6	Q12	9th
		Ecurie Maarsbergen	Holland	H Herrmann	9	Q12	15th
1962							
01	Porsche 547/3	Ecurie Maarsbergen	Holland	G de Beaufort	14	Q14	6th
			Monaco	G de Beaufort	44		DNQ
			Belgium	G de Beaufort	7	Q13	7th
			France	G de Beaufort	38	Q17	6th
			Britain	G de Beaufort	54	Q17	14th

the 1½-litre F1, Porsche set about designing a new chassis, given the unique type number 787, that would be a development of the 718/2 series. As the new engine would not be ready until late into the 1961 season, the new chassis would take the 547/3 flat-4 in the meantime.

A significant change was made to the front suspension of the chassis. For the first time on a Porsche, the VW-derived trailing links and torsion bars had been discarded in favour of an orthodox double wishbone and coil spring layout that would provide both greater wheel movement and a softer suspension. It was orthodox in that it comprised short upper and longer lower wishbones, although the upper forward arms were curved. The combined coil spring/damper units were mounted conventionally between the arms of the wishbones. This layout had been tested and developed on 718/2 chassis 05 prior to being adopted for the 787.

Porsche type 787 specification – as for type 718/2 except:

Suspension:	Front: fabricated unequal length tubular wishbones with combined coil spring/damper units. Rear: wide-based and angle pivoted wishbones; lower ishbone reversed and located by radius arm picking up at seat-back bulkhead. Combined coil spring/damper units.
Brakes:	Experimental: Porsche designed disc brakes mounted outboard.
Dimensions:	Wheelbase 2300mm (7ft 6.5in); track 1300mm (4ft 3.2in) front, 1290mm (4ft 2.8in) rear.

Porsche 787 chassis record – 1961-62

Chassis no.	Engine	Entrant	GP	Driver	No.	Grid	Result
1961							
01	Porsche 547/3	Dr Ing hc F Porsche KG	Monaco	J Bonnier	2	Q9	Fuel-injection drive lap 59/100
			Holland	D Gurney	7	Q6	10th
02	Porsche 547/3	Dr Ing hc F Porsche KG	Holland	J Bonnier	6	Q11	11th
1962							
02	Porsche 547/3	Ecurie Maarsbergen	Holland	B Pon	15	Q18	Accident – lap 2/80

The rear suspension was identical to the 718/2, as were the two leading shoe type drum brakes. Even at Porsche, however, drum brakes were on their way out. Experimental Porsche-designed discs were fitted to chassis 02 and race-tested in the non-Championship Solitude GP in July, following which Dan Gurney's 718/2 was quickly adapted to take them and continue race development. The disc was suspended on a light alloy spider drum with the two-piece calliper assembly on the inside. This was claimed to provide a lighter assembly and better dissipate heat.

The wheelbase was longer by 100mm (4in) than the 718/2 in the engine bay to provide space for the forthcoming flat-8. Front track was increased by 10mm (0.4in).

Performance/chassis record

The first chassis was completed in April and fitted with the flat-4 type 547/3 engine with Kugelfischer fuel-injection. Driven by Jo Bonnier at Monaco, it ran as high as second before a fuel-injection problem cut the engine. The second chassis was ready for the Dutch GP at Zandvoort, always a good test of race car handling. Both cars failed dismally, not only had they handled diabolically but the engines had lacked the performance to compete with their Climax-engined rivals, let alone the Ferrari V6s.

Porsche took the dismal performance hard and Ferry Porsche decided that the 787 should be set aside in favour of the 718/2 until the flat-8 engine was ready. As mentioned, 02 was used to test experimental Porsche disc brakes and 01 for occasional engine testing. As a postscript, 02 was lent to Godin de Beaufort's Ecurie Maarsbergen for the 1962 Dutch GP only for fellow Dutchman Ben Pon to spin off after 2 laps and bend it. With that, the short and dramatically unsuccessful career of the type 787 ended, although the two chassis were not finally scrapped until 1964.

PORSCHE TYPE 804

Porsche was unique amongst the 1962 F1 constructors in racing an air-cooled engine with horizontally-opposed cylinders while all its competitors' engines were water cooled with cylinders in a vee formation. In chassis terms, Porsche was also unique in using torsion bars in its suspension, in place of coil springs, and its own design of disc brake. Following the failure of the first 8-cylinder type 787 chassis in 1961, Porsche designed a new chassis for the 1962 season, type numbered 804. Once again there was a plan to race this with the 4-cylinder engine if the new flat-8 was not considered raceworthy.

The multi-tubular space frame was necessarily wider than the typical British chassis to allow the wider horizontally-opposed engine to slip down between main longitudinal chassis members. While the lower main longitudinal members ran parallel to each other from front to rear, the upper members were wider apart at the rear of the cockpit than at the front bulkhead. This made triangulation of the cockpit sides and the engine bay more complex than in a frame designed for a V engine. Bare weight of the frame was 84lb.

The front suspension followed the trend set by Colin Chapman with a narrow-based upper wishbone pivoting on the

Porsche 804: the new car (this is Gurney's chassis 02) arrived at Zandvoort for the 1962 Dutch GP unannounced and, had it not shown any promise in practice, would have returned to the factory unraced.

now entered in the name of Porsche System Engineering. Their arrival aroused some surprise as the motoring press had expected to see the new chassis but powered by the flat-4. Under strict instructions from Ferry Porsche, the team was to return to its Zuffenhausen base if the cars did not run competitively in practice. Dan Gurney managed a lap nearly 2sec quicker than his 1961 time, although 2sec slower than the pole time for a place on the third row of the grid. The team was allowed to race but Ferry Porsche was not impressed by Gurney's retirement from the race with a broken gearchange and Bonnier's seventh place.

An entry for the Monaco GP was not contemplated until Gurney was able to persuade Ferry Porsche to allow a single entry. Unfortunately, it all came to naught when Dan was rammed from behind in the first corner shunt and the car was too badly damaged to continue. The Belgian GP was forgone in favour of further development work back at base, and Ferry Porsche set a performance target of completion of a full GP distance around the Nürburgring, without problem, before any further GP entries were contemplated. Gurney's enthusiasm was stimulating the team and he underlined this by achieving the target with an average lap time well within the existing lap record. The chassis had required additional diagonal stiffening in the engine bay and cockpit sides following the car's first race at Zandvoort, where roadholding had proved to be less than satisfactory. The front suspension was strengthened with an upper radius arm to feed loads into the scuttle bulkhead and the rear track widened by

By this time, Powell had lost interest in the venture and returned to the US, never to reappear, and leaving behind accumulated debts for which, it transpired, he was not legally liable by virtue of being under age. The team folded and Tim Parnell purchased the cars. Maybe with testing and development, and with a young and talented driver, something could have been achieved.

Performance – 1964

Chassis SP-2-63 was run by Tim Parnell for the Belgian veteran André Pilette in the name of Equipe Scirocco Belge. The Reg Parnell (Racing) mechanics installed a Climax FWMV engine in place of the BRM unit and the body sprayed Belgian racing yellow. Two 1964 GPs were entered although only one start was made, that being in his home GP in which he failed to finish.

The Scirocco GP car was not seen again.

Stebro

The Stebro was a Canadian-built Formula Junior car. The Mk IV version comprised a low built multi-tubular space frame with conventional, Lotus type suspension – double wishbones at the front and a single upper link, reversed lower wishbone with twin parallel radius arms at the rear, and combined coil spring/damper units at each corner.

Fitted with a 1500cc pushrod ohv Ford 105E engine producing approximately 110bhp on two twin choke Weber carburettors, two cars were entered for the 1963 US GP at Watkins Glen. Only one example materialised on race day, driven by Peter Broeker who qualified last, 15sec off the pace, having distinguished himself by leaving an oil slick on the circuit. The first Canadian entry for a World Championship GP trundled around in the race to finish 22 laps behind winner Graham Hill, too far behind to be classified.

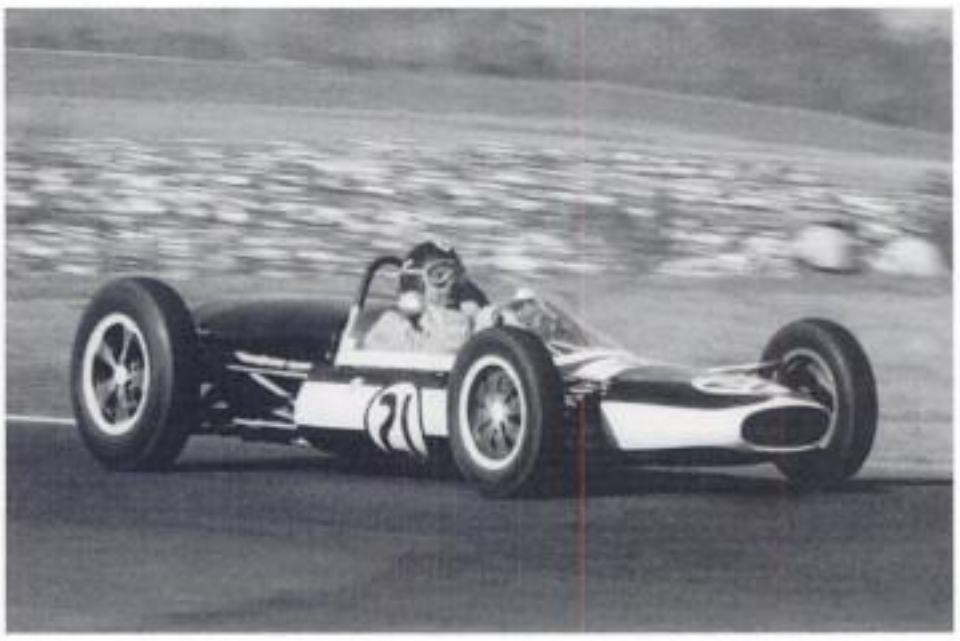
In 1964, Broeker brought a Mk V version of the Stebro to Europe to run in the new 1-litre F2 category. It proved to be equally uncompetitive and after only a couple of appearances it returned home to Canada.

Summary of all F1 chassis performance 1961-65

	Chassis	Starts	Finishes	1st	2nd	3rd	4th	5th	6th	Gross points	PP	FL
1.	Lotus	255	114	22	2	6	9	6	10	252	25	23
2.	BRM	120	82	11	17	9	10	10	4	220	8	8
3.	Ferrari	109	69	9	12	14	9	6	4	177	9	10
4.	Brabham	129	62	2	5	9	9	4	7	109	2	5
5.	Cooper	161	85	1	6	8	6	12	12	111	1	2
6.	Porsche	60	44	1	3	1	1	4	7	47	1	-
7.	Honda	17	5	1	-	-	-	1	2	11	-	-
8.	Lola	28	11	-	2	-	1	2	-	19	1	-
9.	BRP	18	10	-	-	-	2	2	1	11	-	-
	Alfa Special	2	1									
	ATS	10	1									
	Derrington-Francis	1	-									
	de Tomaso	4	-									
	Emeryson	3	1									
	ENB	1	1									
	Ferguson	1	-									
	Gilby	3	1									
	JBW	1	-									
	LDS	4	1									
	Scirocco	7	-									
	Stebro	1	-									

Stebro Mk IV chassis record – 1963

Chassis no.	Engine	Entrant	GP	Driver	No.	Grid	Result
-	Ford 105E	Canadian Stebro Racing	USA	P Broeker	21	Q21	N/C 88 laps/110



Stebro: Peter Broeker takes the FJ-based car to an unclassified finish at Watkins Glen 1963.

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Alfa Romeo

At a glance:	Alfa Romeo Giulietta
Cylinders:	4 in line
Stroke/bore ratio:	0.97:1
Carburetion:	2 t/c Weber carburettors
No. of valves:	2 per cylinder
Piston area:	196.1cm²
Max. power:	140bhp @ 6500rpm
Bhp per litre:	93.3

Although Alfa Romeo had had a long and distinguished history in GP racing, the use of its engines within the 1½-litre F1 was on a purely amateur basis. The Alfa Romeo Giulietta series of saloons and coupés were powered by a 4-cylinder, twin overhead camshaft engine of 1290cc with aluminium cylinder head and block, and five main bearing crankshaft. In Sprint Veloce form it developed 90bhp at 6500rpm and was a favourite within Italian racing circles for tuning and improving to obtain up to 115bhp. Well-known Alfa tuner Conrero enlarged the engine close to 1500cc and fitted a modified cylinder head with twin plugs per cylinder. In this form it was useful in Italian club racing but, when fitted in a de Tomaso chassis, it was hardly likely to be effective in F1. Two such entries were made in 1961, one each from Scuderia Serenissima and Scuderia de Tomaso itself, but both resulted in retirements due to engine failure.

The engine was very popular in South Africa where a number of special builders installed it in their own chassis to compete in the Gold Star Championship that catered for 4-cylinder, 1½-litre single-seaters. Typically the bore would be increased by 5mm to 74mm and the stroke lengthened by 1.5mm to 76.5mm and, in suitably tuned form, it could develop about 140bhp. When the South African GP came around, many Gold Star competitors would attempt to qualify their Alfa-engined chassis for the race. Those who competed included Doug Serrurier with his own LDS series of chassis, one of which finished 11th in 1963, and Piet de Klerk whose 'Alfa' Special finished 10th in 1965.

Alfa Romeo 'Guilietta' 4-cylinder performance summary

Year	Starts	Finishes	Engine related failures	1st	2nd	3rd	4th	5th	6th	PP	FL
1961-63 & 1965	8	2	3	-	-	-	-	-	-	-	-

ATS (Automobili Tourismo e Sport)

During his time at Ferrari, Carlo Chiti had worked on and developed Jano's Dino V6 series of engines. His appointment to ATS gave him the opportunity to design a new 1½-litre engine starting with a clean sheet of paper. His energy and capacity for working long hours enabled him to have the new engine up, running and installed in a new chassis within ten months of formation of the company.

ATS T100 V8

Design

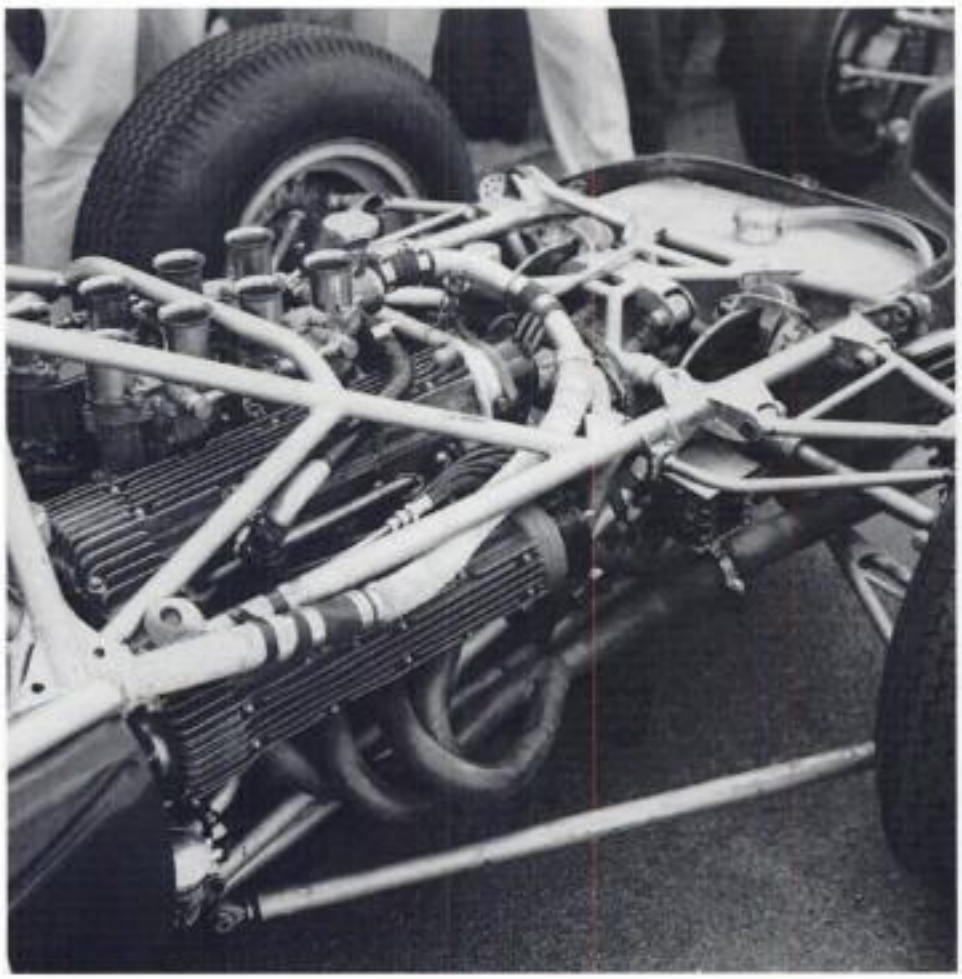
Chiti decided on a 90° V8 engine with bore and stroke dimensions of 66mm by 54.6mm. Twin overhead camshafts per cylinder bank ran in three bearings and were driven by a double chain from the crankshaft. Valve sizes were 32mm for the inlet and 28mm for the exhaust, both closed by triple helical springs. Twin coils and Marelli distributors driven off the rear of the inlet camshaft powered twin spark plugs per cylinder. Induction was via four twin choke Weber 40IDM carburettors and the claimed output was 190bhp at 10,500rpm on a compression ratio of 10 to 1. Maximum torque was claimed at 115.7lb/ft at 8700rpm.

At a glance:	ATS T100
Cylinders:	90° V8
Stroke/bore ratio:	0.83:1
Carburetion:	4 t/c Weber carburettors
No. of valves:	2 per cylinder
Piston area:	273.8 cm²
Max. power:	190bhp @ 10,500rpm
Bhp per litre:	126.7

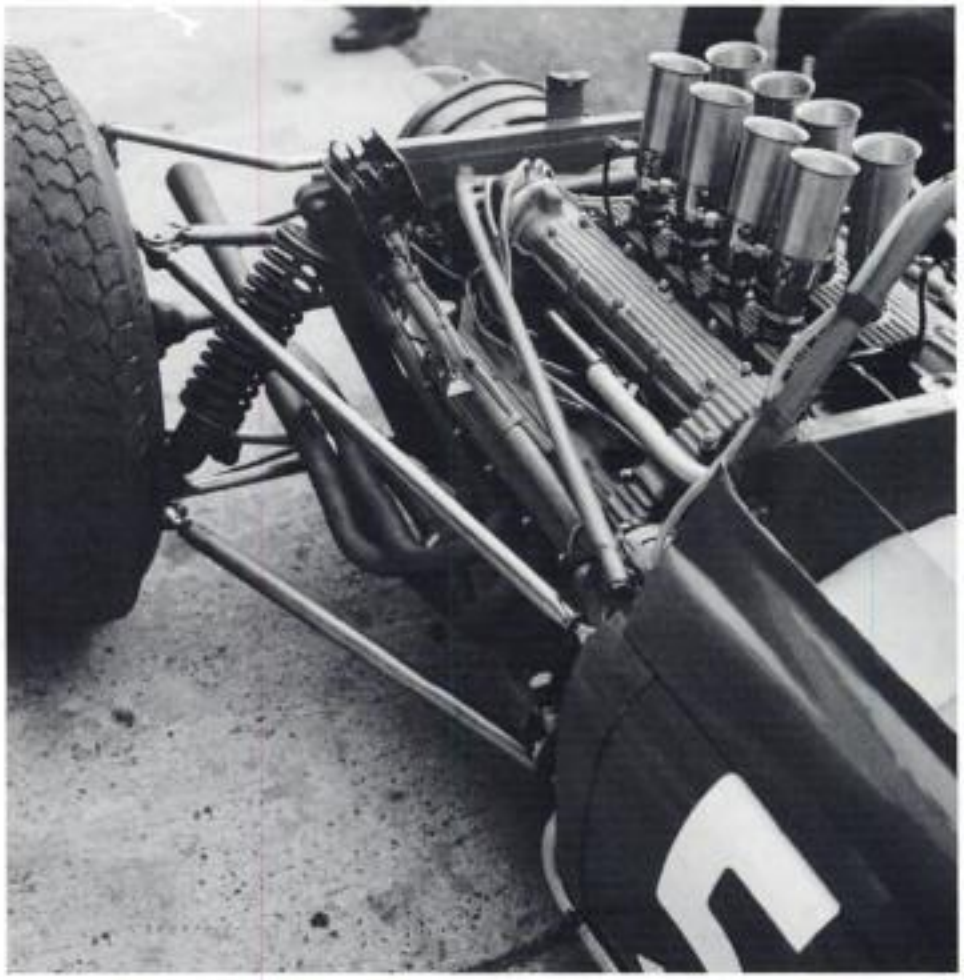
Future development proposed for the engine included replacement of the ignition system with a Lucas transistorised system and the carburettors with Lucas fuel-injection. Fuel-injection actually appeared on the engines for a single GP but without any discernable improvement in performance.

Performance – 1963

The engine is reported to have sounded glorious but its performance on track did not support the claimed power output. In an abbreviated season of five GPs, the cars were well off the pace and usually eliminated by engine-related problems, a performance that sealed the fate of ATS, and by the end of the year the company had folded. In 1964, Stirling Moss' former mechanic Alf Francis attempted to do something with the remains of ATS, fitting the engine with Lucas fuel-injection and



ATS T100: as seen on its debut at Spa in 1963, complete with engine bay cross-bracing welded in above it.



The tidier-looking V8 with Lucas fuel-injection during its one-off 1964 appearance in the Derrington-Francis chassis at Monza.

claiming a power output of 200bhp at 11,000rpm. Installed in a new chassis built by Francis, the combination made a single appearance at the 1964 Italian GP but retired from the tail of the field with ignition problems before half distance.

ATS T100 V8 performance summary

Year	Starts	Finishes	Engine related failures	1st	2nd	3rd	4th	5th	6th	PP	FL
1963-64	11	1	5	-	-	-	-	-	-	-	-

BRM

Between 1946 and 1960, BRM had produced and raced two quite different engines. The first was a highly complex, two-stage supercharged 1½-litre V16 and the second a 2½-litre normally aspirated 4-cylinder with a very large bore/stroke ratio, but both failed to achieve expectations, though for different reasons. A great deal of work went into development of the V16 but it still produced all of its power at high revolutions and had little mid-range torque. The extremely large valves of the 4-cylinder engine contributed to a high reciprocating weight resulting in a valve gear that was always unreliable and prone to frequent valve spring failures.

In designing a new engine for the 1½-litre F1, BRM set out to produce a more conventional engine, although designer Peter Berthon would draw on experience gained with the previous engines and a number of mechanical components would be carried over from the V16. Part of the thinking behind the new engine was a requirement to produce it in sufficient numbers to satisfy a perceived customer demand. BRM had never produced engines for sale but the success achieved by Coventry Climax in doing just that had not gone unnoticed by the board of the Owen Organisation, BRM's parent company. A return on parent company investment in the new engine would not go amiss.

BRM P56 V8

Design and development

The new engine, given BRM project number 56, was conceived by Peter Berthon with contributions from Amherst Villiers and Aubrey Woods, and would be developed into race-winning form by technical director Tony Rudd. The general layout was decided upon by August 1960 and drawings completed in November. The resulting engine was a conventional 90° V8 with a bore and stroke of 68.5mm by 50.8mm, designed to produce its power at the relatively high crankshaft speed for the time of 11,000rpm, with the ability to run up to 13,000rpm without damaging the valve gear.

At a glance: BRM P56

Cylinders:	90° V8
Stroke/bore ratio:	0.74:1
Carburetion:	Lucas fuel-injection
No. of valves:	2 per cylinder
Piston area:	294.9 cm²
Max. power:	220bhp @ 11,750rpm (1965)
Bhp per litre:	146.7

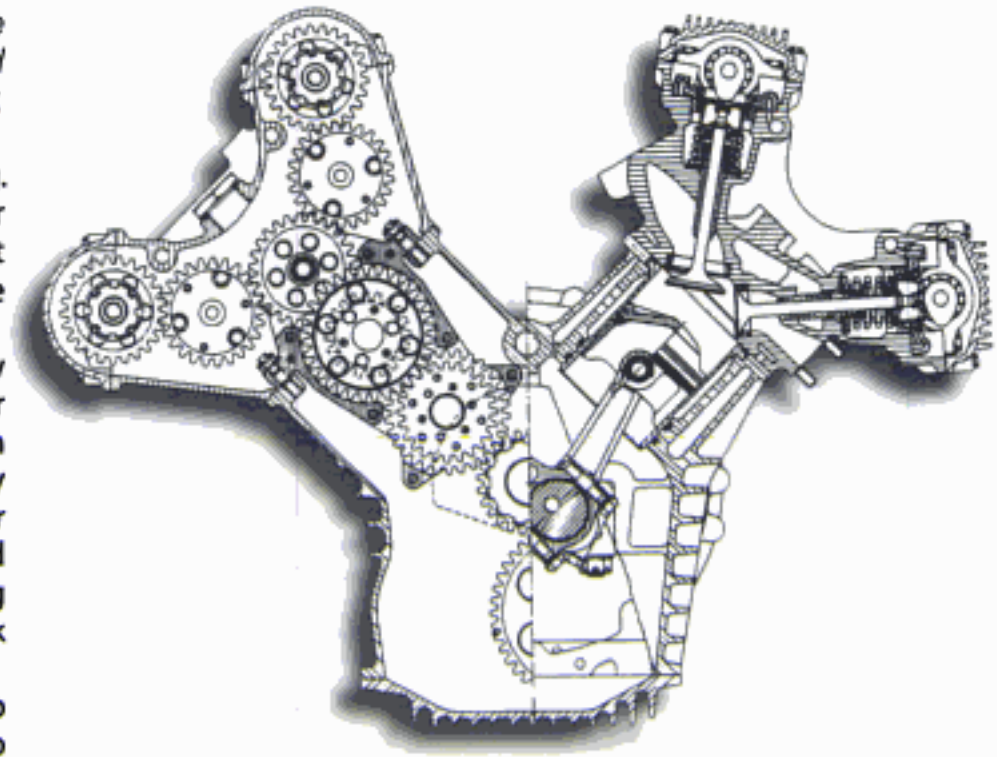
The combined crankcase/cylinder block and cylinder heads were cast in LM8 aluminium alloy with a separate magnesium alloy sump. Compression type wet cylinder liners were retained by a top flange with two rubber rings at the bottom end for coolant sealing. This allowed them axial freedom for changes in working temperature, with a Cooper Nimonic gasket ring at the top end for gas sealing.

The two-plane crankshaft was machined from nitrided EN40U alloy steel and ran in five main bearings of 2½in width with opposing piston assemblies sharing common big-end journals of 1.6in width. No effort was made to eliminate the primary cross shaking forces inherent with this configuration of crankshaft – normally achieved by making the two outer counterweights heavier than the intermediate ones. With a stroke dimension close to that of the V16, it seemed convenient to use the same connecting rods, as they should have been less stressed in a normally aspirated application. This proved not to be the case, however, as the heavier piston of the V8 resulted in big-end bolt failures during testing at Monza in September 1961. These were replaced by rods with a stud fixing and eventually by a design with a set bolt. Initially die cast pistons were used with one compression ring and a two-piece oil control ring. In late 1962 revised, forged pistons with a different profile were introduced to improve combustion chamber efficiency.

Twin overhead camshafts per cylinder bank ran in five roller bearings and opened the two valves per cylinder via inverted tappets, closure being by double coil springs. The inlet valves were inclined at 45° to the bore axis with the exhausts at 30°, giving a total included angle of 75°. Valve sizes were 1.56in for the inlet and 1.20in for the exhaust. Gear clusters drove the camshafts from a pinion on the crankshaft, each cluster easily removable, as in the V16. A second drive powered the oil pressure pump, formed integrally with the front cover on the right-hand side of the engine, and the oil scavenge pump located beneath the second main bearing. The coolant pump had branched outlets to each cylinder bank and was mounted co-axially with the oil scavenge pump.

Fuel-injection was specified from the outset as an integral part of the pursuit of high power at high engine speeds. In keeping with BRM's tradition of using British component manufacturers, the Lucas low pressure, port type system was chosen, the two companies working closely in its adaptation to the V8. The metering unit was located in the centre of the vee, driven by an internally-cogged belt from the right-hand cylinder bank. Initially, butterfly throttles and downstream injectors were used but during development sliding throttles were substituted

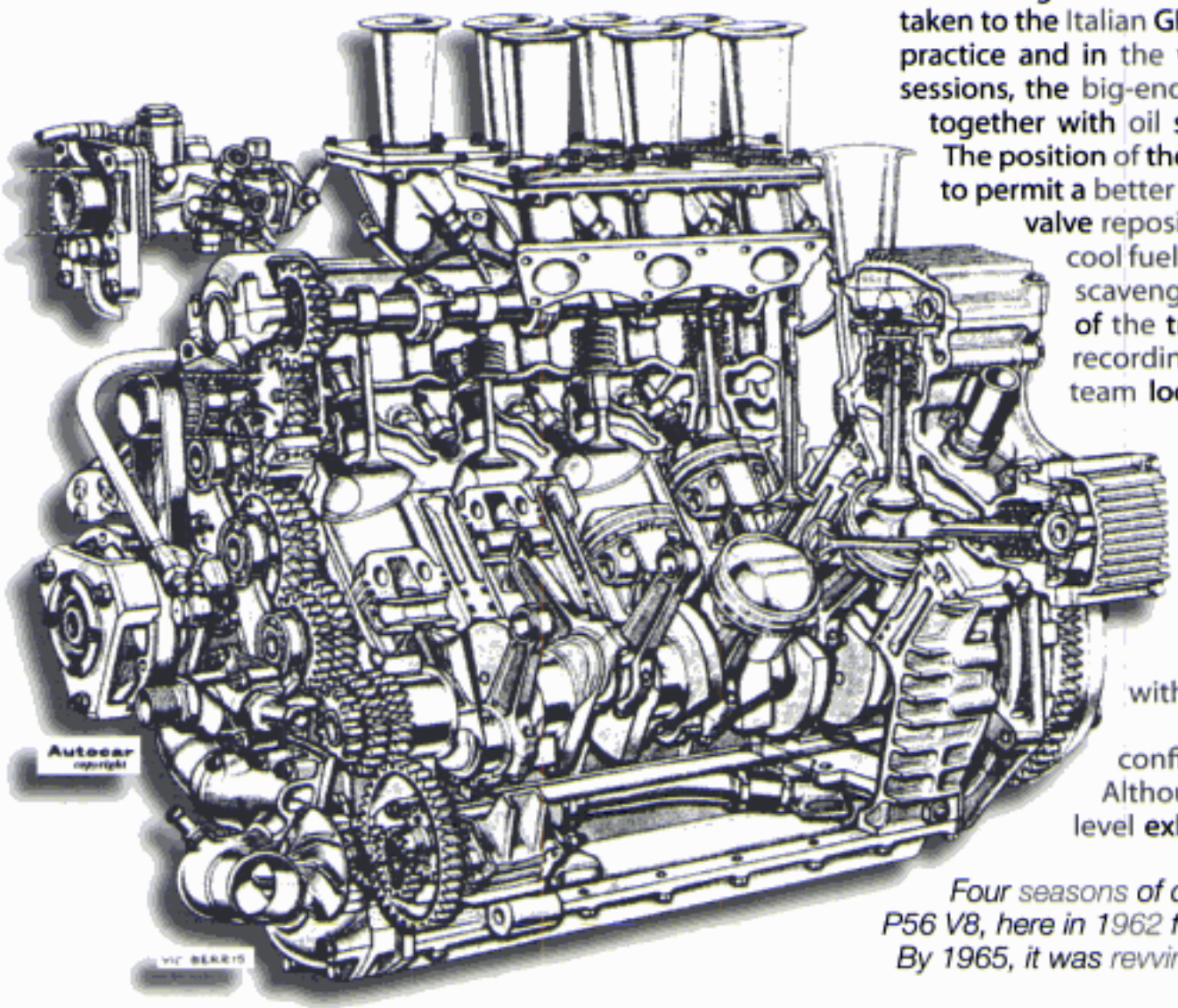
Cross-sectional view of the 1962 BRM P56 V8 showing the gear drive to the camshafts and details of the cylinder head and valve gear.



and upstream injectors proved to be less sensitive to timing. Opening or closing the throttle was achieved by sliding circular openings in the plate into or out of alignment with the inlet tract and removed the mid-tract obstruction associated with the butterfly spindle.

Lucas also supplied the transistorised ignition system, a new departure in 1961, its advantage laying in its ability to deliver up to 1000 sparks per second without a voltage drop. The then conventional coil or magneto type ignition was restricted by mechanical constraints to between 400 and 500 sparks per second while the V8, designed to run up to 11,000rpm, required over 700 sparks per second. The system sparked a single plug per cylinder, an alternator driven off the left-hand cylinder bank supplying the current.

The first engine was assembled in June 1961 and fired-up on the BRM test bed on 12 July. It was soon developing 180bhp and an engine was installed in the prototype P578 chassis and taken to the Italian GP at Monza in September for testing during practice and in the week following the GP. During these test sessions, the big-end bolt failures referred to above occurred together with oil scavenge and fuel vaporisation problems. The position of the injection metering unit was raised slightly to permit a better flow of air around it and the pressure relief valve repositioned to the metering unit to ensure that cool fuel was continuously circulating through it. Oil scavenging was improved by increasing the width of the triple gears in the pump. With the new car recording lap times second only to the Ferraris, the team looked forward to winter development and testing with some optimism.



Four seasons of continuous development proved the BRM P56 V8, here in 1962 form, to be an exceptionally sturdy engine. By 1965, it was revving to 13,500rpm and producing 220bhp.

Development and performance – 1962

The new engine proved remarkably trouble free during development, and the early 1962 season non-Championship F1 races clearly demonstrated that it was powerful, reliable and a winner – something with which the team was unfamiliar.

A number of different exhaust configurations were tried over the season. Although the prototype had featured a low level exhaust system, early races in 1962 were run

engine speed range, enabling it to be taken up to 11,000rpm for the first time. The optimum exhaust layout, providing a good compromise throughout the rev range, was now a low level, 4-into-1 system terminating in single 19in long tailpipes per bank. A total of four GP wins over the season gave BRM an historic Constructors' Championship title. Maximum power output during 1962 had been approximately 193bhp at 10,250rpm with 100lb/ft of torque at 9750rpm.

BRM also supplied the engine to five customer teams/Private entrants but with a poor record, although it has to be said that the majority of these fell into the 'also ran' category. The first customer engines breathed through Weber 35 DCOE twin choke carburettors rather than fuel-injection, and were at least 10bhp down on the works units. Team Lotus acquired one engine for evaluation purposes which never made a GP start. Jack Lewis acquired an engine installed in a 1961 BRM P57 chassis that proved to be so troublesome and lacking in performance that it was returned to BRM in disgust under threat of legal action after the talented Lewis had failed to qualify for the Dutch GP. The only 'professional' customer team to use the V8 was the UDT-Laystall Racing Team that ran one installed in a Lotus 24 alongside a Coventry Climax-engined example.

Development and performance – 1963

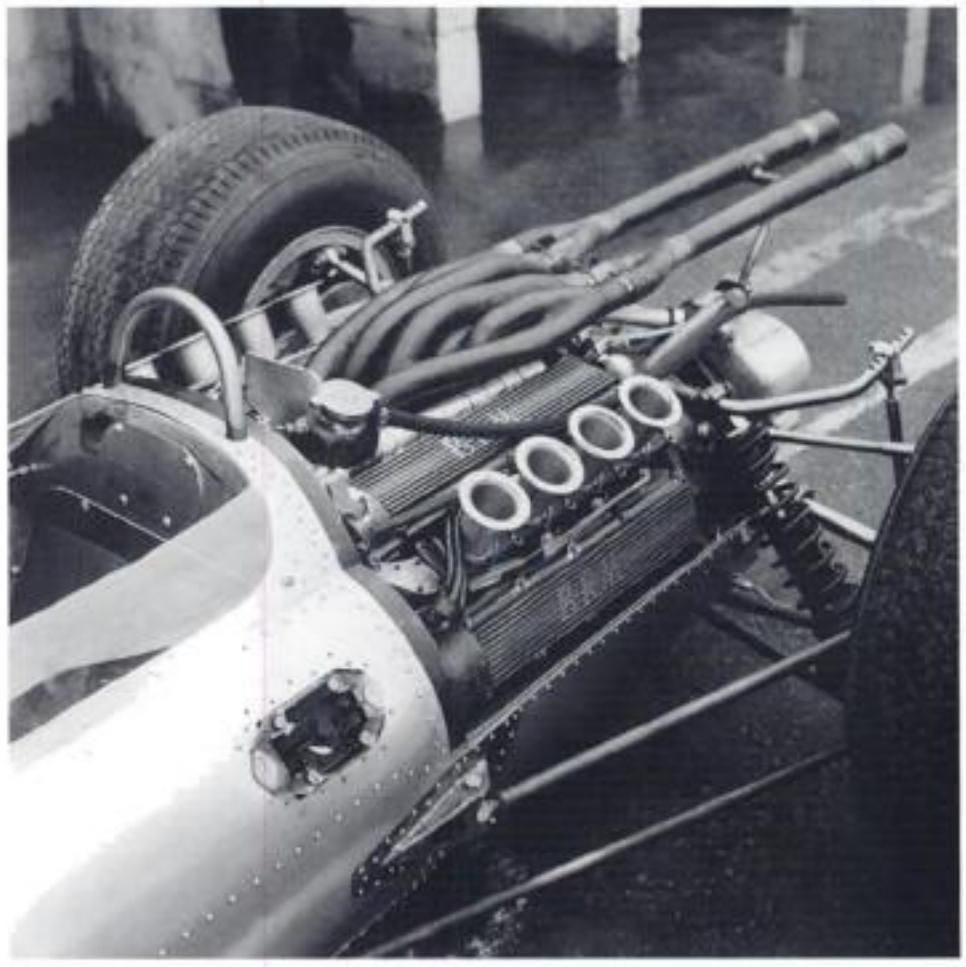
For 1963, new camshafts were developed to alter the valve timing and improve power output to a genuine 200bhp at 11,000rpm on a 10.5 to 1 compression ratio. This improvement was aided by the replacement of the original two-plane crankshaft by a single-plane version, using fewer counterweights to lighten it and reduce churning losses in the crankcase. Theoretically, the dynamic balance of a V8 engine with a single-plane crank should be inferior to one with a two-plane version but, because of the relatively small diameter pistons and short stroke of the BRM engine, there was no increase in engine vibration – if anything, it actually ran smoother. More importantly, the latitude for exhaust tuning, and maximisation of power output, was widened. The equal firing impulses per cylinder bank of a single-plane crank allowed the exhaust pipes to be linked as on a 4-cylinder engine. On 1963 engines, the outlets from cylinders 1 and 4 and from 2 and 3 were joined in equal lengths before merging into a common tailpipe.

The BRM V8 produced as much power as its immediate rival from Coventry Climax but only in works specification. While the BRM P578 could not match the Clark-Lotus-Climax combination, it proved a good second. High points of the season were 1-2 finishes at Monaco and Watkins Glen, and the outstanding reliability achieved with only one engine-related failure from 20 starts, all finishes being in the top five positions. This was sufficient to earn BRM the runner-up position in the Constructors' Championship.

Customer engines were regarded as having a disappointingly lower power output but were generally reliable with only seven failures from 44 starts, a 16 per cent failure rate. With Coventry Climax having now restricted its customer list, the BRM V8 was the only option available to Private entrants. The British Racing Partnership was the more successful, picking up four point scoring places (including two fourths) with Scuderia Centro Sud and Siffert Racing one each.

Development and performance – 1964

Two seasons of continuous development had proved the P56 V8 an exceptionally sturdy engine. It could rev up to 13,500rpm without blowing up, and, if kept to 10,500rpm, it would last for three GPs between overhauls. Tony Rudd felt that the power output of 200bhp might be inadequate for the 1964 season and initiated development of new cylinder heads. These featured 4 valves per cylinder with downdraught inlet ports passing between the two cam boxes of each bank, and exhaust ports emerging where the inlet ports had been in the centre of the V. This arrangement added flexibility in exhaust layout, making it much easier to couple cylinders without complex pipe work.



BRM P56: reverse cylinder head engine showing position of inlet and exhaust systems, testing in purpose-built chassis 2616.

The 4-valve heads gave results that, while encouraging on the airflow rig, could not be reproduced on the dynamometer, particularly at the top end. The works BRMs had to resort to the 1963 engine while development continued. Nevertheless, the team was able to repeat the 1-2 finish at Monaco and score five second places. Tony Rudd decided to try a 2-valve version of the head with 4-valve porting. Airflow tests were again encouraging and were reflected by improved torque at lower revs although with no appreciable gain in maximum power. The first engine to this specification appeared at Monza in September, developing 208bhp at 10,750rpm, and powered Graham Hill to victory in the US GP.

Once again, the works BRMs had an enviable reliability record with only one engine-related failure in 20 starts, that resulting from a broken distributor drive. BRM had now assumed the role of leading engine supplier, BRM-powered chassis making 84 GP starts in the season compared to the 77 of Coventry Climax. The Siffert Racing Team, Scuderia Centro Sud, BRP and the Reg Parnell teams all scored points, Siffert the more successful with a third and a fourth. Although Climax had the edge on results, mainly down to Jim Clark and Lotus, the BRM V8 was significantly more reliable with a 17 per cent failure rate compared to 31 per cent for Climax.

Development and performance – 1965

Tony Rudd pushed ahead with engine development, feeling that some 225bhp would be needed to meet the expected challenge from Honda and the flat-12 Ferrari. The team worked long and hard to extract more power from the V8, eventually deciding on a new design of combustion chamber. This was achieved by filling the reverse port head combustion chambers with weld metal and re-machining them to the new design. An engine with this new cylinder head produced 220bhp at 11,750rpm on the test bed and became Graham Hill's regular engine for the season, ultimately producing 222bhp.

This season there were 3 wins, including a 1-2 finish in Italy and third consecutive wins at both Monaco and Watkins Glen. There was only one engine-related failure in 20 starts, Hill's engine blowing in Mexico as a result of a snapped big-end bolt. For the third year running, BRM finished runner-up in the Constructors' Championship. Of the private teams, only the Reg Parnell and Rob Walker teams scored points, the latter the more successful with a fourth and two sixths. The number of private entries per GP had shrunk this season and this was reflected in a lower usage of the BRM V8. It remained the more reliable, however, with a failure rate of just 16 per cent.

BRM P56 V8 performance summary – 1962-65

Over a four year period, 28 P56 V8 engines were built and raced. They remained consistently competitive throughout the period, winning 11 GPs and powering the BRM marque to win the Constructors' Championship in 1962 and the runner-up position in the following three years. Since the first test running in 1961, power output had risen from 180bhp to the maximum of 222bhp obtained in 1965 – equivalent to 148bhp per litre. After years in the doldrums, BRM had justified Sir Arthur Owen's investment in the company's design and manufacturing expertise.

BRM P56 V8 performance summary – 1962-65

Year	Entrant	Starts	Finishes	Engine related failures	1st	2nd	3rd	4th	5th	6th	PP	FL
1962	Owen Racing Organisation	19	14	3	4	3	1	1	-	1	1	3
	Private entrants	8	2	3	-	-	-	-	-	1	-	-
	Total	27	16	6	4	3	1	1	-	2	1	3
1963	Owen Racing Organisation	20	14	1	2	3	5	3	1	-	2	-
	Private entrants	44	17	7	-	-	-	2	2	2	-	-
	Total	64	31	8	2	3	5	5	3	2	2	-
1964	Owen Racing Organisation	20	17	1	2	5	-	4	2	-	1	1
	Private entrants	64	28	13	-	-	1	2	4	3	-	-
	Total	84	45	14	2	5	1	6	6	3	1	1
1965	Owen Racing Organisation	20	16	1	3	6	2	1	3	1	4	3
	Private entrants	44	19	9	-	-	-	1	-	4	-	-
	Total	64	35	10	3	6	2	2	3	5	4	3
	Total 1962-65	239	127	38	11	17	9	14	12	12	8	7

Clisby

In November 1961 a new GP engine, designed and built in Australia, was about to begin development testing. The project had been instigated by Harold Clisby, the owner of a successful engineering company and a part-time racer and special builder.

The engine was something of an Australian version of the Ferrari 156/120° V6 of the time, sharing the 120° V6 configuration and with identical bore and stroke measurements of 73mm by 58.8mm giving a capacity of 1476cc. A three-throw crankshaft ran in four main bearings and lubrication was, surprisingly, by a wet sump. A gear train at the front of the engine drove the twin overhead camshafts per bank, dual coolant pumps and single oil pump in the sump. There were two valves per cylinder in a hemispherical combustion chamber with twin sparkplugs per cylinder fed from four distributors driven from the rear of each camshaft. Clisby had decided to manufacture his own

carburettors, as he could not obtain the triple choke Webers unique to Ferrari, but fuel-injection was an option. Photographs released at the time showed a very compact engine with an expected dry weight of 260lb and dimensions of 26in wide by 17in high and 20in long. Power output was optimistically forecast at 175bhp on an 8.5 to 1 compression ratio. This was expected to rise to 195bhp at 10,000rpm on increasing the compression ratio to 10.5 to 1. The engines were to be made available for private sale at a cost of £3500 each.

Unfortunately for the design team, the project came to nought when the cylinder block was found to be porous. The cost of re-design and other priorities forced the engine to be shelved.

Coventry Climax

There can be little doubt that the major contributor to British supremacy in GP racing in the period between 1959 and 1965 was the Coventry Climax racing engine. While John Cooper initiated the rear-engined revolution and Colin Chapman took chassis and suspension technology to new levels of sophistication, without a Coventry Climax engine their influence on the GP scene would have been delayed some years.

The origins of Coventry Climax Racing Engines Ltd. goes back to the early 1900s and a proprietary engine manufacturing business set up by H Pelham Lee in Coventry. These engines powered a number of both well-known and lesser known makes of automobile until the Depression sent them to the wall. Meanwhile, the company had won a contract to supply portable fire-pump engines, and these became standard Fire Service equipment throughout World War II. By 1950, with Leonard Lee, the son of the founder, now running the company, a talented design team had been assembled. Walter Hassan was technical director and his experience embraced the Bentley racing department during its Le Mans winning heyday, a number of Brooklands orientated racing teams and projects, and time with Jaguar on the design of the XK engine. He had recruited Harry Mundy from the BRM V16 project to work alongside him.

In 1950, the Home Office issued a specification for a brand new, lightweight fire-pump engine capable of producing 35bhp at 3500rpm. Lee's team won the contract with an all aluminium, single overhead camshaft 4-cylinder petrol engine of just over 1-litre capacity. The requirements of a fire-pump engine of good power to weight ratio, high efficiency and reliability matched those of a racing engine, and with the designers' motor sport backgrounds, the engine soon generated interest from British racing car constructors. Lee foresaw a potential additional market for his FW (feather weight) engine and gave the go-ahead to upgrade it for competition work. Designated FWA, the engine dominated the 1100cc sports racing class during the 1950s with an output of 90bhp at 7300rpm.

Even before production had commenced on the FWA, Coventry Climax was to become involved in a far more ambitious project. With the company's talented design staff in mind, the British F1 teams approached Leonard Lee to see if he could provide them with an affordable, competitive engine for the new 2½-litre GP formula due to run from 1 January 1954. Hassan and Mundy began working on a V8 engine in their spare time which, when built, produced 264bhp at 7900rpm. Compared to the outputs claimed by continental manufacturers, this figure was considered insufficient and, despite pressure from the British constructors, the engine was not released for racing. In the event, the power output would have been sufficient to be competitive, and with continuous development would no doubt have remained so throughout the seven year life of the formula.

Rather than be wasted, the time and experience gained on the V8 was applied to an engine to suit a new 1½-litre F2 category due to come into force from 1957. It was apparent that there was a much larger market for such an engine, constructors Cooper and Lotus in particular were keen to see such a power unit while they were not at that time interested in the V8. Investigations revealed that, with small alterations to water passages and ports, the cylinder head from the V8 could form the basis of a new 4-cylinder engine. The bore of the V8 was increased to 3.20in (81.2mm) while the stroke was lengthened marginally to 2.80in (71.1mm) because of the desirability of utilising V8 connecting rods. This gave a capacity of 1475cc from which 141bhp was extracted at 7300rpm with a band of useable torque extending from 4000 to 7500rpm. Basic features of the engine included a combined light alloy crankcase and cylinder block with detachable wet liners and a train of spur gears to drive the twin overhead camshafts, auxiliaries, single pressure and twin oil scavenge pumps. Valves in the hemispherical combustion chamber were operated through inverted tappets, the inlet positioned at 32° and the exhaust at 34° from the vertical, both slightly offset from the geometrical centre point of the hemisphere to permit larger areas. Valve sizes were 1.75in for the inlet and 1.60in for the exhaust. Dry engine weight was 225lb.

This engine, designated FPF, would become the dominant force in F2 racing between 1957 and 1960, but even before it had done so, there were requests for it to be enlarged for F1 use. Both the bore and stroke were increased to produce versions of 1960cc and 2203cc although valve sizes remained unchanged. In 1958, under pressure from Cooper and Lotus, work commenced on a full, 2495cc version. This required considerable redesign to overcome weakening of the cylinder block and crankcase, and balance problems created by the progressive increase in capacity. A brand new block was produced, the entire bottom end robustly cross-braced with studs screwed horizontally through the five main bearing caps, and additional weights bolted to the existing balance weights to provide more effective counter balancing. In

circuits of Spa and Reims, the Cooper had proved quicker than the Ferraris. This was not to be the case, however, as the Ferraris now had a more up-to-date chassis and were faster everywhere. Nevertheless, Moss managed to beat them again on pure skill at the Nürburgring and Lotus scored the engine's third win in the USA, although in the absence of the Ferrari team. With a remarkable 113 GP starts, the FPF had the distinction of being the most widely used engine of the season.

In 1962, the FPF was totally outclassed by the new generation V8s from BRM and Coventry Climax. Nevertheless, it was raced extensively by privateers in a variety of 1961 and older Cooper, Lotus and Emeryson chassis. After 1962, the FPF continued in use in local racing in South Africa only, making appearances in that country's GP in both 1963 and 1965.

COVENTRY CLIMAX FWMV V8

Design of the new 1½-litre Coventry Climax engine did not commence until September 1960 due to the resistance of British interests to support the new formula until long after it was obvious that their objections had fallen on deaf ears. By dint of concentrated effort, however, the first new engine would make its race debut in August 1961.

Walter Hassan, with Peter Windsor Smith now as chief designer, reasoned that a V8 layout would give the right balance between adequate power, a good spread of torque over a wide rev band, light weight and fuel economy. The new engine, designated FWMV, would be straightforward and simple with many features carried over from previous Climax race engines. A 4-cylinder 742cc engine, the FWMC, had already been built and, although effectively half of the V8, no parts were actually interchangeable. Nevertheless, much of the basic cylinder head and valve gear design was carried over to the new FWMV.

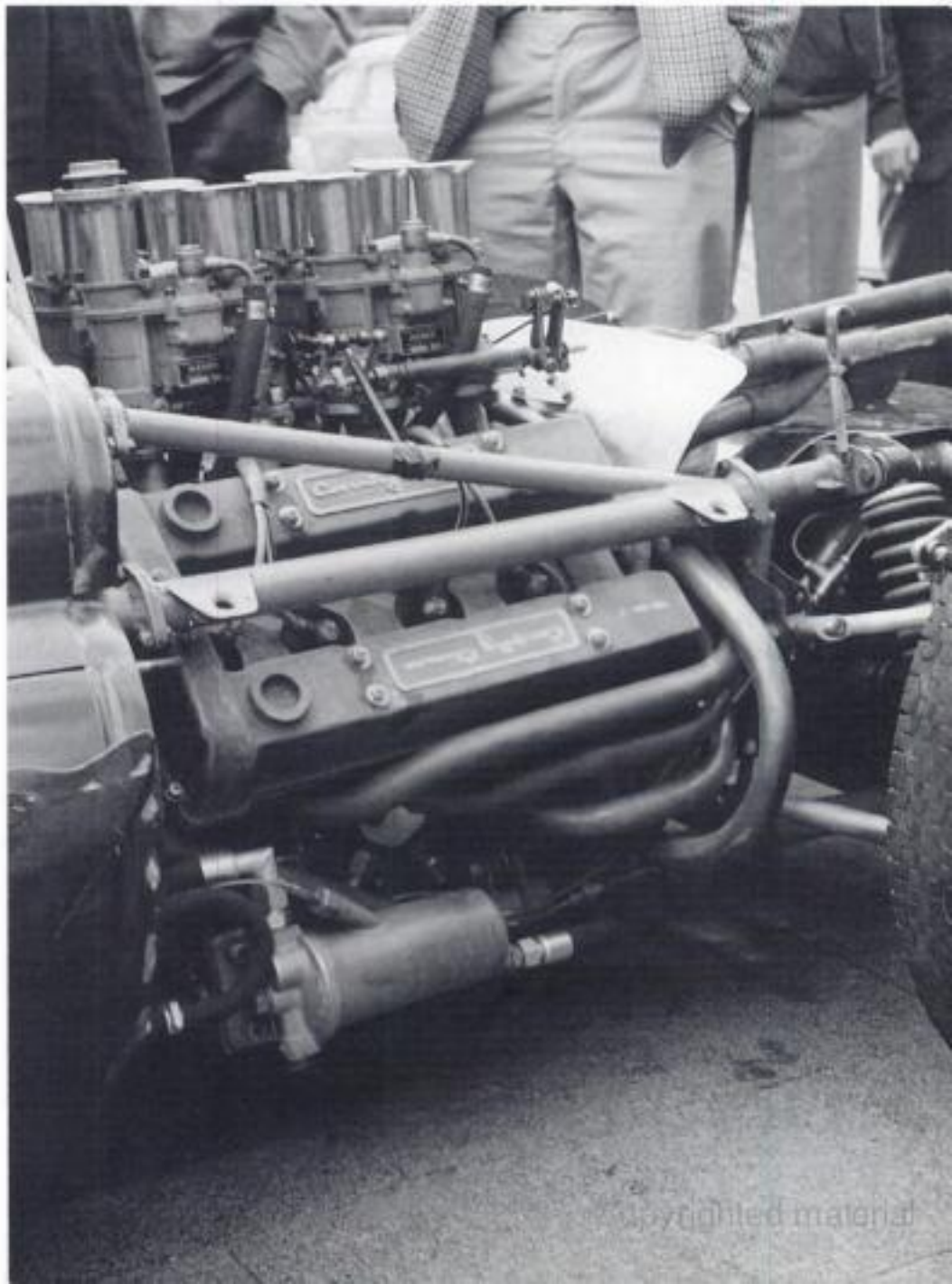
Coventry Climax FPF performance summary 1961-65

Year	Starts	Finishes	Engine related failures	1st	2nd	3rd	4th	5th	6th	PP	FL
1961	113	59	28	3	-	4	6	5	6	1	3
1962	25	12	3	-	-	-	-	1	1	-	-
1963	1	1	-								
1965	2	1	-								
Total	141	73	31	3	-	4	6	6	7	1	3

Design and construction

The bore and stroke dimensions of the V8 were arrived at after a detailed analysis of the performance of the FPF series engines and a desire to achieve the stated aim of the best relationship between power and torque. Dimensions chosen of 63mm bore by 60mm stroke gave a capacity of 1494cc. The cylinder block was a one piece aluminium casting, extending down well below the main bearing caps, and completed by a shallow sump. As in the 2½-litre FPF and the Mk 2 1½-litre FPF, there were five steel main bearing caps, the centre and intermediate ones being side-bolted to the crankcase walls for increased rigidity. Wet cylinder liners were of the compression type with the top and bottom flanges compressed by cylinder head tightening.

The two-plane crankshaft was machined from nickel-chrome-molybdenum steel and was fully balanced, with additional balance weights on the front end and the flywheel to counter the inherent rocking couple associated with this type of crankshaft. The inner and outer throws were diametrically opposed, the outer out of phase with the inner by 90°. Five main bearings were



Coventry Climax FWMV: the first Mk 1 testing in the Cooper T58 chassis at Silverstone on 1 August 1961.

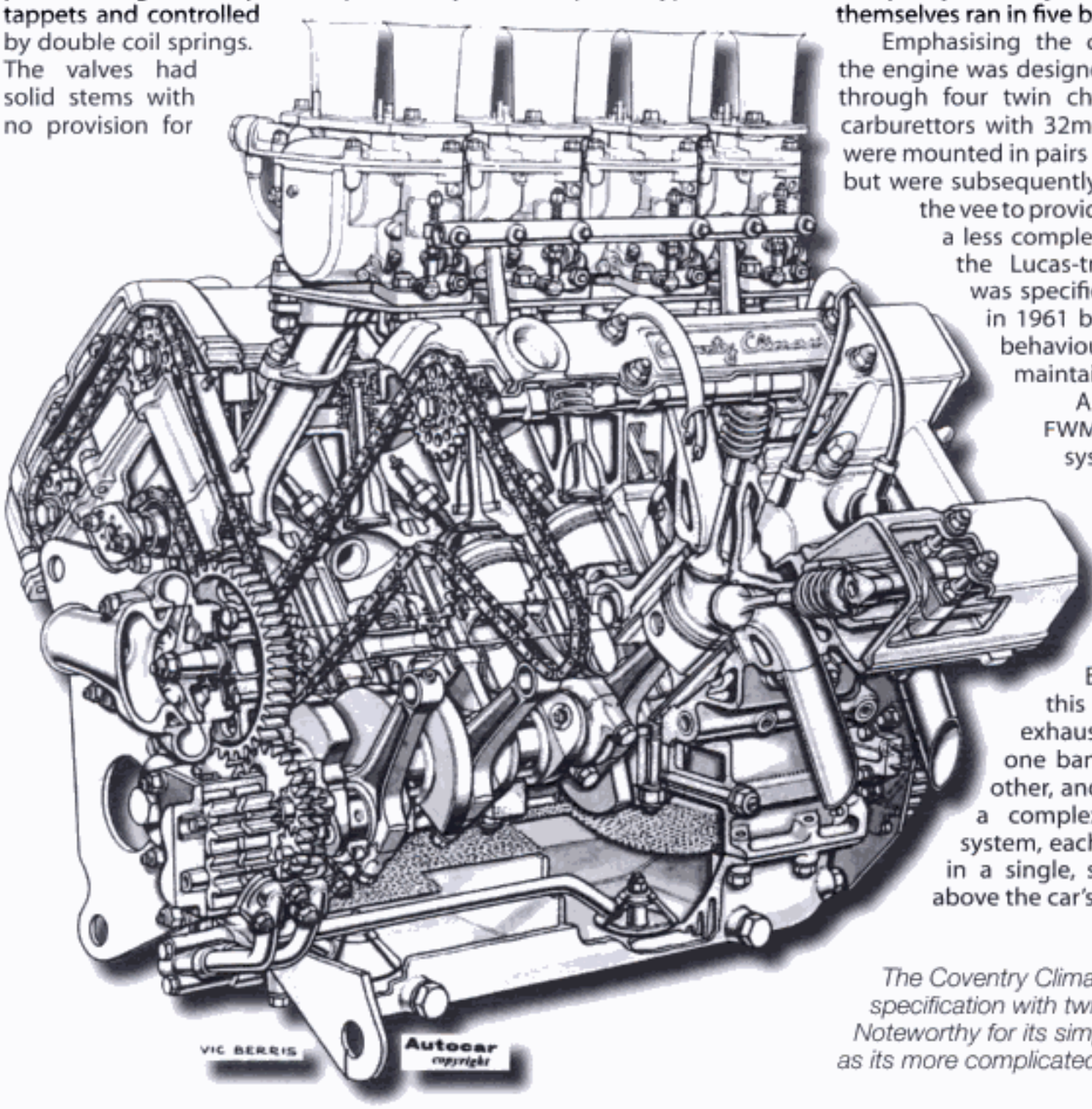
of 2in diameter, numbers 1, 3 and 5 being 0.85in wide while 2 and 4 were 0.725in wide. Big ends were 1.625in in diameter by 0.75in wide. Semi-die cast Brico pistons were fitted with one pressure-backed Dykes compression ring, a plain compression ring and a scraper ring. Drop-forged nickel-chrome steel connecting rods measured 4.2in between big-end and gudgeon pin centres.

The cylinder head was cast in aluminium alloy with austenitic shrunk-in cast iron valve inserts. Two valves per cylinder were disposed at 30° to either side of the cylinder axis to provide a more compact, hemispherical combustion chamber than on previous engines. They were operated by inverted piston-type tappets and controlled by double coil springs. The valves had solid stems with no provision for cooling, and diameters were 1.30in for the inlet and 1.24in for the exhaust.

Ancillaries were driven by a tubular jackshaft running up the centre of the vee, gear driven off the crankshaft at half engine speed. At its rear it drove the vertically-mounted ignition distributor via spiral gears and a water pump at the front with outlets to each cylinder bank. Triple oil pumps were gear driven at 0.68 engine speed and comprised one pressure and twin scavenge pumps. A single roller chain drove the twin overhead camshafts on each cylinder bank from sprockets on the jackshaft with externally adjustable jockey sprockets. The camshafts themselves ran in five bearings.

Emphasising the conservative approach taken, the engine was designed from the outset to breathe through four twin choke Weber DCNL-4 type 38 carburettors with 32mm choke tubes. Initially these were mounted in pairs along the length of the engine but were subsequently mounted transversely across the vee to provide improved inlet passages and a less complex throttle linkage. By contrast, the Lucas-transistorised ignition system was specified for the engine, a bold step in 1961 both in terms of reliability and behaviour. A belt-driven alternator maintained battery voltage.

A distinctive feature of the FWMV was the complex exhaust system. With a two-plane crankshaft, firing sequences are unequal in each cylinder bank and a considerable amount of effort was put into obtaining evenly spaced gas flow pulses and higher power over a wide rev band. By a process of trial and error, this was achieved by linking the exhausts of the inner cylinders of one bank with the outer ones of the other, and vice versa. This necessitated a complex crossover 'spaghetti' type system, each set of four pipes combining in a single, slightly megaphoned tailpipe above the car's transmission.



The Coventry Climax FWMV V8 in 1962 Mk 2 specification with twin choke Weber carburettors. Noteworthy for its simplicity, it proved as powerful as its more complicated rivals.

Development and initial performance

The first engine ran in May 1961 but power was initially disappointing. Once the crossover exhaust system had been adopted and a late change to inlet port shape reversed, it was soon developing 174bhp. Oil churning in the crankcase was another early problem, resolved initially by lowering the sump by 2in. Further work found that a copper gauze screen arranged to follow the path of the big-ends resolved the problem and enabled the sump to be raised back to within 5/8in of its designed level. On 28 July, the first engine was delivered to the Cooper works at Surbiton where it was installed in a unique T58 chassis. The completed installation was tested at Silverstone on 1 August with encouraging results and the car transported to the Nürburgring for the German GP. Teething problems were encountered during practice with a seized distributor drive and the engine had to be raised 1in in the chassis to prevent bottoming. Nevertheless Jack Brabham was able to lap fast enough for second on the grid, despite the engine overheating. Unfortunately, because of unsuitable tyres, he went off the road within a few miles of the start of the GP on a damp patch of track.

Later in August power was up to 181bhp at 8500rpm with a good spread from 6000rpm upwards. A second V8 was supplied to the Rob Walker Racing Team for Stirling Moss in time for the Italian GP. Moss suffered overheating in practice and decided not to risk the engine, but Jack Brabham raced his to good effect until he too suffered overheating. Brabham raced the engine again at the season finale in the USA but once again overheating foreshortened an impressive showing. The Cooper team had modified the cooling system but nothing seemed to cure the water loss and consequent overheating.

Over the winter months of 1961, Hassan, Windsor-Smith and the team set out to identify and cure the problem by re-creating the cooling system on the test bed – something that was not usually done. This simulation revealed that combustion gases were leaking into the cooling system, pressurising it and causing water to blow out of the header tank. The cause was traced to differential expansion of the cast iron cylinder liners and the alloy block. The upper flange of each liner was clamped by the cylinder head with a Cooper ring providing a seal. While the temperature of the water and block would remain relatively constant, the temperature of the liners varied with throttle openings. As the throttle closed, the liner would cool and shrink relative to the block, sufficient for the Cooper ring seal to fail and allow it to shuffle. The cure was to support the liners in alloy slip-fit type sleeves of the same co-efficient of expansion as the block. The sleeves would thus expand in unison with the block, maintaining the seal against leakage.

The overheating problem now solved, production could commence to satisfy customer orders. The inlet valve size had been increased from 1.30in to 1.35in and power output was now 186bhp at 8500rpm, with a wide spread of power, particularly strong from 6000rpm upwards, and 119lb/ft of torque at 7500rpm. Delivery was slow and the full quota of engines would not be completed until August as the solution to the overheating problem had consumed valuable production time. 16 of these 'Mk 2' engines were produced, 3 each ordered by Cooper, Lotus, Bowmaker Lola and UDT-Laystall, while 2 each went to Brabham and Rob Walker. Engines were supplied at a cost of £3000 each, a more than generous figure when compared to the cost of the 4-cylinder FPF of £2250.

Performance – 1962

The early season non-Championship F1 races proved that the overheating problems were over and 2 wins were scored by the engine's first recipients Team Lotus – one of them when runnning the modified prototype engine. The FWMV scored its first GP win at Monaco in Bruce McLaren's Cooper, followed by wins for Jim Clark's Lotus in the Belgian, British and US GPs. In addition, the engine gained 7 pole positions and 6 fastest laps.

Considering the number of engines in use and the consequent pressure on the Coventry Climax Service department, the 11 (15 per cent) engine-related retirements was commendably low. Early tappet failures were traced to differences between customer lubricants and that used by Coventry Climax itself. The solution was to buff Molyslip compound into the tappets to provide a satisfactory surface treatment. With only three engines per two-car team, there was little leeway for engine blow-ups. Consequently, there were a number of instances of teams cobbling together an engine from parts taken from another team's blow-up. Probably the most significant engine failure of the season occurred in the final round of the Championship in South Africa. The bolt locating the jackshaft bearing worked itself out late in the race, allowing the engine oil to drain away and, with it, the Championship titles for Jim Clark, Lotus and Coventry Climax.

On 17 October 1962, Leonard Lee announced that he

Coventry Climax FWMV performance summary – 1962

Entrant	Starts	Finishes	Engine related failures	1st	2nd	3rd	4th	5th	6th	PP	FL
Bowmaker Lola Racing Team	15	5	5	-	2	-	1	2	-	1	
Brabham Racing Organisation	8	4	1	-	-	-	2	1	1		
Cooper Car Co	15	12	1	1	2	4	1	1	1	1	1
Team Lotus	18	8	2	3	1	-	1	-	-	5	5
Private entrants	18	8	2					1			
Total	74	37	11	4	5	4	5	5	2	7	6

intended to stop the development and manufacture of the FWMV at the end of the year. Coventry Climax was effectively subsidising the British F1 constructors and could not afford to continue to do so. This came as a severe blow to the constructors who were 100 per cent reliant on the company for their continued participation in GP racing. Following the announcement, leading members of the British motor industry gathered to discuss the situation with Lee. It was proposed that financial support given by the industry (mainly the fuel companies) would be increased to the main F1 constructors who would, in turn, contribute towards Climax's development costs. As a result, Lee was able to reverse his decision and development of the FWMV would continue for the 1963 season.

Development 1963 – the short stroke Mk 3

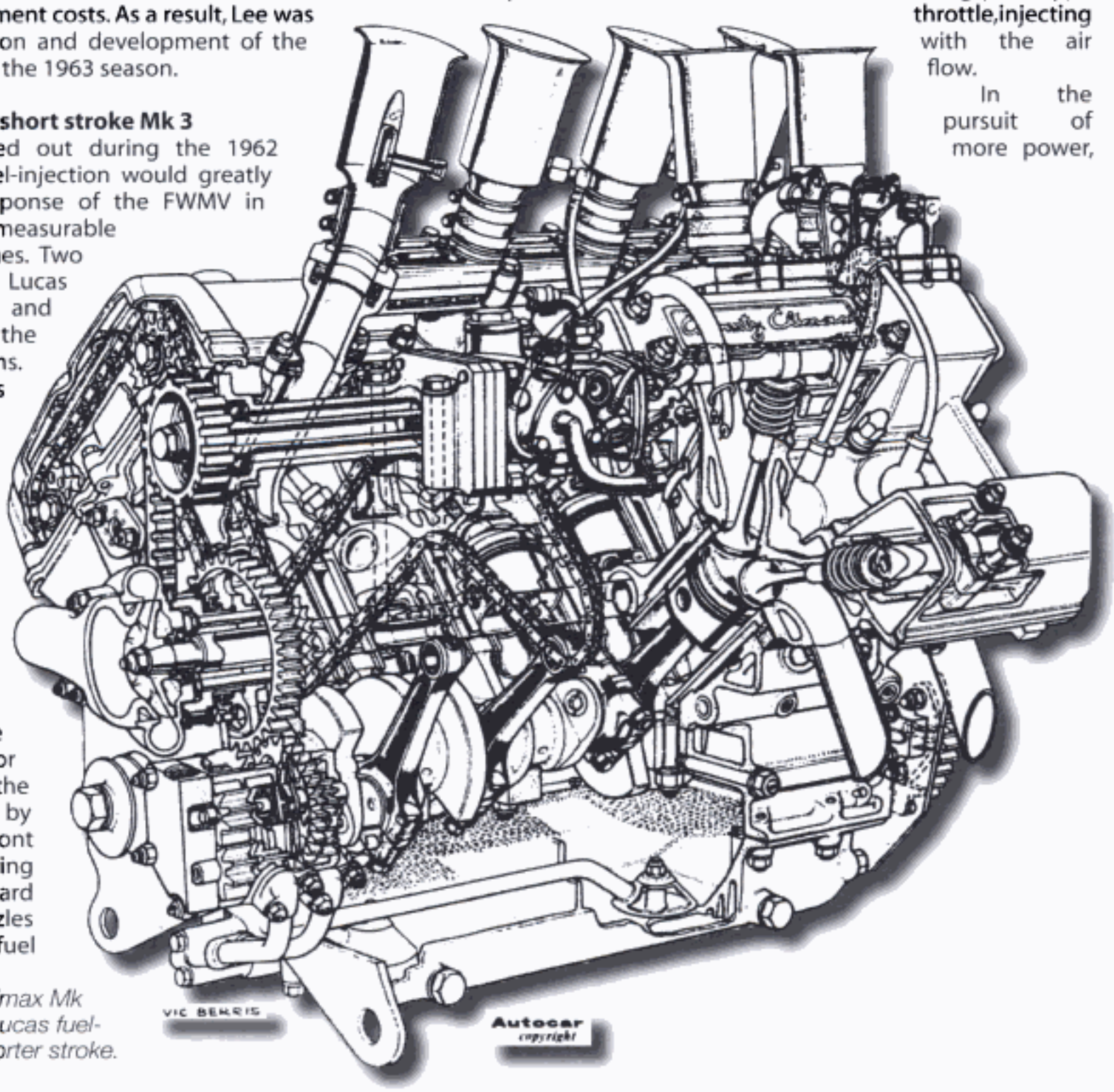
Experimental work carried out during the 1962 season indicated that fuel-injection would greatly improve the throttle response of the FWMV in corners and contribute to measurable improvements in lap times. Two engines were fitted with Lucas port type fuel-injection and sent to South Africa for the Lotus and Cooper teams. Jim Clark practised with his but did not race it due to a high speed misfire but the Cooper version ran reliably in both practice and the race.

Fuel-injection was specified for the Mk 3 version of the FWMV for 1963, the choice of Lucas as supplier rather upsetting BRM, which thoughtithadanexclusive deal for the system. The fuel-injection distributor pump was mounted in the crankcase vee and driven by a cogged belt from the front of the jackshaft after moving the coolant pump forward slightly. The injector nozzles on the BRM V8 injected fuel

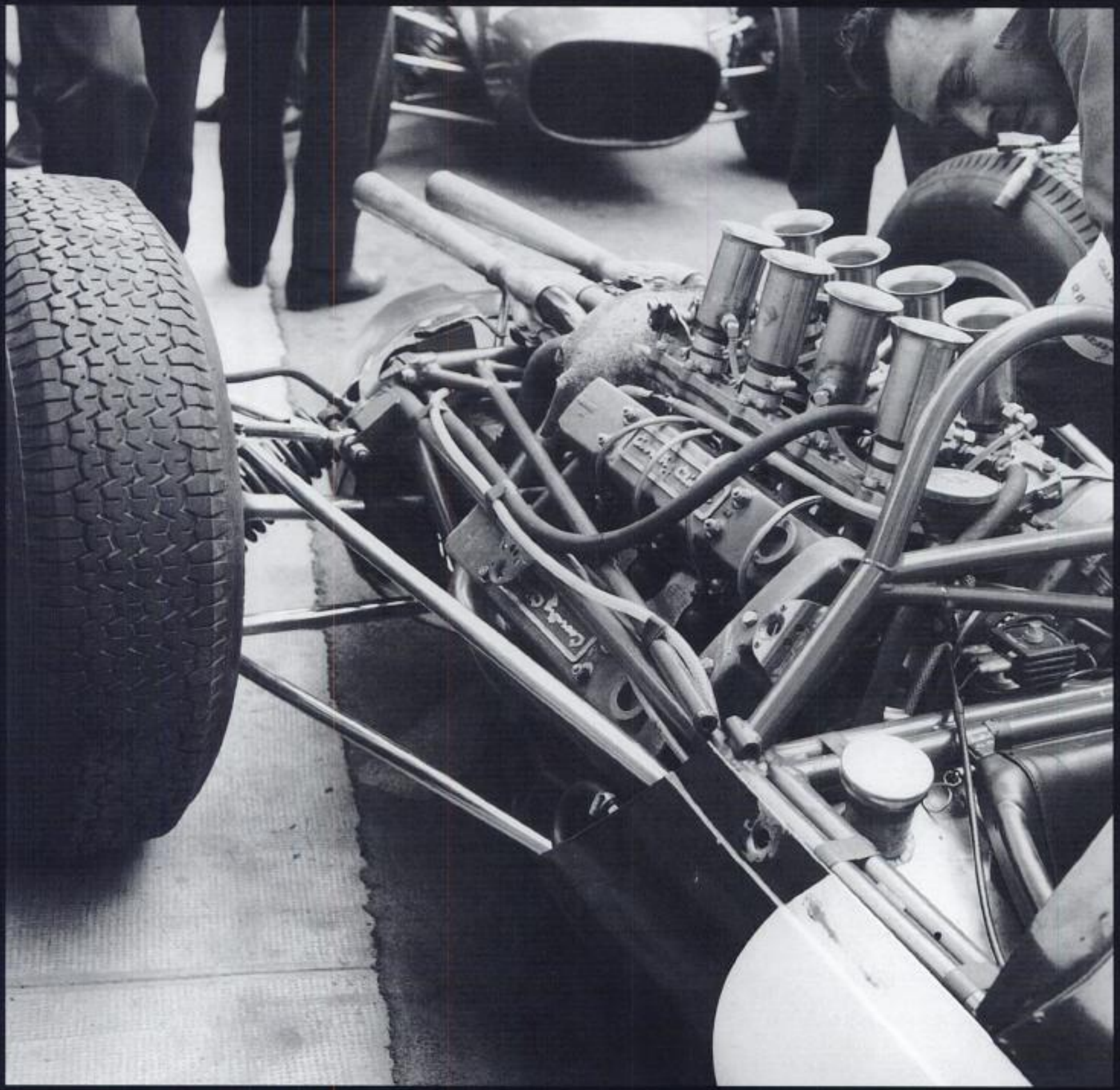
Opposite: Coventry Climax FWMV Mk 3: a shorter stroke and Lucas fuel-injection replacing the Weber carburettors combine to increase peak revs by 1000rpm. It's seen here at Monaco 1963 in the Brabham BT3 chassis.

against incoming air in the inlet ports, but such a position was found to give inferior results on the FWMV. After a process of careful development, the solution evolved was to position the injectors on the central axis of extended, bell-mouthed air trumpets, a considerable distance from a sliding plate type throttle,injecting with the air flow.

In the pursuit of more power,



The 1963 Coventry Climax Mk 3 FWMV, now with Lucas fuel-injection and a shorter stroke.



Hassan and his team realised that it would be necessary to increase crankshaft speed. This was the more significant of a number of internal modifications to the FWMV and was achieved by shortening the stroke from 59.9mm to 51.6mm, together with a commensurate increase in bore from 63mm to 67.9mm to maintain the cubic capacity. Crankshaft speed was increased and breathing improved although valve and port diameters were not enlarged. Important changes were made to the connecting rods to reduce friction losses. Two bolts replaced set screws and the centre distance between the big and little ends increased from 4.2in to 5.1in. Detail changes were also made to the oil pumps, including a strengthened scavenge pump shaft. The net result of these modifications was an increase in power to 195bhp at 9500rpm with a similar output of torque as previously but at 8000rpm rather than 7500rpm. Mk 2 engines updated to Mk 3 specification required a packing plate on the cylinder block to accommodate the changes.

At this time, an engine was built with a single-plane crankshaft to overcome the necessity for the complex crossover exhaust system and avoid installation problems in a proposed update of the front-engined Ferguson P99 chassis. Theory suggested that the single-plane crank would increase engine vibration but, in the event, this failed to materialise, as did the updated Ferguson. Nevertheless, the new crank forged in EN40 nitrided steel was adopted and many FWMVs were rebuilt to this specification.

Six Mk 3 short stroke, fuel-injected engines were built, priced at £5000 each, two going to each of Lotus and Cooper, with one each to Brabham and Rob Walker. In addition, eight Mk 2 engines were converted to Mk 3 specification at a cost of £3000 each.

Performance – 1963

The combination of the FWMV, Jim Clark and the Lotus 25 proved to be virtually unbeatable in 1963, winning 7 out of 10 GPs, starting from pole position 7 times, scoring 6 fastest laps and taking both the Constructors' and Drivers' World Championships. There were also six seconds and four thirds amongst 30 placings from 89 starts. Engine-related problems accounted for 22 retirements, a failure rate of 25 per cent, creditable but bettered by BRM which achieved 16 per cent from 25 fewer starts.

Coventry Climax FPF performance summary 1963

Entrant	Starts	Finishes	Engine related failures	1st	2nd	3rd	4th	5th	6th	PP	FL
Brabham Racing Organisation	19	10	5	-	3	1	2	2	1	-	1
Cooper Car Co	20	9	8	-	2	2	1	1	1		
Team Lotus	23	12	5	7	1	1	-	-	1	7	6
RRC Walker Racing Team	10	6	1					2	2		
Other	17	8	3								
Total	89	45	22	7	6	4	3	5	5	7	7

While Clark enjoyed an almost trouble free season, other FWMV users were unable to achieve the same level of competitiveness. The number 2 Lotus had five engine-related failures, the Brabham team had three engine failures during practice, and both cars were eliminated by comprehensive blow-ups during the British GP, one of which was a single-plane crankshaft first used in the Dutch GP. The Cooper team suffered eight engine failures, nearly all in the second half of the season, with both cars being eliminated from the US and Mexican GPs.

Development 1964 – the 'ultra' short stroke Mk 4

Following on from the success of the short stroke Mk 3 FWMV in 1963, a further shortening of the stroke was instigated, primarily to provide sufficient space within the combustion chamber for four valves. The stroke was reduced by 6mm to 45.47mm and with a 72.39mm bore gave a stroke/bore ratio of 0.63 compared to the 0.76 of the Mk 3. The 4-valve heads did not provide the increase in power anticipated and this ultra short stroke was introduced with existing 2-valve heads. The exhaust valves were enlarged slightly to 1.37in but the inlet valves were unchanged, in keeping with the concept of small bore induction tracts to promote high velocity airflow. In this form, the FWMV now produced 200bhp at 9750rpm, at which speed the 2-valve heads were still considered to be satisfactory. Most of the Mk 3 engines were converted to Mk 4 specification and four new engines were built, two being loaned to Lotus and one each to Brabham and Cooper.

A one-off Mk 5 engine was built, identical to the Mk 4 but with inlet valves enlarged to 1.4in. Running at the peak of 9750rpm, the valve gear with this larger, heavier valve had probably reached its limit. Output increased marginally to 203bhp. This engine was apparently used by Jim Clark 'very successfully' and presumably accounted for one or more of his 3 wins in the season.

Performance – 1964

The FWMV scored 5 wins from 77 starts in the season, compared to 3 for Ferrari and 2 for BRM. As in 1963, engines were supplied to Brabham, Cooper and Lotus with Rob Walker and the DW Racing teams retaining engines from previous years. Lotus accounted for 3 of the wins, the remaining 2 scored by the Brabham team for which further success was thwarted by engine reliability problems. After a promising first half to the season, Jim Clark's Lotus suffered a spate of engine problems, culminating in a loss of oil in Mexico that also lost him his second straight World Championship. Cooper also suffered engine failures in the second half of the season,

Opposite: The 32-valve Coventry Climax FWMV Mk 5l (as used by Team Lotus) identified by its ribbed camshaft covers.

0.935in and 1.043in in diameter respectively. The chain drive to the camshafts of the 32-valve engines proved inadequate for the loadings of 32 valves, and an all-gear drive was devised to overcome this. New crankshaft, pistons and liners were also adopted. Power output was 212bhp at 10,300rpm for the Mk 5I which proved to be the better engine.

Only one each of the Mks VI and VII were produced, the smaller valve Mk 5I going to Team Lotus while the Mk 5II went to the Brabham Racing Organisation. The remainder of the Climax-engined cars relied on the 1964 Mk 4 engine.

Coventry Climax FPF performance summary 1965

Entrant	Starts	Finishes	Engine related failures	1st	2nd	3rd	4th	5th	6th	PP	FL
Brabham Racing Organisation.	22	14	5	-	2	4	2	2	1	-	1
Cooper Car Co	19	9	5	-	-	1	1	3	1		
Team Lotus	22	12	4	6	-	1	2	-	-	6	6
Private entrants	17	5	5	-	-	-	-	-	-	-	-
Total	80	40	19	6	2	6	5	5	2	6	7

Coventry Climax FWMV performance summary 1961-65

Year	Starts	Finishes	Engine related failures	1st	2nd	3rd	4th	5th	6th	PP	FL
1961	3	-	3							1	1
1962	74	37	11	4	5	4	5	5	2	7	6
1963	89	45	22	7	6	4	3	5	5	7	7
1964	77	37	24	5	2	5	4	3	6	7	7
1965	80	40	19	6	2	6	5	5	2	6	7
Total	323	159	79	22	15	19	17	18	15	28	28

Performance – 1965

The first 32-valve FWMV to appear, identified by its ribbed cam box covers, was the Mk 5II run by Jack Brabham at Monaco where he lead prior to a blow-up due to an inoperative rev counter. Thereafter, despite the best efforts of Coventry Climax, the engine was never the same and was usually to be seen leaking oil from every pore. Dan Gurney used it in France where it blew again and it failed on the warm-up lap of the British GP. Repaired, it was tried in practice at Monza and at Watkins Glen but was not raced again, eventually being found to be producing less power than a good 16-valve engine. The Mk 5I run by Jim Clark also had an oil leak problem but this was rectified. It ended the season by seizing during practice in Mexico but had accounted for 3 of Coventry Climax 6 GP wins in 1965, all down to Jim Clark who secured a second World Championship for himself and the Lotus marque. Of the other FWMV users, Brabham could manage only second or third places. Overall, the FWMV had a 24 per cent failure rate during 1965, once again inferior to the BRM P56 but with a 25 per cent higher number of starts.

COVENTRY CLIMAX FWMW FLAT-16

Details were revealed in February 1965 of an exciting new multi-cylinder engine being developed by Coventry Climax for the forthcoming season. It was expected to produce around 240bhp at 12,000rpm from its 16 cylinders and was one of the most

At a glance: Coventry Climax FWMV – 1961-65

	1961 Mk 1	1962 Mk 2	1963 Mk 3	1964 Mk 4	1964 Mk 5	1965 Mk 5I	1965 Mk 5II
Bore	63mm	63mm	67.94mm	72.39mm	72.39mm	72.39mm	72.39mm
Stroke	60mm	60mm	51.56mm	45.47mm	45.47mm	45.47mm	45.47mm
Capacity	1494cc	1494cc	1495cc	1496cc	1496cc	1496cc	1496cc
Bore/Stroke ratio	0.95:1	0.95:1	0.76:1	0.63:1	0.63:1	0.63:1	0.63:1
Compression ratio	11.5:1	11.5:1	11.5:1	12.0:1	12.0:1	12.0:1	12.0:1
Piston area	249.5cm²	249.5cm²	290.1cm²	329.4cm²	329.4cm²	329.4cm²	329.4cm²
Valves/cylinder	2	2	2	2	2	4	4
Valve sizes: Inlet	1.30in	1.35in	1.35in	1.35in	1.40in	1.04in	1.107in
Exhaust	1.237in	1.237in	1.237in	1.37in	1.37in	0.935in	1.043in
Carburetion	4 t/c Weber 38DCNL-4	4 t/c Weber 38DCNL-4	Lucas fuel injection	Lucas fuel injection	Lucas fuel-injection	Lucas fuel-injection	Lucas fuel injection
Max bhp/rpm	181 @ 8500	186 @ 8500	195 @ 9500	200 @ 9750	203 @ 9750	212 @10,300	213 @10,500
Max torque lb/ft	118 @7 500	119 @ 7500	118 @ 8000	117 @ 8000	115 @ 8000	119 @ 8000	115 @ 8000
Bhp/litre	120.7	124.0	130.0	133.3	135.3	141.3	142.0
No. built	2	16	6 new, 8 Mk 2s converted	4 new, most Mk 3s converted	1	1 to Team Lotus	1 to Brabham Racing Org.

respectively. Horizontally-opposed cylinders proved to be the best compromise, providing a lower centre of gravity than a vee, together with a projected cross sectional area of less than half that of the FWMV.

Design and construction

The engine comprised a combined crankcase and cylinder block, split vertically along the crankshaft centre line into two halves and braced on its underside by a rigid cast alloy sump. With the likelihood of it being used as a stressed chassis member, mounting points were provided on the crankcase and cylinder heads. The crankshaft was laid out as two, four throw single-plane units running in five main bearings but turned through 90° to each other with their inner ends shrunk onto a central spur gear. The spur gear passed power to an output shaft running below the crankshaft at 0.8 engine speed to both align with and suit the gearing of existing transmission units in use with the FWMVs. Taking power from the centre avoided the torsional vibration problems of what was still a long crankshaft. The crankshaft arrangement provided even firing impulses and eliminated the need for a complex crossover exhaust system between cylinder banks.

Separate cylinder heads were provided for each group of four cylinders with two valves per combustion chamber and a single sparkplug. The included angle between the valves was 48° and the inlet tracts were designed for high-velocity flows, in keeping with the norm for Climax engines. Lucas supplied the transistorised ignition system and port type fuel-injection with long induction trumpets and sliding plate throttles, as fitted to the FWMV. Trains of spur gears, running off the central power take off, drove oil pressure and scavenge pumps below it and the twin overhead camshafts and auxiliaries above it. The auxiliaries were located out of the way on top of the crankcase and included twin fuel-injection pumps and distributors and a single alternator. As a result, the engine was extremely compact, being only 1in longer than the FWMV at 30.9in and 22.6in wide.

Development

Design work had commenced in 1963 and the first engine ran on the test bed in late 1964. From the outset it suffered severe torsional vibration at low revs and the output shaft running off the crankshaft overheated and sheared. A stronger replacement shaft took time to produce and, when this too failed, a stop was put on running the engine below 4000rpm. Internal power losses severely restricted output and nothing approaching the 240bhp anticipated was achieved. These problems were not insurmountable but time was running out. Eventually an output of 209bhp was seen but this was only marginally better than that produced by an ordinary Mk 4 FWMV. By this time, the 1965 GP season was well under way and Jim Clark's FWMV-powered Lotus was set to take its second World Championship. Such a complex engine was always going to take time to develop and then prove itself under race conditions and there was now little point in continuing development further. In the event, the expected challenge from the Honda and Ferrari 12s did not materialise. Although several months ahead of the FWMW in development, they were still in the process of proving themselves. As it was, the FWMW ended up as little more than an expensive and wasteful blot on Coventry Climax's otherwise excellent reputation.

Epilogue

The end of the 1½-litre F1 also marked the close of Coventry Climax's significant contribution to GP racing. Leonard Lee had announced his irrevocable decision to withdraw from GP and all forms of racing on the grounds of cost. The FPF and FWMV engines had accounted for 25 wins out of the 47 GPs run under the 1½-litre regulations, a remarkable 53 per cent.

de Tomaso

Alejandro de Tomaso had ambitions to emulate BRM, Ferrari and Porsche by designing and manufacturing an F1 car in its entirety, inclusive of engine and transmission. To do so he employed Alberto Massimino to carry out the design work. Massimino was a very experienced engineer who had worked for both Maserati and Ferrari before taking up a consultancy role in semi-retirement.

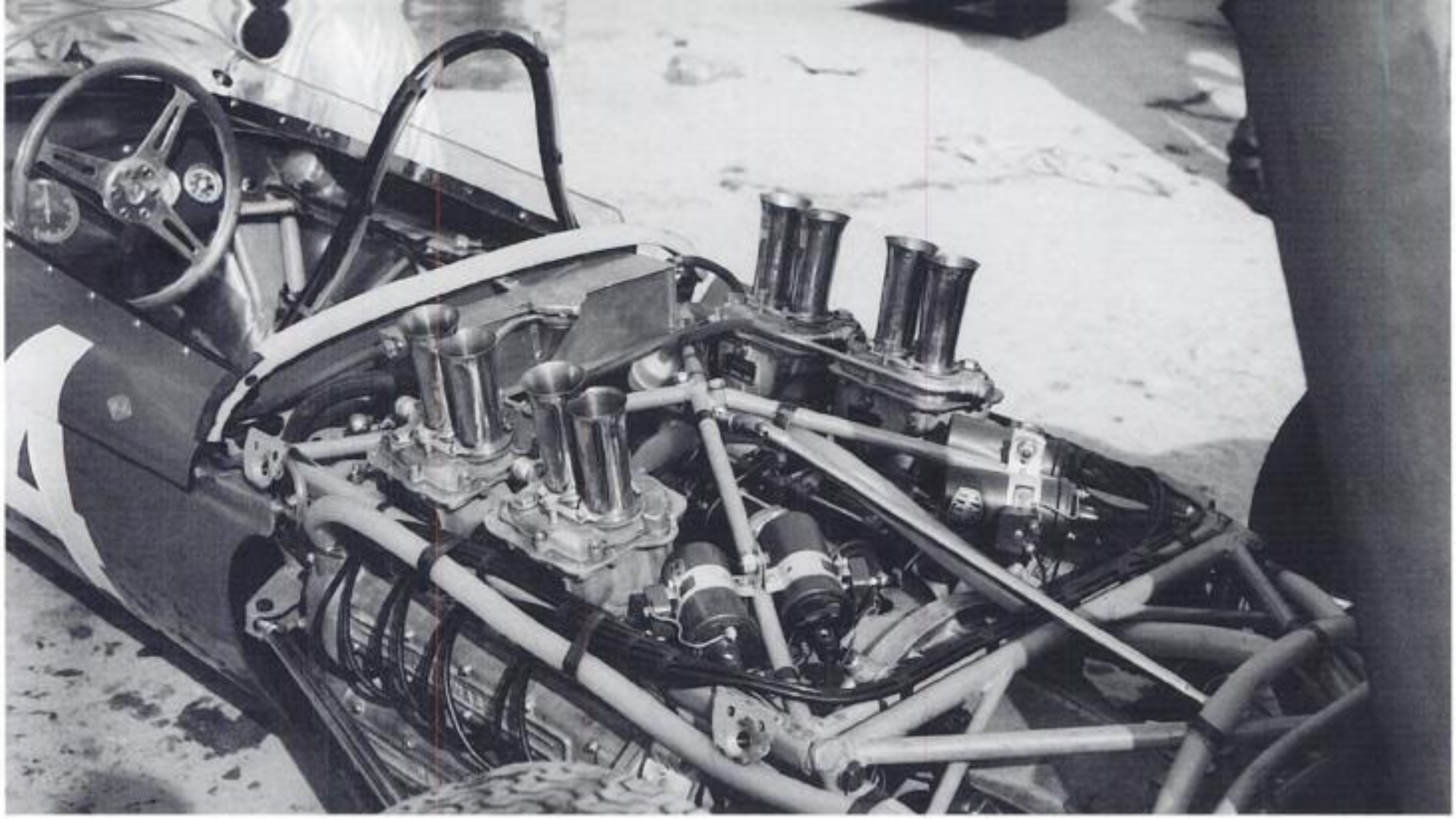
DE TOMASO 801 FLAT-8

Massimino came up with a water-cooled flat-8 engine with a bore and stroke of 68mm by 51mm and twin overhead camshafts per bank. There were four coils, twin distributors driven off the inlet camshafts of each cylinder bank, and twin sparkplugs per cylinder. With four twin choke Weber 32DCM carburettors, an output of 170bhp was claimed. The engine was said to be well finished but, by the time of its first appearance in September 1962, the BRM and Coventry Climax V8s were already producing over 180bhp.

The engine made its debut in a new chassis from de Tomaso at the 1962 Italian GP but would not run properly and the car failed to qualify. One more appearance was made in the non-Championship Rome GP in 1963 before it disappeared, never to be seen again.

Ferrari

In 1955, Ferrari had been handed the Lancia GP team following the financial collapse of that company. As part of the deal, the services of a long-standing friend of Enzo Ferrari were acquired, the brilliant designer Ingegnere Vittorio Jano. Having joined Alfa Romeo at the instigation of Ferrari, he had become technical director in 1926 and been responsible for such 'classic' Alfas as



de Tomaso 801: looked impressive but ran slowly in practice at Monza 1962.

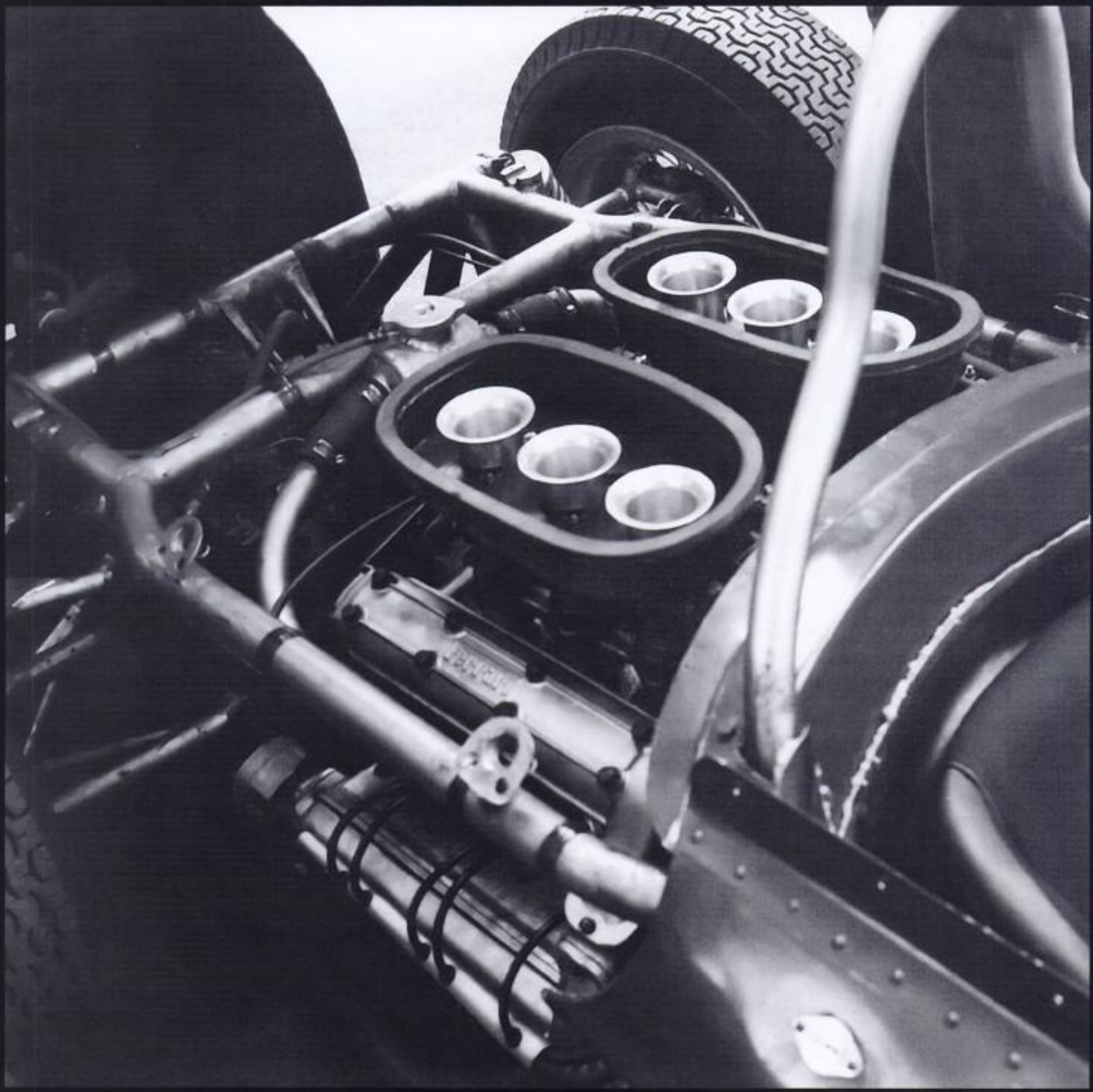
the 6C-1750, Monza and Monoposto GP cars. In 1937, he moved on to Lancia and, postwar, had masterminded its sports racing, GT and, finally, GP cars. His arrival at Maranello coincided with the announcement of a new F2 class with a capacity limit of 1½-litres, to be effective from 1957. Jano designed a new, compact V6 engine for the formula and it was up and running by the end of 1956. It was to be the forerunner of a series of V6 engines, similar in concept and sharing many components, but differing in block size and capacity. These engines carried the name 'Dino' in memory of Enzo Ferrari's son who had died at the age of 26 and who had been involved in the evolution of the V6. The Dino 156 (Ferrari type numbering indicating engine capacity/number of cylinders – hence 1.5 litres/6 cylinders) was raced only infrequently as development impetus concentrated on enlarging it to 2½-litres for F1 use in 1958-60. In this form it powered Mike Hawthorn to his 1958 World Championship.

FERRARI DINO 156/65° V6 AND 156/120° V6

Following the announcement of the 1½-litre F1 for 1961, it was obvious that the Jano designed Dino 156 formed an excellent basis for an engine to power a new generation of rear-engined Ferrari single-seaters. While the British constructors were making their ill-fated attempt to resist the new formula, Ferrari technical director Ingegnere Carlo Chiti was working on the experimental rear-engined Ferrari chassis and on a more over square development of the 156. Bore and stroke were amended to 73mm by 58.8mm, compared to Jano's 70mm by 64.5mm, giving a capacity of 1476cc. Producing around 180bhp, this engine won the 1960 F2 Solitude GP at a time when British engine designers were only just commencing work on their 1½-litre engines.

Over the winter of 1960, Chiti reconsidered his engine configuration and came up with a modified 156 with an included angle of 120° between the cylinder banks, as opposed to the 65° of the original. Such a wide layout was only possible in a rear-engined chassis but offered benefits of improved balance, a lower centre of gravity and sufficient space within the vee to allow for more efficient shaping of inlet tracts and the possibility of installing fuel-injection. The engine was conceived and produced in the space of only three months, although it did share bore and stroke dimensions and a number of components with the 65° Solitude winning engine.

The manufacture of a new combined cylinder block and crankcase enabled Chiti to save metal in the siluminum casting as it was to be built solely as a 1½-litre engine, whereas the Jano V6s had included scope for enlargement to up to 2½-litres. The block was ribbed for rigidity and completed by a wide, finned



Opposite: Ferrari Dino 156 120° V6: two triple choke Weber 40IF3C carburettors: note the kinked upper chassis members to provide clearance during engine installation/removal.

cast alloy sump. A significant change was the reversion to normal Ferrari practice of offsetting the right side cylinder bank ahead of the left, as opposed to the opposite of Jano's engine. Cylinder liners were of the top-seating type with a separate fire joint ring and a single toroidal rubber seal housed in the crankcase and gripping the lower end of the liner. The crankshaft, machined from a solid steel billet, ran in four main bearings and was suitably counterbalanced. As part of Chiti's weight saving exercise, the main bearings were of smaller diameter and cylinder head securing studs were reduced to eight from the twelve of the 65° engine.

Hemispherical combustion chambers contained two valves per cylinder and twin sparkplugs. The valves were set at an included angle of 60°, the inlet set at 28° from the vertical and the exhaust at 32°, as in the Jano engine. Exhaust valves were of 34mm diameter whereas the inlets were either 38.5mm or 42mm, depending on whether there was a requirement for mid-range torque or top end power. The valves were operated by twin chain driven camshafts from two half-speed gears on the crankshaft nose and closed by coil springs. Also driven off the front of the engine was a water pump with one inlet and outlet per cylinder bank, two 6-cylinder distributors for the twin ignition and the oil pressure and scavenge pumps.

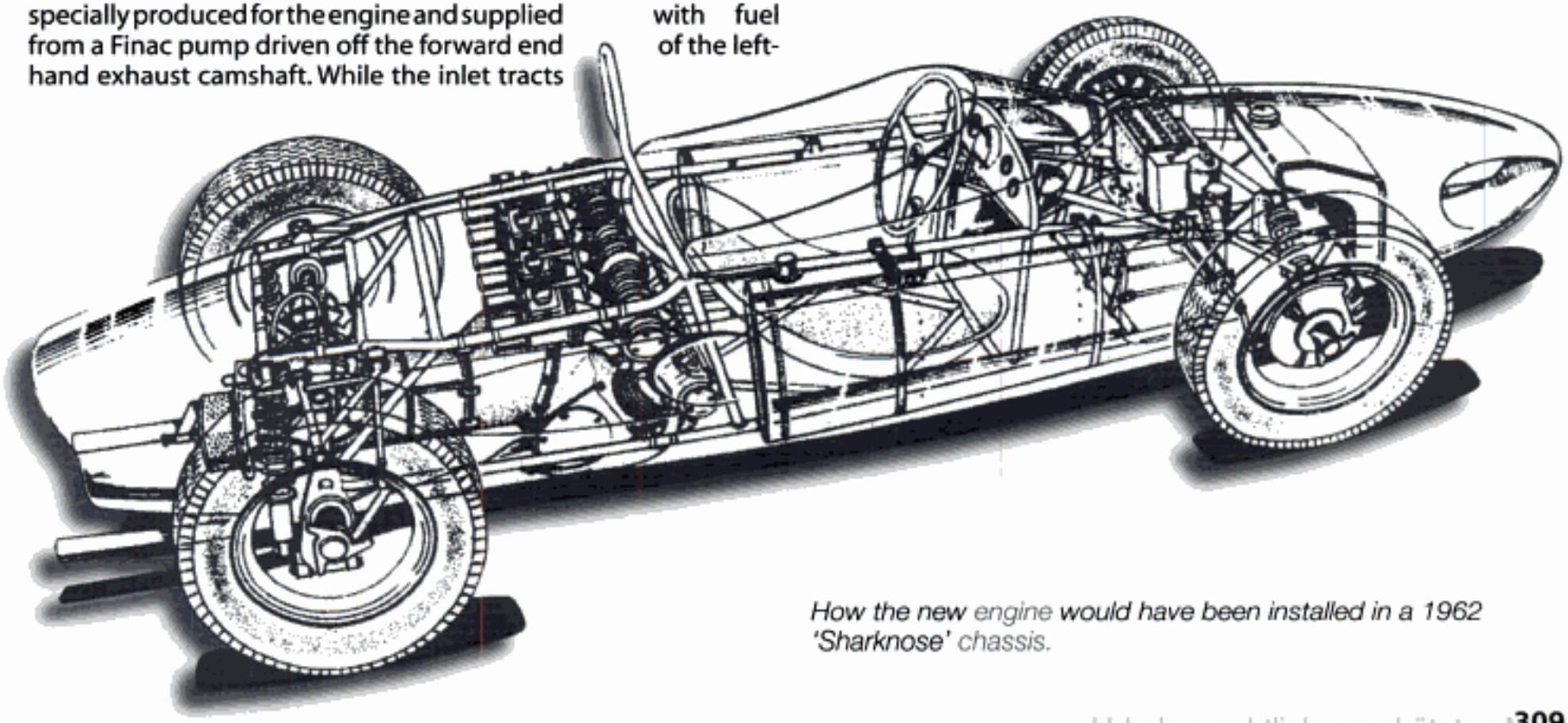
Induction was via twin triple choke Weber 40IF3C carburettors, specially produced for the engine and supplied with fuel from a Finac pump driven off the forward end of the left-hand exhaust camshaft. While the inlet tracts lacked any evidence of fine-tuning, the exhaust system had certainly benefitted. Exhausts from each cylinder merged into a single outlet per bank and extended to over 5ft in length from manifold to megaphoned tailpipe.

The engine was very compact, measuring 16in from front to rear of the crankcase, with a further 6in added to the front for auxiliaries. Claimed dry weight was 225lb, some 30lb lighter than the Coventry Climax FPF in equivalent form. Initial tests of the engine gave a power output of 177bhp but by the end of the season this had improved to a claimed figure of 192bhp at 9500rpm. This was a margin of 40bhp over the Climax FPF Mk 2 equipped British constructors and more than enough to make up for Ferrari's inferior roadholding.

Performance – 1961

Only one Dino 156/120° V6 appeared at Monaco for the opening round of the 1961 Championship after initial track testing had shown up oil scavenge problems. This was rectified by fitting two external scavenge pumps following which no further problems were encountered. Some development work had continued on the Dino 65° V6 to bring its output up to approximately 185bhp, and two of these made up the Monaco entry. Thereafter, the 120° V6 was relied upon for the three works entries with 65° units powering the FISA or additional 'guest' entries.

Reliability was good, with engine-related retirements at Reims and Monza only. At the former, Ginther had his oil pressure zeroise in a race won by the 65° V6 after the other 120° V6s had



How the new engine would have been installed in a 1962 'Sharknose' chassis.

Air-cooled Ferrari engine!

In March 1962, the motoring press revealed that a new air-cooled F1 engine was to be developed by Ferrari in collaboration with Gilera, the Italian motorcycle company. Gilera had an unrivalled racing record having won every 350cc and 500cc World Championship in the years prior to its retirement from racing at the end of 1957. Using motorcycle technology, the engine was to be an 8-cylinder in-line unit mounted transversely in the chassis. Cooling air would be ducted to the engine, there being no mechanical fan. Twin overhead camshafts and desmodromic valve gear was expected to allow it to rev up to 11,000rpm and produce 215bhp on Weber carburettors. All the engine bearings were either needle or roller type and power take-off was from the centre of the engine, avoiding the torsional vibration associated with a long crankshaft.

The project did not materialise, but Carlo Chiti was known to have been working on a car with a transversely-mounted, air-cooled engine when he quit Ferrari, towards the end of 1961.

dropped out or been delayed. At Monza there were three engine failures (including one 65° V6), all due to valve spring failure as a possible result of the use of the high speed banked circuit. The sole surviving Ferrari won its fifth GP of the season that, together with five seconds, four thirds and three other placings, steered the Italian team to convincing wins in both the Manufacturers' and Drivers' World Championships.

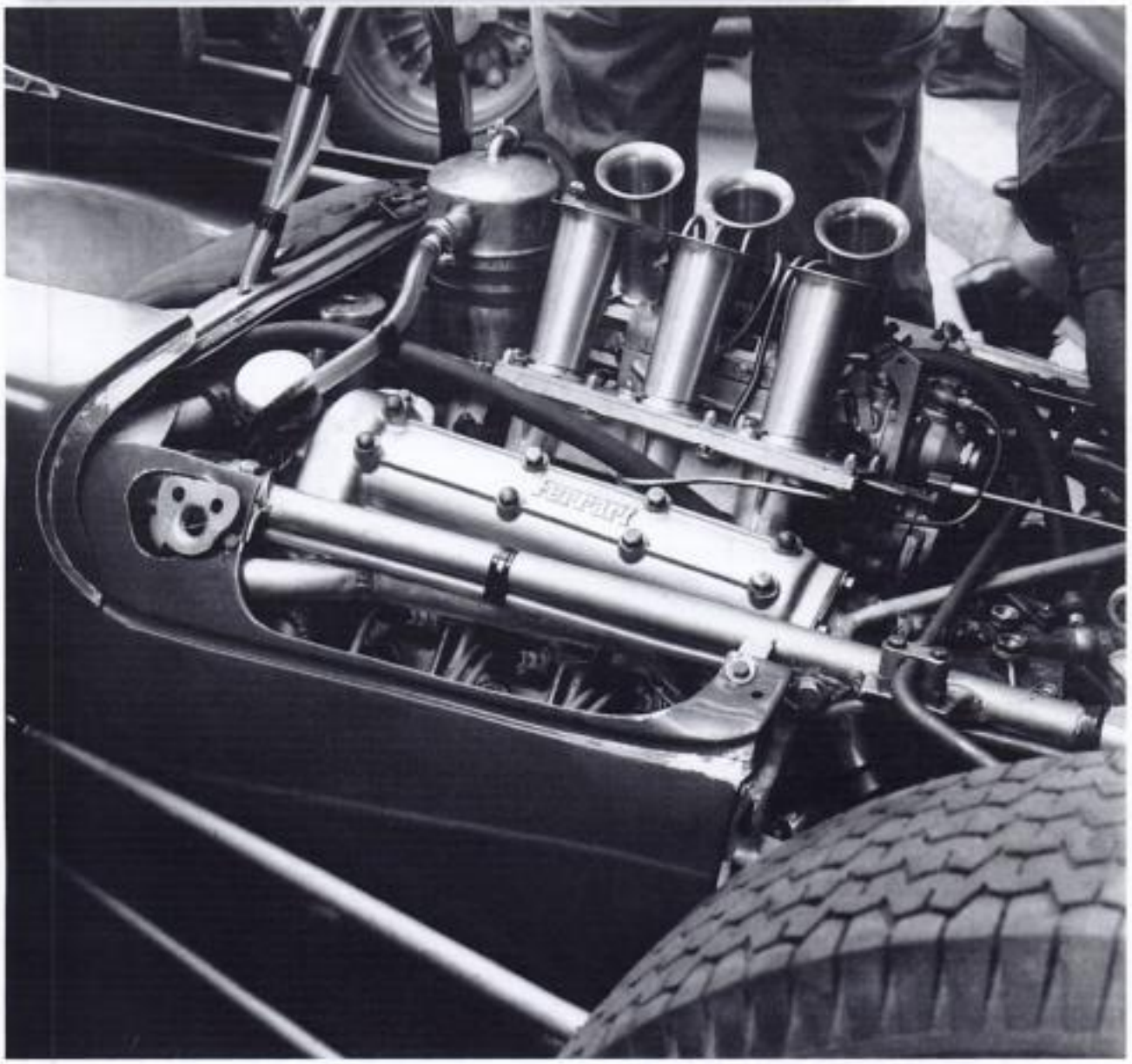
Development and performance – 1962

Prior to his resignation from Ferrari in autumn 1961, Carlo Chiti had been developing a number of alternative cylinder heads for the 120° V6. These included 2-valve cylinder heads with two or three plugs together with three and 4-valve heads with either single or twin plugs, the object being to improve combustion and gas flow. The 4-valve head appeared at Ferrari's Press Conference in February 1962 and was claimed to develop 200bhp at 10,000rpm. In the event, Chiti's successor, Mauro Forghieri, pursued none of these alternatives, the 120° V6 and (surprisingly) the 65° V6 racing throughout 1962 in little more than 1961 specification.

The Dino 156 V6s were now completely outclassed by the new generation of British V8s from BRM and Coventry Climax, and the flat-8 Porsche. The season appeared to start satisfactorily with a second, three thirds and two fourths in the first three GPs but, thereafter, only a further three GPs were entered, with a best finish of fourth. Following the Italian GP, Ferrari withdrew from racing for the remainder of the season.

Developments for 1963

Although Ferrari had a new V8 power unit under development, delays – mainly due to other priorities – meant that it was unlikely to be seen until well into the 1963 season. In fact, it was never raced in 1963, reliance being put on the familiar 120° V6 for a third season. The engine was nearing the limit of its development potential but new life was breathed into it by replacing the Weber carburettors with Bosch fuel-injection. The Swiss fuel-injection expert and sometime GP driver Michael May who had learned his trade at Mercedes and,



Ferrari Dino 156 120° V6: in its final form with Bosch fuel-injection early in 1963.

from the conventional position on the outside of each cylinder bank, a four-into-one system feeding into a long tailpipe tipped with a megaphone.

A Bosch high-pressure direct fuel-injection system was developed by the Swiss expert Michael May who had installed a similar system on the Dino 156. The metering unit was mounted in the vee, driven by a cogged belt from the rear of the right-hand inlet camshaft. Twin Bendix electric pumps drew fuel into a filter/collector tank from whence it was drawn off by a mechanical pump driven off the left-hand exhaust camshaft. Fuel was injected into each cylinder at a point within the vee, just below the cylinder head joint, aimed across the combustion chamber at the exhaust valve. Sliding plate throttles, as seen on the British V8s, were drawn rearwards on opening.

Two twin-contact breaker Marelli distributors driven by skew gears from the camshaft drive powered two sparkplugs per cylinder, set at an included angle of 20°. Two 10-volt coils were fitted per contact breaker, this being the only way to obtain a satisfactory spark from conventional ignition for crankshaft speeds of around 11,000rpm. Current came from a Marelli alternator driven by a cogged belt from the front end of the right-hand exhaust camshaft.

Development and performance – 1964

Debut of the engine was delayed mainly by the priority given to the endurance racing team and the Le Mans 24 Hour race. It eventually appeared in testing at Modena on 25 August 1963 but was not run in the Italian GP as had been expected due to concerns as to its reliability. It was not seen in public again until the Ferrari press conference in January 1964.

Over the winter of 1963/64 development work concentrated on improving mid-range torque, mainly through camshaft modifications and by lengthening the inlet trumpets with a short, curved extension that brought them into a vertical position. Such modifications gave a claimed power output of 210bhp at 11,000rpm.

The opportunity of matching the engine against the latest British V8s in non-Championship races was forgone in favour of development testing at both Modena and Monza. This testing had revealed that the crankcase was not sufficiently stressed to act as a structural member of the chassis, as had been intended. There was a risk that loads fed into the crankcase could cause it to distort, misalign the bearings and give rise to increased wear and friction, and loss of power. This was resolved by adding a simple tubular sub-frame to the chassis, relieving the engine of major suspension loadings.

Although five engines had been built by the opening round of the 1964 Championship, bearing and lubrication problems had prompted the addition of a second oil scavenge pump before a lone V8 made its GP debut at Monaco. Bearing problems persisted, however, and a third scavenge pump was added after the French GP in June. In the Belgian GP, fuel vaporisation problems were encountered and the fuel collector tank was replaced with a large, finned filter mounted in the airstream, behind the driver's left shoulder but both cars were early retirements with piston failures.

In an effort to concentrate on the production of at least one reliable V8 engine, only a single 158 chassis was prepared for the British GP and this seemed to work as John Surtees finished third. The team now had more time for F1 having discharged its endurance racing responsibilities. Fuel-injection problems encountered at small throttle openings due to weak mixture were overcome by fitting an electrically operated enrichment device controlled by the driver, and the bearing problem was finally resolved in August following a visit to Modena by a team from the British Vandervell bearing company. A spare 158 was available to Surtees at the Nürburgring, and resolution of the fuel-injection and bearing problems provided him with the opportunity to repeat the previous year's victory. Surtees was on form at Monza, qualifying on pole and winning comfortably while Bandini brought a second 158 home third. Ferrari was now on a roll, having won three GPs on the trot (two to the V8 and one to the Dino 156) and, together with three seconds and two thirds, were sufficient to net Ferrari and John Surtees the 1964 World Constructors' and Drivers' Championships.

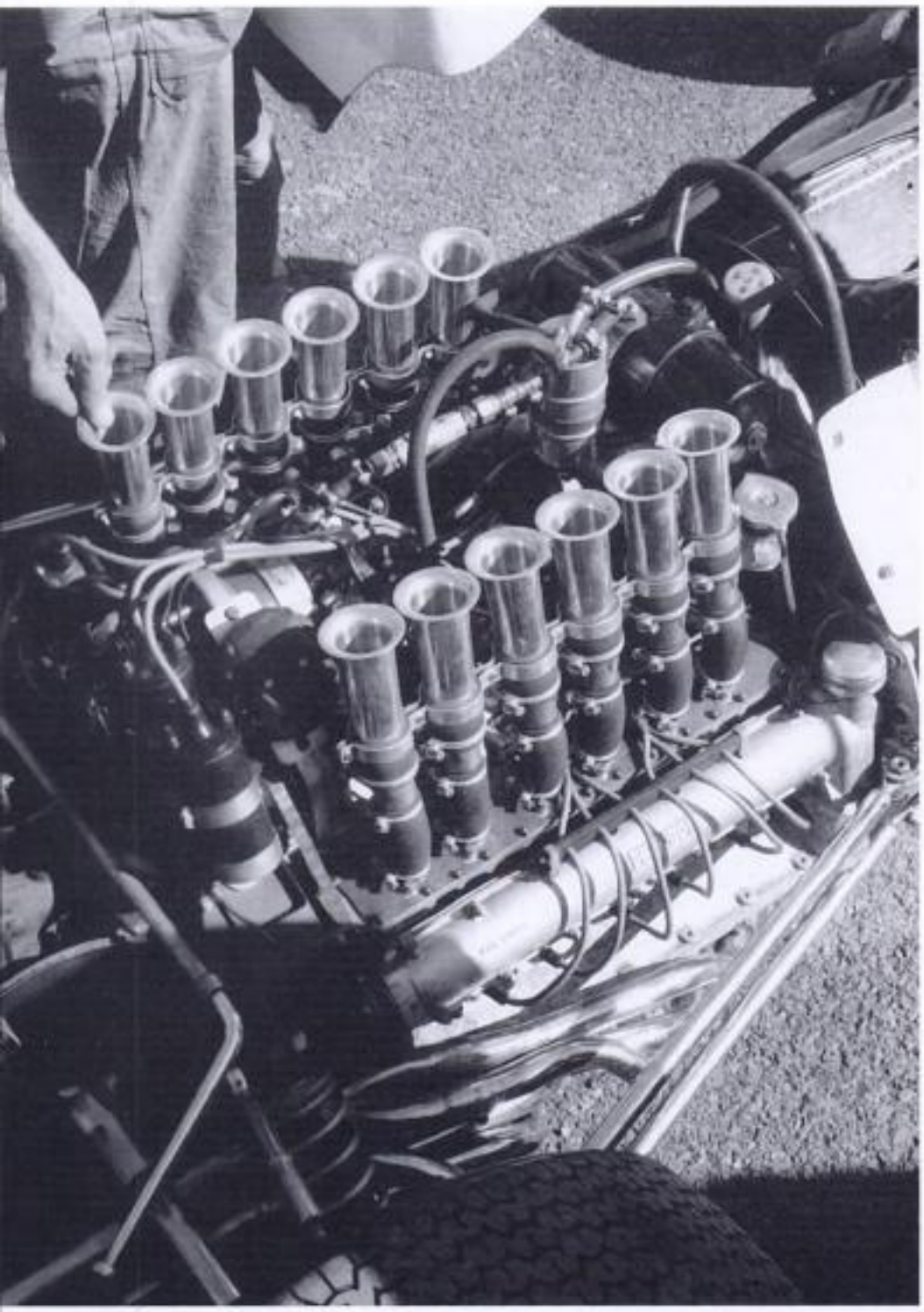
Development and performance – 1965

Only minor changes were made to the 158 for 1965, greater emphasis being put on the new flat-12. A smaller Bosch injection pump was fitted and the ignition coils had been relocated from a position above the pump to the rear suspension crossmember. The lengths of the inlet tracts had apparently been finalised as there was now a new monobloc casting per cylinder bank, eliminating the original multi-part inlet tracts.

In the absence of a fully developed 1512, John Surtees continued to use the 158 during the first half of the season. In 1964, the poor reliability of Jim Clark's Coventry Climax engine had given Ferrari the opportunity to contest the Championship down to the wire but there was no such opportunity in 1965. The 158 proved inferior to both the Climax (in Clark's Lotus) and BRM V8s. Highest placings achieved were only a second, third and fourth.

Ferrari Tipo 158 V8 performance summary

Year	Starts	Finishes	Engine related failures	1st	2nd	3rd	4th	5th	6th	PP	FL
1964	14	8	4	2	3	2	-	-	-	2	2
1965	10	7	3	-	1	1	1	-	1		
Total	24	15	7	2	4	3	1	-	1	2	2



Ferrari 1512: flat-12 complexity on top of the 1964 version of the engine – 12 plug leads, 12 fuel-injection trumpets, high-tension leads from four coils and Lucas fuel-injection pump just aft of the roll bar. During 1965, twin ignition heads were introduced, each of the four coils feeding six plugs per cylinder bank.

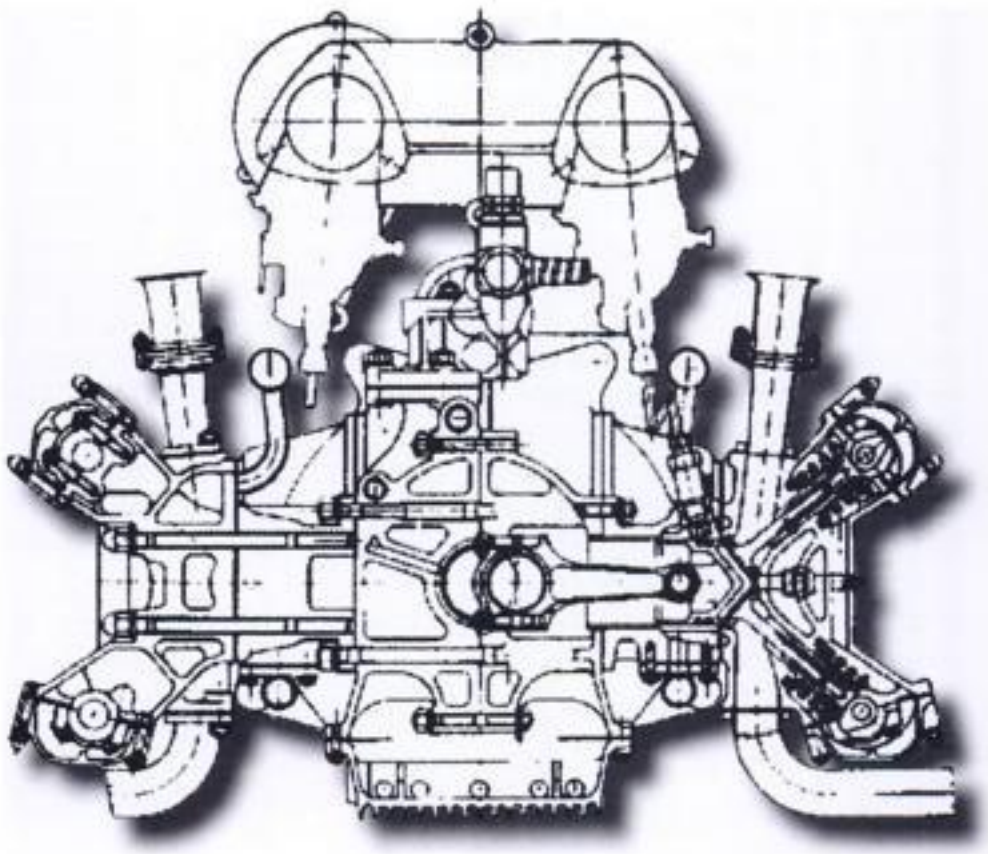
FERRARI TIPO 1512 FLAT-12

The flat 12-cylinder engine was the second new generation Ferrari racing engine conceived in late 1962 to replace the Dino 156 V6. It was reasoned that the way ahead lay with higher revving multi-cylinder engines. A 12-cylinder unit, apart from being a traditional Ferrari configuration, offered potential to rev up to 12,000rpm and horizontally-opposed cylinders offered perfect balance. This layout would also be very compact as most of the engine accessories could be located on top of the cylinder block/crankcase. Up to 1964 a number of flat-12 racing engines had been conceived and built, notably by Alfa Romeo and Cisitalia, but none had actually raced. Ferrari would earn the distinction of being the first manufacturer to do so.

At a glance:	Ferrari 1512
Cylinders:	12 horizontally-opposed
Stroke/bore ratio:	0.90:1
Carburetion:	Lucas fuel-injection
No. of valves:	2 per cylinder
Piston area:	295.7cm²
Max. power:	225bhp @ 11,500rpm
Bhp per litre:	150.0

Design and construction

The engine was largely the work of Chief Engineer Mauro Forghieri whose design team was heavily committed both to F1 and the endurance racing series. Consequently, work on the engine did



Cross-sectional view of the Ferrari 1512 flat-12 engine. This is an early version with Bosch fuel-injection, short inlet trumpets and a single plug head.

not proceed as quickly as anticipated. It was type numbered 1512 in accordance with Ferrari F1 convention of combining capacity and number of cylinders, i.e. 1.5 litres, 12 cylinders.

After some experimentation, a bore and stroke of 56mm by 50.4mm was settled upon, giving a capacity of 1490cc and a stroke-to-bore ratio of 0.9 to 1. The combined cylinder block and crankcase was cast in aluminium alloy, split into two halves along the crankshaft centre line and braced on the underside by a cast alloy sump. The engine was designed with sufficient rigidity to act as a load bearing member when installed in the Aero type monocoque chassis. Bolted rigidly to the back of the chassis, rear suspension, braking and transmission loadings were fed through mounting points cast into the engine and transmission unit.

The crankshaft ran in seven main bearings and had three equally spaced throws with side-by-side connecting rods. Two valves per cylinder were actuated by twin over head camshafts per cylinder bank driven by a train of spur gears from the front of the crankshaft. At an included angle of 80°, the inlet and exhaust valves were more widely spaced than on contemporary British V8s. Downdraught inlet ports and Bosch direct fuel-injection provided the mixture for each cylinder. An internally cogged belt drove a six plunger Bosch fuel-injection pump from the rear of the right-hand inlet camshaft. A further belt took drive from the first to a second Bosch pump with the alternator running in parallel. A single spark plug per cylinder was a break with Ferrari twin ignition tradition. These were energised by twin, orthodox high-tension distributors driven by a separate enclosed chain drive from the spur gears on the front of the engine.

The engine was first revealed to an unsuspecting motoring press at the annual Ferrari press conference at Maranello on Saturday 18 January 1964. No details were revealed and it did not appear to have run, but there was an expectation that it would race late in that season. Forghieri's engine team pressed ahead with development but the flat-12 was not seen again until September when it appeared in Saturday practice for the Italian GP. By this time some significant changes had been made, notably the adoption of Lucas port-type fuel-injection. The injectors were positioned some 3in above a sliding plate throttle on each cylinder bank. Inlet trumpets were much longer, to extend the torque range, and angled inwards slightly. Bosch ignition was retained with two distributors and four coils mounted high on the back of the engine, each coil feeding three cylinders. Twin Lucas fuel pumps were driven by cogged belts, as on the initial version of the engine. The exhaust system was of a three-into-one type, running under the engine with twin tailpipes per bank exiting through the rear suspension. Power output was claimed as 210bhp at 11,500rpm on a compression ratio of 9.8 to 1.

Performance – 1964

The new engine was entrusted to Lorenzo Bandini at Monza but Saturday practice was wet and lap times unrepresentative. The decision was taken not to race it due to uncertainties over fuel consumption and endurance. The 1512 made its race debut a month later in the 1964 US GP at Watkins Glen where Bandini qualified eighth and ran as high as fifth before the engine failed just after half distance, one bank of cylinders smoking badly. Revised camshaft profiles and injection system modifications were said to boost power output by a further 5bhp and helped Bandini to third on the grid in the rarefied atmosphere of Mexico. The engine was competitive throughout the race, Bandini letting Surtees into second to claim the World Championship.

Development and performance – 1965

Despite the engine's apparently promising performance in the last GP of 1964, it lacked development. This was slow to be accomplished as Ferrari's priority was defending its endurance racing title, particularly in the light of Ford's challenge for victory at Le Mans. Nevertheless, a revised cylinder head with twin sparkplugs per cylinder was ready for the season opener in South Africa – Ferrari's break with tradition having been short-lived. The engine that appeared at Monaco in May had longer inlet trumpets, angled outwards rather than inwards, in an attempt to extend a torque range that remained inferior to that of the 158 V8. Each inlet tract comprised an aluminium spinning, a steel section incorporating the Lucas injectors, and a rubber hose as a vibration insulator. Oil surges and fuel consumption were problems but Bandini drove the 1512 to an encouraging second at Monaco in a riveting contest with Hill's BRM. This was to prove the engine's best result of the season and John Surtees did not use it until halfway through the season, by which time it was considered to be more fully developed.

Ferrari Tipo 1512 Flat-12 performance summary

Year	Starts	Finishes	Engine related failures	1st	2nd	3rd	4th	5th	6th	PP	FL
1964	2	1	1			1					
1965	12	9	1	-	1	1	2	1	-		
Total	14	10	2	-	1	2	2	1	-	-	-

Ferrari engine performance summary 1961-65

Year	Starts	Finishes	Engine related failures	1st	2nd	3rd	4th	5th	6th	PP	FL
1961	27	19	5	5	5	4	2	1	-	6	5
1962	20	13	3	-	1	3	3	1	1		
1963	18	7	7	1	1	1	1	2	1	1	3
1964	22	14	5	3	3	4	-	1	1	2	2
1965	22	16	4	-	2	2	3	1	1		
Total	109	69	24	9	12	14	9	6	4	9	10

New cylinder heads were ready for the team's home GP at Monza, incorporating altered port angles and revised inlet trumpets. Power was now up to 225bhp at 11,500rpm and Surtees felt that the engine was in good shape. Having qualified in second at Monza, he had fallen back with clutch problems to 13th place on lap 1 but by lap 14 was contesting the lead, only for the clutch problem to prove terminal. In Surtees' absence due to injury for the North American GPs, this performance was not repeated. Overall, the engine's torque curve was never broad enough to give it an advantage on any type of circuit.

Ford

A number of privateers took part in GPs in modified Formula Junior single-seaters, ballasted by 140lb to bring them up to the F1 minimum weight limit. Production-based Ford engines were dominant in the lower formulae and provided an easily obtainable, cheap power unit, yet were considerably underpowered compared to the customer BRM P56 V8 or second-hand Coventry Climax FWMV V8. Three types of Ford-based engines made World Championship GP starts over the period:

COSWORTH-MODIFIED FORD 105E

Cosworth Engineering dominated the FJ market with modified versions of the production Ford 105E engine from the Anglia saloon. This basic iron block engine with 'over square' stroke-to-bore ratio and pushrod-operated overhead valves developed approximately 100bhp at 7500rpm on two twin choke Weber carburettors in FJ trim. 1500cc versions of the engine could be persuaded up to circa 125bhp. This engine powered two entries in 1963 GPs – the Stebro in the US GP and Brausch Niemann's Lotus 22 in South Africa.

LOTUS FORD TWIN CAM

This engine was developed for the Lotus Elan sports car and was subsequently fitted to the Ford Cortina Lotus sports saloon. Based around a Ford 116E cylinder block with five bearing crankshaft, it was fitted with a light alloy, Cosworth-developed, chain driven twin overhead camshaft cylinder head. In standard tune this engine would develop 105bhp at 5500rpm and in racing trim could be persuaded to produce up to 150bhp. David Prophet ran this engine in his Brabham BT6 for the 1963 South African GP, and both Gerard Racing and John Willment Automobiles ran one in their Cooper T73 and Brabham BT10 chassis respectively in the 1964 British GP. The Willment Brabham was also entered for the 1965 South African GP recording a Ford-based engine's only finish in a 1½-litre F1 GP with a ninth place, 4 laps down on the winner.

Various Ford engines performance summary – 1963-65

Year	Starts	Finishes	Engine related failures	1st	2nd	3rd	4th	5th	6th	PP	FL
1963-65	7	1	1	-	-	-	-	-	-	-	-

COSWORTH SCA

This engine was developed for the new 1-litre F2 category introduced in 1964 and comprised a 5 main bearing, cast iron Ford 116E block fitted with a Cosworth-designed light alloy, single overhead camshaft cylinder head. As supplied to F2 customers, the SCA was equipped with two twin choke downdraught Weber carburettors and Lucas transistorised ignition. Power output was 124bhp at 9000rpm. David Prophet entered his Cosworth SCA-engined Brabham BT10 in the 1965 South African GP.

Although a cheap way into F1 for Private entrants, Ford powered cars were generally too slow to be classified as a GP finisher and consequently achieved nothing.

Honda

Honda Research & Development initiated an F1 project in late 1961 under the direction of Yoshio Nakamura. A number of engine configurations were evaluated before the go-ahead was given to build a V8 with an included angle of 135° between the cylinder banks. This was up and running by May 1962 and produced 209bhp at 10,600rpm but did not provide the desired margin of superiority over the competition (producing approximately 190bhp at the time) that was sought. Authority was given to build a new multi-cylinder engine to achieve this aim.

HONDA RA271 V12

Design and construction

The new engine was to be a 60° V12 designed for installation transversely across the chassis, the engine, gearbox and final drive comprising a single unit. In concept, it proved to be very similar to the Maserati Tipo 8 V12 revealed to the press in May 1964 (q.v.).

Bore and stroke were 58.1mm by 47mm, giving a capacity of 1495cc with a stroke-to-bore ratio of 0.8 to 1. The combined cylinder block and crankcase, together with cylinder heads and other components were cast in aluminium alloy. Using experience gained from its successful racing motorcycle engines, Honda designed cylinder heads with four valves per cylinder in pent-roof type combustion chambers. Although both

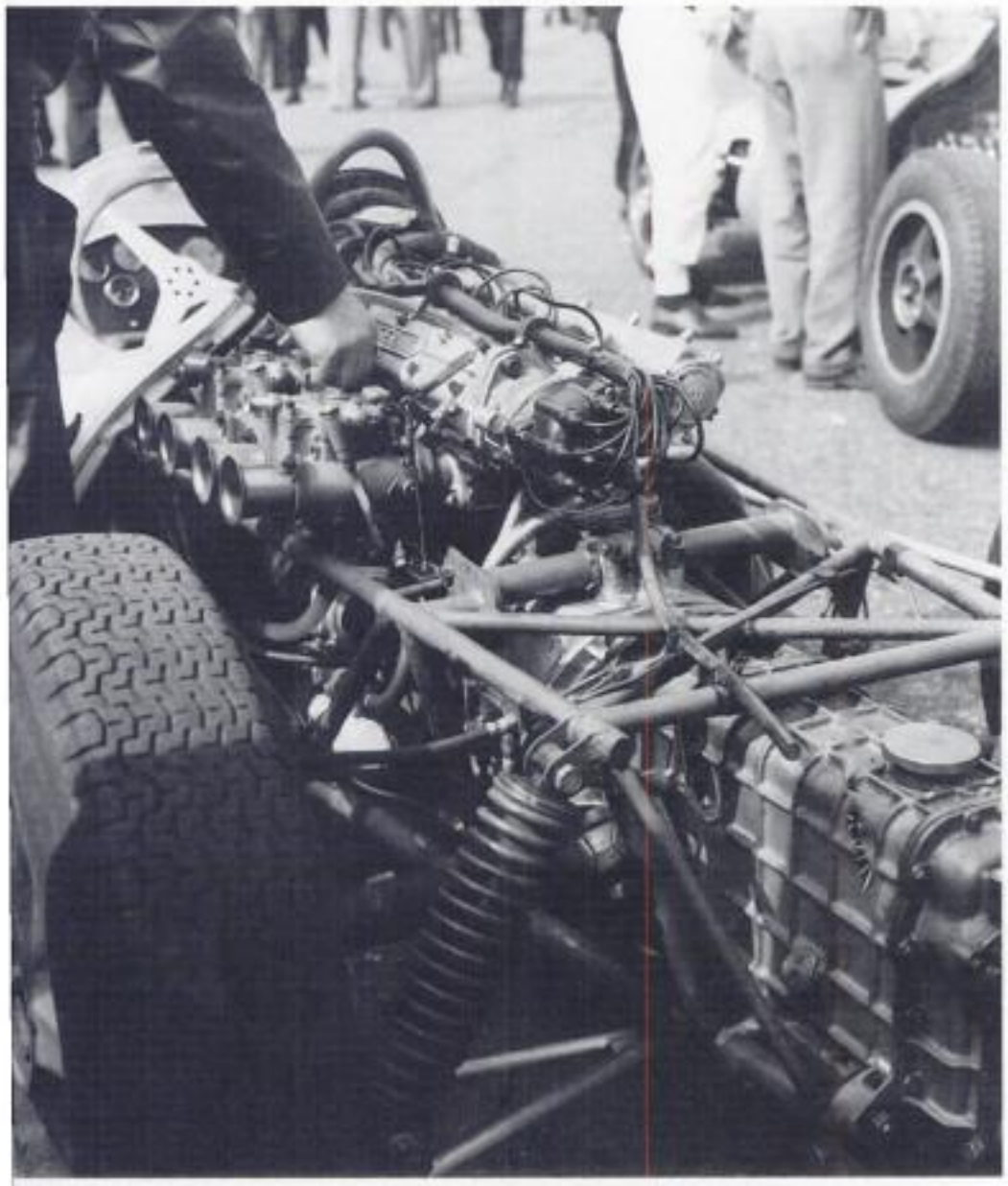
At a glance: Honda RA271 V12

Cylinders:	60° V12
Stroke/bore ratio:	0.81:1
Carburetion:	Honda fuel-injection
No. of valves:	4 per cylinder
Piston area:	318.3cm²
Max. power:	230bhp @ 11,000rpm
Bhp per litre:	153.3

Maserati 150S 4-cylinder performance											
Year	Starts	Finishes	Engine related failures	1st	2nd	3rd	4th	5th	6th	PP	FL
1961-63	14	8	4	-	-	-	-	-	-	-	-

In 1961, Scuderia Serenissima and Mimo Dei's BP Italia-backed Scuderia Centro Sud installed the 150S in Cooper T51 or T53 chassis. Between them they made 12 GP starts with a best finish of seventh for a Serenissima Cooper at Monaco. The engine was also the choice of Equipe National Belge for its team of Emerysons but they never managed a GP start.

Into 1962 and only one 150S-engined entry made a GP start, that being the ENB (née Emeryson) of Equipe National Belge. In South Africa, local driver Trevor Blokdyk ran a 150S engined Cooper T51 and entered it for the 1963 South African GP, finishing 12th some 8 laps down on the winner.



Maserati 150S: the engine achieved little in 1961, least of all in the Emeryson chassis.

MASERATI TIPO 8 V12

In May 1964, Omer Orsi released technical details and photographs of a V12 F1 engine designed for transverse installation in the chassis. Design work on the engine had started in October 1961 with drawings completed in just three months although the first engine was not assembled until April 1963 due to more pressing priorities in the Maserati machine shop. Unfortunately, the engine ran for only four hours on the test bench before financial considerations halted further development. The decision to reveal details of the engine was mainly prompted by the expected debut of a Honda GP car with a virtually identical engine design. Although the engine never reached installation in a chassis, details are included here as a matter of technical interest.

At a glance:	Maserati tipo 8
Cylinders:	60° V12
Stroke/bore ratio:	0.94:1
Carburetion:	Lucas fuel-injection
No. of valves:	2 per cylinder
Piston area:	287.3cm²
Initial Power:	170bhp @ 12,000rpm
Bhp per litre:	113.3

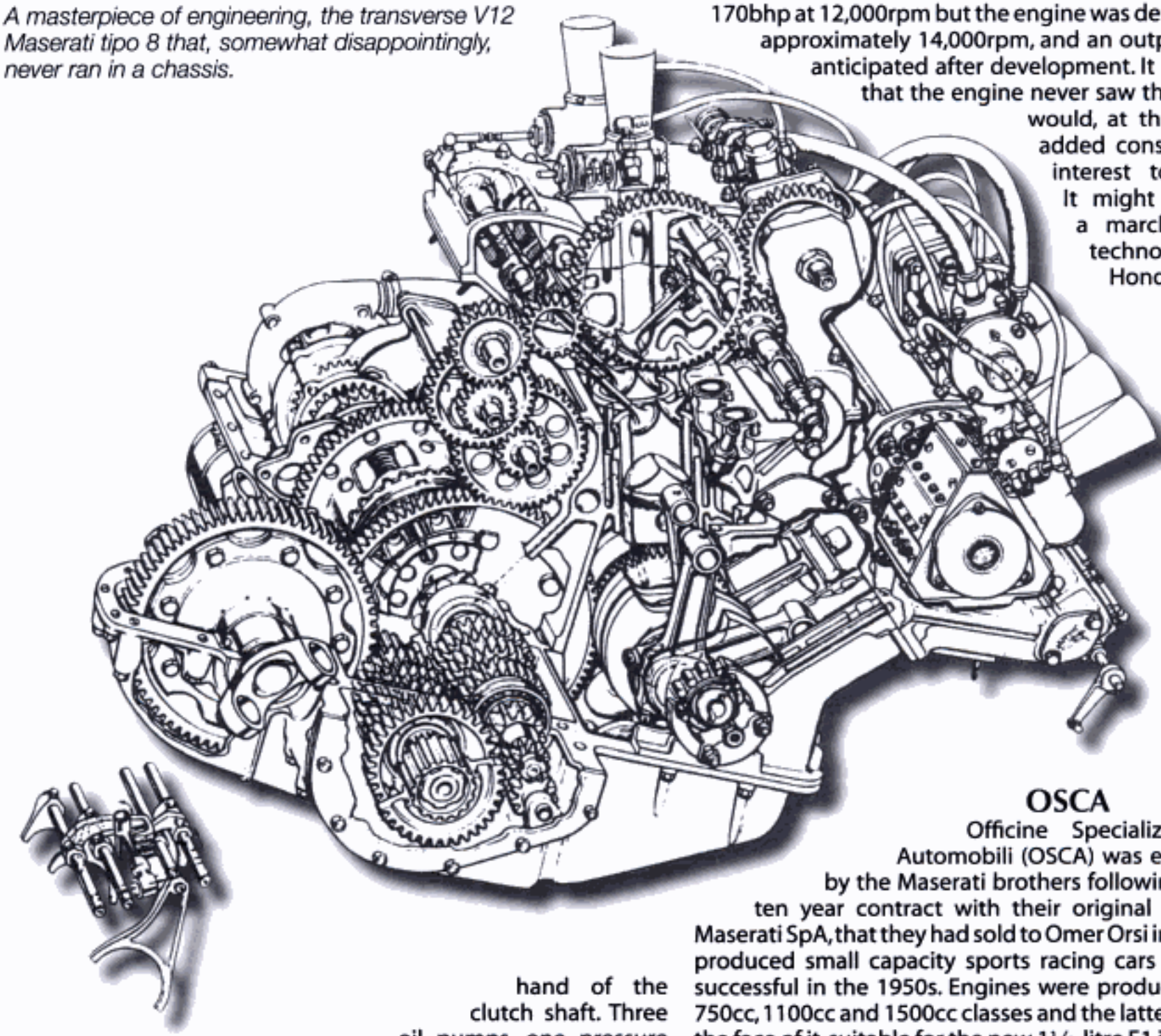
Design and construction

Chief engineer Ing Alfieri's choice of a transverse layout gave him the freedom to tilt the engine forward in the chassis by approximately 45° from its vertical axis, lowering the centre of gravity without incurring installation or asymmetric weight distribution problems. It also offered the advantage of a central power take-off from the crankshaft to reduce torsional loads and the opportunity to produce a remarkably compact engine. Overall width was 24.8in, height 18in and it measured 26in from front to driveshaft line, little more than the contemporary BRM or Coventry Climax V8.

The engine, gearbox and final drive were in a single unit made up of light alloy castings. The 12-cylinders were arranged in a 60° vee formation and followed normal Maserati practice. A bore and stroke of 55.2mm by 52mm gave a capacity of 1494cc and a stroke-to-bore ratio of 0.94 to 1. The most interesting feature was the power take-off. The six-throw crankshaft was divided into three equal sections of two throws each by two spur gears that meshed with two more on a parallel shaft carrying the clutch between them. Further spur gears transmitted power through a 6-speed gearbox to the differential.

Twin overhead camshafts and the auxiliaries were driven by a train of spur gears, those for the rear cylinder bank from the left-hand crankshaft power take-off, the forward bank from the right-

A masterpiece of engineering, the transverse V12 Maserati tipo 8 that, somewhat disappointingly, never ran in a chassis.



hand of the clutch shaft. Three oil pumps, one pressure and two scavenge, mounted in line were driven from the left-hand of the clutch shaft. Downdraught inlet tracts entered each cylinder between the inlet and exhaust camshaft boxes and were fitted with Del'Orto motorcycle piston type throttles. Fuel was injected into the ports by a Lucas injection system with one fuel distributor per cylinder bank driven off the camshaft gears. The crankshaft ran in seven main bearings, five plain and one roller type at each end. The latter were narrower than the plain bearings to minimise engine width.

Initial power output seen on a 11.5 to 1 compression ratio was 170bhp at 12,000rpm but the engine was designed to run up to approximately 14,000rpm, and an output of 225bhp was anticipated after development. It was disappointing that the engine never saw the light of day, as it would, at the very least, have added considerable technical interest to the GP scene. It might also have stolen a march on the similar technologically advanced Honda design that won the last GP in which it competed.

OSCA

Officine Specializzate Construttori Automobili (OSCA) was established in 1948 by the Maserati brothers following the end of their ten year contract with their original company, Officine Maserati SpA, that they had sold to Omer Orsi in 1937. They mostly produced small capacity sports racing cars that proved quite successful in the 1950s. Engines were produced to contest the 750cc, 1100cc and 1500cc classes and the latter at 1492cc was, on the face of it, suitable for the new 1½-litre F1 in 1961. The engine was noteworthy for having desmodromic (i.e. mechanically opening and closing) valve gear, and produced about 158bhp at 7500rpm from its 'square' bore and stroke dimensions of 78mm by 78mm.

Scuderia Serenissima installed the engine in a de Tomaso chassis and two GPs were entered in 1961, both resulting in retirements due to engine failure.

Porsche

Porsche was unique amongst the GP constructors of the 1½-

litre formula in employing air-cooling for its engines. This feature, together with the horizontally-opposed (or 'flat') cylinder layout had been inherited from the Volkswagen Beetle engine that had powered the first production Porsches. The VW itself was a product of the forward thinking of Dr Ferdinand Porsche but, that apart, the engine was relatively cheap and easily available in the early 1950s. Gradually, as development proceeded and production increased, Porsche redesigned and manufactured its own components to replace the VW equivalents. Through the 1950s, Porsche built its reputation on – and became identified with – air-cooled flat-4 engines and, with motor sport being used as a means of development, there was little incentive to move away from the original concept, had there ever been a desire to do so.

Unlike the British constructors, Porsche had no objection to the 1½-litre formula, seeing it as an opportunity to progress to F1 from its successful series of sports racing and GT cars via the F2 single-seaters of 1959/60. Consequently, by late 1960, it was reasonably well advanced in the design of a purpose-built flat-8 engine. In the event, however, development did not proceed as planned and reliance had to be placed on the familiar F2 type 547/3 4-cylinder power unit for 1961. This was a 'sprint' version of the engine used in the successful type 718 RSK sports racing cars that had been developed from the original VW unit.

At a glance: Porsche type 547/3

Cylinders:	4 horizontally-opposed, air-cooled
Stroke/bore ratio:	0.78:1
Carburetion:	2 t/c Weber carburettors
No. of valves:	2 per cylinder
Piston area:	227.1cm²
Max. power:	165bhp @ 8000rpm
Bhp per litre:	110.0

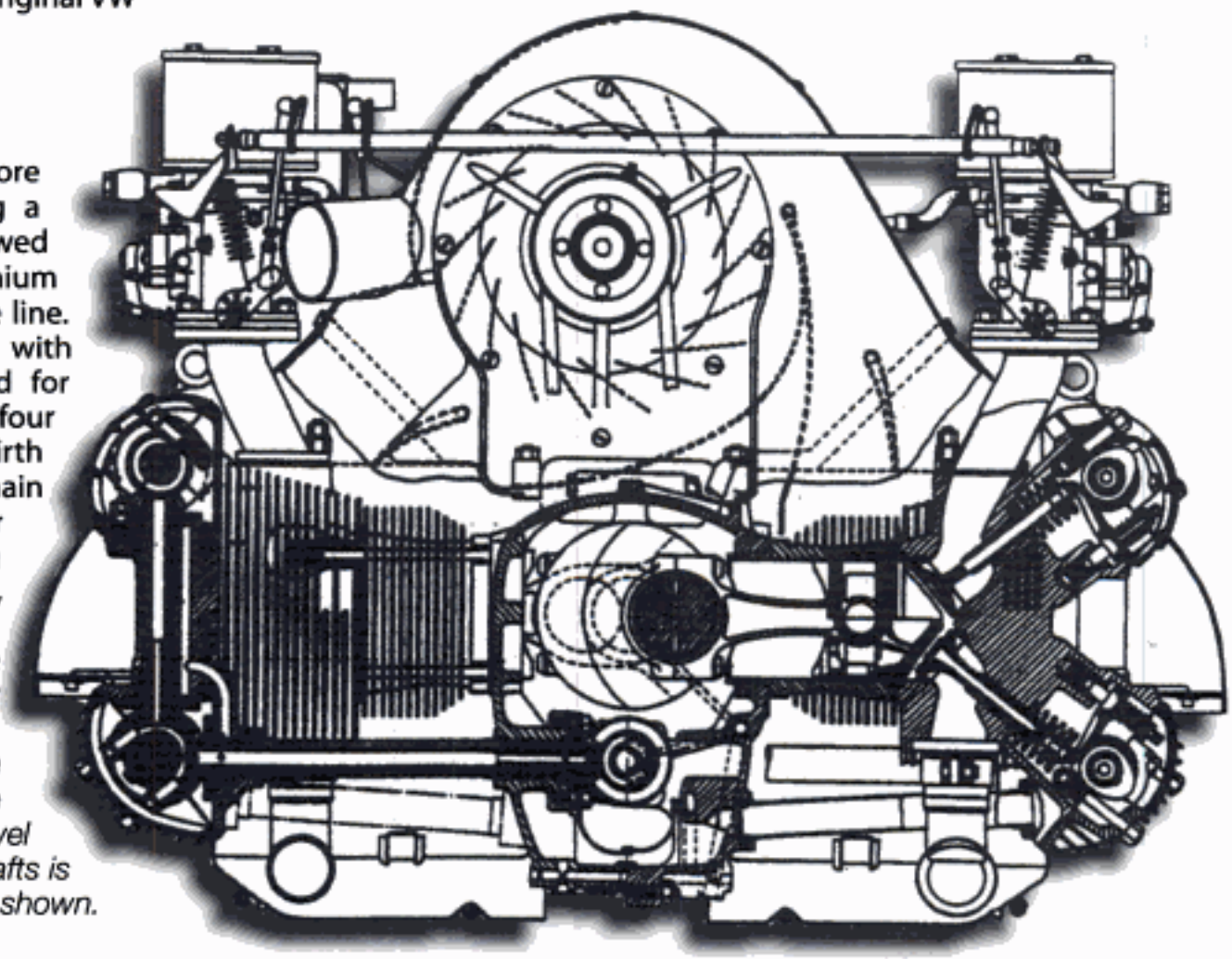
PORSCHE TYPE 547/3 FLAT-4

Design and construction

In F2 specification, the engine had a bore and stroke of 85mm by 66mm giving a capacity of 1498cc. The crankcase followed VW practice and was a two-piece aluminium casting, split along the crankshaft centre line. Individual aluminium cylinder barrels with chromium-plated cylinder bores, finned for heat dissipation, were each secured by four stud fixings. The crankshaft was of the Hirth built-up type, running in three roller main bearings. The advantages claimed for this construction were reduced bearing friction and the ability to use a lighter, stronger one-piece connecting rod.

The aluminium cylinder heads were cast in pairs and had two valves per cylinder and twin ignition. Valve sizes were 1.89in inlet and 1.61in exhaust in hemispherical combustion chambers. One sparkplug was biased slightly towards the inlet valve and the other similarly towards the exhaust. The valves were operated by twin overhead camshafts per cylinder bank.

On an air-cooled engine it is important that airflow across the cylinders should not be interrupted, particularly by the presence of a timing gear or chain case on the front of the engine. Porsche overcame this by adopting a bevel and shaft drive for the camshafts, as had been evolved by Dr. Porsche for the 1947 Cisitalia GP car. A central shaft driven by spur gears at half engine speed ran directly below the crankshaft. Drive was taken from this shaft by bevel pinions and gears to a crossshaft running between and below each bank of cylinders to the exhaust camshaft and then via a further vertical shaft to the inlet camshaft. Each bevel gear train comprised three gears



Cross-sectional view of the Porsche type 550 engine, basically similar to the type 547/3 F1 version raced in 1961. The bevel and shaft drive to the overhead camshafts is clearly shown.

and four bevel pinions. Individual cams were locked and keyed in position so that variations in valve timing could be provided comparatively easily. Oil scavenge and pressure pumps were driven off the central shaft.

The cooling fan was of the double entry type with a diameter of 240mm (9.4in) and running at approximately 0.9 engine speed. Cooling air was ducted through a sheet metal cowling containing carefully sited baffles to route the flow across the cylinders. Although the fan absorbed a small percentage of engine power, Porsche had satisfied itself that the power loss was no greater than that required to push a radiator of a water cooled car through the air. Exhausts from each cylinder merged into a single collector pipe per bank that itself merged into a single wide, oval section tailpipe exiting from beneath the centre of the car. Running on two twin-choke Weber 46-IDM1 carburettors, the engine would produce 165bhp at 8000rpm. Dry weight was given as 304lb.

Development and performance – 1961

For Porsche's GP debut at Monaco, the Weber carburettors had been replaced by Kugelfischer fuel-injection. Jo Bonnier ran second in the GP until a fuel system vapour lock cut his engine. Modifications were made to prevent the vapour locks in time for the Dutch GP but the engines lacked performance compared to not only Ferrari but also the Coventry Climax-engined British chassis, the highest placing being tenth. Porsche took this apparent failure hard but it was resolved to carry on. The fuel-injection set-up was dumped and the engines returned to Weber carburettors. The situation improved and, with reliability on their side, the cars began to pick up good placings, the highlight of which was the desperate duel for the lead in the French GP between Dan Gurney and the Ferrari of Giancarlo Baghetti, the decision going to the latter by 0.1sec.

The engine's power output was limited by its capacity to cool itself and by the life of its components. Typically, the life of a crankcase was five hours, its tie bolts six hours and a crankshaft, running at maximum power, only a single hour. Nevertheless, by the end of its debut season, Porsche had picked up sufficient placings to be classified third in the Constructors' Championship behind Ferrari and Lotus.

Porsche type 547/3 flat-4 performance summary

Year	Starts	Finishes	Engine related failures	1st	2nd	3rd	4th	5th	6th	PP	FL
1961	25	21	3	-	3	-	-	2	2	-	-
1962	12	9	1	-	-	-	-	1	2	-	-
1963	9	7	-				1	-	2		
1964	1	-	1								
Total	47	37	5	-	3	-	1	3	6	-	-

Over the winter of 1961/62, the Swiss fuel-injection specialist Michael May was engaged to work on the engine. By early 1962, he had achieved 185bhp by adopting Bosch direct fuel-injection and modifying porting and piston crowns. At this point, however, Porsche politics intervened, May was released and his improved engines set aside – the flat-4 could not be seen to have a power output superior to the new purpose-built flat-8.

Performance 1962-64

The 547/3 engine lived on through 1962 to 1964 in Dutchman Carel Godin de Beaufort's privately run Ecurie Maarsbergen Porsche 718. The engine proved to be extremely reliable, helping him to point finishes in both 1962 and 1963.

PORSCHE TYPE 753 FLAT-8

Porsche had already committed to the 1½-litre F1 by the beginning of 1960, much earlier than the British constructors who were still clinging to the vain hope that the new formula would fail to attract adequate support and be abandoned. Recognising that the existing Type 547/3 4-cylinder engine could never be developed to produce more than 175bhp, it was decided to design and build an entirely new engine that would be race ready early in 1961. In the event, the new engine took longer to develop than anticipated and did not appear on the grid until after the later starting British V8s.

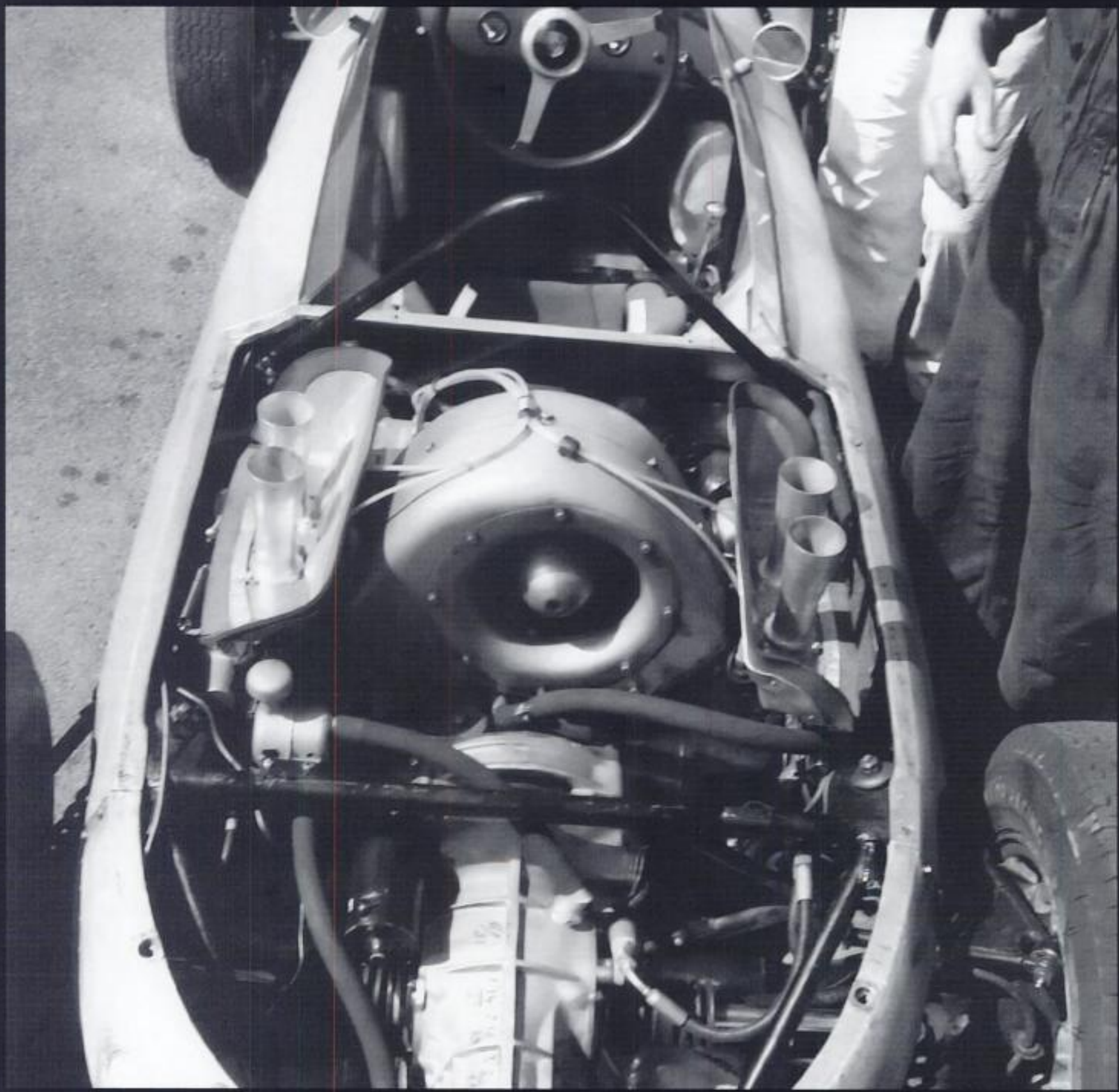
After the evaluation of both 12 and 16-cylinder alternatives, an 8-cylinder proposal with a relatively short stroke was decided upon. It was reasoned that this would allow the engine to run up to 10,000rpm at which speed a target power output of 220bhp, the minimum considered acceptable, would be achievable. The new engine would be air-cooled with a horizontally-opposed cylinder layout, the short stroke influencing the construction of the engine by reducing its overall width. It was no coincidence that all previous Porsche engines were of this layout but it was eminently suitable for air-cooling, had a lower centre of gravity and good internal balance.

Despite the success achieved by Porsche in

At a glance: Porsche type 753

Cylinders:	8 horizontally-opposed, air-cooled
Stroke/bore ratio:	0.78:1
Carburetion:	4 t/c Weber carburettors
No. of valves:	2 per cylinder
Piston area:	227.1cm²
Max. power:	178bhp @ 9200rpm
Bhp per litre:	118.7

Opposite: Porsche 547/3: the flat-4 is dominated by the cooling fan and air trumpets for the unsuccessful experiment with Kugelfischer fuel-injection, as here at Monaco 1961, installed in the equally unsuccessful 787 chassis.



endurance racing, commentators often expressed doubts as to the efficiency of air-cooling for an F1 engine, particularly in terms of the amount of power absorbed by the cooling fan. Figures were not published at the time but, in fact, only 9bhp was lost at 9000rpm, much less than the power lost from the drag created by the radiator of a water-cooled engine, although Porsches always had an, admittedly smaller, oil cooler in the nose. In 1962, the water radiator of an F1 car was, without exception, mounted in the nose of the car, and little thought had been applied to the aerodynamics of this arrangement, particularly the efficient ducting of hot air away from the radiator.

Design and construction

The new engine, type numbered 753, was designed by Hans Honich and valve gear specialist Hans Mezger. The latter would become better known in the late '60s for his work on the legendary Porsche 917. Simultaneously with the 753, a 2-litre version, type 771, was developed for sports and endurance racing. A 10mm increase in cylinder bore provided the extra capacity over the 1495cc of the F1 version with its 66mm bore and 54.6mm stroke.

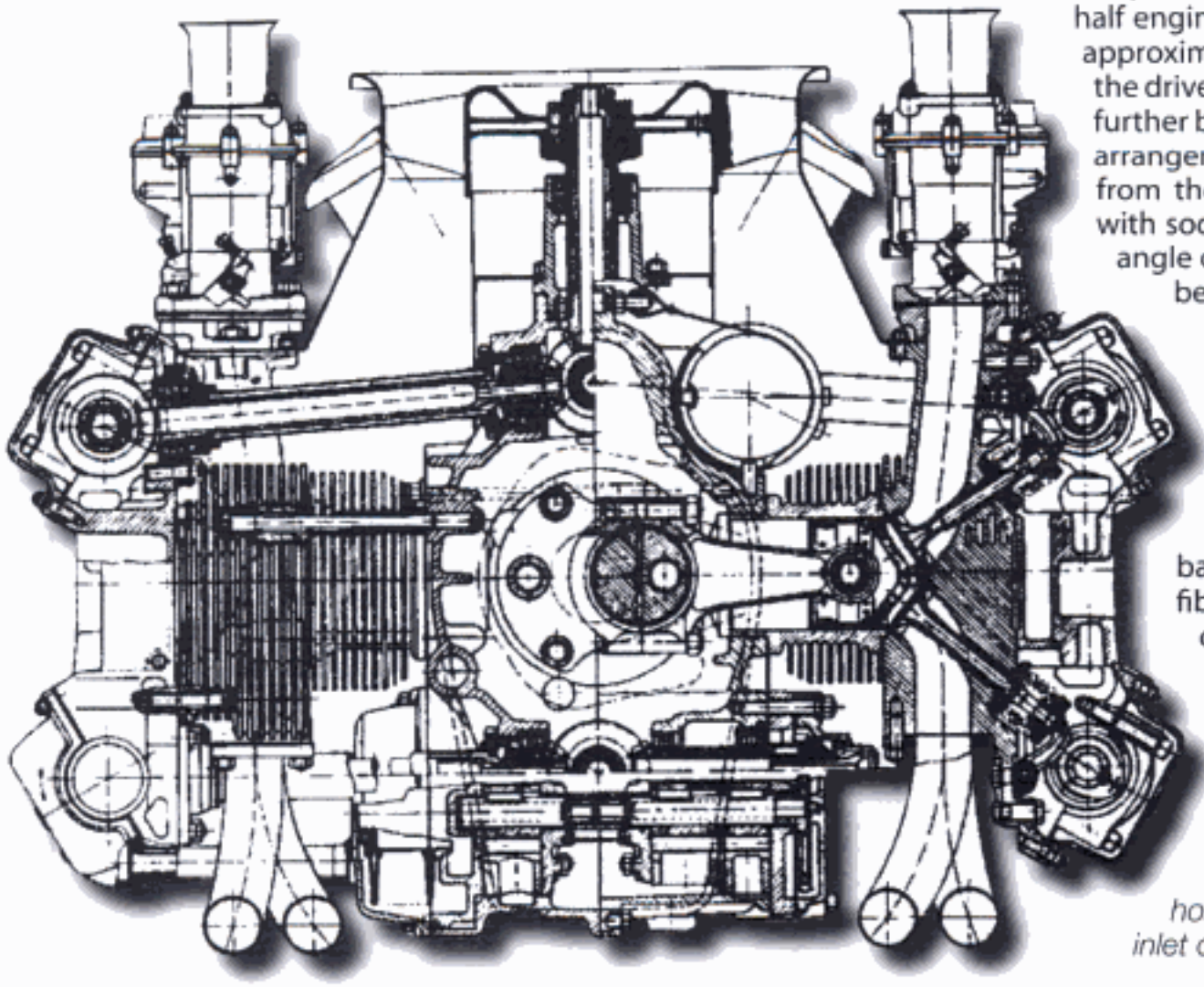
The heart of the engine was a cast magnesium alloy crankcase of two-piece mirror image construction, split vertically along the crankshaft centre line. Eight individual cylinder barrels, extensively finned for cooling purposes, were of aluminium alloy with Ferral treated bores – a sprayed molybdenum steel coating. Each cylinder had an individual cast aluminium alloy cylinder head with cast-in valve inserts. Four common studs, reducing in diameter between the upper and lower threads, secured a head and barrel to the crankcase. A one-piece aluminium valve gear cover braced the four cylinders in each bank.

Early experiments with a Hirth-type built up crankshaft running in roller bearings were set aside in favour of a solid crankshaft and nine plain lead-bronze bearings. It was configured as two 4-cylinder crankshafts, one being cut in half and each half joined to one end of the other crankshaft but rotated in opposite directions through 90°. In this way all primary and secondary forces and couples were in balance.

The valve gear was designed to be reliable up to engine speeds of 10,000rpm and was operated by twin overhead camshafts per cylinder bank driven by bevel gears and shafts from the crankshaft. Reduction gears from the crankshaft drove twin primary shafts, one above it and one below it, at half engine speed. Two bevel-geared shafts located approximately halfway along the crankcase took the drive at right angles from the upper primary via further bevel gears to each inlet camshaft. A similar arrangement powered the exhaust camshafts from the lower primary. Two valves per cylinder with sodium-cooled stems and set at an included angle of 84° were opened by a finger interposed between the cam and valve stem and closed by double helical coil springs.

A horizontally mounted fan driven from the upper primary shaft at 0.92 engine speed provided engine cooling. At 10,000rpm the engine would receive 1400 litres of cooling air per second, blown downwards through ducting and baffles moulded, like the fan itself, in glass fibre. Oil scavenge pumps for the sump and camshaft boxes and a pressure feed pump were driven off the lower primary.

The engine breathed through four



Cross-sectional view of the flat-8 Porsche type 771 engine, the 2-litre version of the type 753 F1 engine, showing the bevel and shaft drive to the horizontal air-cooling fan and the left-hand inlet camshaft.

Glossary

General:

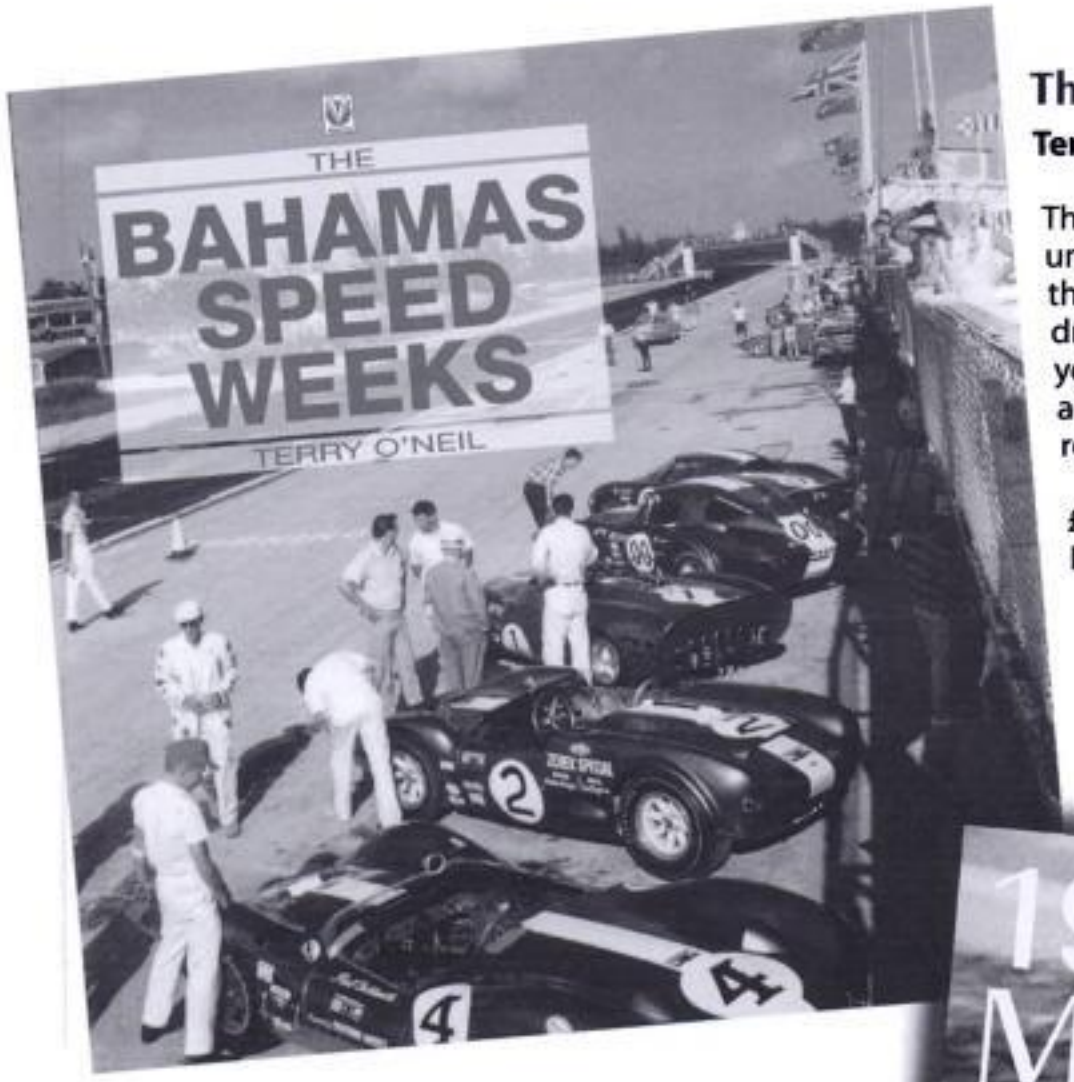
ACF	Automobile Club de la France
CSI	Commission Sportive Internationale
Endurance racing	Long distance sports/GT races such as the Le Mans 24 Hours, Nürburgring 1000km, Sebring 12 Hours, etc.
FIA	Fédération Internationale de l'Automobile
F1	Formula One
F2	Formula 2 1957-60 maximum capacity 1500cc 1964-67 maximum capacity 1000cc limited to 4-cylinder engines.
F3	Formula 3 1950-60 maximum capacity 500cc. 1964-70 maximum capacity 1000cc limited to 4-cylinder production-based engines.
FJ	Formula Junior 1959-63 engines derived from production car units with a maximum capacity of 1000cc with a minimum weight of 360kg or 100cc minimum weight 400kg.
GP	Grand Prix
4WD	four-wheel-drive

GP result panels & chassis histories:

DNF	did not finish
DNQ	did not qualify
DNS	did not start
DSQ	disqualified
FL	fastest lap
N/C	not classified
PP	pole position
WDN	withdrawn

International abbreviations:

A	Austria
AUS	Australia
B	Belgium
CDN	Canada
CH	Switzerland
D	Germany
E	Spain
F	France
GB	Great Britain
I	Italy
MEX	Mexico
NL	Netherlands
NZ	New Zealand
P	Portugal
RA	Argentina
RSR	Southern Rhodesia (now Zimbabwe)
S	Sweden
USA	United States of America
ZA	South Africa



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