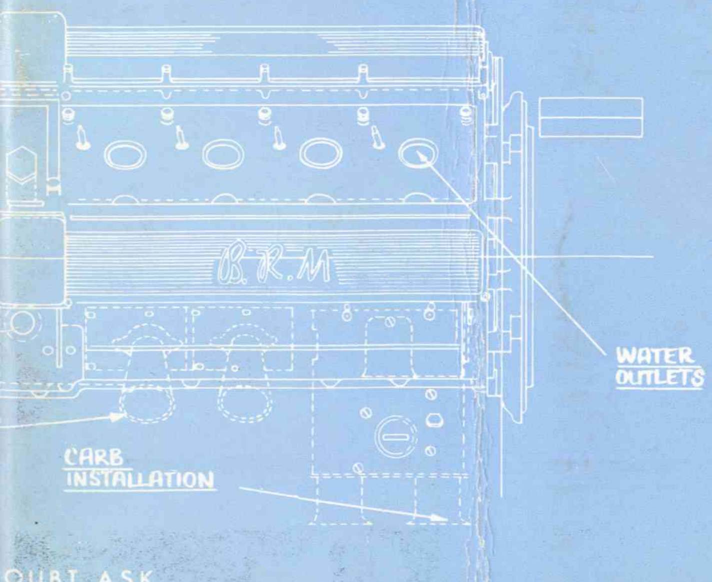
The Owen Organisation

B.R.M GRAND PRIX RACING CAR



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Behind this is the combined resources of the Group for . . . design . . . development . . . and manufacture.

Anything and everything in metal . . .

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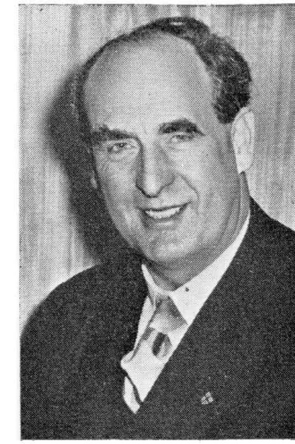
THE OWEN ORGANISATION

A LINKED FAMILY OF MORE THAN SEVENTY COMPANIES

FOREWORD

by

SIR ALFRED OWEN, C.B.E.



SIR ALFRED OWEN, C.B.E.

CHAIRMAN OF RUBERY, OWEN AND COMPANY LIMITED AND CHAIRMAN OF THE OWEN ORGANISATION

I am very pleased to have the opportunity of writing this foreword to the short history of the B.R.M. It is a story of initial great optimism, later long and bitter disappointments and then eventual success.

The B.R.M. racing car is very much part of the Owen Organisation. It is designed, developed, built and raced by Rubery, Owen & Co. Ltd., the Parent Firm in our Group.

The B.R.M. into which we have continually poured considerable resources of talent and money has become something of a household name in almost every country. Such is the magic and absorbing interest in International Grand Prix racing shown by young and old alike.

I should like to thank all the Companies, not only in our Group but amongst our suppliers, who have stood by the B.R.M. through thick and thin. I hope, and believe, that they are reaping the just reward.

Amongst our suppliers we must give a special vote of thanks to Shell who have helped and are helping in every direction.

Deeply involved as we are in the manufacture of components for the motor industry and indeed for many other industrial fields, B.R.M. provides a test bed for research of many kinds, particularly the performance of materials under sudden stress.

Valuable information gathered in consequence is utilised by our engineers and passed on to the motor industry.

Once the lone representative in international motor racing against formidable opposition, B.R.M., is of completely English design and manufacture.

To-day, with other British racing cars which have since entered the field, British supremacy in motor racing is widely acknowledged and is a tribute to her engineering skills. We shall continue to apply to the B.R.M. new researches, always to the benefit of the ordinary motorist.

Alfred Owen.

OWEN ORGANISATION B.R.M.

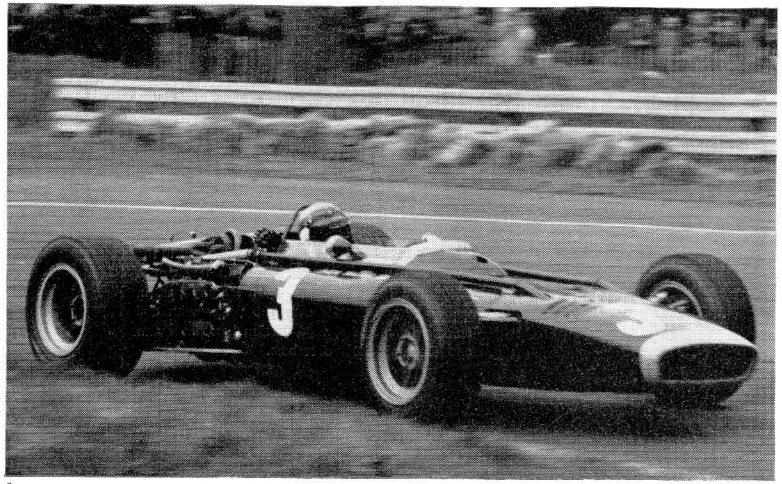
The Owen Organisation

B.R.M GRAND PRIX RACING CAR

By A. F. RIVERS FLETCHER,

A.M.I.PROD.E., A.M.INST.B.E., M.I.P.R.

PRINTED IN ENGLAND

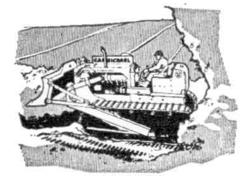


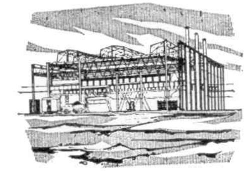
Behind the B.R.M. lie the resources and skills of

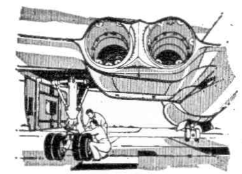
THE OWEN ORGANISATION

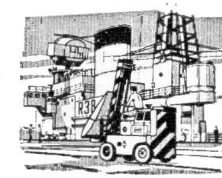
A Linked Family of more than Seventy Companies

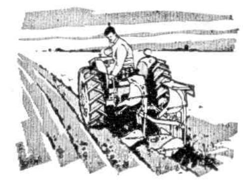
The Midlands, rich in character, enterprise and skill plays a vital part in British Industry. The Owen Organisation, which has its roots in this thriving community, has progressed through three generation—a natural outcome of harnessing hereditary skills to modern requirements through the years. This group of over 70 companies have subsidiary plants in Australia, South Africa, India and Canada. Goods for every industry are produced—all contributing to international trade. The B.R.M. symbol of British enterprise, is also the epitome of the engineering skills evident in all Owen products.











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Parent Company: Rubery Owen & Co. Ltd., P.O. Box 10, Darlaston, Wednesbury, Staffs. *London Office & Export Division*: York House, Empire Way, Wembley, Middx.

The B.R.M. Project was instigated by Raymond Mays, one of the greatest racing drivers of his day, and also the originator of the E.R.A., the famous British Voiturette racing car that brought notable successes to Great Britain against Continental opposition between 1934 and 1939. Raymond Mays realised how profitably Italy and Germany had used their motor racing successes immediately before the war, and was determined to put Great Britain in the forefront in this sphere. He conceived a plan to enhance this country's international prestige.

The then current Grand Prix formula set a limit of $1\frac{1}{2}$ litres capacity for supercharged engines and $4\frac{1}{2}$ litres capacity for unsupercharged engines, and Peter Berthon, who had previously been responsible for the design of the E.R.A., joined Raymond Mays and set to work on the preliminary design of a $1\frac{1}{2}$ litre supercharged racing car of very advanced specification.

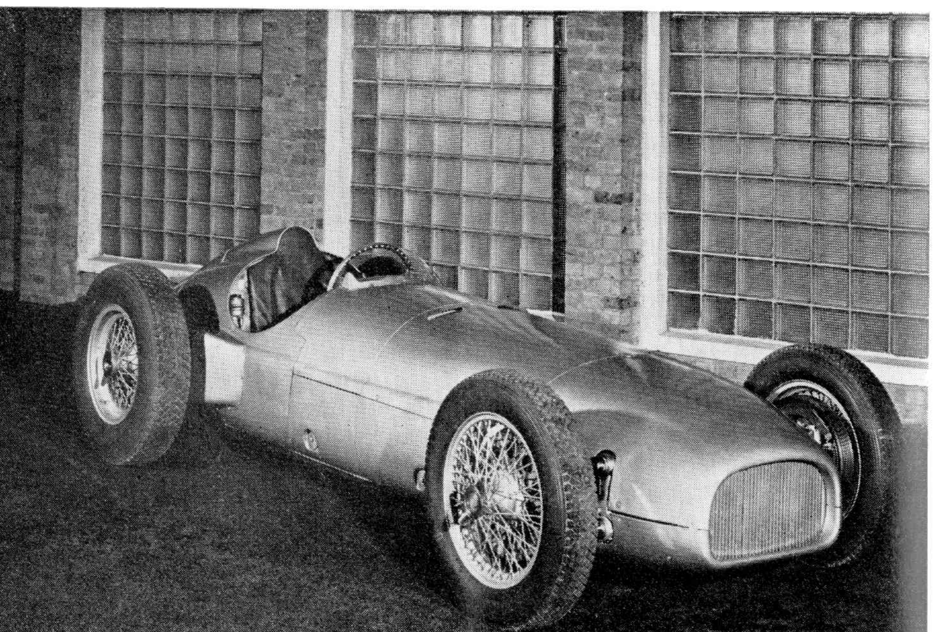
With this preliminary design roughed out, Raymond Mays obtained promised assistance from the late Oliver Lucas, of Joseph Lucas Ltd., and Sir Alfred Owen of Rubery, Owen & Co. Ltd. Sir Alfred Owen was eventually destined to play the leading part in B.R.M. affairs. Tall and quietly spoken, deeply religious and devoting much of his time to welfare and civic duties, although head of one of the largest privately owned companies in Great Britain, he was far from the popular conception of an industrial tycoon, and up till then he had little interest in motor racing. Right from the start of his interest in the venture, he, and his group of companies, became the B.R.M.s staunchest allies. Many other companies followed suit with offers of money and materials for the B.R.M.

At Bourne, at Raymond Mays' home in Lincolnshire, design and development continued, but although the financial support was quite considerable, it never kept up with the rising costs of development and production.

The British Motor Racing Research Trust was formed to administer the funds, and Donald McCullough, the well-known broadcaster, became its Chairman. Many heads of large companies gave unstintingly of their time and energy, but it was always a case of too little money chasing too vast a project, in addition to which the prevailing economic conditions of that time made it increasingly difficult to get the specialised engineering parts manufactured in time.

The old E.R.A. workshops alongside Raymond Mays' house in Bourne were enlarged, and here the assembly and testing of the engines took place, although many of the parts were manufactured in the factories of the supporting companies.

On the 15th December, 1949, Raymond Mays demonstrated the first B.R.M. to the Press and notabilities of the motoring world at Folkingham Airfield close to Bourne, and the car's first public appearance in a race was at Silverstone in 1950. All motor racing enthusiasts will remember that fatal day when the car, driven by Raymond Sommer, broke both drive shafts on the starting line. Later that year, however, Reg. Parnell scored a sensational victory for B.R.M. when he won the Richmond Trophy at Goodwood in pouring rain.



1949—the first B.R.M. prototype V.16 1½ litre outside the engine test shop at Bourne, Lincolnshire, England.

We all hoped that this would be the end of the beginning, but the following years were terribly disappointing for B.R.M. The engine had terrific potential and it certainly developed astronomical horse-power, but somehow or other reliability was never achieved, and time and time again the B.R.M. flattered only to deceive. There had been too much "bally-hoo"; too much was promised, and too much expected. A supporters club was inaugurated, the B.R.M. Association, but when the expected Grand Prix victories failed to materialise the number of supporters dwindled. Nevertheless, throughout all these vicissitudes, the original sponsors and many of their staunch supporters remained intensely loyal to the project, and a hard core of enthusiasts amongst the supporters club and the general public stuck to the project through thick and thin. In 1952, B.R.M. managed to engage the services of the Argentinian aces, Fangio, and Gonzales, and the then up-and-coming young Britisher Stirling Moss, but even with all this talent available no Grand Prix successes were achieved.

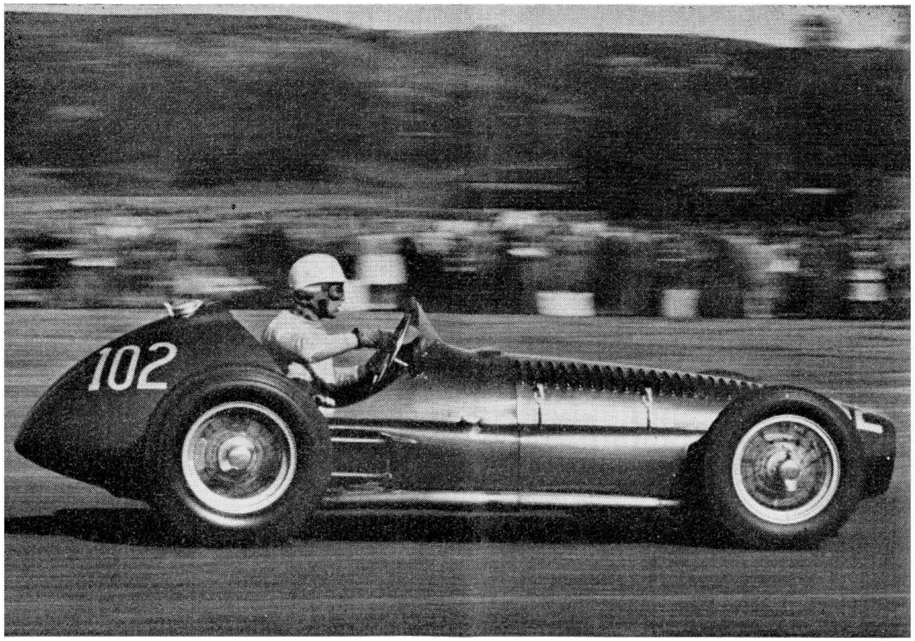
The cars were beginning to show their real speed, but they seldom lasted the distance and had so much technical trouble during the preparation and practice before each race, and spare parts were consumed at such a rate, that more often than not the B.R.M's were posted as non-starters. There were a few bright spots when the English drivers Reg. Parnell and Ken Wharton scored successes in short races in Great Britain, and the B.R.M's were first, second, and third in the principal race at the International Goodwood Meeting in September, 1952, driven by Gonzales, Parnell and Wharton.

Successes were coming too late, however, and at the end of the season the B.R.M. Trust decided to wind up and sell the assets of the Company. Not very surprisingly, the only serious offer came from Rubery, Owen & Co. Ltd. Sir Alfred Owen had never lost faith in the project and was determined to vindicate the good name of B.R.M. From thence B.R.M. became a division of the parent company in the Owen Organisation, and although they started the 1953 season with the same old cars, they were improved and many of the original mistakes were rectified.

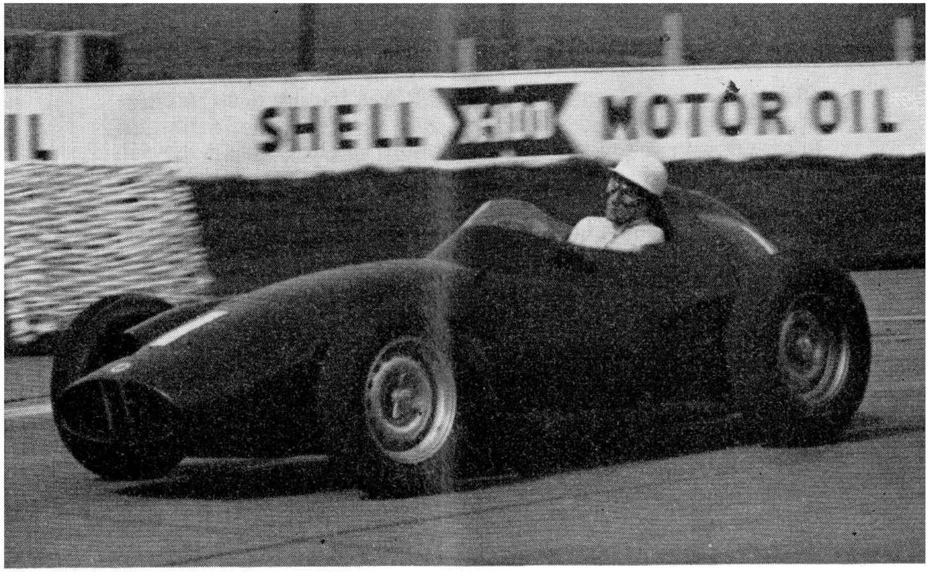
The cars were entered in all the races for which they were eligible, but the current Grand Prix formula was running out, and they were only able to compete in one event of Grand Prix status. This was at Albi in the South of France, where Fangio secured a notable victory when he won his heat and broke the lap record.

Production experts and technicians from Rubery Owen were getting the bugs out of the B.R.M., and there was valued assistance from other Companies in the Owen Organisation, such as Electro-Hydraulics of Warrington, Brook Tool of Birmingham and Motor Panels of Coventry; this latter company attaining fame in another direction, as the builders of the 'Bluebird' car for Donald Campbell's land speed record bid. Since, for many years, the Motor Industry had been the largest customer of the Owen Organisation, the amount of 'know-how' available was very considerable.

The B.R.M's were now proving consistently successful in Formula Libre events in Great Britain, especially when driven by Ken Wharton and Ron Flockhart.



1954—The late Ron Flockhart driving the 1½ litre V.16 B.R.M. to victory in a Formula Libre race at Ibsley, England.



1959—Stirling Moss testing the 2½ litre front engined B.R.M. at Goodwood and achieving the first ever 100 m.p.h. lap recorded on that circuit.

When the Formula changed again, a new 2½ litre 4 cylinder Owen Organisation B.R.M. was produced, and although it put up some stirring performances, it never became a world beater. The most notable successes of this model were Jean Behra's win in the Grand Prix at Caen; the English victory at Silverstone when Behra, Schell and Flockhart were first, second, and third in the International Trophy, having won both the heats and establishing a new record; and finest of all, Joakim Bonnier's victory in the Dutch Grand Prix at Zandvoort.

The original Supporters Club had changed its name to Owen Racing Motor Association, and under its enthusiastic Secretary, Mrs. Molly Wheeler, the number of supporters started to mount again. It no longer attempted to raise funds for the car, but by awarding special trophies for B.R.M. drivers and arranging social functions for its members, it provided valuable moral support.

In 1961 the Owen Organisation had another new car on the drawing board for the next formula—a rear-engined V.8 1½ litre. Sir Alfred Owen insisted that this must be an entirely all-British car, and, since previous B.R.M's had used carburettors of foreign make, the Lucas Company developed a British fuel injection system for the new B.R.M. The Project had the full support of the whole of the Owen Organisation, comprising over fifty companies serving the engineering needs of the world. The names of the companies in this group are not necessarily known to the general public because many of the parts and components are built into end products carrying their own manufacturers' names. It is said that it is scarcely possible to buy a car that does not contain some parts made within the Owen Organisation. The B.R.M. is a product of many skills from many other fields in the Owen Group such as Aircraft Engineering, Earthmoving and Roadmaking Machinery, Agricultural Machinery, the Structural Steel for buildings, Machine Tools and the manufacture of Nuts and Bolts. At first sight it seems that these and other Owen Organisation products and services are a far cry from the modern racing car, but the "engineering thinking" in all these spheres is used in the B.R.M. project, and time and time again the brains and "know-how" concentrated in the Owen Organisation in widely different spheres have proved their worth in the racing car project. Conversely, the specialised knowledge and skills in producing the B.R.M. helps the production of all the other commodities made within the Owen Organisation.

The B.R.M. was already running on Super Shell and using Shell lubricants; but now with the new engine there was a special collaboration with the Shell company and valuable technical help from their Thornton Research Centre. The first tests on the car at Monza proved very promising, all these people, and companies within the Owen Organisation, were more than pleased because, of course, this was to be an all-out effort from the Owen Group of Companies, all anxious to provide the best possible backing for the B.R.M. project. Amongst those most to the fore had been the Research and Development Division of Rubery Owen at Darlaston, which had been of great assistance on metallurgic problems, and on various problems in connection with strains and stresses and special treatment of the metals required. Then C. & L. Hill of Heckmondwike in Yorkshire did special gear cutting and Motor Panels of Coventry built some of the bodies for the 1962 season.

Raymond Mays continued as Racing Director, and Peter Berthon was appointed Chief Consultant to Rubery Owen and also responsible for long term design and development for B.R.M. working with Peter Spear, whose work on research and development for Rubery Owen had already been of material assistance on the previous 2½ litre B.R.M. Tony Rudd, who had been with B.R.M. since V.16 days, became Chief Engineer and Team Manager, and as such had virtually sole control of the whole of the racing. The scheme was popular with the drivers, and Graham Hill, now starting his third year with the B.R.M., and the new recruit, Californian, Richie Ginther, both felt the greatest confidence in the new arrangements. Most of the mechanics were the stalwarts who had worked with B.R.M. through thick and thin, and their team spirit was magnificent.

Before the season there was a set back when one car caught fire while Richie Ginther was testing the car at an airfield, but Graham Hill won on his first outing with the new car in the first heat of the Brussels Grand Prix. He was second to Jim Clark in the Lombank Trophy at Snetterton and, by Easter, a second car was ready for Richie Ginther, so that there were two new V.8 B.R.M's for the big race at the Easter Monday Goodwood meeting. Graham Hill scored another victory here, winning the race in which poor Stirling Moss had his disastrous crash. The International Trophy at Silverstone was another of those good days for B.R.M., with Graham Hill sensationally snatching victory from Jim Clark in the Lotus right on the finishing line.

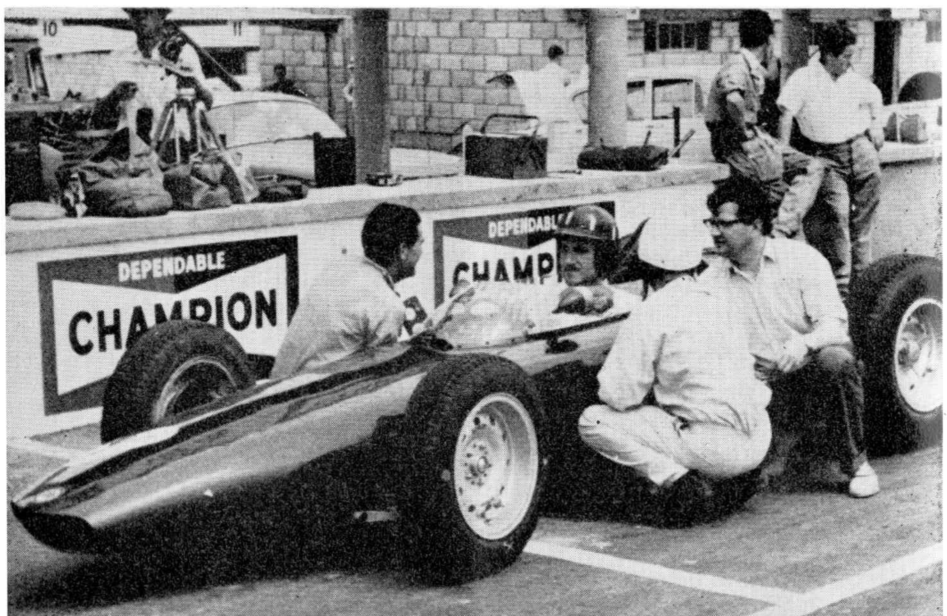
The Grand Prix season was about to begin, with its desperate struggle for points for World Championship. The Blue Ribands of Motor Racing are the Manufacturers' Cup and the Drivers' World Championship and, for both of these, points are scored only from their five best races. For first, second, third, fourth, fifth and sixth places with 9, 6, 4, 3, 2, 1 points each. The first of these races in 1962 was the European Grand Prix at Zandvoort —where Graham Hill achieved a magnificent victory; and in the next one at Monaco he very nearly repeated the dose, looking like a certain winner until a few laps before the end of the race, when he was put out with lack of oil pressure, and victory went to Bruce McLaren in a Works Cooper. Graham Hill was second in the B.R.M. in the Belgian Grand Prix at Spa, behind Jim Clark on a Works Lotus.

Three drivers in three different cars were proving the fastest in the world ! Graham Hill (B.R.M.), Jim Clark (Lotus), and Bruce McLaren (Cooper). Now we came to the French Grand Prix at Rouen, where, once again, Graham Hill led in the B.R.M.

and looked a certain winner until a minor derangement of the controls caused his retirement, and all the favourites fell out with some sort of trouble, and Dan Gurney won with a Porsche.

It was perhaps a pity for British enthusiasts that the B.R.M's poorest performance in 1962 was in the British Grand Prix at Aintree, but that particular circuit really required six-speed gear boxes for the V.8 B.R.M. and they had only five-speed gear boxes available, and Graham Hill could not do better than fourth.

The next two Grand Prix were quite outstanding. The German Grand Prix at Nurburgring, held in appalling weather conditions—in teaming rain with very poor visibility—gave Graham Hill and the B.R.M. their greatest victory to date. First of all, Dan Gurney led in a Porche with Graham Hill in second place and John Surtees third in a Lola, but after the first lap, the B.R.M. went into the lead and Graham Hill maintained his lead throughout that long race with Surtees and Gurney snapping at his heels, and all three drivers on the absolute limit, with no let-up despite the appalling conditions. Hill's victory was followed by an even more sensational win for him in the Italian Grand Prix at Monza, and this time it was supported by Richie Ginther in the other B.R.M. in second place. It really was a field day for B.R.M. against the cream of the opposition. By that time Graham Hill was well ahead in the Drivers' Championship and Ginther, who had a bad start to the season, with a series of unlucky breaks, had not only supported Hill in his race for the Championship, but had also scored useful points in the Manufacturers' Cup.



1962—First ever " All British " car to win the World Championship. Graham Hill the champion driver in the victorious car out-side the pits at East London before the South African Grand Prix. Richie Ginther with his back to the camera in the white helmet, and beside him kneeling, Tony Rudd. On the other side of tne car, Chief Mechanic, Cyril Atkins.

For the penultimate round of the Championship, the Grand Prix Circus travelled to Watkin's Glen for the American Grand Prix, where Jim Clark scored another victory for Lotus and Graham Hill was second. This left B.R.M. still leading for both the Championships and with only one driver and one car—Jim Clark in the Lotus—who could beat them in the last race of the season, the South African Grand Prix.

There had been quite a lot of drama during practice, with both the leading teams having trouble—but Jim Clark, with the Lotus, and Graham Hill, in the B.R.M., were on the first row of the grid. The East London circuit was excellently laid out, and the organisation was first class. The weather was fine, and the stage set for the final race of the championships.

The story of the race is easily told. Jim Clark led for two-thirds of the distance with Graham Hill in second place; Trevor Taylor in the second Lotus was soon out with gear box trouble, and Ginther, in the second works B.R.M., was delayed when he oiled a plug but later was travelling well.

Then at 63 laps, of the 82 lap race, Jim Clark suddenly plumed a smoke screen, and the number one Lotus had run its race. Graham Hill, with the B.R.M., went on to win the race, the Drivers' Championship, and the Constructors' Cup as well. Ginther in the other works B.R.M. finished strongly.

Throughout the whole season B.R.M. worked very much as a united team, and its nucleus was the very happy Rudd-Hill-Ginther set-up. All this is very much to the credit of Raymond Mays, who started the whole project (and in fact was the only person who could have done so); Peter Berthon, the designer, all the staff and mechanics; and, of course, Sir Alfred Owen himself who was present in South Africa to see his team win.

From that momentous year the Owen Organisation B.R.M. Team never looked back. The next three years were almost as successful—the Monaco Grand Prix—the most glamorous motor race in the world became the perquisite of B.R.M., Graham Hill achieving victories in three successive years; three wins in the American Grand Prix; two in the Italian Grand Prix; and many more notable performances by other racing cars using Owen Organisation B.R.M. engines, not only in Formula 1 events but in Sports car races and hill climbs.

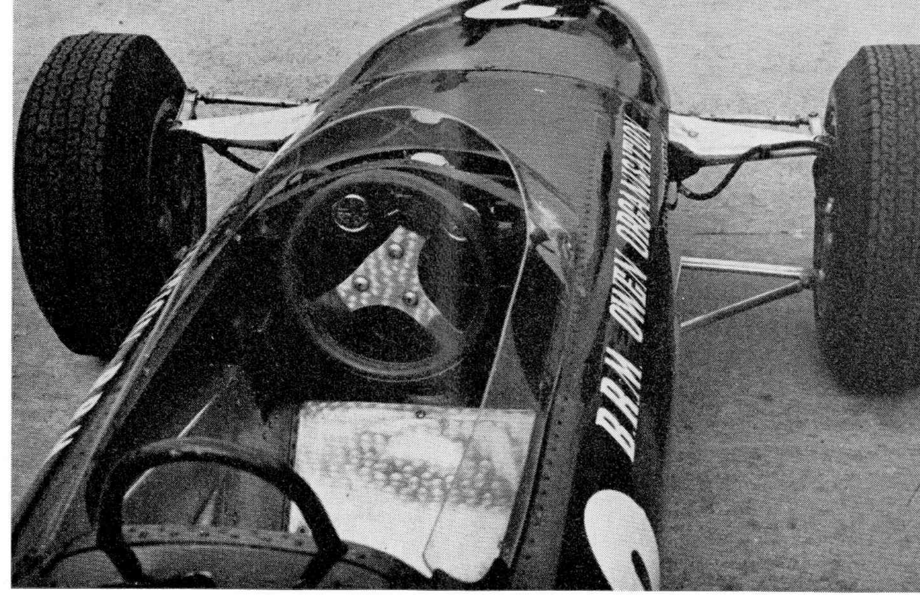
A 4 cylinder Formula 2 engine was produced, and Lotus Cortina engines were modified and improved for the Lotus Company for competition work.

Then, in co-operation with the Rover Company, an experimental Gas Turbine engined G.T. car was produced for the Le Mans twenty-four hour race. Rover made the engine and the Owen Organisation provided the Chassis, gear box and much of the racing know-how. This car, driven by the B.R.M. team drivers—Graham Hill and Richie Ginther, scored a notable triumph and achieved a mile-stone in history by its successful performance in the race. Then, two years later, in 1965, an improved version of the same car was the first British car to finish in the Le Mans 24 hour race.

1966 proved another bumper year for the Owen Organisation racing activities, when 2 litre versions of the well proved B.R.M.V.8 won nine races out of ten in New Zealand and Australia, with Jackie Stewart the most successful driver winning the Tasman Cup. Then to cap it all, a fourth consecutive victory at Monaco — this time in the hands of Jackie Stewart.

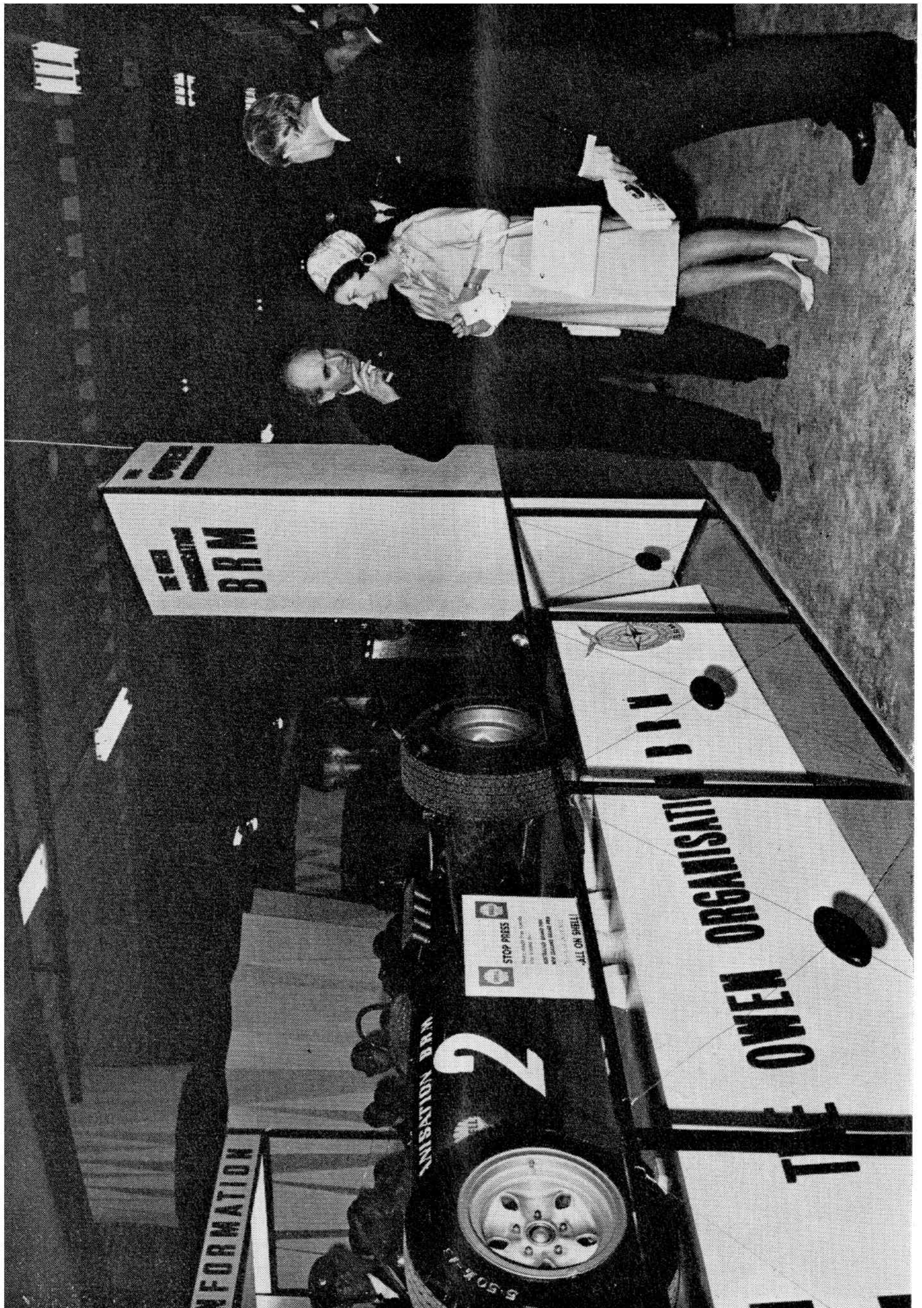
Now we come to the latest B.R.M.—the very advanced and sophisticated H.16 3 litre.

Leading the B.R.M. Team for 1967—
Jackie Stewart.



A driver's view—the cockpit of Jackie Stewart's Tasman B.R.M. Note the very small 14" steering wheel and the regulation roll bar hehind the drivers head.

Members of the victorious B.R.M. Tasman Team in New Zealand. Stan Collier—Reg Parnell Team Mechanic; Tim Parnell—Guest Team Manager for B.R.M.; Jackie Stewart; Jim Collins—B.R.M. mechanic; Richard Attwood; Alan Challis—B.R.M. mechanic



H.R.H. Princess Margaret, Countess of Snowdon being shown the victorious Tasman Owen Organisation B.R.M. by Sir Alfred Owen at the opening of the Hong Kong British Week 1966.

This car is of monocoque construction, rear engined, and of basically similar design to the 1965 Grand Prix car, designed by a team under the direction of Tony Rudd, Chief Engineer of Rubery Owen & Co. Ltd., B.R.M. Engine Development Division, Bourne.

The engine is an H-16, the configuration consisting virtually of two flat 8s. one above the other. Many components of the previous V.8. can be used in the 16 cylinder unchanged, and many more follow the same design and material.

The crankshafts follow the same principles as the V.8. and are nitrided. They are connected by means of three gears so that drive can be taken from the upper or lower gear.

Two Lucas fuel injection units are used, mounted above the inlet cam boxes to keep pipe lengths short, and the units which are identical to those from the V.8's are out in the airstream; they are driven by toothed rubber belts, as in the V.8 engines, and each bank of four cylinders has its own set of throttle slides similar to the V.8.

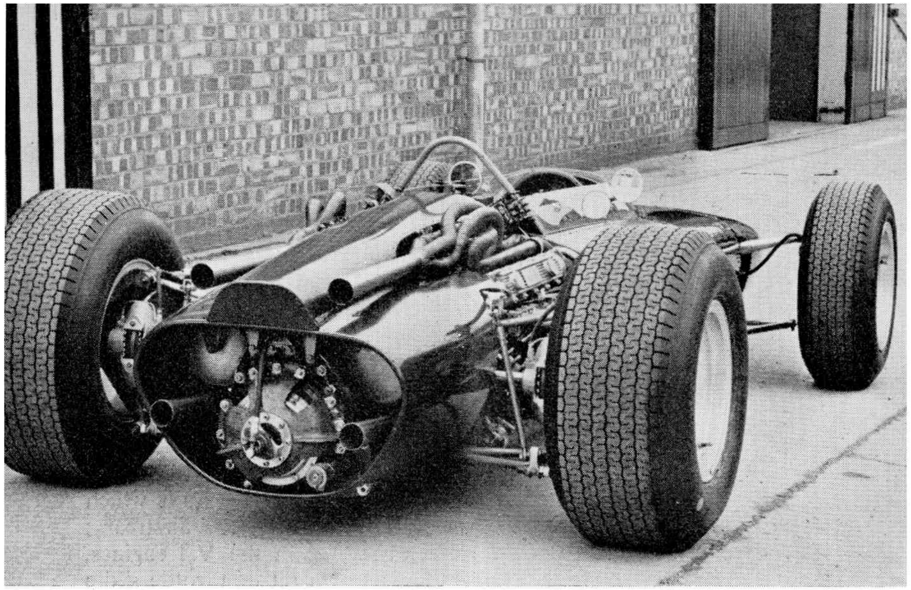
Lucas transistorised ignition is used, triggered from a small disc, driven from the front of the upper crankshaft. A skew gear drives a pair of transverse distributors, which feed a single sparking plug per cylinder.

Small oil scavenge pumps are driven from the rear of each lower exhaust camshaft, as these camboxes cannot drain into the crankcase by gravity.

The engine has been designed with monocoques in mind, and the items that require maintenance are mounted either on the top or sides in the interests of accessibility. Four rows of bosses are provided at the upper and lower corner of the crankcase for engine mountings. The engine can be sat on the lower two sets, or mounted on four booms. Two passages are cast between the cylinder head and block, halfway between the upper and lower banks, to accommodate a drive shaft to the front wheels, if four drive is employed.

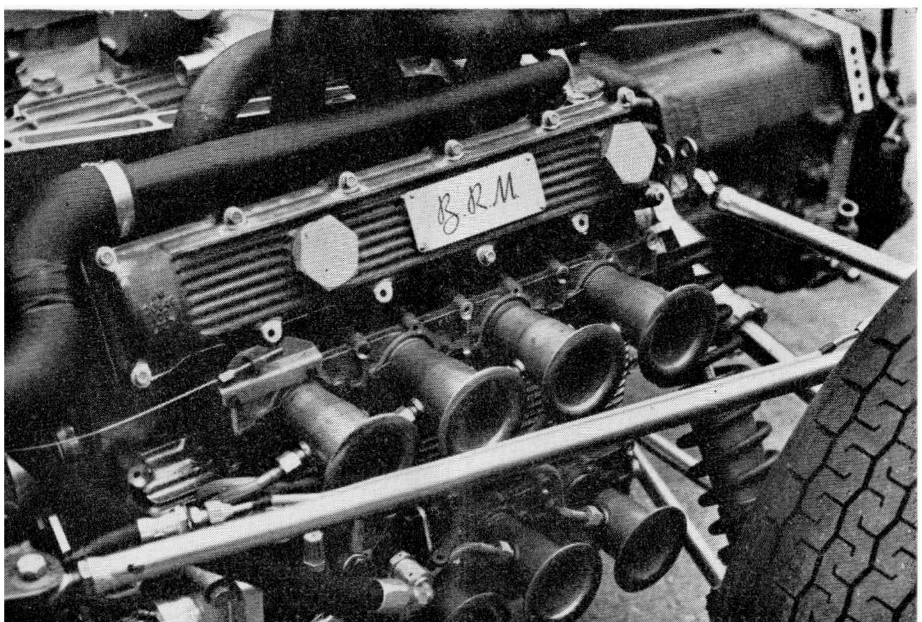
The 3 litre Owen Organisation B.R.M. engine is stressed to 600 h.p. and 13,500 r.p.m. and it is hoped that will develop over 500 h.p. by the end of the formula.

Now whilst development is continuing on the H-16, the Owen Organisation has produced another 3 litre unit of simpler type—a V.12 with bore and stroke of 2.9375″ by 2.250″ giving a



Three-quarter rear view of the H.16 3 litre B.R.M.

Practice for the South African Grand Prix 1967. Owen Organisation B.R.M. drivers; Mike Spence, in the cockpit talking to Jackie Stewart, in the white helmet. Chief Mechanic, Cyril Atkins, peering at the water temperature gauge—this was on a very, very hot day !



Engine installation of the H.16, showing the near side bank of cylinders.

capacity of 2,999.5 cc. This is a 60° V. and it gives about 375 B.H.P. at 9,500 r.p.m. This engine is principally intended as a unit for sale for sports car racing. A $2\frac{1}{2}$ litre version of this unit is intended for the Tasman Series and the Grand Prix version is an alternative to the H-16 and, of course, more suitable for racing by private teams without the resources of the works.

Now the Owen Organisation looks forward to International Motor Racing events all over the world during the following years. This group of Companies and the great British companies who support this project have faith in the value of this International competition, knowing that it will be the keenest in the world. Whether they will win or lose, the Owen Organisation must benefit from the tremendous struggle for supremacy in which the greatest companies, the finest racing cars, and the best drivers in the world will be competing.

A.F.R.F.

ototype of the new Owen Organisation B.R.M. V.12 car. The engine, a development of the very successful ven Organisation V.8. is fitted in this Len Terry designed and built single seater for the Tasmam Series.

Owen motor components travel the world

The production of motor vehicles is perhaps the most highly organised and prolific industry in the world. Components and assemblies of many kinds which constitute the automobile, goods truck or passenger vehicle are, in terms of volume production, numbered by the million.

Many of these are supplied to the automated assembly lines of the motor industry by independent manufacturers, themselves specialists in their own particular field.

The Owen Organisation, particularly the main company of Rubery Owen & Co. Ltd., have built up their service over many years of such specialisation and by close collaboration with the Motor Industry since the commencement of the automobile. Present day manufacturing resources enable them to supply not only the British Motor Industry but that of other nations, particularly on the Continent of Europe.

Sister plants in Australia, South Africa and India give a similar service to their own territory. Components produced by the Owen Organisation cover a wide field. Collectively they are considered one of the largest and most versatile manufacturers automatic car parking systems.
in the world, with mass production facilities to satisfy a large part of an almost insatiable demand.

Wheels for automobiles, caravans, and light trailers are produced by the million every year. So are fuel tanks, chassis frames, chassis members and pressed steel rear axle housings for automobile, trucks and passenger transport vehicles. Bolts, nuts, wheel studs, and special fasteners are also produced in limitless quantity. The ever-increasing use of trailer transport has also led to specialisation in the production of a complete range of heavy duty trailer axles and suspensions from 5 to 13 tons load capacity, also a range for the caravan and light trailer market.

Companies in the Owen Group also produce drivers' control cabs for commercial vehicles, automobile body assemblies and complete trailers.

Service to the motor industry does not cease with the supply of components for vehicle assembly. It is extended still further along the line to the user with equipment for garage servicing such as parts storage equipment, for fuel dispensing pumps and automatic car parking systems.

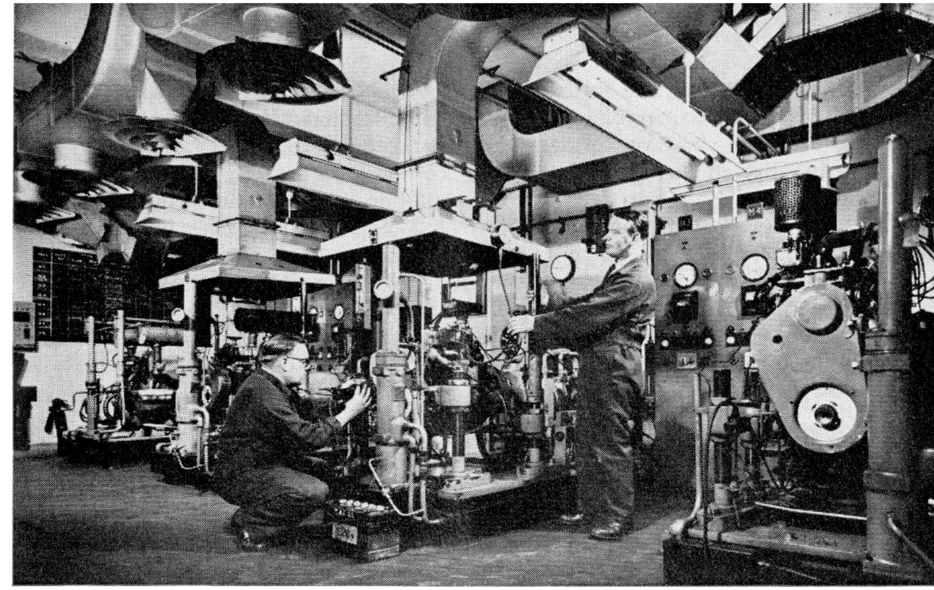
BETTER BURNING—MORE POWER

B.R.M. had a problem with their formula 1 racing engines. These varied in output in a puzzling manner. This article tells how Shell experts, after patient research helped the designers at Bourne to obtain consistently good results.

One of the most remarkable features of Grand Prix cars today is that they run on normal commercial fuel, the same fuel in fact that the ordinary motorist uses in the family car. This surely goes a long way towards answering the old question, "Does racing improve the breed?" Look at it like this: besides fuel, the engine capacity and weight of formula 1 cars are closely defined; other things, such as tyres, road-holding, chassis lay-out and suspension, define themselves during development and in competition. Engine design, aimed at getting the most out of the fuel, remains as a rich field for research.

Unfortunately, research is extremely expensive, and when its cost is added to the already tremendous expense of building and operating modern racing machines, it may be virtually impossible for the ordinary constructor. Trial and error, often based as much on intuition as on scientific knowledge, then takes its place. Certain types of research, however, provide a logical field for collaboration between the engineer and a fuel company. This is demonstrated by the joint work on combustion which has been going on for the past four years between the Owen Organization, B.R.M. at Bourne and Shell at their Thornton Research Centre in Cheshire.

The story started in 1962, when the Owen Organization became concerned as their current B.R.M. formula 1 engine, designed to give 225 h.p. was only giving 190 h.p. from a good one and 165 h.p. from a poor one. Worse still, they could not establish the reason for the difference between a good and bad engine. All the known variables, including timing, breathing, etc., were eliminated, so that poor combustion seemed to be the cause of the trouble. Owen Organization technicians had already established that the engine was relatively insensitive to changes in ignition timing, which is another sure sign of poor combustion. However, having a major motor race once a fortnight hampered any attempt at long-term research, while the Owen Organization were unable to find any suitable instruments with which to carry



An engine being installed on a dynamometer test bed at Shell's Thornton research centre in Cheshire. This is the largest of all Shell research plants in Britain and is some 8 miles north of Chester.

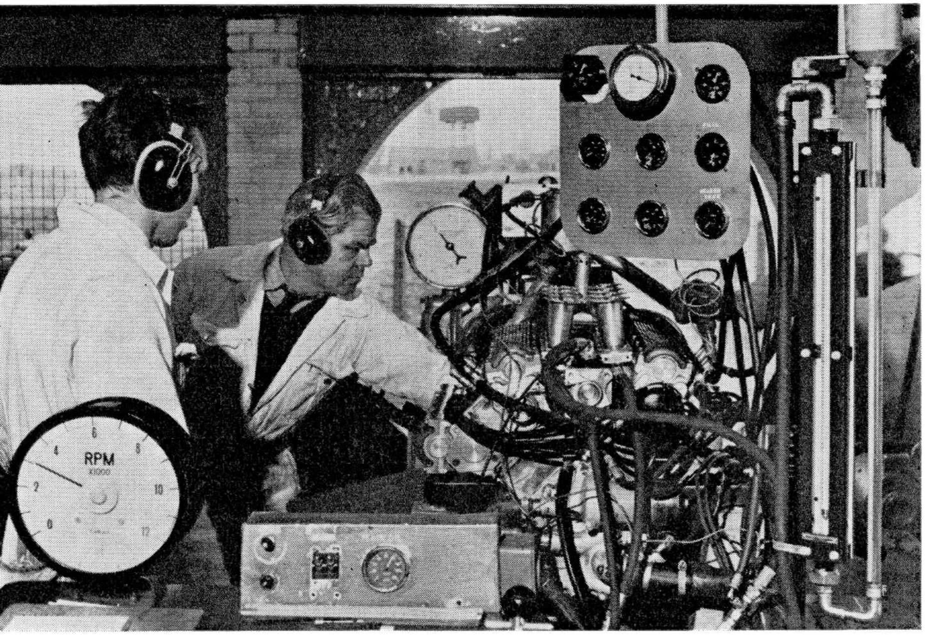
out the investigation. They, therefore, approach the Shell Group, who agreed to collaborate, putting Dr. Geoff Harrow of their Thornton Research Centre in charge of investigations, using one of the bad B.R.M. engines.

Considerable work on combustion was already in hand at Thornton and certain commonly accepted general principles had been examined carefully. One of these is that the power output in a normal engine is closely related to its ability to breathe the explosive mixture into the combustion chambers; efficient scavenging, though generally considered to be less important, could become a limiting feature in certain circumstances.

Maximum efficiency also depends on a fast but controlled combustion correctly phased with the piston movement. As engine r.p.m. increases, combustion tends to take up a larger part of each cycle, and in a conventional engine the correct phasing is maintained by advancing the spark timing. However, this was an unacceptable complication with the transistorized ignition system of the B.R.M., which has fixed spark timing. This makes it even more important to obtain high flame speeds as the engine r.p.m. increases.

Shell studied the way in which changes in the shape of the combustion chamber and the design of inlet and exhaust ducts affected the variations in flame speed with engine speed, which in turn affected the phasing of peak combustion pressure. One problem they had to face was the evolution of new instrumentation for working at speeds between 8 and 10,000 r.p.m., far above those with which they had hitherto been concerned. Moreover, because the engine was designed for maximum output, it had the largest possible valves that could be crammed into the combustion chamber, and the Shell team also had to develop miniaturized probes and instruments which could be inserted in the very small space available.

The new equipment enabled a number of readings of different factors to be taken simultaneously while the engine was running at high speed. Different designs of combustion chamber were compared. It was also possible to determine the mechanical efficiency of the engine by cutting out one spark only in a given cycle—e.g. one in every seven firing strokes of the engine. A series of misfires thus runs progressively through each cylinder in turn. By comparing brake load readings taken during this type



A B.R.M. racing engine undergoing a test by Shell before the 1965 Grand Prix season started.

of operation with those when all cylinders are firing normally, the mechanical efficiency of the engine can be calculated, and different mechanical layouts of the engine compared.

Tested to 11,000 r.p.m.

The Thornton team set up this equipment at Bourne and worked in close collaboration with the B.R.M. engineers on a variety of tests in which the engines were run up to 11,000. In the course of this work two interesting side factors were noted. The first was that there was a higher than anticipated residual pressure within the cylinder during the exhaust stroke, indicating that a larger exhaust valve or a changed exhaust valve timing would be beneficial, as indeed it was. Second, there was a considerable variation in average pressure and rate of pressure rise from cylinder to cylinder, and more important, from cycle to cycle within the same cylinder. Laboriously the Shell and B.R.M. team together eliminated one by one the factors that caused these variations. The final result, in the words of Tony Rudd of B.R.M., was the development of a combustion chamber shape, pistons and valve gear of competitive design, which could be used for engines ranging from a 4-cylinder 1 litre to the 16-cylinder 3 litre power unit for the present formula 1 machines. The basic proportions, bearings and other items are common to the whole range, so that development work done on any one engine can be fed back and used in the others.

" One of the great things about this co-operative research " Rudd said, " is having someone outside, who has the remote scientific approach to the problems away from the smell of hot oil, the noise, the glow of red-hot exhausts—the romantic overtones, in fact, of running a racing engine on a test bed." At the same time, experience of these very things, on their visits to Bourne, gives the Shell scientists the chance to see their experiments being put to use in actual machinery—and provides an occasional welcome change from the quiet concentration of the laboratory.

Finally, from the point of view of the ordinary motorist, improved combustion chamber shapes and better breathing systems can give improved performance. Even more important perhaps for the majority, these give greater economy through taking greatest advantage of octane quality of the fuel. For, to quote Tony Rudd once again, " if you get the design right the octane requirement can be quite modest "—proved by the fact the engines now run very happily indeed on the fuels available to every motorist.

PETER COLLINS.

Why Dunlop Go Racing

The question is often asked "how does the ordinary motorist benefit from the intensive effort that goes into motor racing?" From the tyre point of view he benefits in a number of ways.

In any competitive motor event, the component parts of the vehicle are subjected to far higher stresses than they are in day-to-day motoring. Special efforts must be made to meet these extreme conditions and in doing so new techniques are often discovered, which can afterwards be used—in modified form—to meet the needs of the ordinary motorist.

Under the special conditions of motor racing, it is possible to study tyre performance more closely and quickly than in road testing, however thoroughly the latter may be done. Results also come quickly and instead of taking weeks or months to assess the effects of a change in construction or materials, these can often be noted in a matter of hours. As a result, development work is considerably speeded up.

A careful analysis is made of tyre performance at every major event in the world, which is studied by the tyre designers and discussed with the circuit team on their return.

Grand Prix racing has been used as a proving ground for one of the biggest advances made in safer motoring in recent years—the marked increase in wet hold. This has been brought about by the use of improved tread pattern designs, in conjunction with special types of synthetic rubber which have a higher co-efficient of friction against the road surfaces. The techniques which are now used so successfully in production tyres were first tried out in the Dunlop Rain Tyre, which was introduced in Grand Prix racing about six years ago and enabled higher speeds to be safely maintained on a wet track.

Another valuable feature which has emerged from Grand Prix racing in the last few years has been a new approach towards determining the most efficient casing shape for a tyre. For many years tyre technicians have been working to develop a process in which the tyre components are assembled in such a position that they "want" to spring out into a circular shape from the start. This would mean that when the tyre was moulded into its final shape it would have fewer internal stresses, run cooler on the road and provide better car control.

This idea took a practical form during the 1964 Racing Season, when a new tyre was introduced, in which the correct stress-free shape had been determined with the aid of a computer.

Progress in vehicle design is continuous, with performance rising every year. The tyre manufacturer must therefore always have something up his sleeve by way of new materials, designs and manufacturing techniques. Motor racing in all its forms provides the testing ground for many new ideas which are ultimately incorporated in the tyres for the ordinary motorist.