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MECCANO MAGAZINE

THE STORY OF THE MOTOR CAR (See page 98)

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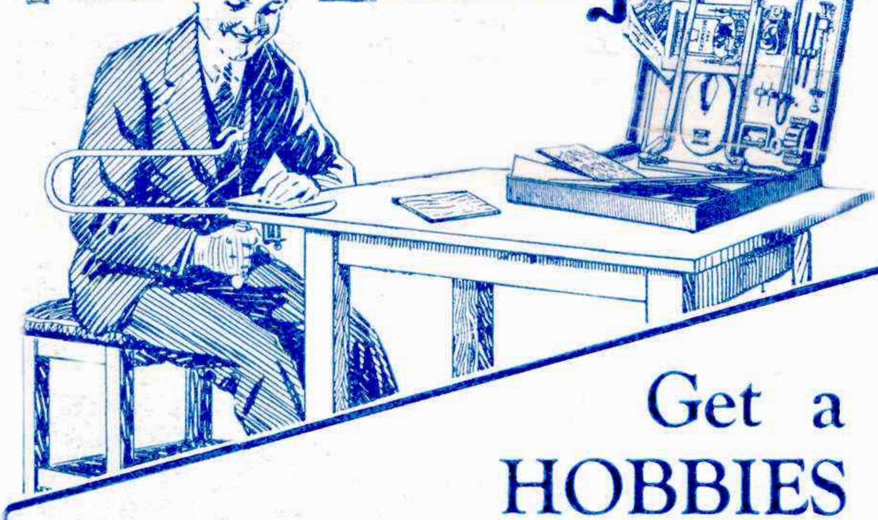

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Next Month: FIGHTING SNOW ON SWISS RAILWAYS. PUBLISHING DATE: 1st MARCH

MECCANO MAGAZINE

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With the Editor

The Love of Beautiful Things

Many people seem to give too much thought to "making a living" and do not think enough about what we may call "making a life." Because we must have money to purchase the necessaries of life, it certainly is of the first importance that each of us should make a living, but in doing this we should not lose sight of the fact that we may be missing many things that are worth while.

The idea of making plans so that our lives may be as rich and as interesting as possible is surely an attractive one, and with a little care it should not be difficult for us to arrange things so that we see, understand, and experience the gift of life to the best advantage. In making our plans, we should endeavour to arrange them so as to get as much good out of the world as possible; to see as much of it as circumstances will allow; and to meet as many of the people in it as are worth meeting. We shall then realise that there are many other things that are worth knowing besides mere facts. It is very interesting, for instance, to know how many miles the earth is from the sun, or to know which is the earth's deepest coal mine. We are infinitely richer, however, if we are able to appreciate good qualities—to know what is good whenever we find it in nature, in art, in literature, in people, or in government.

Finding the best in life is both adventurous and exciting, and often we find ourselves "up a blind alley." Even so this is better than being content with second-rate or even third-rate things—looking at inferior pictures, for instance, when we might be seeing fine ones. Of course, some people cannot distinguish fine pictures when they see them—that is no fault of theirs, for they have not learned how to distinguish between first and second-rate art. After we have looked at as many really good pictures as we can see—and there are many in the Art Galleries in our big cities—we are no longer content with even second-rate art. We begin to understand what the artist is striving for, and to realise how near he comes, or how far he falls short of the ideal. It is the same with books—when we read a good book we appreciate beauty in literature and, because we are in touch with a finer mind, our own minds are uplifted.

By seeking only for good and beautiful things we find that our lives will broaden out as we gain a bigger conception of life in general. Once it has been started, this love of beautiful things grows within us and will continue until material things cease to interest us.

Expert Aid for Explorers

Launching an exploring expedition is no simple matter. The difficulties are not in the preparation and equipment only, although great care and thought have to be given to these points, but are also concerned with finance. Modern exploring is a costly business, as Shackleton found, and his expeditions were only rendered possible by the generosity of interested individuals. From his first expedition, in fact, he returned heavily in debt and it was only a timely grant from the Government, given in recognition of his great march up the Beardmore Glacier and across the frozen plateau almost to the South Pole, that removed the load from his shoulders. Scott was more fortunate in that he received Government aid from the start, but in his case there were difficulties in obtaining a suitable ship, with the result that the vessel was grossly overloaded and was in grave danger during the voyage to Ross Island. Leaders of many other expeditions have found it necessary to recover the costs by lecturing, the publication of books, and the sale of film rights.

With difficulties of this character in mind, Commander Fitzhugh Green has now resigned his position in the U.S. Navy to create and control an organisation to assist explorers. The staff that he will assemble will be competent to give advice to all degrees of explorers—from those contemplating work in Polar regions to those hunting big game in Africa. Assistance will also be rendered to scientific expeditions—such as that of Roy Andrews to Central Asia in search of prehistoric relics of man and animals, or the deep-sea diving expedition of Dr. Beebe to which reference was made on page 119 of "Our Wonderful World" in the February "*M.M.*" of last year.

The Qualifications of an Explorer

Commander Green himself spent many years in the Polar regions and accompanied MacMillan on his journey in search of the elusive Crocker Land. He is also a scientist and during the war held a responsible position in the American Fighting Fleet. His wide experience lends weight, therefore, to his view that the modern explorer has to be at one and the same time a military man, a business man, a writer, technician and publicist. As he is often something of a genius and, therefore, usually unpractical—according to Commander Green, at all events—one purpose of the new organisation is to supply the deficiencies. Any expedition carried out under its auspices will start with a proper equipment gathered together at a smaller cost than usual.

When we learn that a modern exploring expedition may cost anything between £10,000 and £100,000 it will be realised that there is room for a central body to undertake the work of fitting out with economy as well as efficiency. Further, Commander Green's expert knowledge is likely to stimulate others to explore the vast unknown areas of the earth's surface and we wish him success in his novel venture. (Incidentally, some readers may be able to say off-hand what proportion of the earth's surface has never been visited by man. I will send an autographed copy of my book "*Engineering for Boys*" to the sender of the first correct solution received.)

Readers are evidently finding our series of articles on the Exploration of the Arctic to be of great interest, for I have received a large number of letters about them. In answer to many enquiries I would say that when the series has been completed it will be followed by another series, dealing with the Exploration of the Antarctic and the discovery of the South Pole.

Famous Author's Centenary

One of the most interesting events of the month is the hundredth anniversary of the birth of Jules Verne, who was born on 8th February, 1828. The stories of this famous French author have delighted many generations of boys and will continue to delight many more. They combine in the most marvellous manner exciting adventures and hairbreadth escapes with a wealth of scientific fact and imagination.

Many of the things of which Verne wrote appeared wildly fantastic and improbable at the time, but now they are matters of everyday routine. A striking example of this is afforded by that wonderful story, "*Twenty Thousand Leagues Under the Sea.*" At the time when this book was written Captain Nemo's submarine must have seemed utterly visionary and hopeless of realisation—to-day the submarine is just as much a reality as the surface ship. Even the idea of sending a giant rocket to the Moon is showing signs of becoming a matter for serious discussion.

The STORY OF THE MOTOR CAR

I.—HOW PETROL SOLVED THE ROAD TRANSPORT PROBLEM

It is a remarkable fact that although the first practical motor car was built over 160 years ago, it was not until the commencement of the present century that motor cars came into general use. It is interesting to compare illustrations of early motor cars with a modern car, for by so doing we are better able to understand the extensive progress that has been made in a comparatively short space of time. This article describes the various developments that have led to the motor car of to-day—a veritable triumph of engineering.

IT is very difficult for us to-day to realise the enormous change that has taken place recently in the traffic of our roads. Thirty years ago the motor car was almost unheard of and the appearance of a self-propelled vehicle in the streets was the occasion of so much curiosity that crowds immediately collected.

The earliest mechanical contrivances to run on the road were propelled by steam. The first of these was constructed in Paris in 1769 by Nicolas Joseph Cugnot. This cumbrous-looking vehicle succeeded in attaining a speed of 2½ miles per hour with four passengers but the supply of steam lasted only some 15 minutes, at the expiration of which the passengers were obliged to dismount and wait until a further supply of steam was raised! After several exciting journeys through the streets of Paris, Cugnot's machine succeeded in scaring everybody so seriously that it was locked up in the arsenal to keep it out of mischief! It is now exhibited in the Paris Museum of Arts and Crafts.

Other power vehicles were subsequently produced at various times, the most successful of these being the inventions of Murdoch, Trevithick, and Symington. It is evident that Trevithick might have accomplished great things in this direction if he had persisted, and a patent taken out by him shows clearly that he had actually conceived the idea of a gear box for varying the road speed.

The first great development of road carriages on anything like a commercial scale took place about 1830. Readers of the article on Sir Goldsworthy Gurney in the *"M.M."* for October last will remember that this inventor's steam carriages were used with considerable success on the roads in the south of England. For a while it seemed as though the steam road carriage would develop rapidly and become a regular institution, but its progress was effectually killed by increased road tolls and by the rapidly growing competition of railways. Progress in regard to road transport was further impeded by the introduction of a law restricting speed to a maximum of four miles per hour and compelling the drivers of all power vehicles to have in front of them a man with a red flag.

Apart from traction engines for hauling heavy loads at low speeds, mechanically-propelled road vehicles were of little importance until the invention of the petrol-consuming internal combustion engine. The idea of the pioneers of this type of engine was that the fuel should provide power directly instead of through an intermediary as in the steam engine.

The first internal combustion engine was the gun. In this the pressure produced by the explosion of gunpowder was used to hurl a missile out of a cylindrical tube. Suggestions for obtaining mechanical power by such explosions were made by various individuals but all came to nothing until a more suitable fuel or explosive was discovered. Coal and coke were of course impossible, if only because of the ash they left when burned, while gunpowder was not a practicable fuel. Another great difficulty with fuel of this type was that it was almost impossible to arrange the intermittent feeding of the fuel that was required.

In 1794 a suggestion for using inflammable gases was made by R. Street. It is easy to see that gaseous fuel is much more suitable than solid fuel for an internal combustion engine, and in 1823 a gas engine was actually constructed by Samuel Brown in Great Britain. It was quite a long time before a really successful gas engine was produced, however, and this was constructed by Lenoir in 1860. It worked in a somewhat similar manner to a steam engine. A valve admitted a mixture of gas and air for about half the stroke of the piston and the mixture was fired by an electric spark immediately the valve closed. The piston was returned by a similar explosion on the other side, and so swept the products of combustion out of the cylinder. There were thus two explosions to each revolution of the crank shaft.

Lenoir's engine only came into use on a limited scale as it was very wasteful. It introduced one important feature of the modern engine, and that was the electrical method of starting the combustion of the fuel.

The chief defect of this early gas engine was that the mixture was not compressed before firing. A suggestion that this should be done had been made as early as 1838 by W. Barnett, but its advantages were not fully realised until 1862 when the theory of the internal combustion engine as we have it to-day was outlined by Beau de Rochas, a French engineer. His plan was to have four different operations taking place during two revolutions of the crank shaft. The cylinder was open at the crank side, all the operations taking place on one side of the piston only, and each operation was controlled by one of the four strokes of the piston in conjunction with two valves fitted to the cylinder head.

The cycle of operations proposed by Beau de Rochas is as follows. The first stroke of the piston outward increases the available space in the cylinder and the explosive mixture is drawn into it through one valve. This is compressed by the return stroke, at the end of which the mixture is ignited, so that the third stroke is the actual working stroke. Finally the next return stroke sweeps out the gaseous products of combustion through the second valve. It will be seen that power would only be communicated to the crank shaft during one of the four strokes, and a fly-wheel was therefore necessary to maintain speed during the idle strokes. Successful engines working on coal gas in accordance with this cycle were designed a few years later by Otto, who is now famous as a pioneer of gas engines.

The final step in the construction of an engine suitable for a road vehicle was made in 1884 by the famous engineer Gottlieb Daimler. Daimler had previously worked in Otto's factory and had seen the great opening for a small engine of the Otto type to propel cycles and other vehicles on the road. Accordingly he designed and brought out a light compact engine in which petrol vapour was used as fuel.

The first motor cars were simply ordinary light carriages with a small petrol motor placed beneath them and connected to the back axle. Even to modern eyes these old vehicles look as if they ought to have a horse in front of them, and they must have seemed still more ridiculous to their contemporaries.

The British authorities took a very serious view of mechanically propelled vehicles in this country, however, and insisted that a man with a red flag should precede them in accordance with the law previously referred to.

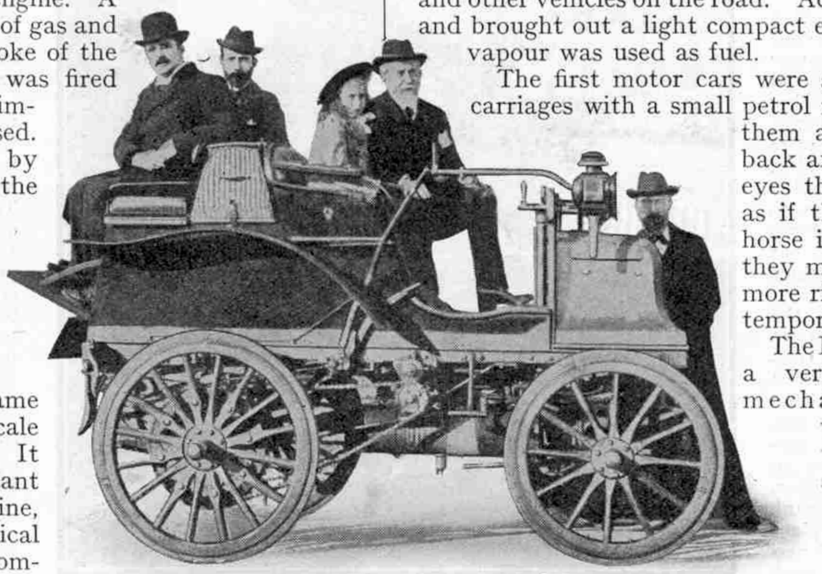
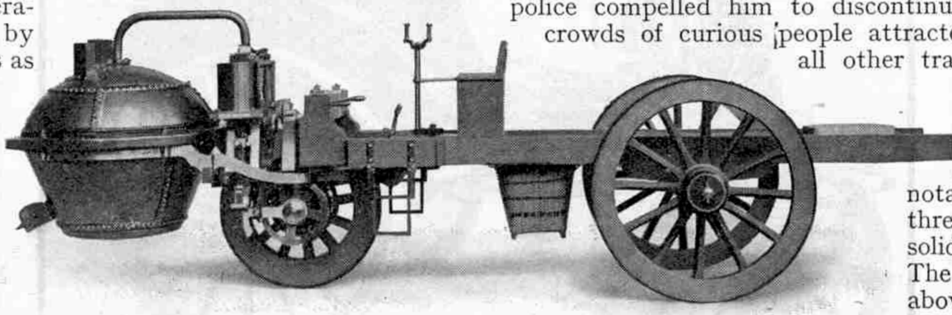


Photo by permission] *[Board of Education*

One of the first Motor Cars in this Country

It is not surprising therefore that the earliest steps in the further development of Daimler's idea were taken abroad. The manufacture of motor vehicles commenced in Germany and France, where Benz and Panhard machines were the first to become prominent.

It is almost certain that the first man to make a petrol car was Siegfried Markus in Austria. He fixed a small petrol engine under the base of a two-wheeled handcart and connected it to the axle, on which he mounted two flywheels. A two-wheeled fore-carriage was added, by means of which the vehicle was steered. Markus ran his car on the roads chiefly at night, for enormous crowds gathered to see it. Eventually the police compelled him to discontinue its use, as the crowds of curious people attracted by it impeded all other traffic!



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The first practical Motor Car: Cugnot's Steam Lorry

Carl Benz of Mannheim built his first car in 1885. This notable vehicle had three wheels fitted with solid rubber tyres. The motor was placed above the rear axle and had one horizontal cylinder and a vertical crank shaft. This drove a horizontal shaft through bevel gears, which in its turn was connected by a belt with a shaft that had fast and loose pulleys mounted on it. The drive was finally communicated to the rear wheels by sprockets and chains.

The engine, rated at 0.75 h.p., was supplied with the explosive mixture by drawing air over the surface of petrol. The car was very crude in comparison with later developments, but it is noteworthy that ignition was by coil and battery, a method that recently has shown signs of being generally adopted once more.

Other cars were made by Benz in the following years and they did more perhaps than any others to demonstrate the possibilities of the new form of locomotion. In general they were similar to the one already described and the influence of early carriage building methods is easily seen on practically all of them. The seating arrangements, leather hood and large road wheels are examples of this. Braking was accomplished just as in the old horse carriages by pressing wooden blocks on the tyres.

Cars of a similar type were being made in France also. The pioneers in that country were Panhard and Levassor, who very soon developed features that distinguished their car from that of Benz and have since become generally adopted.

An early example of the Panhard car was brought to England in 1894. It had a two-cylinder motor placed in front in practically the same position as the engine of a modern car. The cylinders were placed vertically and were inclined at an angle of 15° to each other. Both worked on the same crank pin, the explosions taking place alternately, so that there was one working stroke in each revolution of the crank shaft, instead of in two revolutions as in the single-cylinder engine. From the fore-and-aft crankshaft the drive was taken through a friction clutch and gear wheels to a shaft placed horizontally across the car. At the end of this shaft were sprocket wheels, that were connected with the rear road wheels by chains.

Photo by permission] [*Board of Education*

King Edward at the wheel of an early Motor Car

It will be seen that the number of cylinders had been increased and a clutch introduced in this car. The clutch was of the leather-faced cone type and was controlled by a pedal as in modern machines. This was a great improvement on the fast-and-loose pulley method used in the Benz cars.

The gear-box also was introduced in the Panhard cars made at this time or it really would be more accurate to say the contents of the gear-box, for the gear wheels were not enclosed, the inventor of this device for giving variable speed believing that it was only a makeshift. There were two shafts, one driven by the engine and the other connected to the driving shaft, on each of which gear wheels of different sizes were mounted so that they could be brought into mesh by the manipulation of a lever. In actual working this had to be done as the wheels were rotating. Horrible clashes and great wear and tear resulted with the crudely cut gear wheels then available, but the system became adopted for practically all cars and, with many improvements in construction remains in use to this day, although there are signs that a system of continuously variable gears may shortly become practicable.

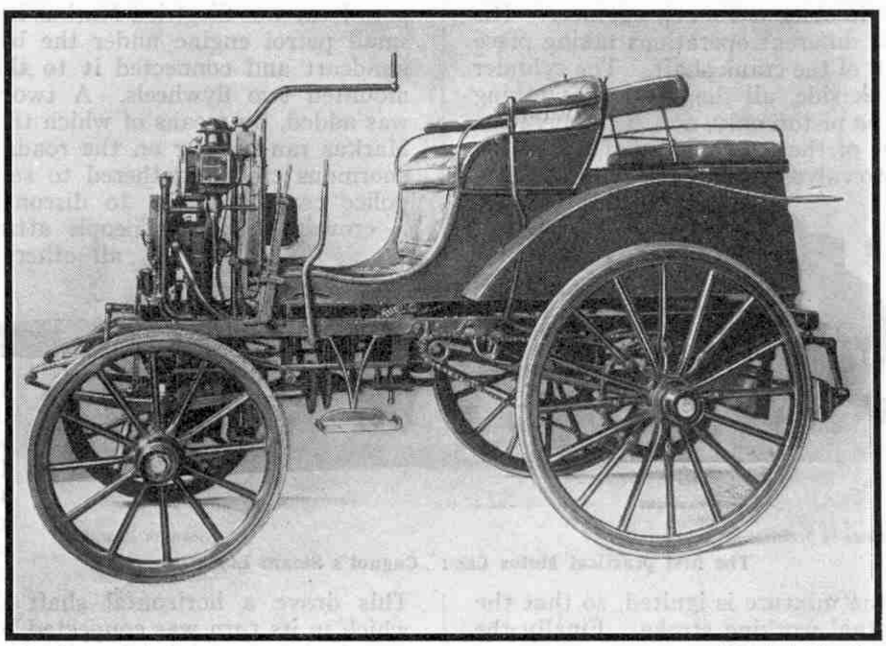


Photo by permission] [*Board of Education*

The above Panhard and Levassor Motor Car was built in 1894 and was brought to England in the following year. It is now in the South Kensington Museum

One peculiarity of the Panhard-Levassor and certain other cars was the ignition system used. The coil and battery had not found favour with the famous French engineers, who used instead a hot tube in the cylinder wall. This was of platinum, closed at the outer end and so situated that a portion of the explosive mixture was introduced into it at the moment when ignition was required. The tube was made red hot by heating from the outside with a petrol flame, and ignited the mixture by coming in contact with it, thereby exploding the entire charge.

In Great Britain matters did not progress so rapidly as in France and Germany. A motor tricycle had been introduced by Edward Butler in 1887. This had two front wheels and a single rear driving wheel. Its engine was of the compressionless type, but it had steering gear of the kind in use to-day, electric ignition with battery and coil, and a radiator for cooling with water circulating round the cylinders. Butler's machine was to have been developed on a commercial scale, but unfortunately a close study of the red flag law failed to disclose any method of circumventing it.

A distinctive motor cycle with a four-cylinder engine was patented by Colonel Holden in 1896, while J. H. Knight, a successful designer of gas engines, built a motor car in 1895 that ran well—indeed, it ran too well, for it ran him into trouble. He was prosecuted by the police for not having a traction engine licence and also for driving his car on the road without having a man in front with a red flag to give warning of the approach of the fearsome vehicle. He was found guilty on each charge and was fined.

The same fate overtook several other daring spirits who brought Benz or Panhard cars to England and ventured on the roads with them. The prospect of vehicles careering along at the rate of 15 miles per hour—for such speeds were now possible—undoubtedly created some alarm in this country. Eventually, however, demonstrations of the docility of cars and a growing appreciation of the benefits likely to result from their development led to the removal of all restrictions in 1896.

To celebrate the abolition of the red flag law a grand procession of cars from London to Brighton was arranged, a demonstration that was partially intended to prove that the new vehicle was reliable. Forty cars started from Charing Cross and eight hours later 13 of them crawled into Brighton, the remaining 27 having broken down. The number of failures may now seem large, but in the circumstances then prevailing it is surprising that there were not more.

To-day a car may be run from London to Brighton and back in far less time than was required for the single journey by the best of the pioneer cars, but this is after 30 years of constant improvement in an industry that has attracted the best brains of the engineering world. In 1896 engines were crude, transmission gear was faulty, and ignition systems were extremely unreliable. Motor mechanics were practically unknown, garages non-existent, and drivers were often compelled to spend an enormous amount of time on the road carrying out repairs of varying degrees of seriousness.

In the meantime motor cars in France had reached such a pitch of perfection that long-distance races were held and the story of these races illustrates how rapidly the industry went ahead after it had once obtained a fair start. The first race was from Paris to Rouen in 1894 and was won by Count de Dion with a steam car. Later the Count became the maker of a famous petrol car, and steam cars never again proved superior to petrol cars in races. In the following years still longer races were organised. The Paris to Bordeaux race in 1895 was won by a 4 h.p. Panhard at 15 m.p.h., while in the next year a 6 h.p. Panhard attained a speed of nearly 16 m.p.h. in winning a race of some 400 miles from Paris to Marseilles.

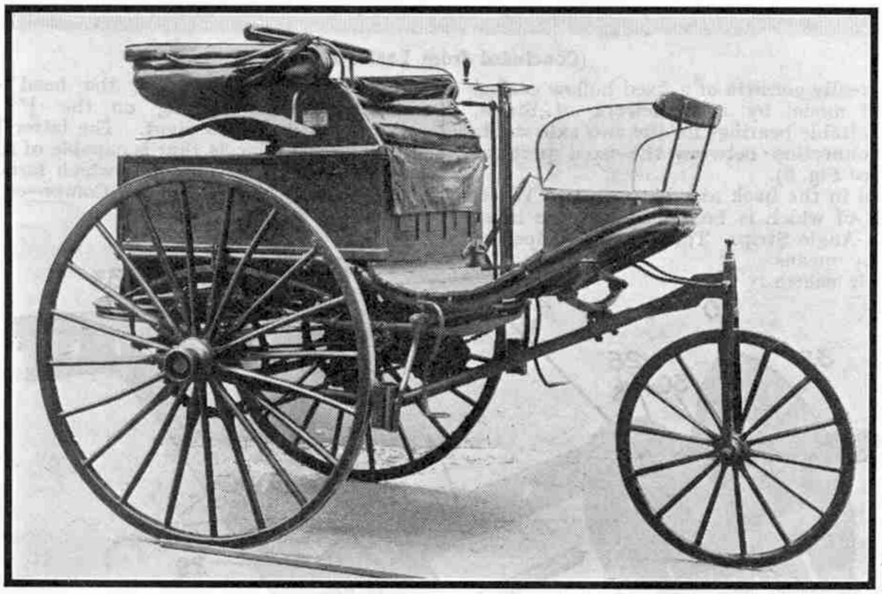


Photo by permission] [*Board of Education*

A Benz Motor Car made in 1888. This car, now in the Science Museum, South Kensington, was probably the first petrol car to be brought to England. It was built by Carl Benz of Mannheim, who first successfully applied the high-speed spirit motor to light and practical road vehicles

More interest was aroused in racing as the number of firms making cars increased. In 1897 a 3 h.p. Bollee tricycle administered a rude shock to the hitherto invincible Panhard by winning the Paris-Dieppe race at the surprising speed of 25 m.p.h. This speed was considered to be absolutely terrific at that time but in the following year the still higher speeds of 30 and 32 m.p.h. were reached by two cars that regained supremacy for the Panhard Company by winning the two principal races of the year. In 1901 the famous Gordon Bennett races were instituted. These were international, and in the first two years were won by Charron with a Panhard, thus continuing the series of racing successes of the famous pioneer firm. In 1902, however, a British car with a British driver scored a sensational victory. The car was a 30 h.p. Napier, built by the firm whose aero engines played so large a part in last year's Schneider Trophy race, and was driven by S. F. Edge, the most famous of British motor pioneers.

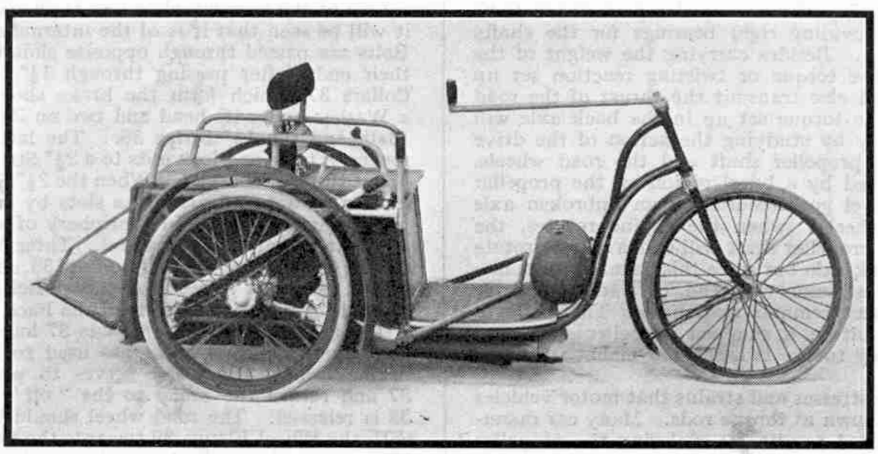


Photo by permission] [*Board of Education*

A Wolseley Car built in 1897. Note the primitive braking device

By this time the general outlines of the motor car had been largely settled. Multi-cylinder engines under a bonnet in front of the car had been adopted, and the use of a radiator either of the tube or honeycomb type for cooling the water circulating round the cylinder heads was practically universal. Brakes, clutches and change-speed gears working in an oil bath in a gear-box were standard fittings. The final drive of the rear wheels was still often accomplished by sprockets and chains, but the floating axle with a bevel drive was fast coming into favour.

In addition the pneumatic tyre was in general use and the bodywork had changed considerably from the carriage type. The pneumatic tyre was originally introduced for use with the bicycle, its inventor being J. B. Dunlop, a surgeon, and the years following its production saw a great expansion in the use of the bicycle as a result of the increased speed and comfort possible. The idea of using the tyre for motor cars possibly occurred to some innovators, but they were deterred by the weight of these vehicles. Finally the Michelin brothers decided that this was no obstacle and attempted to persuade the makers of motor cars to fit tyres made for the purpose. They met with no success whatever and in the end were compelled to buy a car themselves and compete in a race in order to give their ideas a practical test. They competed in the Paris-Bordeaux race of 1895 and during its course used no fewer than 20 inner tubes! Two or three years later they were completely vindicated and solid tyres such as are seen in the illustrations of early cars accompanying this article had given place to the modern type.

The detachable rim was also suggested about this time and the advantages to be derived from it were realised by all, but particularly by those who had had the unpleasant experience of mending or changing tyres in bad weather. It was not until 1906, however, that such rims came into use, and at about the same time the Rudge-Whitworth detachable wheel was also introduced. In later years this device not only added to the comfort of motoring but played a great part in motor racing, the speed with which tyre changes could be effected being astonishing.

Although motor car bodies were now made lower and therefore were more suited to the nature of the vehicle and its speed, complete protection from inclement weather was still lacking, except in the case of a few heavy and expensive cars. No motorist was completely equipped without thick furs or leather coats and goggles and even a short drive was still an adventure.

Signs were not wanting that this state of affairs would soon be altered. As the general outlines of cars became somewhat standardised, parts were better adapted to each other and growing experience led to the use of better material. The mechanism thereby became much more reliable, and reduction in weight became possible without loss of strength.

In regard to the engine, it was becoming recognised that a more even torque, or turning force, was obtainable with a multi-cylinder engine, and the use of four cylinders became common at a comparatively early date. Ignition methods, too, had changed. The use of a battery and coil had been discontinued in most cars in favour of the magneto, in which current was produced by rotating a coil in a magnetic field. The motive power was obtained from the engine itself, and the ease with which current could thus be generated led to its use for lighting and later for starting the engine. (*To be continued*)

The New Meccano Motor Chassis

Fine Example of the Latest Meccano Construction

(Concluded from Last Month)

THE back axle, which really consists of a fixed hollow casing, is represented in the model by a framework of Strips, etc., that provides suitable bearings for the two axle shafts and also forms a rigid connection between the fixed portions of the rear wheel brakes (see Fig. 8).

The differential is housed in the back axle between two Wheel Flanges 26 and 26a, each of which is bolted against the inner side of a $2\frac{1}{2}'' \times 1\frac{1}{2}''$ Double Angle Strip. These Angle Strips are secured rigidly together by means of 3″ Strips 26b, and their centre holes form the inner bearings for the axle shafts 27 and 28. In addition, shaft 28 passes through the centre hole of a $2\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip 29 bolted to the Wheel Flange 26a. One Washer should be placed between the Wheel Flange and the Angle Strip 29 on each of the bolts that hold the latter in position. The rear wheel brake mountings consist of two Face Plates 30 bolted rigidly to the back axle casing, one being secured to the ends of two 1″ Reversed Angle Brackets and the other to the ends of two $2\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strips.

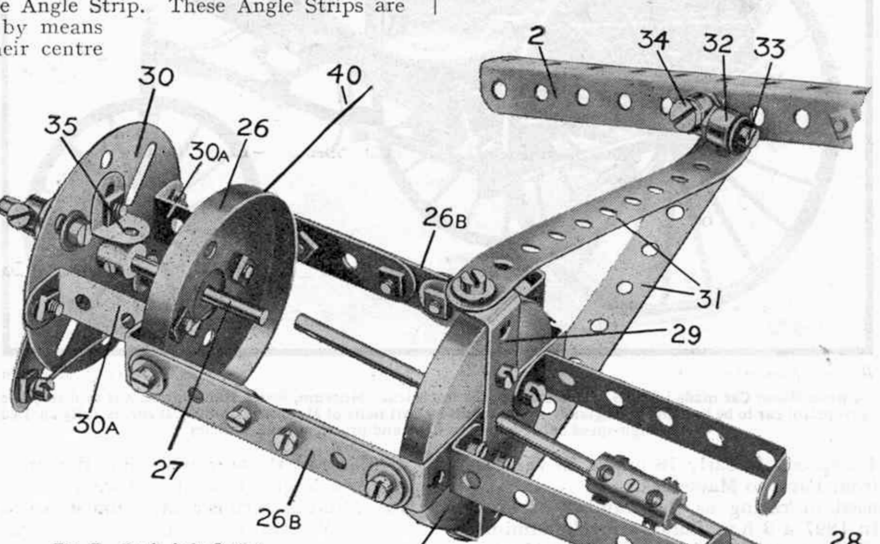


Fig. 7. Back Axle Casing and Torque Rods

The Torque Rods

The rear axle casing (Fig. 7) performs several important functions in addition to that of providing rigid bearings for the shafts secured to the road wheels. Besides carrying the weight of the vehicle, it must absorb the torque or twisting reaction set up by the propeller shaft, and also transmit the thrust of the road wheels to the chassis. The torque set up in the back axle will be understood more clearly by studying the action of the drive transmission between the propeller shaft and the road wheels. Suppose that this is effected by a bevel pinion on the propeller shaft driving a larger bevel gear secured to an unbroken axle carrying the two road wheels: when the engine rotates, the small bevel pinion on the propeller shaft will endeavour to rotate the bevel wheel on the back axle but since this naturally is somewhat difficult to move, the pinion will tend to *travel round the bevel wheel* while the latter remains stationary. This state of affairs possibly might result in a snapped propeller shaft and even broken springs, owing to the twisting movement imparted to the axle casing.

It is to counteract these stresses and strains that motor vehicles are fitted with what are known as torque rods. Many car manufacturers obtain the required results by enclosing the propeller shaft in a torque tube, which not only forms a torque reaction resistance, but also receives the forward thrust of the back axle. In the Meccano model the torque rods are shown quite separately from the propeller shaft, so that their functions may be understood more readily.

The torque rods consist of two $5\frac{1}{2}''$ Strips 31 secured to the ends of the $2\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip 29. These $5\frac{1}{2}''$ Strips taper together at their other ends, where they are secured to a Collar 32 by means of an ordinary bolt inserted in place of the grub screw. Two Washers should be placed beneath the head of this bolt to prevent its shank from binding on the $\frac{1}{2}''$ Bolt 33, about which the Collar is free to pivot. The latter bolt, in turn, is inserted in another Collar 34 that is capable of turning about a Pivot Bolt secured to the $5\frac{1}{2}''$ Girder 2, which forms the main cross member of the frame (see Fig. 2). A Compression Spring (part No. 120b) is placed between the Collar and the Girder to act as a shock absorber when the back axle is forced up and down by irregularities in the road surface.

It will now be seen that the torque rods 31 effectively counteract any twisting tendency in the back axle without interfering with the free vertical movement of the latter as a whole or the independent movement of one or other of the rear wheels.

The back axle casing is secured to the rear cantilever springs by an Angle Bracket 35 secured to each Face Plate 30. These Angle Brackets are bolted to the end holes of the springs, as will be seen in Fig. 2.

Brake Mechanism

One of the rear wheel brakes is shown in detail in Fig. 8, and it will be seen that it is of the internal expanding type. Two $\frac{1}{2}''$ Bolts are passed through opposite slots in the Face Plate 30 and their ends, after passing through $1\frac{1}{2}''$ Strips 36, are secured in Collars 37, which form the brake shoes. Each $\frac{1}{2}''$ Bolt carries a Washer under its head and two on its shank between the Face Plate and the $1\frac{1}{2}''$ Strips 36. The latter Strips are pivoted by means of bolts and lock nuts to a $2\frac{1}{2}''$ Strip 38 that is free to turn about the axle shaft 27. When the $2\frac{1}{2}''$ Strip is moved, the Collars are thrust outward along the slots by means of the links 36 and pressed against the inside periphery of a Wheel Flange 39 bolted to the inside of the road wheel. Three Washers should be placed on the axle 27 between the Strip 38 and the Face Plate. Care should be taken to see that the $\frac{1}{2}''$ Bolts are able to move quite freely to and fro in the slots of the Face Plate.

The grub screws in the Collars 37 have been replaced by 7/32″ Meccano Bolts, and these are used to secure a short length of Spring Cord. The latter serves to withdraw the brake shoes 37 and return the brake to the "off" position when the Strip 38 is released. The road wheel should be placed on the axle 27 with the Wheel Flange 39 towards the Collars 37, care being taken to see that the latter have plenty of room to move before the road wheel is secured rigidly to the axle.

Each brake rod 40 (see Figs. 2 and 8) consists of two Meccano loom Healds bolted together (a length of cord will serve almost as well in their place if preferred). The Healds are connected pivotally at one end to the Strip 38 by means of a bolt and two nuts (see S.M. 262) and at the other end by a similar method to a

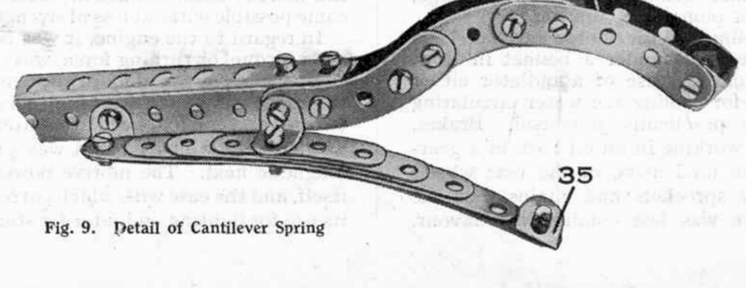


Fig. 9. Detail of Cantilever Spring

Crank 41 secured to a $6\frac{1}{2}$″ Rod 42 (Fig. 2). This Rod 42 carries a hand lever 43 (a $2\frac{1}{2}$″ Rod) by means of which the brakes are operated.

A second brake is fitted to the chassis and is operated by the foot pedal 44, the mounting of which is clearly shown in the general view of the power unit (Fig. 10). It will be seen that the lever consists of a $2\frac{1}{2}$″ large radius Curved Strip pivoted by its centre hole to a $3\frac{1}{2}$″ Rod 45 journalled in two Trunnions. A length of cord 46 (Figs. 2 and 10) is tied to the second hole of the lever and is led under the $\frac{1}{2}$″ loose Pulley 47 (Fig. 2), round a second $\frac{1}{2}$″ Pulley 48 (mounted on a Pivot Bolt secured in the end of a Single Bent Strip bolted to the cross member 2) and thence round the groove of a 1″ Pulley 49 (Fig. 10) secured to the cardan shaft. The cord is finally brought back and tied under the head of the Pivot Bolt carrying the Pulley 48. A slight pressure on the pedal 44 tightens the cord round the Pulley 49 and thereby retards the motion of the cardan shaft. When the brake is off the lower portion of the pedal rests against a $\frac{3}{4}$″ Bolt 50 secured in one of the Trunnions, and the pedal is held thereby in a convenient upright position.

The Power Unit

The 4-volt Electric Motor representing the engine, and the gear box, clutch, etc., are all rigidly connected together, so that they form a complete unit that may be removed from the chassis simply and quickly. This method of construction ensures that the gear wheels and other working parts will always be in proper alignment with each other, and that their functions will not be affected in any way by stresses and strains set up in the chassis frame.

The main frame of the unit consists of two $9\frac{1}{2}$″ Angle Girders 51 connected together by two $2\frac{1}{2}$″ × $\frac{1}{2}$″ Double Angle Strips 52 and a $4\frac{1}{2}$″ Strip 53. The Motor is secured to the frame by a bolt passing through hole A in its side and hole B in the $3\frac{1}{2}$″ Strip 54, and by two other bolts engaging the holes C and D of one of the $9\frac{1}{2}$″ Girders. A Washer is placed on each of these bolts between the Motor and the frame. It will be observed that the Motor rests on the far side $9\frac{1}{2}$″ Angle Girder (Fig. 10) only, and is bolted thereto. The near $9\frac{1}{2}$″ Angle Girder is not attached to the Motor except by the 3″ Strip 54.

A $2\frac{1}{2}$″ × $\frac{1}{2}$″ Double Angle Strip bolted across the two Double Angle Strips 52 forms a bearing for the 5″ Rod 56, which corresponds to the crankshaft of an actual car. This Rod 56 carries a 1″ fast Pulley 57, a $1\frac{1}{2}$″ Contrate Wheel 58, and a 1″ fast Pulley 59 (Fig. 11). A length of cord connects the Pulley 57 with the $\frac{1}{2}$″ fast Pulley 60 (Fig. 10) secured to the shaft of the radiator cooling fan, which is free to rotate in the boss of a Crank 61. The latter is bolted by its end hole to an Angle Bracket secured to the top of the Motor. When the engine is in motion the fan rotates at a considerable speed immediately behind the radiator.

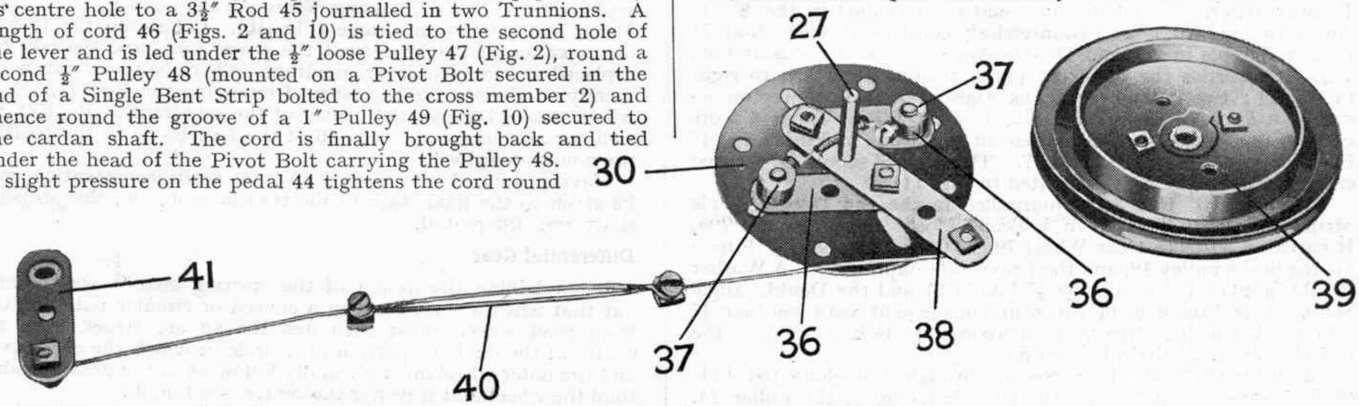


Fig. 8. Internal-expanding Rear Wheel Brake, ready for assembly. The road wheel is shown separately on the right

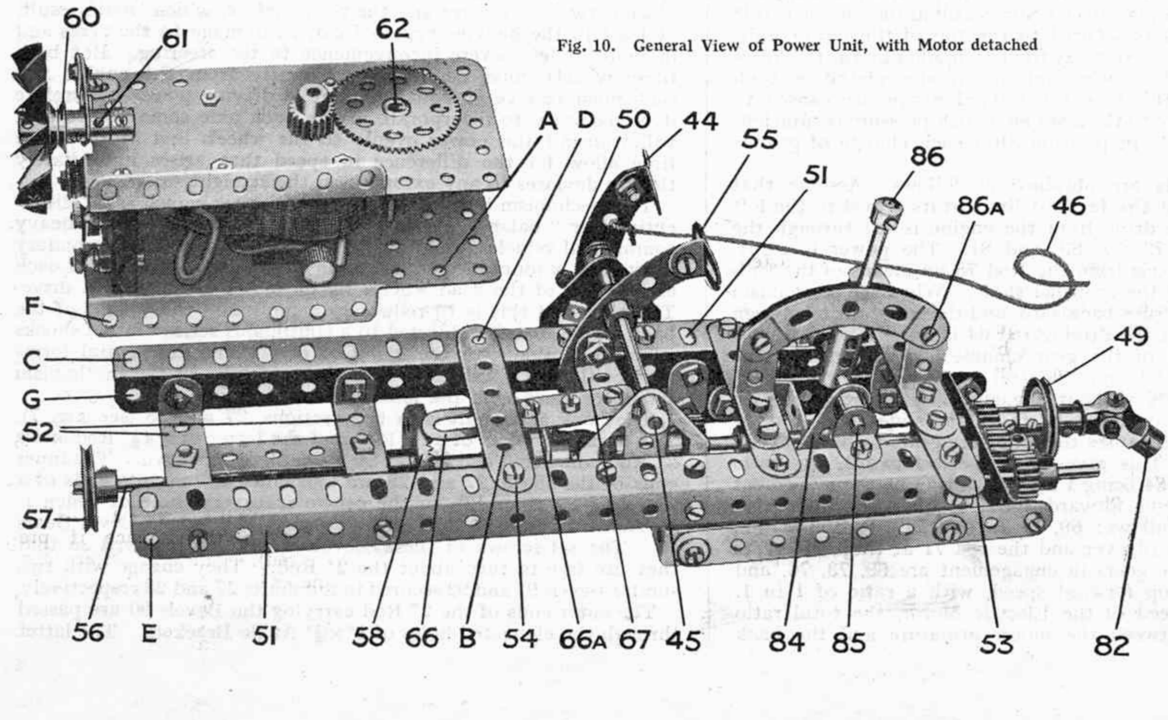
Transmission—The Clutch

The drive from the Motor armature is first led to a secondary shaft 62, on the lower end of which is secured a $\frac{1}{2}$″ Pinion, boss downward, engaging with the $1\frac{1}{2}$″ Contrate Wheel 58. The 1″ Pulley 59 on the 5″ Rod 56 forms the male portion of the clutch (Fig. 11) and is fitted with a Meccano Rubber Ring (Part No. 155), which provides the resilient surface required in a frictional contact clutch of this type. The female clutch member consists of a Flanged Wheel 63, with set-screw removed, placed on the end of a $3\frac{1}{2}$″ Rod 64.

The Flanged Wheel must slide on the Rod 64 and yet be mounted in such a way that when it is engaged by the clutch member 59 it transmits power to the Rod 64. This is accomplished in the following manner: two Angle Brackets bolted to the Flanged Wheel by $\frac{3}{8}$″ Bolts and spaced therefrom by Collars engage by their slotted holes with the shanks of two set screws inserted in the "spider" or central collar 65 of a Universal Coupling. This "spider" is secured to the Rod 64 and a portion of a Compression Spring 65a (part No. 120b) is inserted between it and the boss of the Flanged Wheel. For this purpose it will be necessary to cut the spring approximately in half. The Spring 65a normally holds the Flanged Wheel in engagement with the Rubber Ring on the Pulley 59, but the Flanged Wheel can be forced back on the Rod 64 to an extent just sufficient to throw it out of gear with the clutch member 59.

The clutch withdrawal mechanism consists of a 2″ Slotted Strip 66 (Fig. 10) bolted to a $1\frac{1}{2}$″ Strip, the latter in turn being bolted to a 1″ × $\frac{1}{2}$″ Angle Bracket 67 that is connected by a bolt and lock-nuts to the second hole of the pedal 55. The slot of the Strip 66 engages the Rod 62 immediately behind the Pinion driving the Contrate Wheel 58. The Rod 62 thus forms a guide for the Strip 66, which moves in a direction parallel to the Rod 56. It will be found that when the pedal 55 is depressed the shank of the bolt 66a engages with the rim of the Flanged Wheel 63, and the latter is thereby withdrawn from contact with the clutch member 59.

Fig. 10. General View of Power Unit, with Motor detached



Gear Box

The gear box provides three speeds

forward, neutral, and reverse gears. It is built up from two 4½" Strips connected together at the front end by a 2½"×1" Double Angle Strip and at the other end by a 2½"×½" Double Angle Strip (Fig. 11). It is bolted to the Angle Girders 51 in the position shown in Fig. 10 by means of four Flat Brackets.

The 3½" Rod 64 carrying the clutch member represents the primary driving shaft. It is provided with a ¾" Pinion 68 and a 1" Gear Wheel 69, and its inner end is journalled in the 1"×1" Angle Bracket 70. The countershaft consists of a 6½" Rod 71 that is slidable in the end Double Angle Strips of the gear box. This Rod carries the following parts, reading from left to right in Fig. 11: two Collars (acting as stops to limit its sliding movement), a 50-teeth Gear Wheel 72, 1" Gear Wheel 73, two more Collars, one of which (74) is free on the Rod, ¾" Pinion 75, 1" Gear Wheel 76, and ½" Pinion 77. These parts should be secured carefully in the positions indicated in Fig. 11.

The driven 3" Rod 78 is journalled in the end Double Angle Strip of the gear box and in a second 1"×1" Angle Bracket 70a. It carries a 50-teeth Gear Wheel 79, 1" Gear Wheel 80, ½" Pinion 81, the brake pulley 49, and the Universal Coupling 82. A Washer should be placed between the ½" Pinion 81 and the Double Angle Strip. This Pinion is in constant engagement with another ½" Pinion 83, which is free to turn upon a ¾" Bolt secured to the end Double Angle Strip by two nuts.

An ordinary 7/32" Bolt passes through the elongated hole of the Crank 84 and enters the threaded bore of the Collar 74. A nut placed upon it is secured tightly against the Collar in order to prevent its shank touching the rod 71 and also to ensure that the Crank is quite free to pivot about the bolt. The Crank is secured to a 2" Axle Rod 85 (Fig. 10) journalled in Angle Brackets bolted to the Angle Girders 51 of the power unit, and a Coupling secured to this Rod carries the gear change lever 86.

It will be seen that the lever moves in a quadrant constructed from two 2½" small radius Curved Strips bolted one on each side of 1"×1" Angle Brackets secured to the top of the power unit. The Curved Strips are spaced away from each other by the thickness of the supporting Angle Bracket and one Washer placed on each connecting bolt. In this way the Curved Strips are caused to apply a certain pressure to the lever 86, which pressure is sufficient to hold the lever firmly in position after each change of gear is effected.

The different speeds are obtained as follows. Assume that the sliding rod 71 is at the furthest limit of its travel to the left in Fig. 11. Then the drive from the engine is led through the following gears: 68, 72, 77, 83, and 81. The power is transmitted to the road wheels from the Rod 78 by means of the Universal Coupling 82 and the propeller shaft. When the mechanism is so placed the chassis runs backward, and the speed ratio between the propeller shaft and the driving rod 64 is 1 in 2.

A slight movement of the gear change lever disengages the Pinion 77 from Pinion 83, and "neutral" gear results, the secondary shaft revolving idly without engaging any of the wheels 79, 80 or 83. Further movement of the lever slides the Rod 71 further to the right and causes the following gears to be engaged: 68, 72, 75, and 79. This gives first speed forward, the ratio between shafts 78 and 64 being 1 in 4. Continuing the movement of the lever, the second forward speed is obtained, the drive now being directed as follows: 69, 73, 75, and 79. Ratio: 1 in 2.

When the lever is hard over and the rod 71 at the limit of its travel to the right, the gears in engagement are 69, 73, 76, and 80. This represents top forward speed, with a ratio of 1 in 1. Owing to the high speed of the Electric Motor, the total ratio of speed reduction between the motor armature and the back road wheels is fairly considerable.

The power unit is mounted in the chassis as follows. First remove the radiator by unscrewing the Strip 7a (Fig. 2) on which it is mounted; remove the bolt 86a (Fig. 10) from the change gear lever quadrant, and draw out the 5" Rod 87 (Fig. 2). Now place the power unit in position and bolt the end holes of the 4½" Strip 53 to the ½" Reversed Angle Brackets 88 (Fig. 2), and replace the 5" Rod 87, passing it through the holes E, F, G, of the Motor and power unit frame (Fig. 10). Collars on the Rod 87 are next screwed tight against the power unit, and the bolt 86a replaced in the gear lever quadrant. (This bolt was taken out merely to obviate the necessity of removing the Rod 42, Fig. 2, which passes through the centre of the quadrant). Replace the radiator and secure the cord 46 of the foot brake in the position previously described.

Having secured the power unit in position, attention may be given to the final stage in the transmission, i.e., the propeller shaft and differential.

Differential Gear

In explaining the design of the steering gear it was pointed out that when a car travels in a curved or circular path the two front road wheels must each describe an arc struck from the centre of the circle or portion of a circle in which the car moves, and the outer wheel must naturally follow an arc of greater radius than the wheel that is nearer the centre (see Fig. 3).

The difference in speed thus set up between the two wheels is not important in the case of the front wheels, for they are both free to turn on their individual axles; but it is obvious that since the rear or driving wheels are similarly placed in regard to the central point A, Fig. 3, the same rule must apply to them. To state this more plainly, the rear wheels must rotate at different speeds when the car moves in a curve, otherwise slip must take place between the tyres and the road surface, which would result, at least in the heavier types of car, in damage to the tyres and in more or less severe inconvenience to the steering. But both these wheels must be driven constantly from the engine and each must receive an equal amount of driving power; therefore it is necessary to incorporate in the back axle some device that will transmit the power evenly to the wheels and at the same time allow for the difference in speed that arises immediately the car deviates to any extent from the straight.

The mechanism that fulfils these functions is known as a "differential" or "balance" gear. In some cars, especially in heavy commercial vehicles, the differential is incorporated in a secondary shaft that is journalled in the main frame and connected at each end to one of the road wheels by means of chain or belt drive. The object of this is to reduce to a minimum the weight of the back axle, which is subjected to a continuous series of road shocks when in motion. In the Meccano model, the differential forms part of the back axle unit, and the principles of the mechanism should be clear from the following description.

The back axle shaft is in two sections, 27 and 28 (see Fig. 7). The former consists of a 3" Rod and the latter of a 4½" Rod and a 2" Rod connected end to end by a Coupling as shown. The inner ends of the shafts 27 and 28 are journalled in opposite ends of a Coupling 89 (Fig. 12), in the centre transverse hole of which is secured a 2" Rod 93 that serves to carry the two ⅞" Bevel Gears 90. The set-screws of these Bevels should be removed so that they are free to turn about the 2" Rod. They engage with two similar Bevels 91 and 92 secured to the shafts 27 and 28 respectively.

The outer ends of the 2" Rod carrying the Bevels 90 are passed through the elongated holes of 1"×½" Angle Brackets. The latter

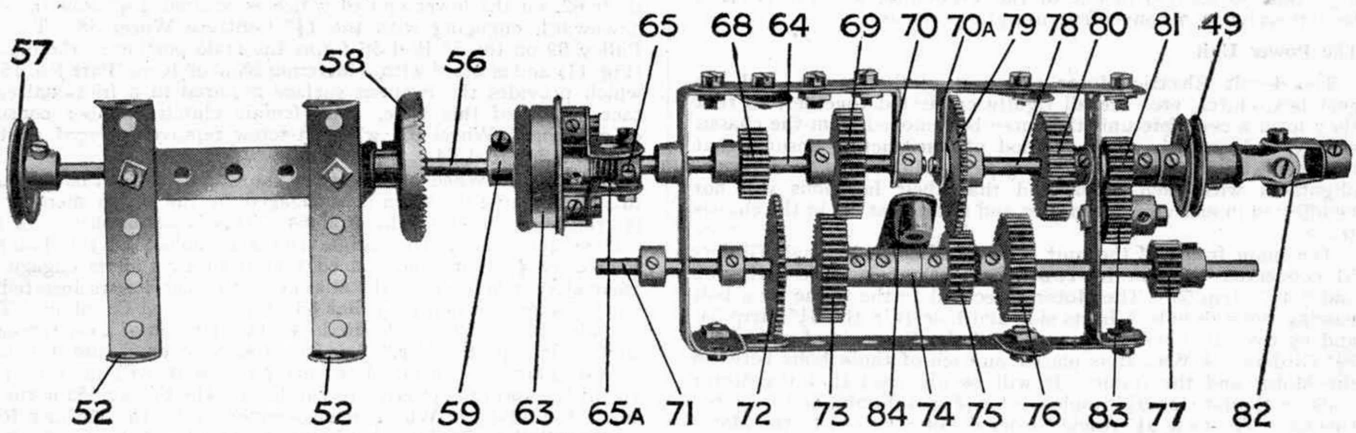


Fig. 11. Gear Box and Clutch

are secured rigidly by means of ½" Bolts to opposite holes in the 1½" Bevel Gear 94, and are spaced therefrom by means of Collars placed upon the bolts between the Brackets and the Bevel Gear. This Bevel Gear is free to revolve independently about the axle shaft 28, its set-screw having been removed.

The propeller shaft consists of a 3½" Rod 95, one end of which is secured in the Universal Joint 82 (Fig. 11) and the other end, after passing through a Double Bent Strip and the side of the differential frame, is secured in the ½" Bevel Gear 96, which engages with the 1½" Bevel Gear 94. Two Collars 98 should be secured to the shaft 28 in the position shown to maintain the various gears in correct alignment and to prevent the gears 94 and 96 from slipping or binding against each other. A Washer should be placed between the outer Collar 98 and the Double Angle Strip forming the end of the differential frame, and two Washers should be placed against the boss of the ⅞" Bevel Gear 91.

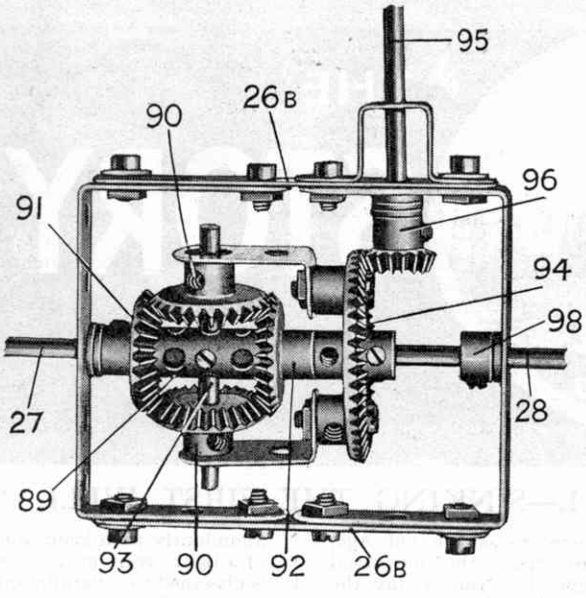


Fig. 12. The New Differential Gear

Care should be taken to see that the various parts of the differential gear work quite freely and that the several Bevel Gears are all placed in the correct positions in relation to each other. Everything should operate smoothly and easily when the shafts 27 and 28 are twisted between thumb and finger, whether simultaneously and in the same direction, or separately and in opposite directions.

If one of the road wheels revolves at a greater speed than the other the Bevel Gears 90 begin to rotate and thereby adjust the difference in speed between the Bevel Gears 91 and 92. If the vehicle is running in a perfectly straight course the axles 27 and 28 and Bevel Gears 90, 91 and 92 must all rotate as one unit, since the road wheels are travelling at the same speed.

The construction of the differential frame will be obvious from Fig. 12. The two 2½" × 1½" Double Angle Strips shown in this illustration may also be seen in Fig. 7, but in the latter case they are shown bolted to Wheel Flanges 26 and 26a and incorporated in the back axle casing. When the gear is ready to assemble, the differential frame (formed by the 2½" × 1½" Double Angle Strips and 3" Strips 26b) should first be incorporated in the fixed back axle (Fig. 7). The gearing should then be placed in the frame and the shafts 27 and 28 inserted in their respective positions. It will be noticed that a Washer is placed beneath the head of the bolts at each corner of the differential frame (Fig. 12); this is to prevent the shanks of the bolts fouling the sides of the Wheel Flanges 26 and 26a (Fig. 7).

Electrical Connections

All that now remains to complete the model is the wiring between the Motor, dashboard switch, and the Accumulator. Either the Meccano 8 amp. or 20 amp. Accumulator may be used, but the former is of a more convenient size. As previously pointed out, it may be mounted on the luggage carrier at the rear of the model.

One wire should be led direct from the Motor terminal to one terminal of the Accumulator, and another wire should be led from the second Motor terminal to a 6BA bolt 99 secured to the dashboard (see Figs. 2 and 4). This bolt is insulated from the 5½" Curved Strip of the dashboard by means of a Meccano Insulating Bush and Washer. The switch handle consists of a Threaded Pin secured to a Flat Bracket 100, which is attached to the dashboard by another 6BA Bolt. An ordinary metal Washer should be placed on each side of the Flat Bracket, but the bolt is insulated from the dashboard by means of an Insulating Bush and Washer. A wire secured to its shank is led to the second terminal of the Accumulator. The Motor is started by sliding the Flat Bracket 100 over the head of the bolt 99, thus completing the electric circuit.

In connecting up the wiring care should be taken to see that the insulation is not damaged in any way, otherwise short circuits may be caused by the current leaking to the metal frame of the chassis.

It is scarcely necessary to add that all the working parts of the Chassis, with the single exception of the actual frictional surfaces of the clutch, should be lubricated at frequent intervals. Great care should be taken to prevent any oil coming in contact with the Rubber Ring on the clutch member 59 (Fig. 11), for the oil would cause the clutch to slip, of course, without transmitting the drive to the road wheels.

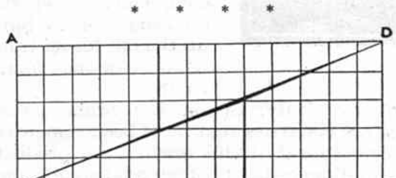
If the Meccano Chassis is to be used for demonstrating the actual working of a motor car, it will obviously be inconvenient to allow the model to run about on its wheels. A good plan, therefore, is to jack up the model on suitable supports. A stand for this purpose can easily be devised by any boy from ordinary Meccano parts.

When the Chassis is raised in this way, with the wheels free to revolve, the various features of the mechanism may be studied while actually in motion and the different movements, such as starting and stopping the Motor, clutching and declutching, gear-changing, reversing, and steering, etc., may be easily demonstrated.

Answers to Last Month's Puzzles

No. 1. Hebrew.

* * * *



No. 2. When the four pieces are fitted together the two angles that come together at B are together slightly less than a right angle. The same is true of D. Consequently, a space equal in area to one small square is left out of the rectangle. The space is so narrow that it does not become apparent on refitting the pieces of the square. In order to show the solution the drawing above is given in slightly exaggerated form.

* * * *

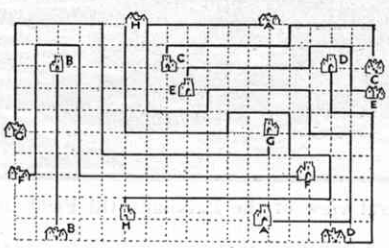
No. 3. Lard, tea, butter, ink, bread, salt, beef, pen, wax, pins, fish, candles, button, matches, ham.

* * * *

No. 4. Time and tide wait for no man.

* * * *

No. 5. Winchester.



No. 6. The solution to the motorists' problem is given in the above diagram.

* * * *

No. 7. 116.

* * * *

No. 8. The completed sum read as under:

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215)37195(173
    215
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    1569
    1505
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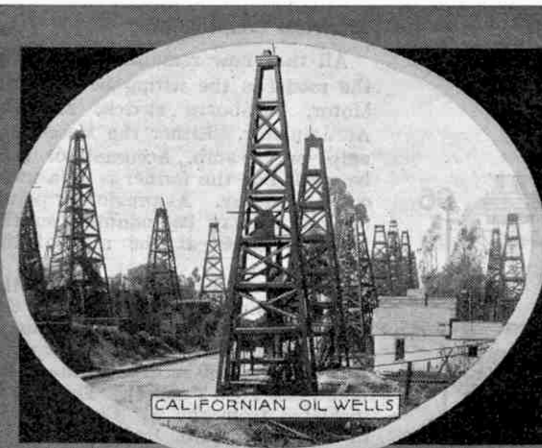
No. 9. Aberdeen, London, Dublin, Dundee, Portsmouth, Hull, Glasgow, Halifax, Wick, Hawick.

An Interesting Railway Booklet

Readers who were interested in the description in the September "*M.M.*" of the Romney Hythe and Dymchurch Railway will be glad to learn that the Locomotive Publishing Co. (3, Amen Corner, London, E.C.4) have prepared an interesting souvenir booklet dealing in detail with this fascinating miniature line. The booklet is illustrated by a series of excellent photographs, including one of the Duke of York driving the "Pacific" type engine "*Green Goddess*" out of New Romney Station in August last year. The price of the booklet is 1/2 post free.


CALIFORNIAN OIL WELLS

THE STORY OF OIL

I.—SINKING THE FIRST WELL

THE present era is already being referred to as the Oil Age, although it is less than a century since the industrial possibilities of oil were first recognised. But to-day the demand for this natural product is insatiable. Coal, so long regarded as the world's finest fuel, is in danger of being outrivalled, for oil has proved to be a fuel of great heating properties, and cleaner and more adaptable in use. Oil has also been found to possess as many fruitful by-products as coal, and on almost every hand there is evidence of its increasing application in some form or other to industry.

The word "oil" is a very comprehensive term, for it is applicable to all fluids and solids of oily constituency obtained from the animal, vegetable and mineral kingdoms. We are now dealing, however, with oils derived from the last source, which are usually classified under the name "petroleum." This is a generic term used in reference to oil extracted from the earth.

The generally accepted theory as to the origin of petroleum is that it is a product of animal and vegetable matter slowly decomposed under great pressure thousands of years ago. In confirmation of this theory it has been proved that petroleum is present in the geological strata of many prehistoric periods, notably the Silurian—a period associated with the Carboniferous Age described in the article on coal, in the "*M.M.*" of February last year. Petroleum is a natural product comprising at least 30 different hydrocarbons, or compounds of carbon and hydrogen, the proportions of these constituents varying according to the locality in which the oil is found. These numerous hydrocarbons can be separated by modern processes of distillation.


General view of the Palkhana Oil Field in Iraq

Petroleum is found, in varying degree, and either in a liquid, plastic or solid form in most countries. The greater portion of the oil found is in liquid form, which varies in the proportion of its constituents in different countries. That derived from many of the oilfields of Mexico, Texas, California and Russia is black in colour, thick as treacle and possesses a strong odour. Asphalt is a predominant characteristic of the oil obtained from these sources which is therefore classed as an asphaltic oil. The petroleum obtained in the Russian, Texan and certain parts of the Mexican oilfields qualifies, after being refined, as an admirable fuel for firing the boilers of steamships, locomotives, etc. The Dutch, East Indian, Roumanian and Pennsylvanian oilfields yield abundantly petroleum almost as odourless and free as water, and of a light green, grey or amber colour. Being rich in paraffins, it is classified as a paraffin oil, and when refined it provides excellent petrol and other naphthas.

Petroleum in the solid form is obtained as a constituent of low grade ozokerite, a hydrocarbon substance mined like coal and which, under distillation, yields burning and lubricating oils, solid paraffin and coke. It is also recovered from deposits of shale, and from tar sands and other materials.

Petroleum is not found in the form of great underground pools but in association with sand, which absorbs it. The irregular formation of the earth's crust due to volcanic upheavals in pre-historic times is reflected in the irregular strata of oil-bearing sand which, in some districts where volcanic action has been acute, have been so disturbed that instead of extending horizontally as in normal localities they are almost vertical. In others they are found interspersed with layers of volcanic matter. The volcanic upheavals that brought about the formation of the Rockies and the Swiss Alps apparently created such a tremendous pressure within the earth there as to completely expel the oil sands, or to burn up the oil, for no trace of it can be found to-day.

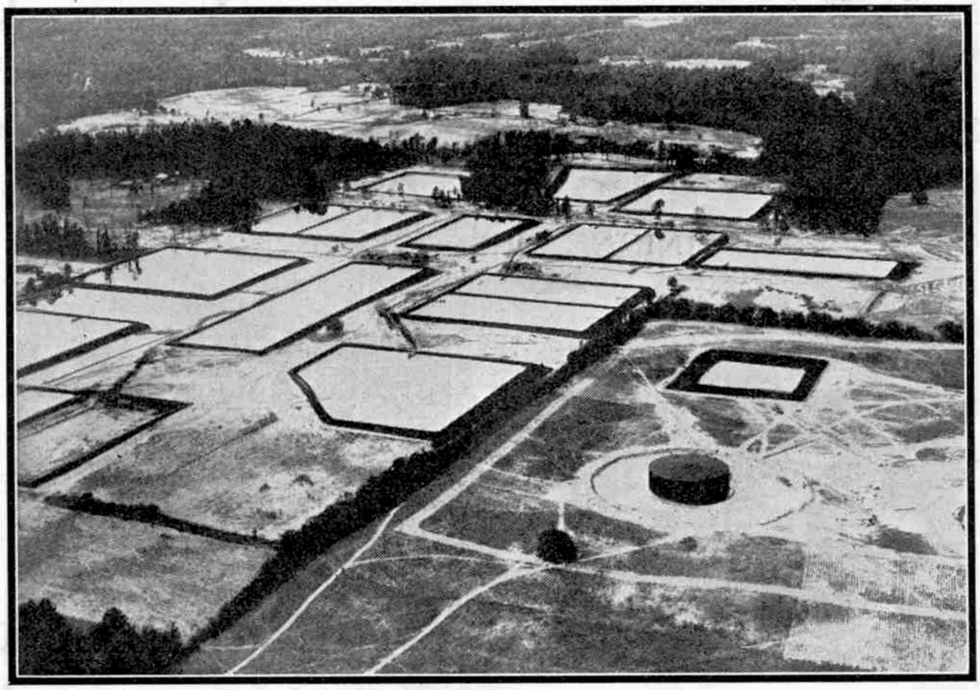
France, Belgium, Germany, Italy, Spain, the Scandinavian countries and South Africa are countries that have been somewhat neglected by Nature in her bestowal of this remarkable product. In the British Isles also no oil deposits of commercial significance have been located, apart from shale deposits in Scotland.

Despite these considerable barren areas, however, the world's supply of petroleum is almost unlimited. The United States might almost be described as one vast oilfield, so extensive are the different areas of oil-bearing strata. Among the richest oilfields are those of Texas, California and Kansas, while in the Appalachian mountains huge quantities of crude oil have been and are still being obtained. Curiously enough, distribution of this product does not appear to extend into Canada, for up to the present no oil wells of any importance have been tapped there. Mexico is to-day one of the most important oil-producing countries, while in some parts of South America considerable oil resources have been located.

The petroleum resources of Russia have only been investigated in the Caucasus region where, in the neighbourhood of Baku, a coastal town on the Caspian Sea, a rich and extensive oilfield is now being exploited. Experts are optimistic regarding the vast areas still untapped.

China is an unknown quantity, while West Africa has been proved to possess limited petroleum deposits. Burmah, the Dutch Indies, Galicia and Roumania are tremendously rich in oil resources, as also is Persia, where the Anglo Persian Oil Co. Ltd. have been remarkably successful in developing the oil industry. Some shale deposits have been located in Australia and in the neighbourhood of Natal, South Africa, but the process involved in separating the oil from the other constituents is complicated and costly.

The heating and lighting properties of petroleum were recognised and utilised by the people of very early times and the writings of philosophers and travellers of olden days contain some interesting references to its use. Thus it is known that in Southern Russia natural oil wells, which somehow had caught fire, were for many centuries used as sacred shrines by "fire worshippers," and in the Caucasus region there was a Parsee shrine the flame in which had been alight since pre-Christian times. The biblical parable of the Virgins, some of whom wisely had their "lamps trimmed and burning," probably refers to the use of oil as a luminant 1,900 years ago, the fluid no doubt being obtained from natural oil springs.



An aerial view of a great Oilfield in Arkansas, U.S.A.

The historian Pliny (23-79 A.D.) mentioned in his writings that roughly fashioned lamps, in which crude oil was burned, had long been used by the people of Agrigentum, a city in Sicily. Ancient historical writings dealing with Roumania and Galicia disclose that for many hundreds of years oil was there obtained from the earth. In the 13th century the famous traveller Marco Polo recorded that in Baku "there is a fountain of great abundance inasmuch as a hundred ship loads might be taken from it at one time. This oil is not good to use with food, but it is good to burn, and is also used to anoint camels that have the mange. People come from vast distances to fetch it........"

In the by-gone days of the "Wild West" the Red Indians of North America had a great veneration for natural oil springs. The "Medicine Man" of a tribe would summon all the ailing members of the fraternity to a "sick parade" at one of these springs, and there administer to them some sort of oil treatment to cure their sundry afflictions. Great healing potency was attributed by the Indians to the oil.

Throughout the centuries of the Early and Middle Ages hardly any exploitation of oil resources was carried out. In 1859 a British chemist named James Young ushered in the era of scientific treatment of petroleum, from which has developed the great world-wide oil industry of the present day.

As a boy, Young lived in Glasgow, where he served as cabinet maker to his father, but the work did not appeal to him. His great love was chemistry, and to the study of this he devoted all his spare time. Later he left his father's business and removed to Manchester, where he took up work as an industrial chemist. Among the eminent people he there became acquainted with was Lord Playfair, who one day invited him to investigate a thick, black fluid that was leaking into a coal mine at Alfreton, Derbyshire. Young identified the invading liquid as crude petroleum, and at his laboratory later he successfully distilled paraffin from a sample of the crude oil.

The importance of the discovery was not lost upon him and he at once determined to erect an experimental refining plant near the mine. He accordingly removed to Alfreton to superintend the construction of the necessary plant. At the time the plant was started up the spring was yielding roughly 300 gallons daily, but afterwards the output steadily decreased. However, Young was able to complete two years of practical experimenting before the spring petered out and the plant of necessity closed down. In that time he completed his research, with the result that in 1850 he obtained a patent covering a method of obtaining paraffin by the distillation of crude petroleum.

At the time of Young's pioneer work it was generally believed that the only useful product obtainable from mineral or crude oil by purifying it was an oil suitable as an illuminant. When details of his patent became known in U.S.A., where rush lights were the accepted mode of artificial lighting, a company was formed, under the title of the Pennsylvania Rock-Oil Company, to exploit his method. Prospecting for oil was commenced in 1854, with a view to sinking wells and erecting plant for refining the crude oil obtained.

During the ensuing two years numerous holes were dug in various likely districts, but nowhere was any oil located and eventually prospecting was abandoned and the company passed out of existence, probably owing to having exhausted all available funds.

In 1859 the search for petroleum was resumed, this time by a Colonel Drake who, aware of the existence of oil deposits in Pennsylvania, decided to prospect along a certain picturesque valley of that State. He was accompanied by an engineer whose name does not appear to have been recorded for posterity, and a workman named William who was familiarly known as "Old Billy Smith," with whom were his two sons. After a thorough investigation of the valley Drake decided upon a place to begin digging operations.

The men at once commenced to fell trees and saw them into rough planks from which was constructed a tall ungainly building resembling a four-sided wooden tower. There were no windows and light was secured by omitting a plank here and there. A strip of wood bearing the name "Drake" was nailed high up at one corner of the tower. The preliminary operations were soon finished and on 20th May, 1859, the party gathered within the tower to commence digging operations. It was intended to dig a capacious hole similar to an open water well, and had the latter been their object success would have speedily been achieved, for after a few day's digging water suddenly appeared with a rush. In a few minutes the cavity, several feet in depth, was flooded and the hole rapidly widened as the sides collapsed. Baling was at once begun, but it soon became apparent that water was flowing into the excavation faster than they could draw it off, and the job was abandoned.

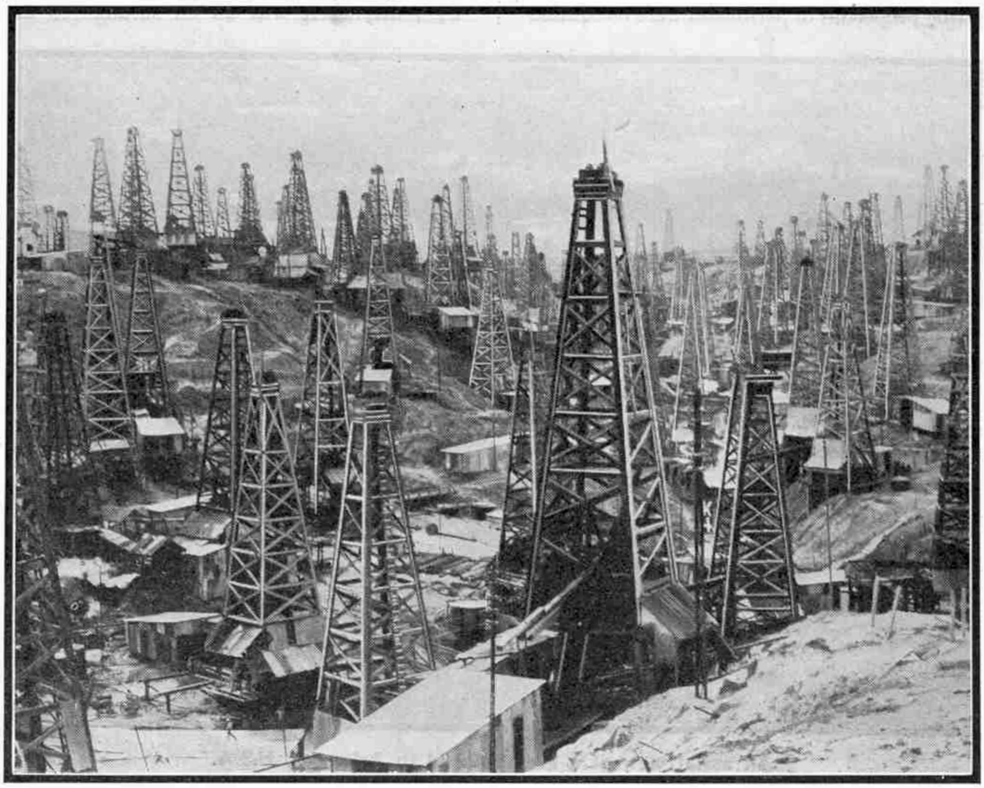
Drake and his engineer then determined to carry the excavation far beneath the water until at length oil, if there was any, should be met. The presence of the water necessitated another method of excavation being adopted and it was decided to work on the lines employed in sinking artesian wells. In this operation a drill bites downward into the earth and is followed closely by a continuous iron pipe, which is so actuated as to crush the broken earth into powder. Water, injected under pressure, forces the powder to the surface in the form of mud. The pipe also serves the purpose of a ready-made shaft.

The task of conveying the purchased piping to the remote valley was slow and laborious, but at length it was safely stored in the shed, the "home made" cutting tools were ready, and once more excavating was begun.

Foot by foot the drill penetrated, the piping following. On the 27th August, 1859, when a depth of 69½ ft. had been reached, a dark and dense fluid was seen to be emerging with the water from the pipe. One thought came to all—Oil!

The men watched the outflow fascinatedly. The fluid steadily increased and the odour of crude petroleum became distinctly noticeable. At length water ceased coming up, and undiluted crude oil poured out of the pipe at the rate of 35 gallons per hour. The wonder of it created an awed silence among the party, for here was irrevocable proof that oil could be obtained from the earth in the same simple manner as water.

The news of Drake's discovery created tremendous excitement throughout America and within a few months the picturesque Pennsylvanian valley was invaded by thousands of fortune seekers. Clerks, financiers, adventurers, and ne'er-do-wellswere among those who rushed to Oil Creek to participate in the frantic search for oil. The timber of the thickly wooded valley was felled to provide material for erecting derricks patterned after Drake's original structure, and all day long the noise of axes and hammers resounded throughout the countryside. The natural beauty of the valley and country for miles around was ruthlessly destroyed and in its place there grew up numerous ugly camps and a vast array of tall ungainly derricks. The camps developed into townships, to which were given fantastic names such as Wild Cat Hollow, Bonanza Flats, Red Hot, Petroleum Centre, etc.



The Burma Corporation's Oil Field at Yenangyoung, on the River Irrawaddy

Many of the prospectors had no knowledge of oil seeking methods, and they devoted their days to feverishly digging, abandoning one part of their claim and commencing work in another if they did not speedily 'strike' oil. Others, after staking their claim, wisely studied the methods of prospectors obviously well versed in the art of boring wells before themselves commencing operations.

Fortunes were made and lost almost in a day. Many a fortune seeker who rejoiced wildly when oil oozed up out of his well was a few hours or days later dismayed to find the flow of the precious liquid diminishing and finally ceasing completely. Often, despite all his efforts to induce the oil flow to recur, nothing but salt water would come up. This fickle characteristic of the oil drove many prospectors to despair and bankruptcy after deluding them into the belief that they had struck a fortune.

The townships born of the oil boom reflected the same sense of uncertainty. Thus, when the oil wells in a locality ceased to be productive their owners abandoned them and removed elsewhere, the roughly built township became deserted and the neglected buildings gradually decayed away. Such was the fate of Pithole City, one of the most flourishing of the fantastically named townships at Pennsylvania's first oilfield. In 1865 Pithole City was a hive of industry and boasted a post office next in size to the great post office at Philadelphia. One by one the oil wells upon which the community depended for its livelihood and prosperity petered out, no new wells were successfully established locally to replace them and the inevitable migration of the oil seekers to other districts set in. The once busy streets became as silent and deserted by day as by night; the empty dwellings in time collapsed or were pulled down, and Nature began to cover the ugliness of the scene with weeds. In time farming developed in the district and all traces of Pithole City were wiped out.

The well dug by Colonel Drake maintained a daily output of 840 gallons of oil for a year before it petered out. But his interest appears to have been solely that of being the first to wrest the precious fluid from the earth, for when success at last crowned his efforts he turned his attention to other matters and left untouched the great fortune that was then within his grasp. The later years of his life were spent in comparative obscurity, but it is known that he was many times in need of the bare necessities of life and that he died practically unknown and unmourned.

Years later a handsome memorial commemorating Drake and his accomplishment at Oil Creek was erected in the cemetery at Titusville by H. H. Rogers, one of the founders of the Standard Oil Company. This district is near Oil Creek and became the centre of the oil industry in that part of the world when the resources of the scene of the original discovery were exhausted.

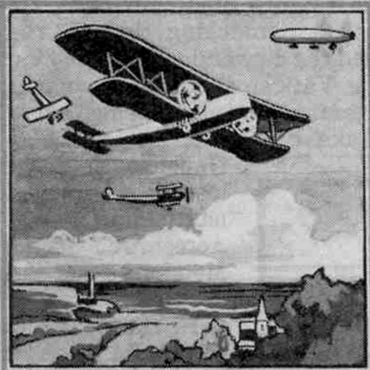
During the latter part of the 19th century prospecting for oil was commenced in various countries, and the discovery of many of the oilfields famous to-day was as romantic as Drake's initial enterprise at Oil Creek.

The oil industry in Mexico dates from 1868 when the oil springs of Cugas were discovered by Dr. Autray, who refined by means of a small still the oil from the spring and obtained thereby a satisfactory illuminating oil. Autray did not, however, carry out operations on a sufficiently large scale to profit by them and he ultimately abandoned the project.

About 1882 certain British and American interests co-operated and drilling operations were commenced in Mexico. The American engineers, however, disliked the idea of British capitalists reaping a share of the big profits expected when the wells should be successfully established, and they are said to have caused drilling operations to be carried out in localities where they knew no oil was likely to be found, with a view to discouraging British interest. They achieved their purpose, for ultimately the British capitalists withdrew in disgust, after having expended considerable money in the venture. The American engineers then gave to the American capitalists glowing accounts of the ample resources of oil they anticipated shortly "proving," but to their dismay the capitalists replied that they did not see how that could be when the engineers' efforts on behalf of the British financiers had been fruitless, and they declined to finance the work any further.

Some ten years later a British firm were engaged in reconstructing the railway at the Tehuantepec Isthmus, and while carrying out one of his tours of inspection, Lord Cowdray, who was president of the Company, came across pools of oil close to the line. At his instigation, boring operations were carried out by the Company's engineers and a considerable flow of oil was struck. The firm erected a small refinery and the output was developed until 14,000 tons of crude oil were refined daily.

Lord Cowdray then decided to prospect on an extensive and systematic scale and the drilling operations carried out by his engineers proved that vast oil resources lay beneath northern Vera Cruz. At the time he instituted a thorough investigation of Mexico's oil resources only two companies were actually operating wells in that country and neither had achieved much success. During 1908 one of Lord Cowdray's (*Continued on page* 143)

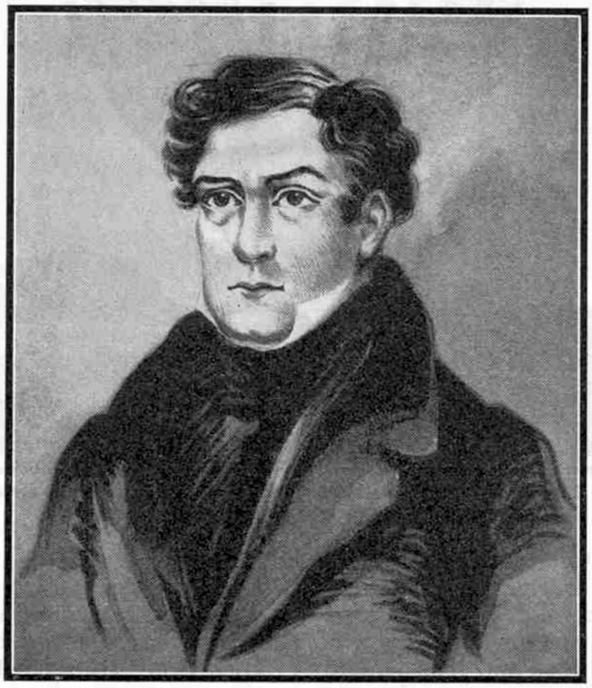


The Conquest of the Air

EARLY BALLOON ASCENTS

THE balloon in which Zambeccari accomplished in 1803 a remarkable night flight from Bologna in Italy, as described last month, was equipped with a spirit lamp invented by the aeronaut. The lamp had 24 openings each provided with a lid that could be quickly opened or closed, and by manipulating these lids Zambeccari expected to be able to make the balloon rise, fall or maintain an even height as desired without either loss of gas or discharge of ballast. As a matter of fact, the lamp was included in the gear that was thrown overboard to lighten the balloon after its premature descent into the sea.

Zambeccari was undeterred by the failure of this first experiment. He equipped a second balloon in a similar manner, and in the following year made another ascent from Bologna, accompanied by his friend Andreoli. On this occasion the balloon rose gracefully, to the accompaniment of the firing of guns and the cheers of many thousands of spectators. When he had travelled some six miles from the starting point Zambeccari decided to land, and descending close to earth he swung overboard the grapnel. Fortune was against him however, for this action caused the balloon to tilt suddenly. The burning spirit from the lamp overflowed and in a few seconds the car of the balloon, the ropes and even the clothes of the aeronauts were alight. In order to escape from the flames Andreoli slid hastily down the grapnel rope and fell heavily to the ground, while Zambeccari extinguished the flames from his own clothes by emptying a bucket of water over himself. He then quickly cast overboard all burning objects that he was unable to extinguish.



Henry Cocking

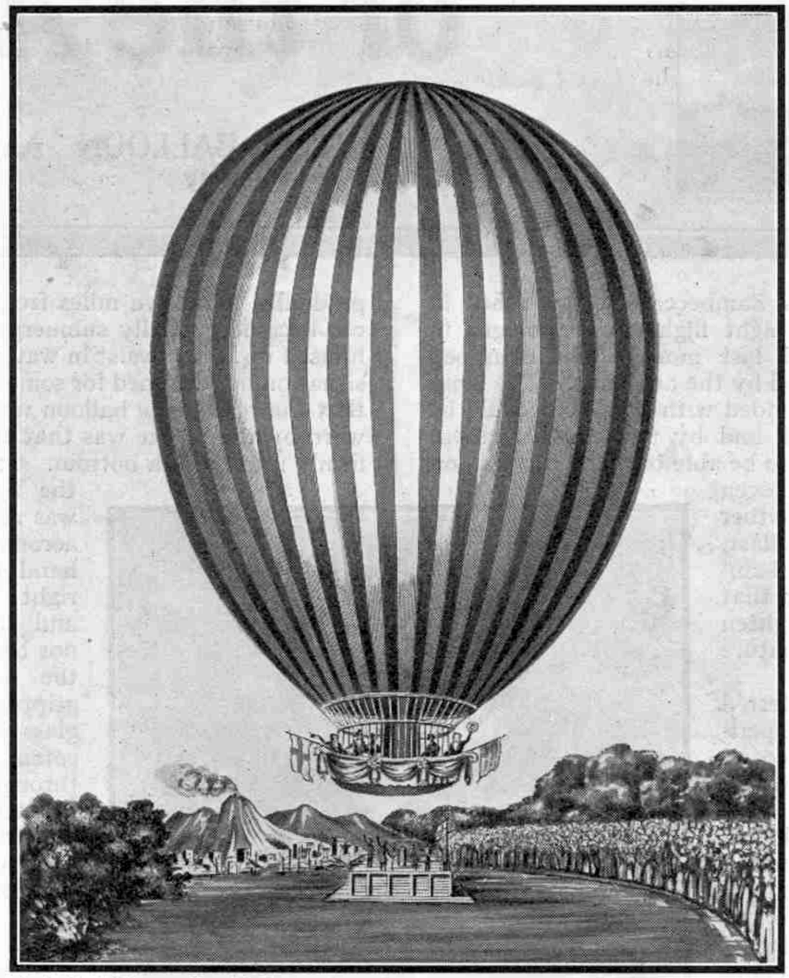
With the departure of Andreoli the balloon was greatly lightened and at once ascended with great rapidity, attaining such a height that Zambeccari, to quote his own words, found himself "looking down upon the clouds as into an abyss." The balloon was carried rapidly over the Adriatic Sea and ultimately descended gradually some five miles from the Italian shore. The car became partially submerged and Zambeccari found himself up to the waist in water. In this uncomfortable situation he remained for some time before he discovered that the reason the balloon was not being driven shoreward by the breeze was that the grapnel had dug itself firmly into the sea bottom. It was necessary to release the balloon quickly, but this was not an easy matter for the aeronaut had injured his left hand during the fire and his right hand was frozen stiff and useless. Zambeccari was not beaten, however. Breaking the lens of a telescope, he gripped the largest piece of glass between his teeth and commenced with it to saw through the grapnel rope. Fortunately the rope in its sodden condition offered little resistance and soon it parted; the balloon lurched forward and began to travel speedily shoreward.

After travelling about two miles Zambeccari came upon a number of fishing boats. The occupants of some of the boats were so terrified at the sight of the strange monster bearing down upon them that they rowed away as fast as they could. Fortunately the fishermen in one boat recognised that the apparition was a balloon, and came alongside, and after considerable difficulty rescued the aeronaut. He spent the night on board the boat and next morning was landed at Magnavacca, from where he journeyed to Bologna and was received with great enthusiasm.

During the French campaign in Egypt Napoleon Bonaparte made use of a balloon to impress the Arabs with his great power, and he is said to have addressed the following words to a gathering of Arab chiefs within the great pyramid of Cheops:—"A celestial chariot shall ascend by my orders as high as the dwellings of the clouds and lightning shall descend to the earth along a metallic wire as soon as I give the word of command." In accordance with this prophecy a balloon that had been specially brought from France was sent up from Cairo, but the Arabs do not appear to have been particularly impressed.

At the conclusion of the campaign in Egypt this balloon was sent back to Paris and was lent by the Government to two young scientists named Biot and Gay Lussac, to enable them to carry out investigations into the "constitution of the higher atmosphere and its electrical properties." This project had been proposed by the famous chemist Laplace to the French Academy of Science, and Gay Lussac and Biot were chosen to make the experiment.

The preparation of the balloon was carried out at the public expense and the best scientific instruments then available were provided. Coils of wire, varying in length from 60 to 300 ft., and a small, feebly charged battery wherewith to examine the electricity of the different strata of the atmosphere, were included in the equipment taken on board, while a number of discs of copper and zinc, together with birds, frogs and insects, the behaviour of which in the higher atmosphere was to be carefully noted, were also included in the outfit. A flask from which air had been withdrawn and which was equipped with a stopcock was taken up for the purpose of obtaining some of the higher atmosphere for testing later in the laboratory. The balloon was filled with hydrogen and ascended from the garden of the Conservatoire des Arts on 23rd August, 1804. After 2½ hours in the air, during which time a height of 13,124 ft. was attained and considerable research work carried out, a safe descent was made near the village of Meriville, some 50 miles from Paris. This was the first occasion on which a balloon was utilised solely for scientific investigation. A second ascent of a similar character was made successfully during the following month by Gay Lussac alone.



A typical Montgolfier Balloon showing the enormous size of the envelope and the elaborate design and decoration of the car

For the coronation of Napoleon I on 16th December, 1804, the French Government commanded Garnerin, the famous aeronaut and parachutist, to arrange for the ascent of a monster balloon from Notre Dame, and 23,500 francs were voted to cover the cost of this event. The ascent duly took place and was witnessed by a vast crowd, including Napoleon himself. This balloon is said to have been of colossal dimensions and it was girdled with a crown of some 3,000 coloured lamps. It rose slowly from the square in front of Notre Dame and eventually passed out of sight. At dawn on the following day some of the inhabitants of Rome were amazed to see a brilliant globe approaching through the air. In due course it reached the city and when in the vicinity of St. Peter's and the Vatican descended momentarily to earth. It then rose again and, flying very low, travelled as far as Lake Bracciano, into which it fell. Napoleon subsequently lost his interest in aeronautics and the Military Aerostatic School at Meudon was closed down.

In the course of the next eight years several of the pioneers of ballooning passed away. Lunardi died in a convent at Lisburn, Spain, in 1806, and three years later occurred the death of Blanchard. Zambeccari, while experimenting with balloons equipped with his spirit lamp, met his death under tragic circumstances in 1812. He was descending after a successful trip from Bologna when the grapnel caught in the branches of a tree and jolted the balloon so severely that the spirit lamp overturned and immediately the car was ablaze. Zambeccari and the passenger found themselves unable to cope with the flames and, in spite of the fact that they were a considerable height above the ground, they jumped out. The aeronaut was so terribly injured that he died on the following morning, but the passenger, although badly hurt, recovered.

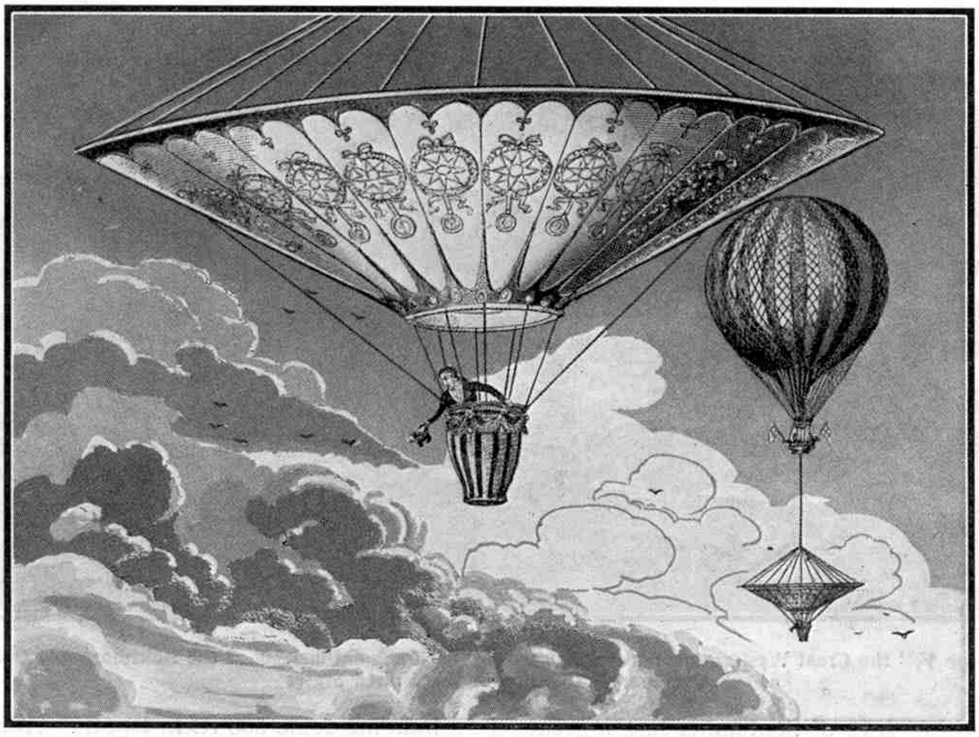
In the same year an aeronaut named James Sadler attempted to make the first balloon crossing of the Irish Sea. He ascended from Dublin and commenced the voyage in favourable circumstances but before long the balloon fell into the sea. Ultimately Sadler was rescued by the crew of a Douglas fishing boat and was landed at Liverpool. This flight was successfully made five years later by his son Wyndham Sadler, who accomplished the crossing from Dublin to Holyhead in 5½ hours. Wyndham Sadler's career ended tragically near Blackburn in 1824. Sadler had made a successful flight and had descended low enough for the retaining rope to be grasped by the men on the ground. Before he could alight, however, the rope was accidentally released and the balloon shot upward. The strong wind that was blowing at the time carried it swiftly along at a low altitude and ultimately it was dashed against the chimney of a house. Sadler was thrown over the side of the car and killed.

In 1821 Charles Green tried the experiment of filling a balloon with coal gas instead of the more expensive gas hydrogen. His attempt was successful, and he found that a balloon envelope could be inflated with coal gas for about one-sixth the cost of hydrogen, the only drawback being a considerable loss in lifting power. After making a large number of successful ascents in balloons filled with coal gas, Green determined to construct an extremely large balloon capable of carrying out scientific work at considerable heights and having a car large enough to accommodate all the necessary scientific instruments. He communicated his scheme to the proprietors of the Vauxhall Gardens, London, who placed their premises at his disposal for the construction of the balloon.

The work was carried out during the spring and summer of 1836. The envelope was made up of 44 silk gores each 90 ft. in length and about 3½ ft. across at the broadest part. The gores were joined, according to an eye-witness of the construction of the balloon, "by each overlapping the other and being doubly stitched, and the seams are overlaid by cement of such a tenacious nature that, when once dry, the join becomes the strongest part; this cement or varnish filling up the minute spaces left by the many thousand stitches which might otherwise allow some escape of gas. The whole of the silk is also coated with a kind of varnish formed of caoutchouc dissolved in turpentine and mixed with a certain proportion of boiled oil." Altogether some 2,000 yards of silk were used in making the envelope, the capacity of which exceeded 85,000 cubic feet. An oval wicker-work car, strongly made and elaborately fitted, was suspended by stout ropes, each plaited with wicker to give additional strength, from a wooden hoop slung beneath the envelope by means of the rope net covering it. The total cost of constructing this balloon was over £2,100.

The first flight was arranged for 9th September, 1836, and on that day the filling of the envelope was carried out under the supervision of the engineer of the London Gas Company. When all was ready Green and eight passengers climbed into the car. In spite of this heavy load, however, the balloon was found to be so buoyant that about 15,000 cubic feet of gas was discharged before the retaining ropes were released. The balloon then rose rapidly and moved off in a south-easterly direction, subsequently descending safely near the village of Cliffe in Kent.

One of the passengers on this occasion, Mr. Robert Holland, was so impressed by the scientific possibilities of a large balloon that he offered to finance a long-distance expedition with the object of obtaining useful scientific data and at the same time demonstrating further the practical usefulness of balloons. This offer was accepted and the preparation of the balloon was commenced immediately. The original car was replaced by a larger one with fittings suitable for a long trip, and scientific instruments of all kinds and food supplies to last three men a fortnight were taken on board.



Cocking and his elaborate Parachute. On the right is shown the Parachute suspended beneath the great Nassau Balloon

On 7th November, 1836, the balloon left Vauxhall Gardens soon after noon, carrying in the car Holland, the financier of the venture, Green, the aeronaut, and a Mr. Monck Mason, the last-named being in charge of the scientific arrangements. The balloon passed over Kent and safely crossed the English Channel. Calais was reached as darkness came on, Liege about midnight and Coblenz in the early hours of the next day. Finally a descent was made at 7.30 a.m. in what proved to be the Duchy of Nassau in Germany. The party then found that they were a few miles from the town of Weinberge and that they had thus journeyed some 500 miles in 18 hours. When it became known where the balloon had come from, the people in the locality became greatly excited. The aeronauts deflated the balloon and loaded it upon a wagon and travelled slowly to Weinberge accompanied by a vast crowd. Their fame went ahead of them and they were given a great reception when they reached the town. This night trip was an event of great importance and the balloon acquired the name of the "Great Nassau Balloon."

The question of the practicability of parachutes was revived about this time by a man named Henry Cocking, who had studied the science of ballooning for some years, and had lectured upon the subject before the Society of Arts as early as 1814. Cocking was particularly interested in parachuting and he sought and obtained permission to give a demonstration from Vauxhall Gardens, the aeronaut Green consenting to take him up.

Cocking's parachute differed considerably from that invented by Garnerin, being shaped like an open umbrella reversed. This form was chosen because it was believed that it would be (Continued on page 143)

"*King George V*" Visits America

A Noteworthy Railway Centenary

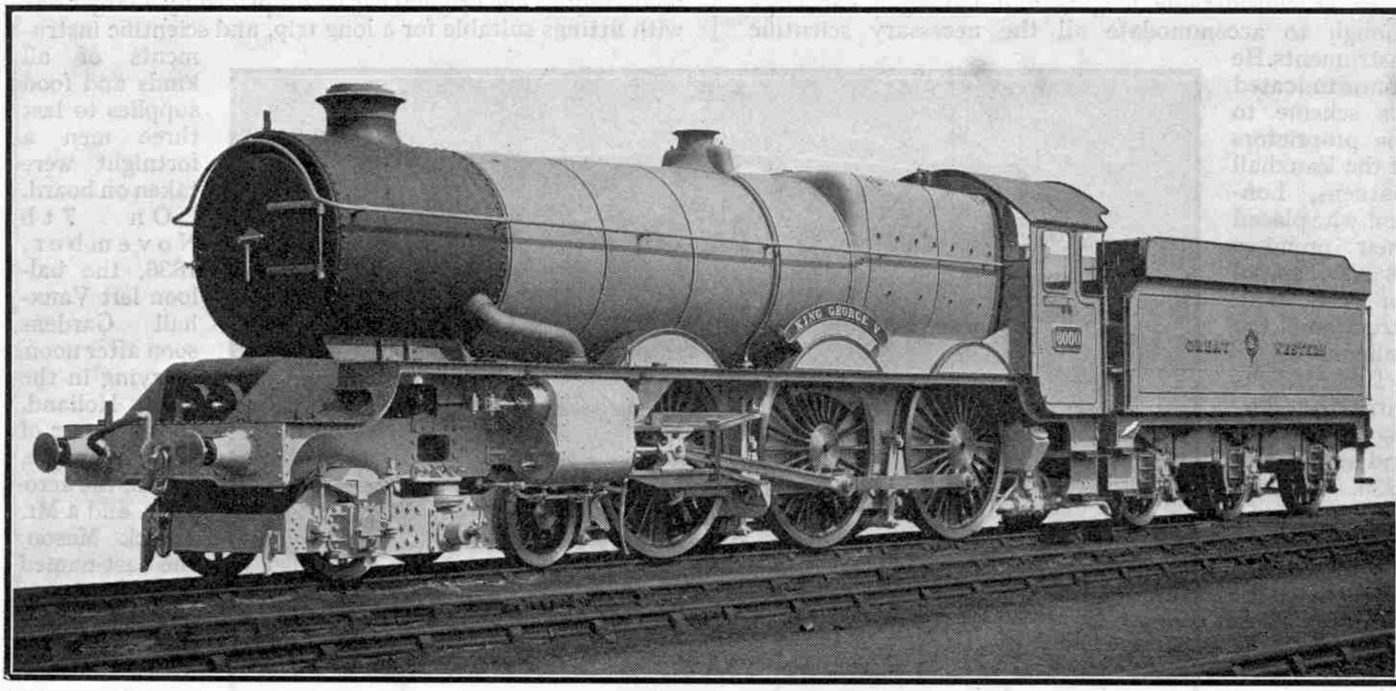


Photo courtesy] [G.W. Railway

"*King George V,*" **the Great Western locomotive that aroused so much enthusiasm at the Baltimore and Ohio Railway Centenary Exhibition in the United States**

During the closing days of September last a great pageant was staged at Baltimore, U.S.A., to celebrate the centenary of the inception of the Baltimore and Ohio Railroad. British interest in the Exhibition centred largely in the presence of England's most powerful passenger express locomotive "*King George V*" of the Great Western Railway, and the re-built "*North Star*" of the same company. The "*North Star*" was built by Robert Stephenson & Co. for the New Orleans Railroad, U.S.A., but for certain reasons was not delivered and was bought by the Great Western Railway in 1837. It was of this engine that Brunel wrote in 1838:—"We have a splendid engine of Stephenson's, it would be a beautyfull ornament in the most elegant drawing-room."

The exhibition was aptly described as the "Fair of the Iron Horse," and was divided into two sections, indoor and outdoor. The former consisted of a wonderfully comprehensive collection of exhibits of all types of railway mechanisms, braking appliances, heating apparatus, signalling gear, and replicas of famous old bridges and historic places associated with the development of the line. There were also models of old-time locomotives, ranging from the quaint 18th century production of Newton and Murdock to the famous "*Director-General,*" the show engine of the 1893 Chicago "World's Fair." This old engine was fitted with 6 ft. driving wheels and boasts a recorded speed of slightly more than 90 m.p.h.

Specially interesting was the Hall of Transportation, a building some 500 ft. in length. Along its south wall was a model panorama 250 ft. in length, depicting scenically the Baltimore and Ohio Line. At one end was Baltimore Town, showing its general appearance in 1830, while at the other end was Chicago, complete with the great skyscrapers of to-day. Ten miniature working models of ancient and modern locomotives, reproducing exactly the essential features of the originals and electrically driven, were busily engaged in hauling coaches and freight cars built to scale. It was interesting to watch these locomotives travelling over miniature bridges of widely differing types, ranging from the old wooden structures to the great concrete and steel spans of the present day.

A special section of this building was set aside for an interesting collection of railroad timepieces. Over 200 watches, local and foreign, and a score of clocks with interesting biographies were exhibited. The Baltimore and Ohio was the first railroad in the United States to establish a strictly supervised time service system requiring the services of 137 certified watch inspectors. Under this system employees of the railroad must carry watches that will not vary more than 30 seconds per week!

The Traffic Building, which was rather smaller than the Hall of Transportation, was devoted to a demonstration of the part that railways play in the development of industry, and also to exhibits relating to railwaymen's welfare schemes. A third building was allotted to the Allied Services, which consisted principally of postal,

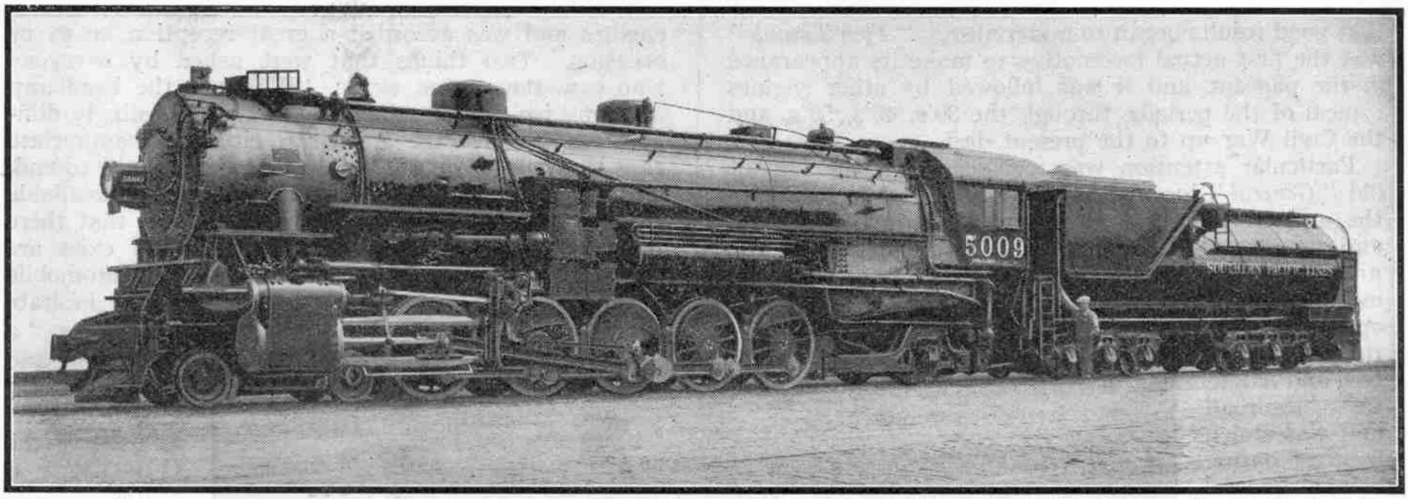


Photo courtesy] [Southern Pacific Railway

The new Southern Pacific type locomotive, the most powerful single engine unit ever built. It has three cylinders and 10 driving wheels. Is 101 ft. 1 in. in length and weighs 121 tons 16 lb.

telegraphic and telephonic exhibits, together with a display of model ships, including models of the "*Aquitania*" and "*Majestic*," loaned by the Cunard and the White Star Companies respectively.

Encircling the exhibition buildings was a loop-track, more than a mile in length, on which was staged the "Pageant of Railroad History," the most spectacular feature of the outdoor section. The rails passed opposite to the Hall of Transportation and in front of a huge grand stand built up in three sections, each 800 ft. in length, providing seating accommodation for 12,000 persons. The story of the development of transport in America was recited by Charles Coburn, the actor, speaking in front of a microphone connected to amplifiers in different parts of the grand stand; and the telling of the story was so arranged that each phase coincided with the passing of the portion of the parade representing that particular period.

The pageant was arranged in the form of tableaux that represented the various eras in the history of transport. First came a group of Blackfeet Indians with their heavily laden pack-horses, symbolical of the crude, slow transport of the early pre-railroad transportation days. Then came a float representing Père Marquette, the famous missionary and explorer, and a tableau depicting a party of early settlers in the frail-looking canoes in which the great rivers of America were first explored. The next tableau represented the days of the "prairie schooner," canals and the conestoga wagon. This type of wagon was the fastest transport vehicle of its day. It was a spacious, heavily-built vehicle covered with a picturesque canvas canopy and it was drawn by six horses. Deep streams were no barrier, for the wagon was built to float and the horses swam. Following this vehicle there came a gorgeous, highly-decorated stage-coach of the George Washington period.

The next tableau was symbolical of the birth of the Baltimore and Ohio Railroad. The vehicles already shown in the procession, although of themselves great improvements upon existing means of travel, did not come up to the demands of a rapidly expanding civilisation. A faster means of transportation was needed. The problem in Baltimore was made more acute by the keen competition set up by the newly-cut Erie Canal. This was diverting a large portion of the port's trade, and to face this crisis a meeting of prominent citizens was held at the home of one George Brown in February, 1827. At this meeting reports of the railroads being built and operated in Great Britain were presented, and it was decided to build a railroad running west from Baltimore. This meeting was shown in tableau form, and afterwards came floats showing the ceremony of laying the first stone of the new railway on Independence Day, 1828, and another tableau symbolical of the actual work of surveying and constructing the new track. Then came a quaint treadmill car mounted on a float, and a preposterous-looking sail-car float, neither of which vehicles had been found practicable. The horse-car also was tried on the line, but without success, and it was not until the tiny locomotive "*Tom Thumb*" was introduced

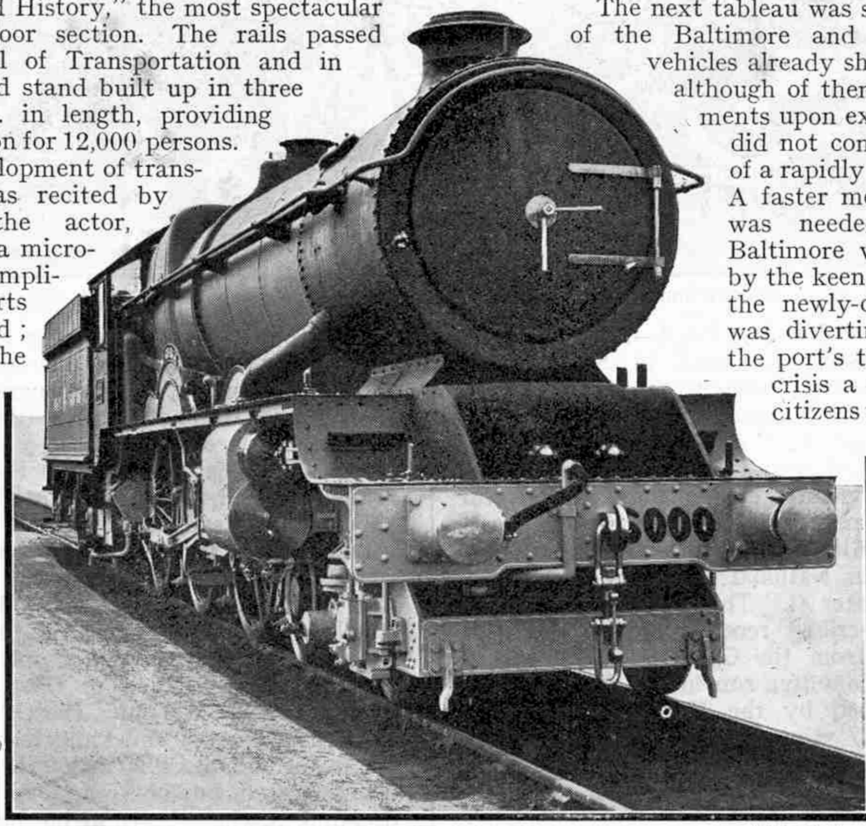
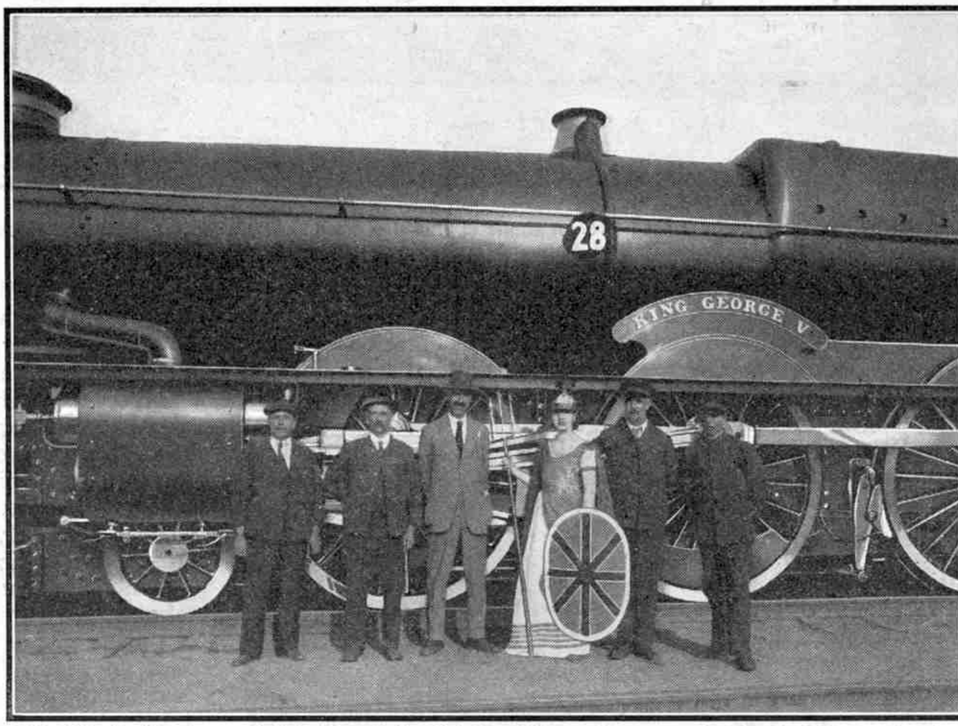


Photo courtesy] [G.W. Railway

Another view of "*King George V*" giving an excellent impression of its combination of grace and power

that good results began to materialise. "*Tom Thumb*" was the first actual locomotive to make its appearance in the pageant and it was followed by other engines typical of the periods, through the 30's, 40's, 50's, and the Civil War up to the present day.

Particular attention was focussed upon the famous old "*General*" locomotive, the central figure in one of the most thrilling episodes of the American Civil War and now so battle-scarred that it is unable to run under its own steam. During the Civil War this locomotive was operating on the old Western and Atlantic Railroad and was stolen by a daring band of Federal spies known as "*Andrew's Raiders.*" It was subsequently recaptured after a long and exciting chase by the Confederate soldiers, who employed a hand cart, a freight train and two passenger locomotives in its pursuit.



Mr. W. A. Stanier and "*Britannia*" with the driver, fireman and two G.W.R. mechanics

The next section of the pageant was headed by a splendid tableau entitled "England—The Mother of Railways," bearing a model of Stephenson's "*Rocket.*" Then came locomotives visiting from "foreign" lines, and the honour of leading this section was given to the G.W.R. "*King George V.*" This locomotive was received with the greatest enthusiasm and on every hand comments were made upon its graceful and handsome appearance. Unfortunately it was somewhat dwarfed by No. 6100 of the huge "Confederation" class of the Canadian National Railways, which followed immediately after it. This locomotive, it will be recalled, was described recently in the "*M.M.*" Then came a giant from the C.P.R.; the "*De Witt Clynton,*" the first locomotive run in the State of New York on tracks owned by the New York Central; and the "*John Bull,*" the first locomotive used in New Jersey, and sent specially from the Smithsonian Institute in Washington where it has been preserved for many years.

The pageant ended with a float entitled "*Maryland,*" symbolical of the State in which this, the first American railway, was founded.

Some interesting reminiscences of the exhibition are being related by the G.W.R. officials who accompanied "*King George V*" to America. Mr. W. A. Stanier, of the Chief Mechanical Engineer's Department, writing in the G.W.R. magazine says:

"More than 1,250,000 people visited the exhibition, and the '*King George V*' led the procession of big engines and was accorded a great reception on every occasion. Two things that were asked by everyone who saw the engine were: 'Where is the headlamp and why isn't there a bell?' It was exceedingly difficult for the average American citizen to appreciate that the railway in England is fenced from end to end, and is private property, and therefore not available for the general public to wander on; also that there are few grade crossings, and those which exist are protected with substantial gates that even an automobile would hesitate to take 'a chance' at, and are not merely a pivoted pole, as used in the United States.

"Among the many visitors to the engine was Mr. Henry Ford, who, after the pageant, came specially to have a short trip on the locomotive. He commented on the smoothness of its working, and had numerous photographs of the engine taken.

"The men in the Baltimore and Ohio sheds at Mount Clare where '*King George V*' was re-assembled after the voyage, were naturally greatly interested in the design and general outline of construction. A frequent comment was: 'It is not a locomotive but an automobile!'

"The engineers at Baltimore presented to '*King George V*' as a souvenir of the visit, an American locomotive bell which is mounted on the front framing above the buffer beam."

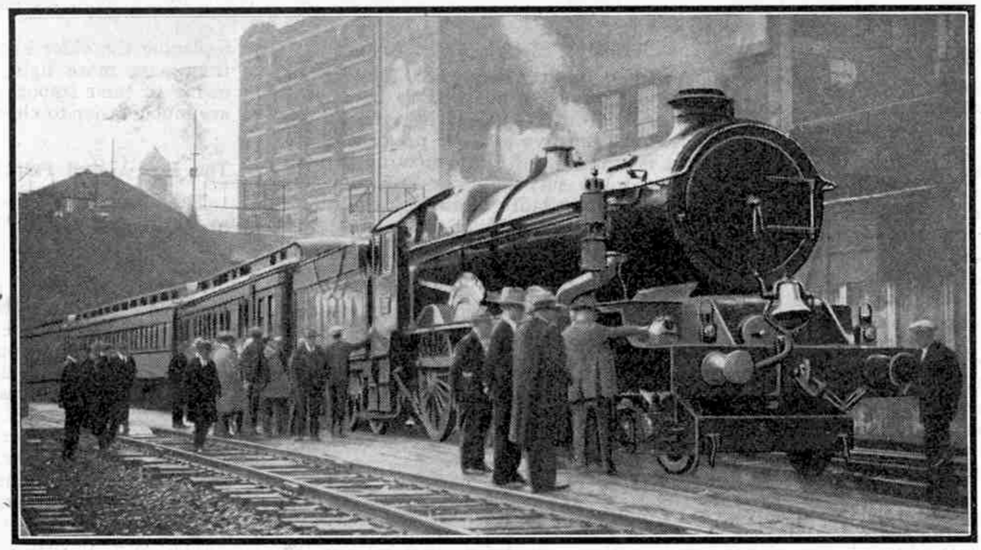
Subsequent to the exhibition "*King George V*" was engaged in trials over the Baltimore and Ohio Company's tracks and in a 290-mile test run it somewhat startled the officials of that road by reaching a speed of 75 m.p.h. with the regulator only three-quarters open! The officials travelling in the dynamometer car immediately ordered Young, the G.W.R. driver in charge, to drop back to 60 miles and to keep that speed. As a result the full possibilities of the locomotive were not demonstrated, but one official of many years' standing declared afterwards that he had never experienced such smooth running.

The following details of the run will be of interest. From Baltimore to Washington, a maximum speed of 73.5 m.p.h. was attained, and 15 consecutive miles were covered at an avera e speed of 62.7 m.p.h. Between Washington and Philadelphia, 20 consecutive miles were run at an average speed of 60.7 m.p.h., the maximum being 73 m.p.h. The whole distance of 131.3 miles between Washington and Philadelphia was covered in a running time of 2 hours 56 min., or 3 hours 12 min. 55 sec. including stops totalling 16 min. 55 sec. On the final stage, between Philadelphia and Baltimore, the highest speed attained was 69.3 m.p.h. The train load on all three trips was a very heavy one, weighing 543.6 tons (seven vehicles), exclusive of engine and tender, considerably above the average English train load.

The trials of "*King George V*" were followed with intense interest by many hundreds of spectators, who lined the route and cheered enthusiastically as, what one American newspaper termed the "Whippet of the Railways," resplendent in dark green paint and shining brass, swept by with seven heavy coaches in its trail.

The overwhelming success of the visit of "*King George V*" to America was a source of pride to all concerned. The Director of the Exhibition (Mr. A. E. Hungerford) writing to Sir Felix Pole, the General Manager of the G.W.R., said:—

"You can never begin to know how much I appreciated your interest and kindness in sending the '*King George V.*' From the beginning to the end it was one of the great features of the show. People heard of it and came from far and near to see it. They climbed all over it . . ."



Courtesy] [G. W. Rly.

"*King George V*" on the trial train at Baltimore, U.S.A.

The President of the Baltimore and Ohio Railroad, writing also to Sir Felix, declared:—

"I doubt if I can tell you how greatly the '*King George V*' and the '*North Star*'—but more particularly the '*King George*'—contributed to the success of our exposition. While some people in the United States have visited England, and are acquainted with the appearance of English railway equipment, of course a very large majority of our people have never been abroad, and to them an English locomotive, and particularly as beautiful a machine as the '*King George,*' was something of more than ordinary interest. You would have been glad, I am sure, if you could have heard the applause which greeted the appearance of the '*King George*' as she moved by the reviewing stand each day in the pageant."

In the "*M.M.*" for August last we described "*King George V*" in detail, but for the benefit of the considerable number of readers who have only recently become acquainted with the "*M.M.*" we give brief particulars of this magnificent locomotive.

"*King George V*" is the first of 20 express passenger locomotives of the 4-cylinder 4–6–0 type that recently have been introduced by the Great Western Railway. These engines have been built at the company's Swindon works and, being named after the Kings of England, are known as the "King" class. They are the most powerful express passenger locomotives in this country, their tractive effort, 40,300 lb. at 85 per cent. of the boiler pressure, being considerably higher than that of any others in Great Britain. The boiler pressure is 250 lb. per sq. in.; each of the four cylinders is 16¼ in. diameter by 28 in. stroke; and the driving wheels are 6 ft. 6 in. in diameter. The total weight of the engine and the tender in full working order is 135 tons 14 cwt., this including 6 tons of coal and 4,000 gallons of water.

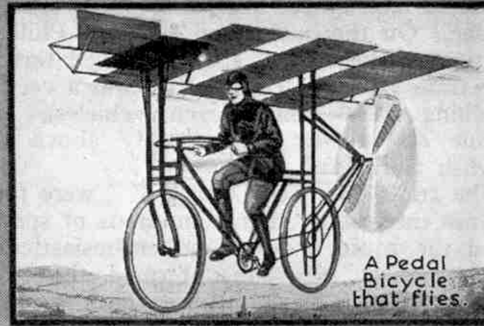
The "*North Star*" was built by Robert Stephenson & Company and strangely enough was originally intended for the New Orleans Railway, U.S.A. As the result of certain financial conditions this locomotive was not delivered and was bought by the G. W. R. in 1837. It had a working pressure of from 50 to 60 lb. per sq. in. and a tractive effort of from 2,000 to 2,400 lb.—a striking contrast to the mighty "*King George V.*" The "*North Star*" was in active service up to 1870 and in the course of its career covered 429,000 miles.

It is of interest to compare certain dimensions of the "*Lord Baltimore,*" the leading passenger engine of the Baltimore and Ohio Railroad, with those of "*King George V*" given above. This engine is of the 4–8–2 Mountain type, and has been introduced for working over the exceedingly heavy gradients between Washington and Grafton. The steady growth in weight of the express passenger trains had proved too great for a single Pacific type engine, and double-heading often had to be resorted to. The tractive effort of the "*Lord Baltimore*" is 68,200 lb.; the boiler is pressed to 220 lb. per sq. in.; and the cylinders each are 30 in. diameter by 30 in. stroke. The driving wheels are 6 ft. 2 in. in diameter. The working order weight of the engine is 330 tons, including 18 tons of coal and 15,000 (American) gallons of water.

"*Tom Thumb*" occupies the same niche in the Baltimore and Ohio Railroad as "*North Star*" in G.W.R. records, and a brief descriptive note will permit a comparison of these famous veterans. "*Tom Thumb*" had a vertical boiler 5 ft. in height and 20 in. in diameter and a vertical cylinder driving a shaft geared to one pair of its four wheels. The cylinder was only 3½ in. in diameter with a stroke of 14¼ in. The engine was set to work on a line 13 miles in length, running from Baltimore to Ellicott's Mills. On its first trip in 1831 "*Tom Thumb*" achieved a speed of 18 m.p.h., hauling one car containing 23 passengers!

The load for the return journey consisted of 30 passengers, and the 13 miles were covered in 57 minutes!

OUR BUSY INVENTORS



An Interesting Rivet Gun

A useful and interesting device recently placed on the market is a rivet gun, of which an illustration on this page shows a section. The purpose of the invention is to facilitate the passing of heated rivets from the minder's fire to the riveter.

The gun consists of a small tank connected to a supply of compressed air. The head-piece above the tank is fitted with a length of flexible tubing sufficient to reach from the rivet-heating furnace to the scene of the actual riveting operations. The hot rivet is dropped into the head-piece through a sort of automatic trap-door and a touch of the foot on a lever below the tank admits compressed air, which shoots the rivet along the flexible tube at a speed of 15 ft. per second. On arrival at its destination the rivet comes to rest in a receiver cage.

The great advantage of this invention is that the fire for heating the rivets may be placed at any convenient point up to 100 ft. distant from the riveter, and consequently does not require constant moving about. In addition, the dangerous practice of throwing the heated rivets is rendered unnecessary, while structures in course of erection are not called upon to carry the weight of the furnace.

* * * *

Pontoon Motor Boat

An interesting type of pontoon motor boat has made its appearance on the Great Lakes of North America. The top of the boat is high above the water and is mounted on two floats shaped like long Indian canoes. The boat carries a radial aeroplane engine that drives a tractor propeller and the general appearance of the machine is similar to that of a seaplane without wings.

The boat is so light that it only draws four inches of water when at rest and therefore it can be used in water that is much too shallow for ordinary boats, and it is not seriously affected by water vegetation. Its builder claims that it will skim across ice as well as run on the surface of water.

* * * *

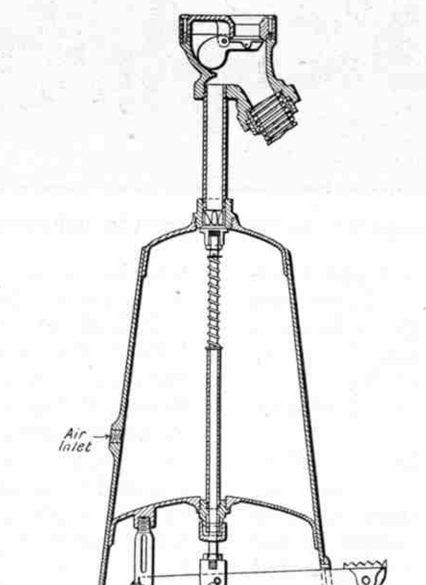
A Self-Winding Watch

A wrist watch that is wound up by movements of the hand and arm is expected to be on the market at an early date. This remarkable instrument is kept going by the natural and inevitable movements of its wearer and it will continue to work for a day or two when left off the wrist. The mechanism is not exceptionally delicate, as might be expected, and it is not disarranged in any way by violent movements such as those involved in playing golf, tennis, or other games. The invention was made some years ago by a Lancashire man but its development has been delayed.

Frosting Electric Light Bulbs

Until quite recently the frosting of electric light bulbs has had to be carried out on the outer surface, in spite of the fact that from two to three per cent. more light is transmitted if the frosting is done on the inner surface. The difficulty has been that glass bulbs frosted on the inside by the ordinary method were liable to break very easily.

The ordinary method of frosting is to spray the surface with an acid that etches it irregularly. This process results in the formation of hollows and sharp-edged



Courtesy] [*"The Engineer"*

The New Rivet Gun

projections, and these sharp edges made the glass very fragile indeed if they were on the inside of the bulb, possibly because of the nature of the strains produced in blowing. Inside-frosted bulbs were highly desirable, however, and after many attempts a solution to the problem has been found.

The new method is exceedingly simple. After the first etching of the inside a weaker acid solution is sprayed on and this acts chiefly on the sharp edges and rounds them off, so that when examined by a microscope they are seen to be hemispherical in shape. The rounding of hollows and projections into one another restores all the strength of the bulb.

Inside frosted bulbs are now steadily replacing the older kind, not only because they pass more light, but also because, owing to their smooth outer surface, they are much easier to clean.

* * * *

The Free-Wheel Principle for Motor-Cars

The free-wheel principle that has been so familiar to cyclists for many years has now been applied to motor-cars. The device that has made this possible is the invention of a British engineer, and it has been adapted from the mechanism used in bicycles, rollers being substituted for pawls. The invention is brought into action immediately the driver of a car fitted with it removes his foot from the accelerator. The engine speed is thereby reduced, but the car continues to run forward without check. In the case of an ordinary car the same action would immediately reduce the speed of the car also, because the engine would act as a brake.

The new device should result in an appreciable saving of petrol and also in a reduction of wear and tear throughout the car, as the length of time during which the engine is "idling" or running at low speed will be largely increased. The only disadvantage was found to be the impossibility of using the engine as a brake in descending long hills, but this difficulty has been overcome by providing means for locking the free-wheel and thus temporarily making the car one of the ordinary type.

* * * *

Eggs Cleaned by Sandblast

A machine has been invented that cleans eggs by means of a sandblast and at the same time provides a means of examining them by transmitted light.

The eggs are dumped 36 at a time on an endless conveyor made of rubber rollers. These rollers are spaced so as to keep the eggs from touching one another, and their movement causes the eggs to rotate. As the eggs are carried along they pass beneath nozzles from which fine white sand is blown by compressed air. The sand spray removes all dirt from the eggs, while the dust produced is carried away by an exhaust fan. The sand may be used repeatedly, bucket conveyors returning it to the storage hopper above the machine. From the sandblast the eggs are carried forward on the conveyor over a battery of very powerful electric lamps, and it is thus easy to pick out any bad ones.

Several of these machines that are now in use are capable of dealing with as many as 100,000 eggs a day. It is interesting to know that eggs cleaned in this manner command a slightly higher price than those cleaned with water or chemicals, as the shell is quite unaffected.

Compass that Works by Sound

Until recently very little attempt has been made to develop what may be called "soundhouses," in which sound is used as a guide in the same manner as light in lighthouses, but a sound compass has now been invented that may make further developments possible. In ordinary circumstances light is a sufficient guide for ships at sea but the new instrument has already proved valuable in avoiding collisions in foggy weather in practical trials that have been carried on in San Francisco Bay. There many of the ferry boats have been fitted with it and have made use of it for some months.

There are two parts to the compass. The first is a sound reflector, about 3 ft. in diameter, its surface being roughly saucer-shaped. The sound waves striking it are reflected to a focus on the centre line, where another reflector is placed to direct them on to a microphone at the back of the instrument. The microphone is affected most when the sound waves come in the direction of the axis of the receiver, which is rotated at a constant speed by an electric motor.

The second part of the apparatus is an indicator dial around which an electric bulb rotates, its position on the card indicating the direction in which the sound receiver is pointing, the two being rotated together by mechanical or electrical gearing. When sound waves actuate the microphone strongly, the electric current produced causes the lamp to glow, an amplifier being used to magnify the effect.

The mode of operation will now be clear. When a siren or whistle is sounding in any direction the receiver will pick up the sound once during each revolution and the bulb will light at the same time. By noting the position of the bulb on the dial the bearing of the source of the sound is immediately discovered. In general, sounds of the type heard at sea last for at least one second, so that a speed of two revolutions per second will ensure the reception of any sound at least twice.

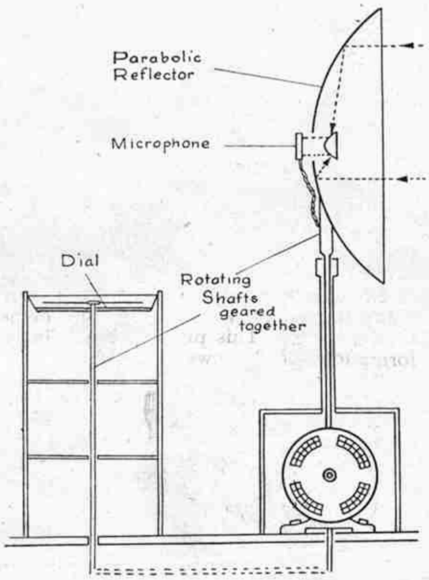
Other developments of this instrument are promised. The fitting of lighthouses or buoys on dangerous reefs with apparatus to produce vibrations of greater frequency than those of audible sounds have already been suggested. By using these supersonic vibrations, as they are called, interference with sounds of everyday life is completely avoided although the sound compass remains useful. The inventor is now experimenting with a system in which the use of two receivers, one at the stern and one at the bow, enables the distance of the source of a sound to be ascertained.

* * * *

Underground Cable-Laying by Machinery

One of the chief problems that arise in the extension of the use of electric light and power on a large scale is that of devising safe and economical methods of transmission. The tendency to-day is to concentrate on the construction of fewer and larger generating stations, and this necessitates the distribution of high-voltage current over long distances. So far overhead cables have been largely used, for economical reasons, but a German firm has now constructed a comparatively cheap and efficient machine that lays cables underground almost as easily as a cable-ship lays a submarine telegraph line. It digs a trench, lays the cable in it and replaces the earth as it moves along.

There are two portions of the machine, both mounted on caterpillar wheels to enable them to work across country. The first is a trench dredger, which digs a trench 16 in. in width and about 4 ft. in depth. The soil extracted passes into a conveyor ending in a rotating chute that throws it back again into the trench immediately in front of the following cable car. This car is drawn by the dredger, and not only carries the cable drum, but rolls in and levels the soil. In the meantime the cable-laying apparatus feeds the cable into the trench in the space between the two vehicles.



A diagrammatic view of the two parts of the sound compass described on this page

A 45 h.p. Diesel engine is used to drive the machine, which only requires five men to operate it. With its aid the cost of laying cable is reduced to about one-eighth of that required by ordinary digging methods, so that the use of underground cable for the transmission of high voltage current is now practicable from a financial point of view. Cables laid underground are safer than the overhead type, and in addition their average life is increased from 15 years to 45 years, while the cost of upkeep is reduced practically to nothing.

* * * *

Glass Silk for Heat Insulation

An interesting new heat insulating material has been introduced in Germany. In order to prepare it glass is melted in a gas-fired furnace with a perforated bottom. The drops of molten glass that fall through are made to strike the surface of a revolving drum with the result that they are spun out into very fine fibres that wrap themselves around the drum, from which they are removed at intervals. Glass in this unusual form is known as glass silk. Its heat conductivity is very low and it is now being applied in various forms for insulating purposes. To prevent heat losses from a pipe, for instance, the pipe is surrounded by a wire cage or sleeve and the intervening spaces are packed with the fibre.

Glass silk may be obtained also made up into a roll like ordinary felt, while a very useful form of it is strip 4 in. in width made in lengths of 8 ft. by enclosing it in fireproof paper or stitching it into jute or asbestos cloth packing.

An Electrical Auctioneer

In the Bremen (Germany) Fruit Market the usual auctioneer has been superseded by an electrical "salesman," the object being to speed up sales and at the same time prevent disputes. In the market every buyer is accommodated with a separate desk while in front is a huge dial with prices marked in a circle on the rim. When a lot is put up for sale a pointer moves in a clockwise direction over these figures, and when the price indicated has fallen to that at which any buyer is willing to purchase he presses a button in front of him. This stops the pointer and at the same time illuminates a number in the centre of the dial to correspond with the number on his desk, thus indicating the purchaser.

All other electrical connections between the various desks and the corresponding numbers in the centre of the dial are broken immediately any button is pressed, and any dispute regarding the first bidder is therefore impossible. When one lot of fruit is sold, the next, or a sample of it, is automatically brought before the bidders on a traveiling belt, and the pointer on the dial begins its travel once more.

* * * *

Speeding Up the Atlantic Crossing

A boat that can travel at an average speed of 93 miles per hour in the stormiest sea figures among the latest German inventions. A 30-foot model of this boat has already been constructed. The chief feature of the vessel is its small cross-section, the model being only 4 ft. in width. It is shaped like a torpedo and is so covered-in that it offers the minimum of resistance to the air as well as to the water. Two motors are used for propelling the vessel by turning two spiral shafts on each side of the ship. A trial trip to Cape Finisterre will be made in the spring with the existing vessel and it is fully expected that a larger boat of this type will be capable of crossing the Atlantic in 40 hours.

Other boats have been designed in France with the same purpose in view and a race across the Atlantic between the various types will be interesting, providing that they prove to be practical propositions!

Two French boats have reached the working model stage. The first is long and narrow, closely resembling a submarine, and is intended to run partly submerged. The second is a water glider, which rests on the water on two pontoons each 70 ft. in length. It has three 500 h.p. motors, and steering is effected by varying the speeds of the engines, which presumably act on different propellers.

* * * *

New Davits for Quick Launching

A Dutch ship has been equipped with davits of a new type that make the launching of a lifeboat easy under any circumstances. Pulling a lever lowers the chocks holding the boat in position and a hand wheel is then turned to operate mechanism that swings the boat out into an easy position for lowering.

The boats used are encased in basket work of closely-woven reeds to prevent injury to the woodwork and to increase buoyancy. Steel runners are fixed to them so that when they are being lowered from a ship with a list they can slide down the side without catching on the plates. The runners may be easily detached when the boat reaches the water.

The Aircraft of the Future

Recent Progress in All-Metal Aeroplane Construction

Courtesy] [Armstrong, Whitworth & Co. Ltd.

Assembling wings, Armstrong Whitworth system of construction

DURING recent years increasing attention has been paid to the use of metals in aeroplane construction and in particular to the use of duralumin, the non-rusting alloy of aluminium which combines much of the lightness of the latter metal with the strength and toughness of steel. More recently special research has been carried out in regard to the possibilities of utilising steel in place of lighter metals of the duralumin type.

The general principles of flight are now well understood and there is in existence a large body of men with wide experience of handling machinery in the air and consequently with a highly developed air sense. A great expansion in aerial engineering does not appear possible, however, until bigger and proportionately stronger machines are available, which in turn involves a somewhat drastic change in constructional methods.

The idea of using steel for the construction of an aeroplane is by no means new, for it was adopted at the end of the last century by Sir Hiram Maxim. It is easy for us to smile at Maxim's huge and clumsy machine, which weighed nearly four tons, yet in many respects the inventor was working on right lines and even with an utterly inadequate steam power plant he achieved results from which many valuable lessons were learned. He employed metal largely in the construction of his machine, making use in particular of steel tubes of large diameter together with steel strips. In short, Maxim's aeroplane was constructed up to a certain point on sound engineering principles, but it did not fly.

Subsequently many other inventors devised wing systems with which they tried to fly, and some of them came to an untimely end as a result. In spite of these disasters, however, it was this method that led to the ultimate solution of the problem of flight while the engineers were still struggling with it as a purely engineering problem. By ignoring power considerations and studying the gliding action of what might be described as glorified kites, by travelling with them through the air from hilltops, experimenters such as the Wright Brothers and Curtiss learned the art of flying as far as it comprises balance and air sense. The consequence was that when the important step was taken of adding motive power—a step in which the contemporary development of the internal combustion engine played the vital part—the constructional methods used for aeroplanes were already decided by the design of the gliders that preceded them.

A distinguishing feature of these gliders was their improvised nature. Being distinctly experimental machines they were constructed of wood and wire, and accordingly the aeroplanes that succeeded them were built of wood with fabric wing covers and wire controls. Until recent times the practical methods evolved along these lines appeared to be satisfactory, but there are two factors that seem to indicate the end of the wooden aeroplane.

The first of these factors, which came into operation particularly during the war, is the increasing scarcity of suitable wood. At one period during the war the shortage of wood became so serious that experiments were commenced with the use of metal spars and tubes with a view to the production of long-range bombing machines. The problem of wood supply is now, of course, much less serious, but in conjunction with the second factor it has been instrumental in the development of new constructional ideas.

The second factor concerns the relation of strength to the weight and bulk of the material used in the manufacture of aeroplanes. This relation becomes more important with every increase in the size and the weight of the machines, and if ever we are to reach the stage when large aeroplanes are used for fast passenger and freight traffic on an extensive scale the matter will have to receive very serious consideration.

There is little doubt that, when of proper design, steel spars are far superior to wooden spars. It has been calculated that a modern spar built of steel strip is about 25 per cent. stronger all round than a wooden spar weighing nearly 20 per cent. more. The use of steel thus makes possible the construction of aeroplanes of greater size. A further point of importance in the comparison of wood and metal is their relative durability. In this respect metal possesses a distinct advantage, for steel parts may be kept in store almost indefinitely, thus rendering replacements and repairs comparatively easy.

For these reasons several firms have turned their attention to the design of aeroplanes constructed entirely of metal, either duralumin or steel. Whichever metal is used, the most important feature is that of longitudinal corrugations, which were introduced by Major Wylie in 1918 during the search for a satisfactory substitute for wood.

Prior to that time the metal spars of aeroplane wings had been made from steel tubing. Under certain conditions, however, this proved as difficult as wood to obtain in the necessary sizes, with the result that tubes made from steel strip bent to shape were introduced. It was while experimenting with this strip that Major Wylie discovered that longitudinal corrugation had the effect of stiffening the metal used. A spar built of strip so treated is well able to withstand the various stresses and strains set up in flying, and on the basis of the constructional method introduced by Major Wylie a technique has been built up for the production in quantities of aeroplanes made of metal throughout, except for the wing covering.

Notable success has been achieved in this direction by Armstrong, Whitworth & Co. Ltd., who have produced the "*Siskin*," an all-metal aeroplane that has been supplied in quantity to the Royal Air Force. In the factories of this firm, at Whitley, near Coventry, a special plant has been installed for the regular construction of steel aeroplanes. The illustration on page 121 shows a machine that rapidly converts strip steel into the corrugated sections that are the basis of the system. The strip fed in on the left passes between five successive pairs of rollers before emerging fully corrugated. The corrugated strips are then bent to the shape required and spars are built up from them. The shape of the spar and the disposition of the corrugated strips composing it depend largely upon the load that the spar is to carry, but the shape may be described as tubular. The actual shape of the strips and the size of the curves of the corrugations are carefully calculated in order to obtain a spar with the required strength. Another point of importance is concerned with the riveting. It is essential that every rivet should completely fill the corresponding rivet hole, as it has been found experimentally that any small pierced hole in the spar is a source of weakness.

It must be remembered that the steel strip used is not very thick, and the edges therefore do not possess great rigidity. When a channel section of the steel strip is subjected to bending, a kink first develops at the edges, but if the strip be given an approximately tubular section with the edges sharply curved and tucked in, the resulting section is less liable to damage at the edges on bending. This method is used, therefore, in building up the spars, the curves of the portions to be joined running into each other, as well as following the curves of their own corrugations.

Large spars are built up by connecting two tubes by a web, also made of longitudinally corrugated strip, the same method of running the curves into each other on the line of the rivets being followed. An 11-inch spar of this type suitable for a large weight-carrying aeroplane has been constructed that weighs only 1.5 lb. per foot length.

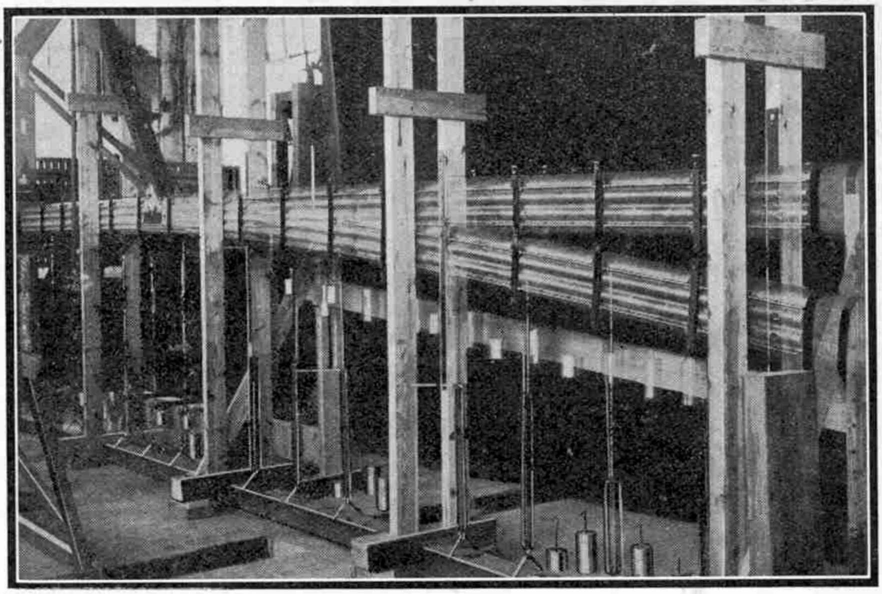
In attaching the spars to the ribs the same principle

Courtesy] [*Short Bros.*

The Short "*Cockle*," the first all-metal flying boat produced in this country

of coincident curves is followed and no flat surfaces are left anywhere. The spars are held in position between two struts mounted on the ribs by spring steel abutments, and no piercing or riveting is done on the spar itself. This method of attachment has been found eminently satisfactory and is specially adapted to easy assembly and dismantling. Similar methods have been developed for attaching the ribs to the leading and trailing edges of the plane.

An interesting feature of the methods employed at Whitley is that they are planned with an eye to repairs and renewals. Ease of renewal follows, of course, from the method of assembly of the parts as already noted. The question of repairs is on a different footing. In the case of aeroplanes that operate at a distance from their base it may easily happen that a damaged machine can be made serviceable by a comparatively small repair, and this is possible on a far more generous scale with the modern metal aeroplane than with the old type. The greater number of the wing spars consist, as already explained, of tubular booms connected by a relatively thin web. It is possible, therefore, to fit fishplates along the grooves between the booms in order to strengthen any weak or damaged part. To facilitate repairs of this kind perforations are made along the centre line of the spar, as in a Meccano strip. The fishplates, either specially prepared or improvised, are placed in position and bolted together, when they effectively reinforce the defective portion.



Courtesy] [Short Bros.

Built-up duralumin spar undergoing test, showing the amount of deflection under five times normal load

For the tubular parts in this system "gaiters" made from strip steel are used, and these also may be carried as spares or improvised when needed. They are forced over the damaged section and drawn together by bolts passing through their ends.

Other aeroplane manufacturing firms have developed the use of metal along somewhat similar lines. The Gloster Aeroplane Company use longitudinally corrugated strips for the flanges in spars of the lattice girder type. High-tensile steel is employed and the resulting spar is definitely lighter than an equivalent one made of wood.

Messrs. Short Bros. on the other hand decided in favour of duralumin. They were led to this choice originally by the favourable impression made by the performance of the alloy when used in the construction of rigid airships, and have since made great use of it in the construction of both aeroplanes and flying boats. One reason advanced in favour of the alloy is that it is much easier to work than high-tensile steel, and therefore less elaborate plant is required. It is also possible to use thicker material on account of the low density of the alloy, which does away with the necessity for internal diaphragms.

We may pass over the earlier experimental aeroplanes constructed of duralumin and deal only with the more interesting later products of this firm. Notable among these was an all-metal flying boat made for Mr. Lebbeus Hordern of Australia. This boat was designed as a single-seater and was fitted with twin 696 c.c. "Blackburne" engines mounted in the wings. The machine, named the "*Cockle,*" was a semi-cantilever monoplane, the wings being in two halves, secured by hinged fittings to the hull and braced by short struts. It was constructed entirely of metal, chiefly duralumin, with the exception of the fabric covering surfaces. On some earlier machines duralumin sheet was used for the wings, but it was abandoned owing to trouble due to the slip stream from the propeller.

Considering that its weight was 1,060 lb., while its horse-power was only 36, this machine put up a remarkably good performance. No difficulty was experienced in rising from the water, and the speed range was from 35 to 64 miles per hour. This machine, which was subsequently taken over by the Air Ministry, was the first all-metal flying boat produced in this country.

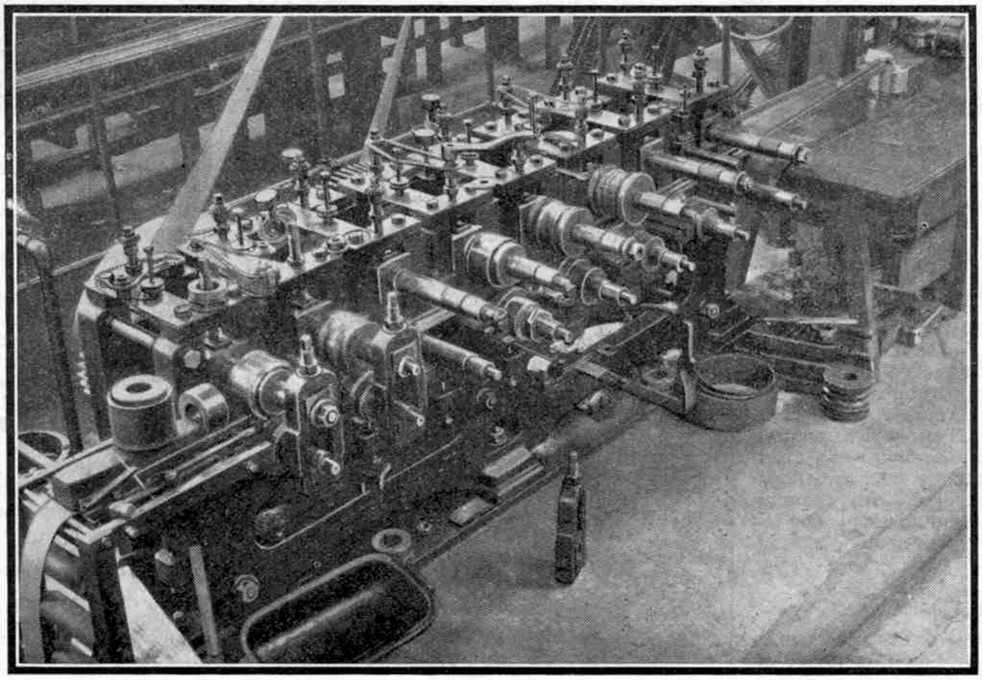
A very great point in favour of metal hulls is the absence of water soakage, which in large boats may amount to 600 lb., or even more; and this alone is sufficient to justify the use of such hulls. In addition it is possible to obtain a very considerable gain in structural weight. Up to recent times the greatest drawback to the use of duralumin for seagoing aircraft was its liability to corrosion and consequent rapid deterioration. This trouble has been overcome, for the duralumin used in seaplane and hull construction is subjected to a special treatment that renders it practically immune from corrosion.

Following upon the successful results obtained from the "*Cockle,*" Short Bros. received an order from the Air Ministry for an F.5 metal hull built on similar lines. The wooden F.5 machine was for some years the standard flying boat of the Services, being fitted with two Rolls "Eagle VIII" engines, and having a total all-up weight of approximately 12,500 lb.

In the machine fitted with the metal hull, the wing structure, tail unit, engine mountings, etc., were parts of a standard F.5, but the hull and its fittings were completely re-designed. For the first experimental hull no attempt was made to produce the lightest structure that the Short method of construction would have permitted, as it was desired to test out thoroughly under service conditions, the capability of such a hull to withstand mooring out under all kinds of weather conditions, and its general behaviour on the water and in the air.

The hull as built proved much stronger than the standard F.5 wooden construction, although its weight was practically the same. After being in service for over 18 months, subjected to hard usage and prolonged periods of mooring out, the hull was still about 95 per cent. efficient. It is built of duralumin and consists of a number of annular rings to which are riveted the sheets forming the covering. The longitudinal members are intercostal and merely serve as stiffeners to the skin. Extra strong frames are provided for the attachment of the wings and tail unit.

The whole of the hull is built entirely of flat sheets without any beaten work, other than the small nose cap. No jointing material is used between the seams as in German practice, yet the hull is remarkably watertight.



Courtesy] [Armstrong, Whitworth & Co. Ltd.

Steel strip passing through machine that produces corrugation

This hull was the forerunner of a number of metal hulls that have been built subsequently on various types of aircraft. Among these were machines of the type known as the "*Singapore*," built for the Air Ministry, the "*Satellite*," and the "*Mussel*."

The "*Mussel*" is a sporting two-seater seaplane with a Cirrus engine and is a low wing monoplane, the wings being of the semi-cantilever type with compression struts running from a point about one-third of the wing out from the fuselage to fittings on the sides. The wing construction is of particular interest, since the main spars are built up of laminations of duralumin sheet pressed out to corrugated sections, the number of laminations being governed by strength requirements.

The type of spar developed by the firm is in no way inferior to a steel spar as regards weight for equal strength and reliability. At the same time duralumin as a material for spar construction offers many advantages. Manufacture is greatly facilitated, machining, drilling and riveting operations being more readily carried out. The duralumin spar, owing to its greater thickness—nearly three times the thickness of steel for the same weight—is, it is claimed, less liable to damage and collapse; is sufficiently stable to require no internal diaphragms and is extremely resistant to torsional loads.

The illustration on the previous page shows the amount of deflection produced in the type of spar used for large flying boats when tested under a load five times that normally expected. Even after this drastic treatment, the amount of permanent bending was exceedingly slight and there was no indication whatever of failure on the part of the spar.

The latest machine at present on the stocks is the "*Calcutta*," a large all-metal flying boat fitted with three "Jupiter VI" engines, and equipped for 15 passengers and luggage, a crew of three and fuel capacity for a range of 500 miles. Two of these machines are now being built for Imperial Airways.

The "*Calcutta*" is to be fitted with a very complete navigational equipment, including direction finding wireless gear of the Bellini-Tosi type. The passenger accommodation is unusually comfortable, all seats being fitted with air cushions and an adequate ventilation system installed, together with cabin heating from the exhaust system. A buffet is provided for the serving of light refreshments during flight. As the petrol is housed in the upper plane, there is no danger of any petrol fumes being present in the hull, and smoking will be permitted during flight. Another interesting feature of this aircraft is that the large single rudder is operated by a small serve rudder, which enables the pilot to deal with large rudder loads with a minimum of effort.

Apart from complete machines, Short Bros. Ltd. have also specialised in the design and construction of duralumin floats for many types of aircraft. The metal floats used on British machines in the Schneider trophy race in America were built by this firm, as also were the floats used on Sir A. J. Cobham's flight to Australia and back. The firm possess a testing tank in which models of floats and hulls are tested for resistance, general behaviour, etc., and this has been of inestimable value in producing hulls and floats with a high water performance.

Recent developments in duralumin construction have been in the direction of metal airscrews. The Short metal airscrew, which has recently undergone successful flying tests, has been developed to meet the demand for a metal airscrew giving the increased efficiency that is characteristic of this type of blade, with a system of construction that is both simple and cheap to produce, and durable in service.

The most important feature of this type of metal airscrew is the separate construction of the blades, which are interlocked together on the well-known halved joint principle. The advantages of (Continued on page 167)

Canadian Mail Experiments

The Canadian experiments in transferring mail from ships at sea to speed-up delivery on land have proved highly successful, and the transfer now is becoming a regular feature. An excellent illustration of the saving in time secured is afforded in connection with the mail taken off the "*Montroyal*" at sunrise one morning on the arrival of the ship off Father Point. A flying boat picked up the mail and flew to Montreal, dropping a bag for Ottawa at Quebec. Another flying boat took up the Ottawa bag, which arrived at its destination an hour-and-a-half after leaving Quebec. Actually over two days were gained as compared with the old method of bringing the mails into port by steamship and carrying them overland by train.

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The Next Schneider Contest

During the past few weeks representatives of the Schneider Cup Committee of the Royal Aero Club have been paying a round of visits to the various towns that have applied for the privilege of staging the next Schneider Trophy Contest. Among the towns visited were Blackpool, Southport and Morecambe on the Lancashire coast, and at each of these places the deputation consulted with representatives of the town in order to receive their proposals for embodiment in a report to be presented to the R.A.C. later.

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Aircraft Production in Canada

Vickers Ltd., who have the only self-contained aircraft factory in Canada, are at present working at heavy pressure on aircraft construction, and during the past year have found it necessary to extend their plant. At the moment 32 machines are being built, of which 12 are for the Royal Canadian Air Force. These are all of the Avro landplane type. In addition, there are eight Vedette three-seater flying boats, three Varuna seven-seater flying boats, one Vista single-seater flying boat, one Vigil forest-patrol landplane, and one Velos twin-engined plane, designed specially for photographic work over land or sea.

* * * *

More Giant Aeroplanes

One of the most interesting features of German aeroplane design within recent years has been the intense rivalry between the Rohrbach and Dornier factories. Each of these two firms seems to have made a special feature of endeavouring to produce a machine larger than anything thought of by its competitor. As a result the latest machine to appear from the Dornier Works is a flying boat that has no less than four 450 h.p. Bristol "Jupiter" engines arranged in tandem pairs side by side. Accommodation is provided for 23 passengers in two cabins, and the main details of the machine are:—Overall length 80 ft. 8 in.; wing span 93 ft. 6 in.; total wing area 1,540 sq. ft.

In America an even larger machine is reported to have been built. This has a wing span of 200 ft., while the fuselage is 90 ft. in length. The power units, consisting of 16 "Liberty" engines, are reported to develop 7,200 h.p.! The engines are grouped in pairs on each side of the fuselage and in the nose of the machine. This monster is reported to be capable of carrying 100 passengers.

* * * *

Safety in the Air

The most interesting aspect of aviation from the point of view of progress is that of safe flying, and a recent lecture given by Mr. Bramson before the Royal Aeronautical Society dealt with many interesting points in this connection. Mr. Bramson enumerated the five main causes of aerial accidents—loss of control, structural failure, engine failure, collision, and weather, and proceeded to deal with the methods for decreasing the risks due to these causes and ensuring the safety of the pilot. He declared that the many ingenious instruments that recently have been invented are making the modern aeroplane fool-proof, and he instanced in particular the Savage-Bramson anti-stall gear, the Handley-Page slotted wing device, the de Havilland differential aileron control, and the Rohrbach device, which are designed to eliminate the failure of the human element.

Wireless direction-finding and telephony, the Reid turn indicator and the leader cable are among the many devices that rapidly are overcoming the aeroplane's dependence on good weather, and it seems, indeed, that the time is not far distant when adverse weather conditions will have no more effect upon the aeroplane than they have upon the motor car or the railway train.

* * * *

Radio-Controlled Aircraft

A radio-controlled Breguet biplane flying without a pilot has been tested recently at Istres, in the South of France. Altogether the machine has made ten pilotless flights and on each occasion has taken off and landed without mishap.

We understand that the French Government have decided to purchase the patent of the device under which this machine is operated and this raises again the interesting question as to whether there is really any use for aircraft of this type in warfare. Radio-controlled aeroplanes are not a new departure, for several years ago an experimental machine was built and tried out at the Royal Aircraft Establishment at Farnborough. In the U.S.A. a flight of machines was similarly equipped and carried out several flights. In this case each machine carried a pilot to ensure its safety in the event of failure of the wireless control, but actually none of the pilots was required to do any work.

* * * *

Liverpool as an Airport

In a recent note we referred to the possibilities of a new airport being established at Liverpool. Negotiations for securing a site that is considered to be practically ideal are now in progress. Imperial Airways have expressed their willingness to operate an experimental service between Liverpool and Croydon to connect with the cross-Channel services, and the Luft-Hansa Company (Germany) are ready to run a direct service from Germany to Liverpool to meet the Trans-Atlantic steamships.

The Liverpool organisation negotiating in this matter have also set in motion a scheme for the inauguration of a Liverpool Light Aeroplane Club. Several prospective members have already been found and two offers of machines have been made. It is anticipated that the cost of acquiring the aerodrome site, and the initial expenditure in connection with the founding of the club, will be forthcoming easily, for the amount is relatively small.

* * * *

The Guggenheim Aircraft Competition

The competition for the £20,000 prize offered by Mr. Daniel Guggenheim for the machine displaying the greatest factor of safety in the air has already attracted the attention of aircraft constructors in all parts of the world. Five British firms, the Cierva Autogiro Co. Ltd., the de Havilland Aircraft Co., the Gloster Aircraft Co., Handley-Page Ltd., and Vickers Ltd. have entered for the competition, which remains open until 31st October, 1929. The tests will be carried out at Mitchelfield, Long Island. This competition is only one item in the research competition programme to which Mr. Guggenheim has given £500,000 as prize money.

Meccano in Parliament

One of the most remarkable features of the wide-spread development of Meccano has been the manner in which the name has passed into current use, both in the Press and in every day conversation, to describe structures of a particular type. There is, indeed, no other word in the English language that can convey at all adequately the idea of an engineering structure showing its framework in full detail unobscured by a cover of any kind.

We have referred from time to time to the giant airship R.100, which is now approaching completion, and our readers will be interested to know that this airship led to a reference to Meccano in the House of Commons recently. Mr. F. H. Rose, Labour Member for Aberdeen N., asked the Secretary of State for Air whether his attention had been called to photographs published in the Press of the R.100, and whether those photographs, which revealed the technical details of the structure, had been published with his authority. In reply the Minister stated that he had seen the photographs in question and that there appeared to be no objection to their publication. Mr. Rose had still another question to put :—" Has the Under-Secretary assured himself that these photographs are not enlargements of some schoolboy's essay with a No. 3 Meccano Set ? "

The Minister remained silent !

* * * *

American Air Enterprise

America's great faith in the future of aviation is reflected in the rapid development of aerial routes throughout the States. Over 8,000 miles of air routes are already in operation and further routes covering 4,000 miles are contemplated. Air mail services are rapidly extending and over 620,000 lb. of mail matter were carried during the first six months of last year. It is estimated the total mileage of American civil aviation in the same period, excluding racing, manufacturers' test flights and private owners' flying, was 12,377,933 ; the number of passengers carried was 395,646. Of the mileage over 2,600,000 was on scheduled route work.

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Upside-Down Flying

Herr Fieseler, the German aerobatic pilot who created a world's record for upside-down flying by maintaining this position for 10 minutes 56 seconds, recently flew from Cologne to Bonn, maintaining his machine in an inverted position throughout the flight, which lasted 15 minutes. He was accompanied by another machine, the occupants of which acted as official observers.

* * * *

The Story of the Flying Forces

An official film dealing with the history and work of the Royal Flying Corps, the Royal Naval Air Service and the Royal Air Force is shortly to be produced. The scenario is being prepared by Major Ian Hay, and it is understood it will take the form of a romance rather than a bare record of incidents.

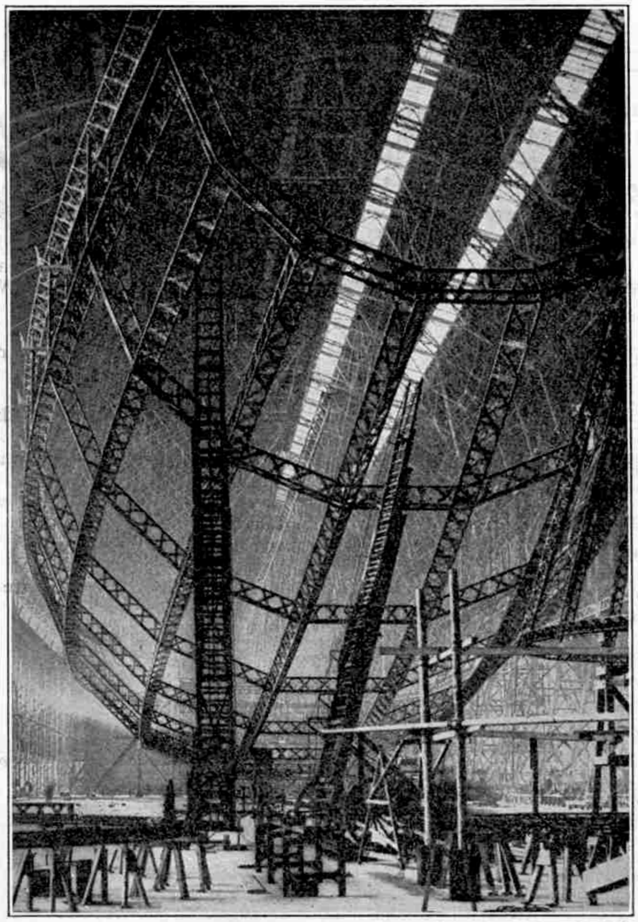
Aerial Tours to the Holy Land

In connection with their Eastern services Imperial Airways Limited are arranging a series of aerial tours to places of interest in the Holy Land. The itinerary covers seven days. Starting from Cairo passengers will visit Gaza, the ruined city of Petra, Amman, Jerash, Jerusalem, the last named being the headquarters for the fifth and sixth days. The seventh day will be occupied by the return flight to Cairo. The fare is £75, which includes hotel accommodation, meals, all necessary motor transport and admission fees to places visited.

* * * *

London to Dublin by Air

Imperial Airways Limited and the Government of the Irish Free State have recently been in negotiation regarding the establishing of an airway between London and Dublin via Liverpool. A combined aeroplane and flying-boat service is projected. Handley-Page machines are to be employed on the London-Liverpool section and Short-Jupiter all-metal flying boats of the type being used by Sir Alan Cobham on his African flight will be put on the Liverpool-Dublin service. It is anticipated that the existing time of 10 hours by the train and boat service will be reduced to four by air.



Courtesy] [" *The Aeroplane* "

R.100—This view toward the bow of the first of Britain's great 5,000,000 cu. ft. commercial airships, gives a remarkable impression of a giant Meccano Model. R.100 is being built at Howden and is rapidly approaching completion

A New Rotating Wing Machine

The Air Ministry have decided to purchase the designs and manufacturing rights of a new type of air machine known as the "helicogyre," invented by an Italian engineer. As the name indicates, the design is a further attempt to secure the advantages of the helicopter, with gyrating wings as the solution. No clear details have yet been published but it is understood that the principle employed is that of a number of wing surfaces rotating around a central shaft and driven by engines and air screws carried on the rotating wings themselves. In fact it is nothing less than a series of small aeroplanes, each propelled by its own engine and restricted to flight in circles around a central point, the main shaft. This feature of the machine secures vertical lift. A separate engine and propeller are used to secure forward motion.

* * * *

A New British Airship

A British company has been formed for the purpose of designing and commercially operating a new type of semi-rigid airship having a gas capacity of one million cubic feet. The company do not propose to build the ship, and this work will be carried out by contractors.

The ship is to be known as B.S.R.1 and is estimated to cost, together with mooring mast and ground equipment, £26,000, an extremely low figure that is the result of certain interesting innovations in the design. The specification of B.S.R.1 calls for a length of 363 ft., and a maximum diameter of 78 ft. 6 in. Four main engines and one spare will be installed, each to develop 300 h.p. Thus the total power available will be 1,500 h.p., of which only 1,200 h.p. normally will be in use. This is sufficient for a cruising speed of 50 m.p.h. and a maximum speed, when fully loaded, of 70 m.p.h. The airship's total lifting power will be 30½ tons and of this 15¾ tons is available for fuel and payable load. The estimated fuel cost per mile is 2/–, but the gas operating cost will vary according to the factors governing consumption, altitude, climate, leakage and so on. It is anticipated that the total operating costs will be low enough to enable the ship profitably to carry passengers and mails at a figure only slightly above the rail and steamer charges for equivalent journeys.

The landing arrangements are specially interesting. A portable mooring mast costing only £3,000, capable of being transported on lorries and erected and dismantled quickly by a ground staff of three men, is to be employed. A special form of keel is to be embodied in the ship's design to facilitate landing on water and picking up and disembarking passengers and cargo while at anchor.

The project seems optimistic, but experts who have examined the designs believe it to be practicable.

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The East Kent Flying Club has been selected for inclusion upon the list of Air Ministry subsidised clubs. Sir Charles Wakefield is the president.

NEW SERIES: WHAT SHALL I BE?

Civil Aviation as a Career

The Opportunities for Keen Boys

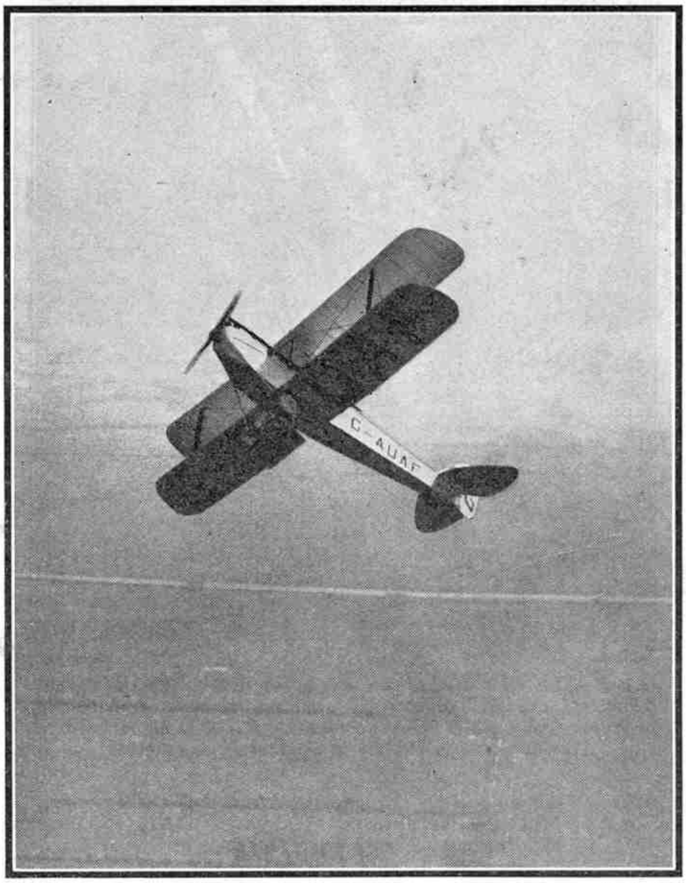
By Norman Jones

THE pages of the "*M.M.*" that deal month by month with aviation in its various aspects form one of the most popular sections of the Magazine and it is evident that there is a wide and growing interest in flying as a means of transport. During the past few months we have received a large number of letters from readers who are thinking of taking up civil aviation as a career, asking our advice as to the best method of obtaining a start in this direction. This article has been specially written to answer such queries and to make clear the steps that a boy must take in order to qualify himself to earn his living in the aeronautical profession.

Before going any further it should be emphasised that civil aviation must not be confused with the Royal Air Force. The R.A.F. is definitely a Service on similar lines to the Navy and the Army, and entry to it is obtained in much the same manner as is the case with the senior Services.

In the year 1909 there were 54,000 people employed in the motor industry and to-day there are over 350,000. What opportunities must have presented themselves to the fortunate few who, 15 years ago, were already in an industry capable of expanding so rapidly! The events of the past few years make it clear that aviation is travelling along the same road and it is safe to predict a brighter and wider future for aviation than can ever be enjoyed by the motor industry. The trans-Atlantic flights successfully undertaken this year bring the time very near when aeroplanes will be the most important means of travel for long distances. At the same time the rapid development of the small light aeroplane is hastening the time when private aeroplanes will be in common use for short-distance trips.

It does not need much imagination to see that during the next five, 10 or 15 years the aviation industry will increase by leaps and bounds. Further, those who set to work at once to learn something about aviation and secure instatement in the industry are bound to reap the benefit when aviation comes into its own as a universal means of transport.



Courtesy] [" *Flight* "

Capt. Broad indulging in mild acrobatics in his de Havilland "Moth"—the commencement of a roll

Those taking up aviation as a profession may either become pilots, that is fly an aeroplane professionally, or they may become connected with the activities of an aeroplane factory. In either case air experience is advisable. Formerly most of the men engaged in designing and making aeroplanes were unable to fly themselves. This was undoubtedly a great mistake. If designers had had more experience of actual work in the air they would have been better able to solve many difficulties, and it is even possible that some of the accidents that occurred in the early history of aviation would have been avoided. Air sense is essential for designers as well as for pilots and the only way to acquire it is by practical experience in the air.

The first step then, no matter what branch of the profession is to be taken up, is to learn to fly. As a preliminary it is advisable to be examined thoroughly by a local doctor who should be informed of the purpose of the examination. The average boy should have no difficulty in passing a suitable medical test, but this little precaution may save much consequent disappointment.

Undoubtedly the best way of learning to fly is to join one of the various light aeroplane clubs that are now being formed in all parts of the country. Most of these are subsidised by the Government and the cost of learning to fly is therefore very much less than would otherwise be the case. After learning the use of the controls of an aeroplane by taxi-ing about on the ground, the learner is taken up by an instructor in an aeroplane fitted with a dual set of controls, and with the moral backing of the instructor he soon becomes capable of controlling the machine in the air. Most boys would take about 12 hours to learn how to control an aeroplane and the only further requirement would be practice in the air.

After two or three practice flights alone the test for the " A " licence may be taken. This is by no means difficult. The trial consists in showing ability to guide the aeroplane several times over a figure eight marked on the ground, and also includes climbing to 6,500 ft. and gliding down to the ground once more with the engine throttled back. An easy oral examination on the rules of the air completes the test.

The possession of an "A" licence does not entitle the pilot to do more than fly a machine for his own amusement, and if he wishes to qualify for work as a pilot of a commercial or passenger aeroplane he must then go on to get a "B" licence. A certain amount of flying experience is essential for this and the pilot must show capability for night flying and also for finding his way across country, neither of which is a really difficult matter. A good working knowledge of aeroplanes and engines is necessary, while the rules of the air and elementary navigation must also be familiar to him.

Many readers with thoughts of entering this field professionally will be interested in the cost of qualifying as a pilot. The cost of an "A" licence depends on the time taken to learn to fly, as it is customary to charge hourly rates for the use of the aeroplanes of the clubs, but £20 will represent the average cost. The cost necessary to qualify for the "B" licence will be rather more, but in this case it is quite possible to gain the experience needed while actually working for an aviation firm.

Courtesy] ["Flight"
A fine photograph of a de Havilland "Moth" at speed, obtained by moving the camera in the direction of flight

The prospects of a pilot who has obtained a "B" licence are quite good at the present time. He must not expect to obtain one of the highest and best paid jobs immediately, but while gaining the experience necessary for these he will be earning a good salary and will be in one of the best and most interesting professions of the present day. The present income of a pilot varies considerably with skill and experience and with the type of work on which he is engaged, but it is safe to say that certified pilots will not earn less than £600 or £700 yearly, and salaries up to £2,000 or £3,000 a year are obtainable.

The most coveted and best paid positions are those offered by the big air line companies, such as Imperial Airways, but only the very best pilots with a good deal of experience are employed in this work. Other ways in which a pilot may be employed are in air-surveying and map-making, or photographic work in all parts of the world—one of the most interesting of all possible occupations for air pilots. Many aircraft firms employ pilots for testing their machines, and others are engaged as instructors in clubs, teaching beginners to fly. An additional possible employment is giving joy rides at shows and galas on behalf of private companies.

The number of pilots required under these headings is at present comparatively small, but there is no doubt that the demands will increase considerably within the next few years and senior pilots will then find themselves in a very favourable situation.

Turning now to the other side of the industry, it will be assumed that the entrant has no practical qualifications. He probably has a superficial knowledge of aircraft acquired because of his own interest in aeroplanes and he is, we hope, willing to get on. If this is the case he should try to obtain admission to the works of some large aeroplane manufacturers and spend at least 18 months in going through the various shops. There should be no great difficulty in finding employment of this kind, for the aircraft industry is looking for keen young men and is only too willing to allow them to get an insight into the profession in this manner. A large salary, of course, would not be expected.

Admission to the works is not the only step to be taken. It has already been pointed out that the acquisition of an "A" licence is advisable and a no less important step to take is to join either the Institute of Aeronautical Engineers or the Royal Aeronautical Society. The former of these has only been in existence for two or three years and membership of it is as valuable in the flying profession as membership of one of the well-known Institutes of Civil, Mechanical and Electrical Engineering is in the older branches of engineering. There are various grades of membership, from students to associates, associate members and finally full members. The Institute holds examinations and grants diplomas at various times of the year and gives direct assistance to its students and associates by means of fortnightly lectures, while a very valuable and extensive library is also available to them. A further advantage of joining the Institute is that many opportunities are afforded of getting to know the important people in the aircraft industry.

The time spent in the shops, carpentering, assembling and engine fitting, should be followed by work in the drawing office, which is the first step towards becoming an aeroplane designer.

A young man able to fly, who has served his apprenticeship in an aircraft factory and obtained experience in the drawing office, will see many opportunities and openings before him. The aircraft industry is now one of the few industries in which skilled men are badly needed, and in a few years' time the position in this respect will be intensified.

At the present moment there are no more than 10,000 persons connected with civil (Continued on page 167)

FAMOUS TRAINS: XIV.

The "*Aberdonian*," L.N.E.R.

By Cecil J. Allen, M.Inst. T., etc.

IN describing the runs of the express trains already dealt with in this series of articles we have in every case started our journey at the London end, with the solitary exception of the "*Folkestone Flyer*" in last month's "*M.M.*" We have thus worked from London northwards, southwards, eastwards or westwards as the case might be, and the result has been, that by the time we have reached the final and furthermost limits of each trip the precious space available has been exhausted. The last stages of the run, therefore, have been passed over very hurriedly and I have had to excuse this, as the lynx-eyed reader may have noticed, on the plea that "by this time you must, of course, be tired and sleepy!"

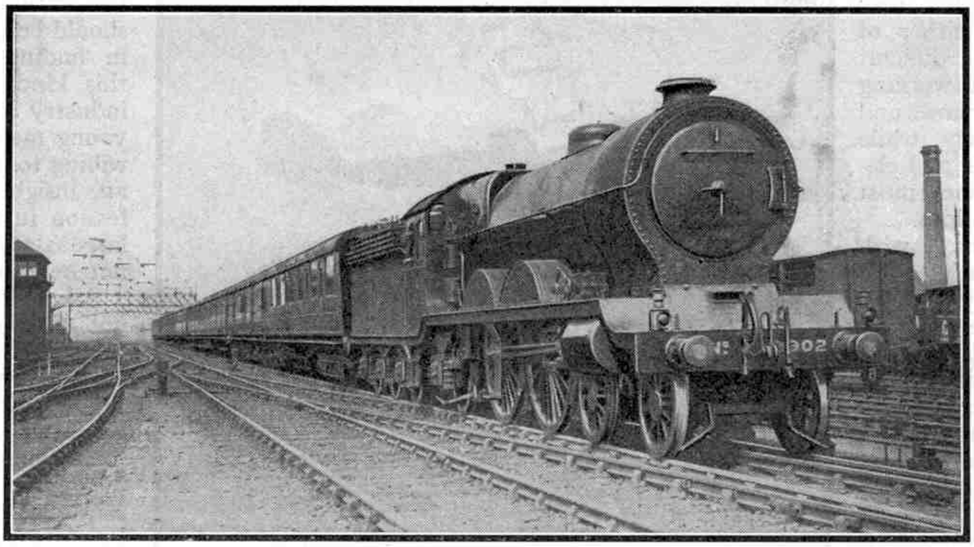
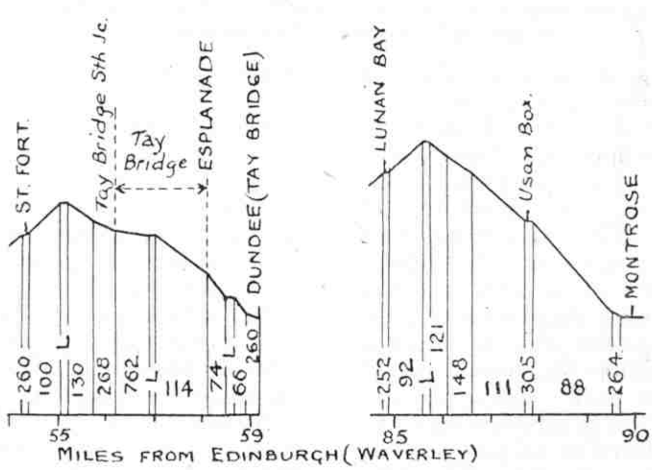


Photo courtesy] [L.N.E.R.

The "*Aberdonian*" leaving Aberdeen, hauled by 4-4-2 engine No. 9902 "Highland Chief"

But I know my friends in Aberdeen too well to attempt any such excuse in the case of a train that bears the name of their illustrious city. I should not like to think of my good friend the Editor being deluged with complaints from indignant Aberdonians that their own very special express had not been properly treated, so it will clearly be the safer plan if we ride with the up train, and begin our expedition in the Granite City. If our journey is made in the summer-time we shall have the additional advantage, not only of seeing many miles of magnificent coastal scenery—for the East Coast Route, unlike its rival, is a *real* coast route!—but also of setting eyes on the greatest railway engineering wonder in Great Britain, the Forth Bridge, over which we must pass.



The "*Aberdonian*" is an historic train. It was away back in 1895 that the down "*Aberdonian*" was concerned in one of the most sensational happenings in British railway history. Seven years earlier, the companies comprising the East and West Coast routes had reached so great a pitch of excitement owing to the fact that the East Coast people had seen fit to admit third-class passengers to their "*Flying Scotsman*"—hitherto the best trains had been confined to the use of first and second-class passengers only—that they had for some days conducted a real "race" over their respective tracks, in order to see which of the two "10 o'clocks" out of London could reach Edinburgh first.

This contest, however, was mild indeed in character as compared with that which, in 1895, followed the completion of the East Coast Route in the opening of the great bridges across the Firth of Forth and Firth of Tay. The "Race to Aberdeen" began modestly enough; the first step was merely that the West Coast companies announced an acceleration by 10 minutes of the time of their down "*Aberdonian*," thereby coming within 5 minutes of the time of their rivals. Promptly the East Coast companies indicated a corresponding acceleration. From that time forward, in July and August, 1895, acceleration succeeded acceleration in bewildering sequence, until hours had been cut from the schedules of but a few weeks before. Finally the timetable was scrapped altogether, relieving trains being run behind the racing "flyers" to pick up passengers who might be stranded by the early running of the expresses.

So far as the East Coast was concerned, the culmination came on the night of 21st August, when the 523½ miles from King's Cross to Aberdeen, inclusive of stops at Grantham, York, Newcastle, Edinburgh and Dundee, as well as the terribly difficult gradients and sharp curves north of Edinburgh—whose acquaintance we shall make in a moment—not to mention a stretch of single track between Arbroath and Kinnaber Junction, north of Montrose, were covered at an average rate of over 60 m.p.h. throughout, in 8 hrs. 40 min. Not to be outdone, the West Coast, with their 915-ft. summit at Shap and the higher 1,015 ft. of Beattock, covered their 540-mile route in 8 min. less on the following night, the time of 8 hrs. 32 min., all stops inclusive, representing an average speed of no less than 63.4 m.p.h. for the whole distance. To-day the "*Aberdonian*" and the corresponding train on the West Coast Route, which between them afford the best service between London and Aberdeen, are allowed 12 hours in which to make the same journey.

There are, however, a good many reasons why the tremendous speeds of the "Race to Aberdeen" could never be made permanent. In the first place, the average passenger, entraining at either end of the journey at the comfortable hour of half-past seven in the evening, has no particular wish to be turned out of the train, on arrival at his destination, much earlier than 7.30 the next morning. It must not be forgotten, also, that the racing trains of 1895 weighed from 70 to 100 tons, as compared with the weight of modern Anglo-Scottish expresses, which frequently exceeds 400 tons. Such speeds as those just mentioned, though doubtless still possible of achievement, with 400-ton trains, by the aid of our vastly more powerful locomotives of to-day, could not be maintained as an everyday proposition. There is little question, on the other hand, that substantial accelerations of Anglo-Scottish running times are practicable, but it is the day service rather than the night service that calls the most loudly for expedition.

When we join the up "*Aberdonian*" at Aberdeen, we shall probably find the weight of the train to be but little less than 400 tons all found. The composition of this express varies considerably, as between the winter and the summer service, but we may be certain of finding, next the engine, a restaurant car portion for Edinburgh, consisting of a 12-wheeled composite restaurant car flanked by open first-class and third-class cars, or possibly the last-mentioned and a composite brake coach. Then comes the London portion—the "*Aberdonian*" proper—which is generally one of the magnificent articulated "twin" sleepers, weighing 62 tons, a composite corridor coach, one or two third-class corridors, according to the season of the year, and a couple of large brake-vans. In the summer there is the Lossiemouth sleeping car and third-class brake to be added to these. The train is then made up, usually, by the addition of vans of fish, attached at the rear, either to the maximum capacity of one of the North British "Atlantics," or, if heavier still, to a double-headed load.

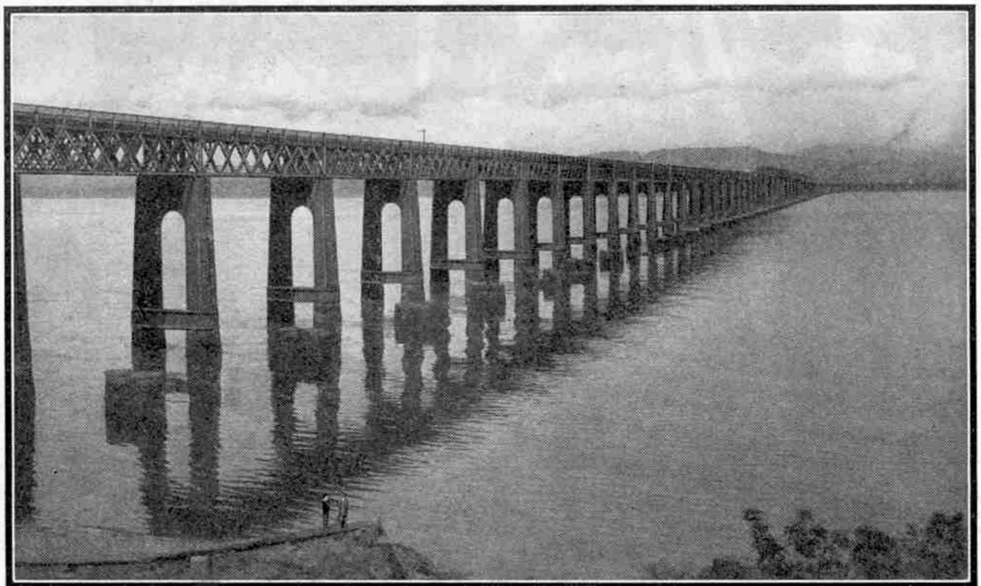
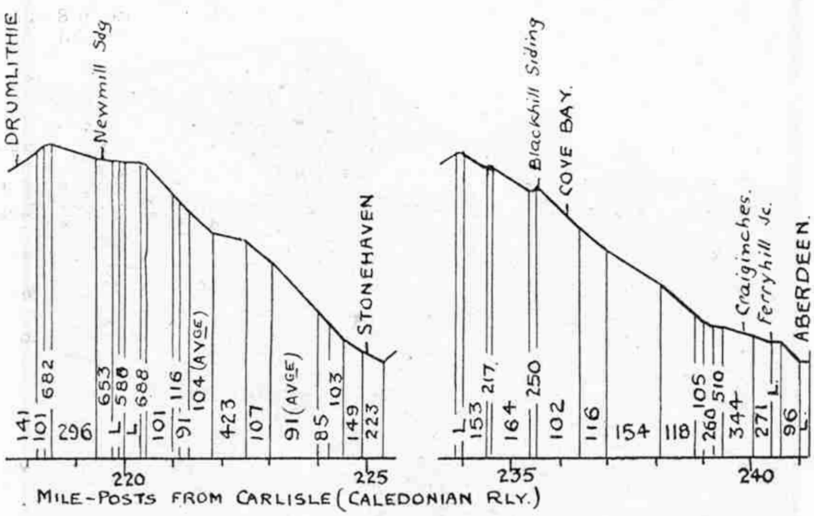


Photo courtesy] [*L.N.E.R.*

The famous Tay Bridge

Almost certainly we shall find one of the "Atlantics" at the head of the train. Disappointing in their early performance, the Reid "Atlantics" of the late North British Railway may be numbered among the numerous classes of express locomotive in this country whose work has been transformed by the addition of superheating equipment. It may be a matter of surprise, in view of the exceptional difficulty of the grading of all the chief routes over which they work, that their designer did not choose the 4–6–0 wheel arrangement in preference to the 4–4–2, but he brought down the maximum weight practicable on his coupled wheels—40 tons—and to-day these engines appear to possess all the requisite adhesion for their hard uphill work. The hardest of this climbing is between Edinburgh and Carlisle, by the Waverley route, where the two summits at Falahill and Whitrope, respectively 900 and 880 ft. above the sea, are approached by many miles of climbing at 1 in 70, and maximum unpiloted tare loads have to be limited to 290 tons. But over the East Coast main line, between Edinburgh and Aberdeen, with gradients in part equally steep, but fortunately shorter, the maximum tare figure is increased to 360 tons. If we are up to this maximum tare load to-night we shall find that our driver has his work cut out to keep time; and we shall note particularly how, after climbing each bank, he gets a good start down the other side by refraining, for a mile or so, from "notching up," so as to snatch fractions of minutes wherever he can. We shall have no time to spare, indeed, on any stage of the very difficult run between Aberdeen and Edinburgh.



We must spare a glance, first of all, for the fine Joint Station at Aberdeen, before we start on our journey. It was at one time the headquarters of the Great North of Scotland Railway which, in the grouping, becomes the Northern Scottish Area of the L.N.E.R. It is interesting to note that, in relation to the parent system, this area is "marooned," being cut off physically from the nearest point on the main L.N.E. system, just north of Montrose by 38 miles of "foreign" line, once Caledonian, and now, of course, L.M.S. territory. Once we are past Ferryhill Junction, on the south side of Aberdeen, therefore, the "*Aberdonian*" has to exercise what are known as "running powers" over L.M.S. metals, before it passes again on to those of the L.N.E.R. Aberdeen Joint Station is partly terminal, with four terminal platforms at the north end and five at the south end, as well as four long through platforms, 1,596 ft. in length, giving through communication from north to south. It is from one of the south platforms that we start away, at 7.35 p.m.

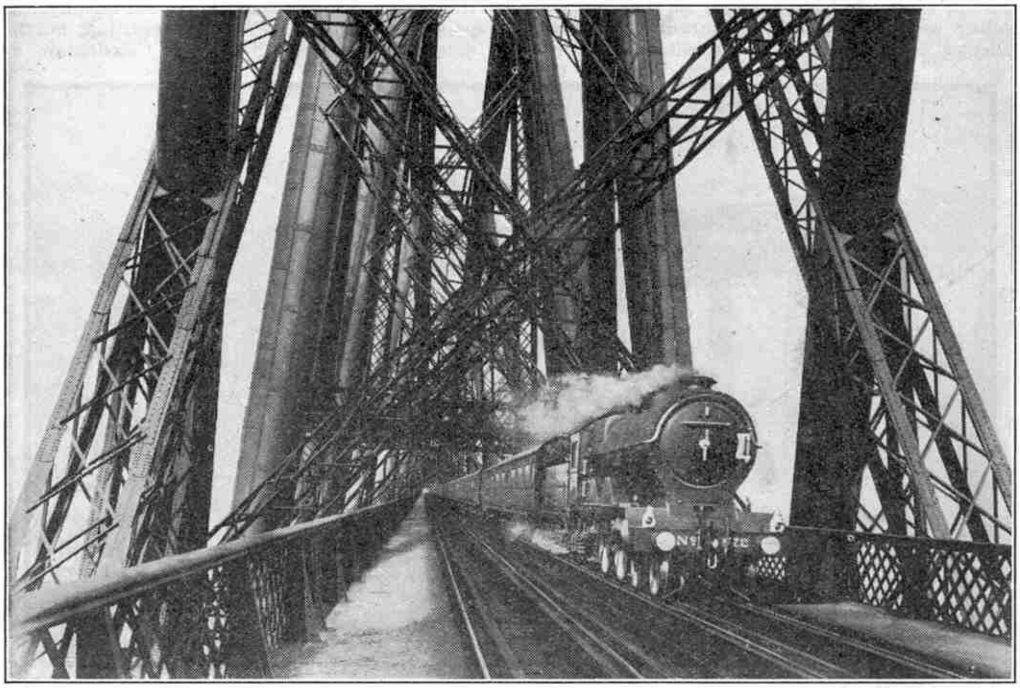
The timetable of the "*Aberdonian*" reveals no startling feats of speed, but the gradient diagrams reproduced will show something of what is before the engine in the four successive starts from Aberdeen, Stonehaven, Montrose and Dundee. From Aberdeen we must toil for six miles without a break, in the first ½-mile at 1 in 96, and then for miles at between 1 in 118 and 1 in 164, but steadily accelerating to a maintained speed of between 35 and 40 m.p.h. on the upper part of the climb.

Then follows a descent to Stonehaven, where the sight of the distant signal "on" prepares the driver to stop, as this is a "conditional" halt, made only when passengers require to be picked up. I once remember a driver being thus compelled to stop at Stonehaven to pick up one solitary lady, and I was ungallant enough to think that it would have been cheaper to have compensated her suitably, if need be, and sent her on by the train in front! For at Stonehaven, at the bottom of steep gradients in both directions, we need all the momentum we can muster to help us up the formidable ascent to Drumlithie, and a stop destroys it completely, compelling a restart on an incline of 1 in 149.

Once more, however, we get away well, and with the fillip to the speed given by the short 1 in 423 "breather" in the middle of the climb, which again brings us up to 35 or even 40 m.p.h., we pass Drumlithie, seven miles from Stonehaven, in between 13 and 14 minutes. If we have taken 25 min. to run the 16¼ miles from Aberdeen to Stonehaven, and have stopped there a minute, we have now 18 min., or a little over, in which to complete the 17 downhill miles to Montrose. This is a matter of no difficulty. We may and probably shall exceed 70 m.p.h. at Fordoun, and again below Marykirk—

exchanging our East Coast views temporarily for a magnificent prospect of the Grampian Hills far on the west of us—until a drastic slowing indicates the approach of Kinnaber Junction.

Kinnaber is a name of historic memory. Here it was that the down racing trains of 1895 converged on to the one track for the final 38 miles of their run, and to the lasting credit of the signalman there be it said that on one night, when the "Is Line Clear" bells for both the racers sounded simultaneously in his cabin, he chivalrously gave the "foreigner" the preference—Kinnaber is, of course, a Caledonian cabin—so that on that night the East Coast train arrived in Aberdeen first. Our severe slowing is not alone in order to take the converging junction, but the "tablet" for the single-line section from here to Montrose. At the latter station we stop at 8.33 p.m., having now travelled 40½ miles from Aberdeen.



Photo] [*Photochrom*

The "*Aberdonian*" on the Forth Bridge

From Montrose there is another bad start, steeper, even if shorter, than those from Aberdeen and Stonehaven. The single line continues from here over the summit, 4¼ miles distant, to Lunan Bay, where double line running commences, and downhill we run swiftly to Arbroath, the next stop. For the 13¾ miles from Montrose to Arbroath the time allowance is 21 min., and in view of the severity of the intermediate rise, this proves none too much. Strikingly in contrast, the next 17 miles to Dundee, right along the sea coast past the well-known golfing resorts of Carnoustie, Barry and Monifieth, are dead level throughout, for which the timetable makes a more than generous allowance of 23 min. Dundee, the famous city of jute—and marmalade!—is reached at 9.20 p.m.

It is, of course, only in the height of summer that the engineering wonders of the next section of the journey are clearly visible. From Dundee, where quite possibly we may change engines—substituting for our "Atlantic" another, or a "Director" 4-4-0, piloted if necessary, or, at a not distant date, a new three-cylinder "Shire" 4-4-0—the first of these wonders soon bears into view. Rising sharply out of the depths of the Tay Bridge Station at Dundee, and very likely banked in rear up the initial 1 in 66 and 74 to Esplanade Station, we soon come into full view of the length of the Tay Bridge, curving away to the left for two miles across the waters of the Tay.

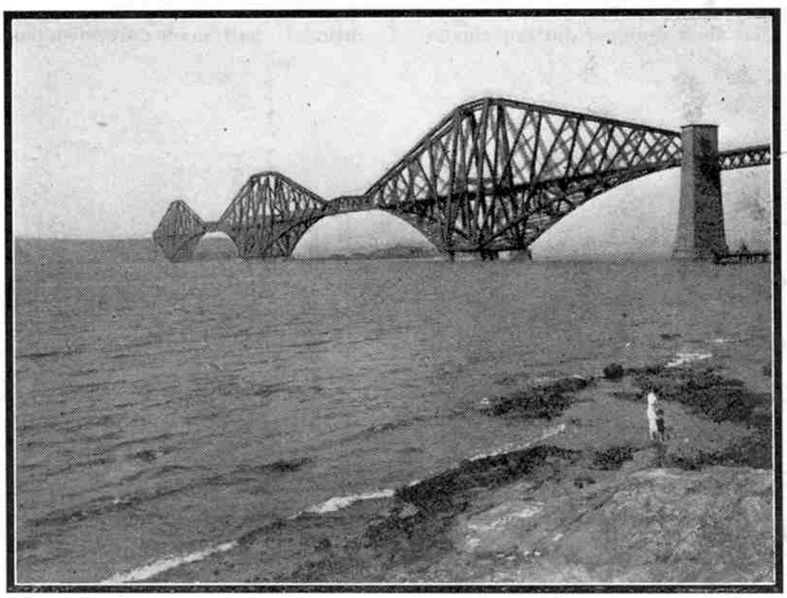


Photo courtesy] [*L.N.E.R.*

The Forth Bridge

The Tay and the Forth Bridges between them have been the making of the East Coast Route, so far as concerns the portion north of Edinburgh. The Tay Bridge, which, owing to the comparative shallowness of the Tay estuary, was considerably the easier engineering proposition of the two, was the first to be completed. In the earlier design, however, insufficient allowance had been made for wind pressure, and on a wild night in December 1879, when the night mail was actually crossing, the whole of the centre portion of the bridge was blown down and the train and every soul on board was lost. There is a perpetual reminder of the tragedy in the stumps of the piers of the old bridge, which still may be seen above water level to the east of the present bridge.

At a later date the Tay Bridge was rebuilt on a much more substantial plan to carry a double instead of a single line. It has eighty-five spans in all and a total length of two miles. The track continues to rise sharply to the centre of the bridge, on a gradient of 1 in 114, after which it is level to the far side, which we may expect to clear six or seven minutes after starting.

Past Leuchars Junction and Cupar to Ladybank Junction the gradients consist of moderate undulations only, save for a short rise at 1 in 107 to Springfield, and we may expect an average speed of round about a mile-a-minute from Leuchars to Cupar. From Ladybank almost all the way to Edinburgh, however, the grades are desperately hard. First we rise for 3½ miles, at 1 in 95 to 111, to Lochmuir cabin, from which we fall sharply to Thornton Junction, where speed must be reduced. Then follows another sharp rise for two miles to the 29th milepost, followed by a long stretch of mostly falling grades, past Kirkcaldy and Kinghorn to Burntisland. Full advantage of this cannot be taken however, owing to curves, and it is unlikely that the speed will exceed 60 m.p.h., while as we approach Burntisland there has to be a very severe reduction of speed owing to the sharp curve north of that station.

Once again we have lost momentum where we most need it, and we are to do so yet again by the equally bad slowing through Inverkeithing, as between these places we have to rise for three miles at 1 in 100 from Aberdour up to Dalgetty cabin, and then, having recovered speed on the ensuing down-grade, the slack at Inverkeithing ruins the driver's chance of "rushing" the last and desperate two miles at 1 in 70 up on to the Forth Bridge.

In such circumstances the schedule of 84 min. for the 59¼ miles from Dundee to Edinburgh is far from excessive; with such a load as this, indeed, it is distinctly "tight." To Tay Bridge South Box, 3½ miles from the start, the time allowed is 8 min., and the next 16½ miles to Ladybank consume about 20 min. 11 minutes for the 8¾ miles over Lochmuir to Thornton, and 13 min. for the 10½ miles to Burntisland, leave no margin. Then comes 10 min. for the seven miles to Inverkeithing, 8 min. up and over the Forth Bridge to Dalmeny, and 14 min.—the only part of the schedule which, given a perfectly clear road into Waverley, allows a small recovery margin—over the final 9½ miles from Dalmeny into Edinburgh, where we are due at 10.50 p.m.

It is as we are travelling along the shores of the Forth, between Burntisland and Aberdour, that we first catch sight of the Forth Bridge. As we toil up the 1 in 70 from Inverkeithing, through rock cuttings and tunnels, we lose it again, until suddenly we are ushered on to the great structure, at a speed, probably, of not more than 20 m.p.h., at North Queensferry. Volumes might be written of this amazing bridge, which still, we are proud to remember, holds its head high among the engineering wonders of the world. The lessons of the Tay Bridge disaster were not lost upon its engineers, for after that the Forth Bridge designs were completely altered in order to make adequate allowance for the effects of wind pressure. Seven years, from 1883 to 1890, were occupied in the colossal task of its erection.

The total length of the Forth Bridge, including approach viaducts, is 1½ miles, and there is only one greater span in the world—the 1,800 ft. of the Quebec Bridge across the St. Lawrence River, in Canada—than the two 1,710 ft. spans of the Forth giant. In order to obtain a good idea of their length we may think of between 28 and 29 modern corridor coaches strung out in a line, which would suffice to reach from one side of each span to the other. As to height, the underside of each span is 157 ft. above water level, and from the water to the top of the cantilever towers is 361 ft., or within 4 ft. of the height of the top of the cross on St. Paul's Cathedral dome above the pavement.

Some 54,000 tons of steel were worked into the Forth Bridge, with its foundations and approaches, held together by 6½ million rivets. Forty-five men are employed unceasingly on the painting of the bridge, to protect it from corrosion. The complete task of painting occupies three years, after which the time has arrived for a recommencement, so that the painting never stops.

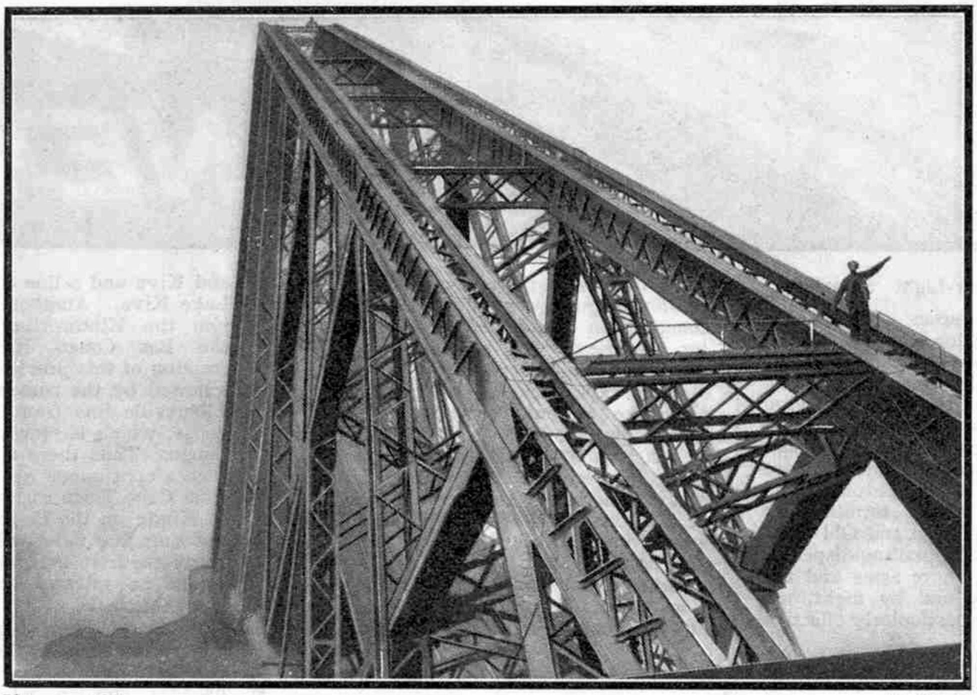


Photo courtesy] [*L.N.E.R.*

A remarkable view of the Forth Bridge, taken from the top of one of the cantilevers

Slowly we run across the bridge, with its magnificent views, through Dalmeny, down the sharp dip to Turnhouse, with a final mile-a-minute maximum, up to Saughton, and then along the level through Saughton and Haymarket, the Haymarket Tunnel and Princes Street Gardens into the busy Waverley Station at Edinbnrgh, where we run into the west end of the main up platform, 1,680 ft. in length and even then—astonishing to relate—shorter by 30 ft. than one of the great spans of the Forth Bridge, which also exceed the still longer platform at York.

It is just ten minutes to eleven, and our engine or engines move off with the dining cars, after which the remainder of the train is pushed forward to join a portion that is standing waiting for us at the east end of the same platform, including a through sleeper and coach from Glasgow to London. A "Pacific" is now in charge of the train, and in charge of "Pacifics" we shall doubtless run through all the way from Edinburgh to King's Cross. But we have been over the route before, in the "*Flying Scotsman*," so that we are quite justified now in seeking our beds and, over the perfect permanent way of the East Coast Route, in going soundly to sleep. It is quite likely that we shall be unconscious of all that is passing until the "*Aberdonian*" is rushing through the tunnels of outer London, and deposits us safely and punctually in King's Cross terminus at 7.30 the next morning.

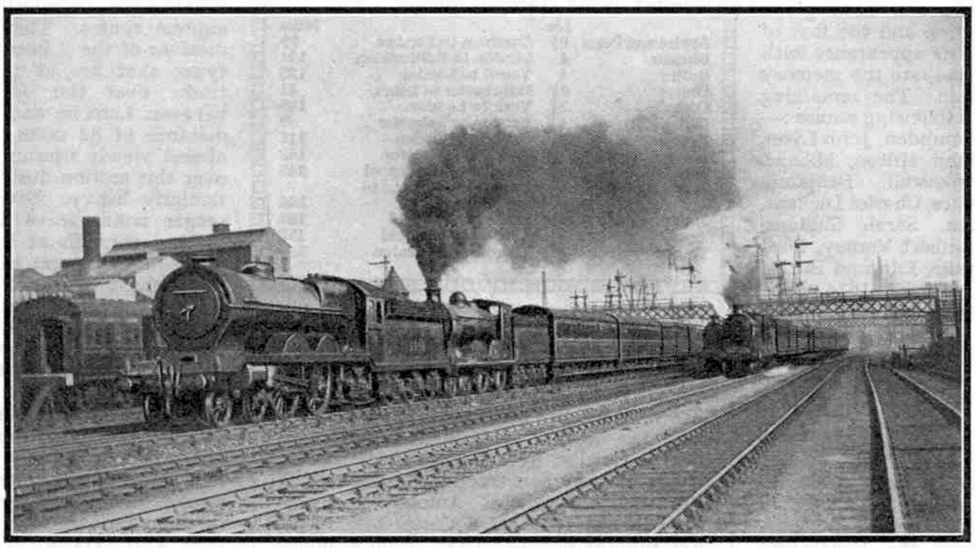


Photo courtesy] [*L.N.E.R.*

Double-headed Aberdeen Express leaving Edinburgh

Thus ends a journey in which we have been carried through no fewer than 18 English and Scottish counties. If it were notable in no other respect, the bridges that are crossed by the train would make it remarkable, for these include the world famous bridges that cross the Firths of Tay and Forth, in addition to the famous Royal Border Bridge at Berwick and the magnificent King Edward VII Bridge that spans the Tyne.

S.R. Extends Colour-Light Signalling

The colour-light system of signalling that has been in operation for some time on the electrified sections of the Southern Railway between Holborn, Blackfriars, Charing Cross, Cannon Street and London Bridge Stations, has been so successful that it is now to be extended from Borough Market Junction through London Bridge to Spa Road, and on the Brighton section from the London Bridge terminus to Bricklayers' Arms Junction and Old Kent Road. This system of signalling dispenses with the use of semaphore arms and the signals, both by day and by night, are given by light. It is particularly effective in foggy weather.

London Bridge Station also is to be equipped with a new signal box containing a Westinghouse all-electric frame of 311 levers, which will replace all the existing boxes working from both London Bridge Stations.

* * * *

Names for Metropolitan Electric Locomotives

The Metropolitan Railway have decided to adopt the practice of naming their engines and as a start are giving the name of some famous person to each of twenty 1,400 h.p. electric locomotives.

Considerable thought has been given to the selection of names, and the first of these engines to make its appearance with its nameplate will perpetuate the memory of Florence Nightingale. The remaining engines are to bear the following names :—William Penn, John Hampden, John Lyon, Dick Whittington, John Milton, Michael Faraday, Oliver Cromwell, Benjamin Disraeli, Sherlock Holmes, Charles Dickens, Sir Christopher Wren, Sarah Siddons, George Romney, Sir Gilbert Verney, Lord Byron, Sir Francis Drake, Edmund Burke, John Wycliffe and B.E.E. 1924. The last name represents British Empire Exhibition, and is to be given to the engine that was exhibited by the Metropolitan Railway at the British Empire Exhibition in 1924 and 1925.

* * * *

Italian Railway Electrification

At the end of last year three new electrified railways were opened to traffic in Italy. These were the Florence-Bologna, the Rome-Sulmona and the Benevento-Foggia lines. They are particularly interesting in that two of them depart from the hitherto recognised Italian practice of running electric lines on low-frequency current. On the Rome-Sulmona line a three-phase high-frequency current (45 periods) is being used at a tension of 10,000 instead of 3,000 volts. This confers a considerable advantage on the line, as the operating current can be drawn from industrial power stations, whereas the low-frequency supply necessitated the construction of special generating stations for the use of the railways alone. On the Benevento-Foggia line an entirely distinct experiment is being carried out. Here the current is continuous and is being supplied by overhead transmission at 3,000 volts. These new departures are being followed with considerable interest, and if satisfactory results are secured one or the other will be adopted in future wherever local conditions present favourable opportunities.

Other new lines between Coni-Nice and Coni-Ventimiglia, are under construction and probably will be completed in May.

What the Railways Carry for One Penny

In view of the criticism that is continually being levelled at the railway companies on the score of heavy freight charges, the information given to the public on the British Railways' Stand at the recent Advertising Exhibition at Olympia entitled "What we Carry for 1d.," makes illuminating reading. We have tabulated below a number of the examples quoted :—

	Lbs.		Miles
Apples and Pears	6¾	Evesham to London	99
Biscuits	4	London to Nottingham	124
Butter	4	Yeovil to London	123
Cheese	6¾	Manchester to Leeds	41
Cocoa	3¾	York to London	189
Coffee	4½	London to Leicester	99
Eggs	1½	Bristol to London	117
Flour	7¾	Cardiff to Leicester	142
Jam	2¾	Dundee to Hartlepool	245
Margarine	4	Partington (Lancs.) to London	186
Sugar	4½	Bristol to Sheffield	164
Tea	2¾	London to Sheffield	157
Tinned Fruit	4	Liverpool to London	199

New Congo Railways

The project for the inauguration of a "through" railway route from Cape Town, through Central Africa and north into the Sudan, is brought appreciably nearer fruition by the commencement of a new railway construction programme in the Belgian Congo. Among the new lines is one to form a Congo-Nile trunk line running north-eastward from Stanleyville. Eventually this will link up with a new extension of the Kenya and Uganda Railway running north into Rejaf in the Sudan.

Other new lines projected are from Kongolo to Kabalo, to connect up the Kindu-Kongolo and Kabalo-Albertville (Lake Tanganyika) sections of the Great Lakes Railway Company's system; a light railway connecting Lakes Tanganyika and Kivu and a line from Ponthierville to Lake Kivu. Another important link will join the Kindu-Albertville section with the Bas Congo Katanga route. The creation of this junction inevitably will be followed by the conversion of the Kindu-Albertville line from metre to 3 ft. 6 in. gauge, which is standard for the Belgian Congo. Thus there will come into existence a continuous run of 3 ft. 6 in. gauge from Cape Town to Lake Tanganyika and to Kindu on the Congo River. A gap of less than 200 miles will separate this long trunk line from Ponthierville, whence there would be railway connection with the navigable Nile.

It would seem highly probable that connection between Cape Town and Rejaf will be established within the next two decades and in all probability in the meantime it will be found possible to put in hand a further extension from Rejaf to El Obeid, the Southern Terminus of the Sudan line.

* * * *

New "Mountain" Locomotives for P.L.M. Railway

The Paris, Lyons and Mediterranean Railway has placed an order for 94 "Mountain" type locomotives for use on its express routes. These will replace locomotives of the "Pacific" and "Mikado" types that are at present handling the traffic over the very heavy gradients between Laroche and Dijon, where, for a distance of 82 miles, the track is on an almost steady upward grade. The traffic over this section during the season is particularly heavy. Seventeen express passenger trains leave Paris each evening, passing through at intervals of from 10 to 20 minutes, and therefore the schedule times must be maintained to avoid the serious operating difficulties that would arise in the event of a breakdown. For this reason the more powerful type of engine now being introduced is considered necessary.

The engines will each have two high and two low-pressure cylinders, the dimensions of the former being 20 in. by 25½ in. stroke and those of the latter 28¼ in. by 27½ in. stroke. The driving wheels are 5 ft. 10¾ in. in diameter, and the total engine wheelbase 42 ft. 11¾ in. The complete weight in working order, exclusive of tender, will be 115 tons. The first tests have been highly satisfactory and during the trials one of the new locomotives hauled a train of 705 tons from Laroche to Dijon at a speed of 49.7 m.p.h. on an up-grade averaging nearly 7 per cent. On another occasion an average speed of 62 m.p.h. was maintained by a train weighing 641 tons, working in the reverse direction.

Smart Engineering Feats on L.N.E.R.

A smart piece of railway engineering was carried out at York Station recently. The job consisted of taking up the existing crossovers north of the station and re-laying an improved type resting on concrete frames. These crossovers formed the intersection of the Scarborough goods lines with the main north lines, and were laid down some ten years ago. They were of the built-up type and therefore trains passing over them created a considerable amount of noise. It is expected that the new crossovers which are of manganese steel rolled in section, will be appreciably quieter.

All the lines affected by the operation were closed down early one Sunday morning and all traffic was worked from subsidiary lines to the west of the station. A detailed schedule had been prepared and the work was carried through without the slightest hitch.

First of all, the lines leading from the north and south to the actual "diamonds" were detached and a huge crane was run alongside the crossovers. Cables were fastened to rings on the waybeams and the whole piece of track—crossovers, sleepers and beams, weighing about eight tons—was swung clear and lowered on to a 35-ton wagon. A pipe-laying gang then dug out the bed of the track to a depth of 4 ft. below rail level and re-made the whole ground.

Previously the waybeams were laid directly on the ballast, but in the new sets they rest on a concrete frame 17 in. in thickness. The frames have been made in the railway yards at York and each of the four required weighs 17 tons. With the concrete frames and waybeams in position the new diamonds were swung down, each in two pieces.

So swiftly was the work carried out that within less than 10 hours the down-line was completed. As the work with the re-fitting of this line went forward, the dismantling of the up-line was commenced, and each gang worked until long after dusk had fallen. The lines were left for a fortnight in order to give the new beds time to settle, and then the interstices of the concrete frames were filled to make up the solid whole.

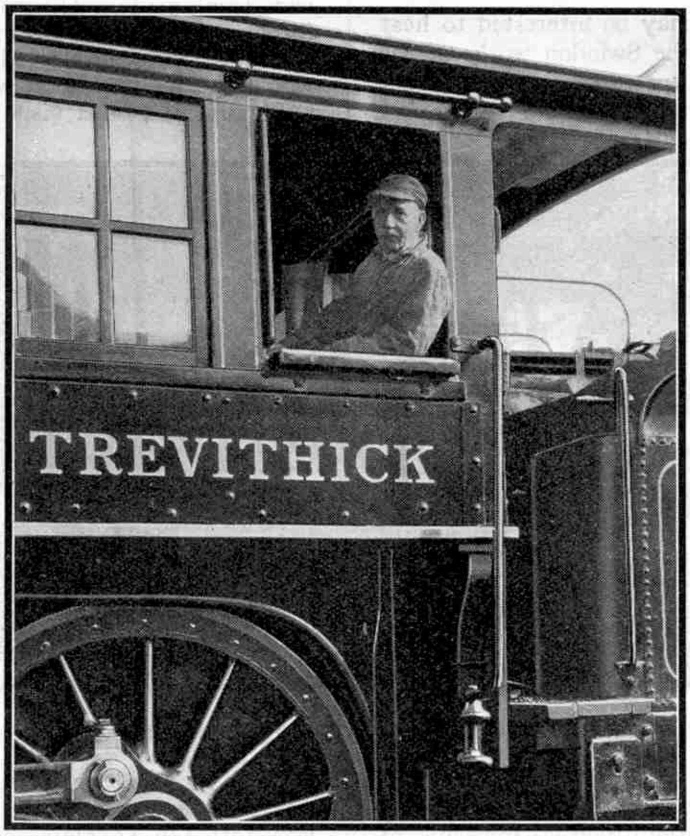
While the York job was in hand, another quick piece of work was being carried out at Grantham. The L.N.E.R. engineers discovered that one of the girders carrying the bridge over the Great North Road showed distinct signs of cracking, and it was decided that the entire bridge should be rebuilt without delay. Designs were quickly got out, tenders called for and the contract placed, all in the space of less than three weeks.

The old bridge was one of the original structures of the old Great Northern Railway and had reached the great age of 72 years. Its original strength must have been remarkable, for it sustained wonderfully well the constantly growing weight and speed of modern traffic. As a matter of fact the strain at this point is exceptional, for it is at the bottom of a sharp incline and the stretch is regarded as ideal for picking-up time.

The new bridge was brought down in one piece from the contractors' works at Stanningley, near Leeds, and when the old structure and a portion of its brickwork had been cut away, the new 40-ton piece was swung up by two giant cranes and dropped into position. Within 12 hours of the commencement of the work an excursion train had crossed the new bridge!

* * * *

Two Railway Veterans



Mr. John Ryburn McIntyre, a retired engineer of the Canadian National Railways, once more took the throttle to pilot the old "Trevithick" from Montreal to Baltimore where his charge was one of the most interesting features of the great international pageant held there recently. The illustration shows Mr. McIntyre in the cab of his locomotive, which is the oldest wood burner in Canada

The Mystery of Creeping Rails

By inadvertence, the acknowledgment for the loan of the blocks used in the above article last month on pages 38/39, showing different applications of the Improved Rail Anchor, was made to the Improved Rail Anchor Co. Ltd. Actually the blocks were loaned by the "*Railway Engineer*," and we are indebted to the Editor of that excellent publication for his courtesy.

Moving a Slag Mountain

In connection with the erection of new gasworks at Burnley it was found necessary recently to move a mountain of slag estimated to weigh 250,000 tons. The mountain had to be transported a distance of about $2\frac{1}{2}$ miles and the L.M.S. were called upon to assist. Two special trains were brought into use and run on a shuttle service, one train being loaded at one end while the other was being unloaded at the other. The trains were composed of special wagons that enabled the slag to be tipped on to the exact spot required, and the big task was thus successfully accomplished.
R.S.M.

* * *

Novel Use for Old Carriages

While many old railway carriages are used for bungalows and hen-roosts, some become giddy in their old age and are even to be found on the theatre stage. The L.N.E.R. (Manchester) Dramatic Society recently produced a play the scenery for which was largely obtained from old coaching stock, while the back of one "flat" informed all and sundry whose business took them behind the scenes that "the 6.5 p.m. Penistone and Sheffield goes from No. 5 Platform."
R.S.M.

* * *

Exit the Milk-Churn

Many hundreds of the familiar noisy metal milk-churns are being dispensed with on the L.M.S. and G.W. Railways, following the introduction of special milk-tanks each of which will hold 3,000 gallons and dispense with the use of three loaded vans of churns. As far as the railways are concerned, nothing like this has been attempted before for carrying milk in bulk, but glass-lined motor lorries for conveying milk by road have been in operation for some time. R.S.M.

* * * *

Sad End to a Railroad

The 300 villagers of Ettrick, Winsconsin, U.S.A., built their own branch line as a connection with the outside world, and operated it with one small locomotive and three carriages. All went well for a time, but with the development of road buses the line failed to pay. Quite recently the poor old locomotive fell down an embankment, and as there were no funds to salvage it, the line has come to an end as a going concern. It is now for sale to anybody wanting a hobby! R.S.M.

* * * *

An automatic machine for supplying handkerchiefs has been installed at Euston Station, and by placing sixpence in the slot a forgetful passenger can have his need supplied.

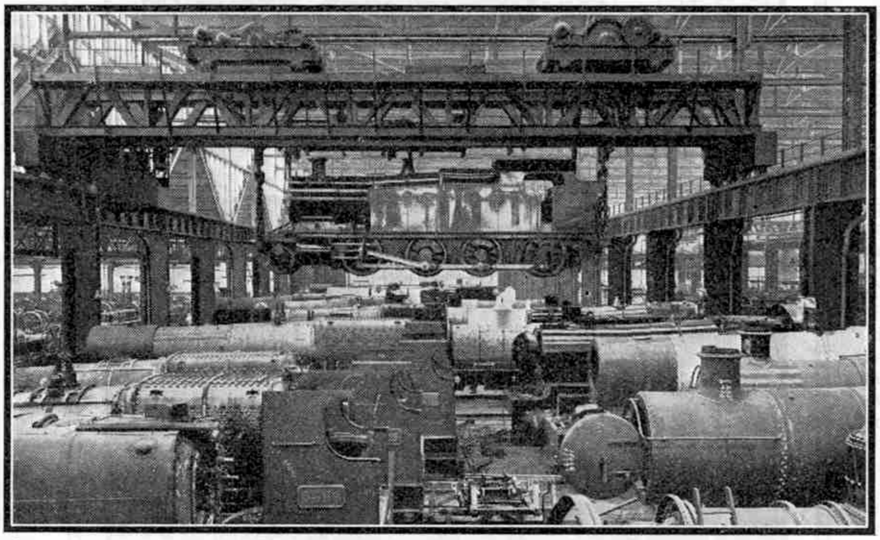
FROM OUR READERS

These pages are reserved for articles from our readers. Contributions not exceeding 500 words in length are invited on any subject of general interest. These should be written neatly on one side of the paper only, and they may be accompanied by photographs or sketches for use as illustrations. Articles that are published will be paid for at our usual rates. Statements contained in articles submitted for these pages are accepted as being sent in good faith, but the Editor takes no responsibility for their accuracy.

The Building of a "Castle" Locomotive

I think my fellow readers may be interested to hear of a visit I paid recently to the Swindon works of the G.W.R. All the "Castle" type of engines were constructed here but unfortunately I did not see any in the erecting shops although one, the "*Berkeley Castle*," was being repaired.

First of all we visited the rolling mills where red-hot steel was being rolled out into long bars. We then went to where the various parts of the mechanism, such as the cross-heads and slide-bars, were being made. In the boiler shops the din made by pneumatic riveters was tremendous. A main road runs between two of the shops and the boilers are conveyed underground through a tunnel on trolleys.



Courtesy] [G.W. Rly.

A 100-ton overhead crane lifting a 2–8–0 T engine at Swindon Works

Next we came to a building where oxygen was being prepared. The man in charge drew a mug-full of liquid air which was so cold that it was impossible to touch it without having the skin taken off one's hand. A piece of flexible rubber tube was placed in this liquid air and was rendered so brittle that it cracked into pieces when it dropped on the floor! An orange also was dropped in the liquid air and became as hard as a brick.

We then visited the erecting shops and I enjoyed this part perhaps most of all. Our guide explained, with the aid of a real cylinder and steam-chest, the action of the slide-valves. We then went on to see some new tank engines that were being constructed for heavy goods work. Several "Moguls" also were being built and we went underneath one to examine the valve gear. In this erecting shop the "*Berkeley Castle*" was being overhauled and, as may be imagined, we took a good look at this fine engine. We also got up on to the footplate of a new "Mogul." Some 2–8–0's also were under construction and we saw them being tested. Another interesting part was the making of wheels, and the fitting of the tyres was particularly fascinating. The tyres were heated up and placed on the outside of the wheels where they shrank to a tight fit, a key-iron being fitted to keep them in position.

Later we visited the foundry where all sorts of castings were being made. The iron was heated up in a colossal furnace and poured out in a molten state into small barrows. These were wheeled to the moulds into which the molten metal was poured.

Finally we paid a visit to the fine fire-station of the Swindon Works. Every kind of fire-fighting mechanism is included here and there are several fine fire engines. An interesting demonstration was held to show how a fierce fire may be extinguished.

Swindon was of note as a market town in the old coaching days, long before the railway line was opened. Brunel was mainly responsible for the choice of the town as the engineering centre of the Great Western Railway, and also for the design of the locomotive shops. Building was commenced in 1841, but although the machinery was started in November of the following year the shops were not put into general working until January, 1843. The works are now among the largest in the world, occupying a total area of 310 acres of which 65 are roofed. Large quantities of munitions were made at Swindon during the war and Great Western engines and wagons played their part in every war area.

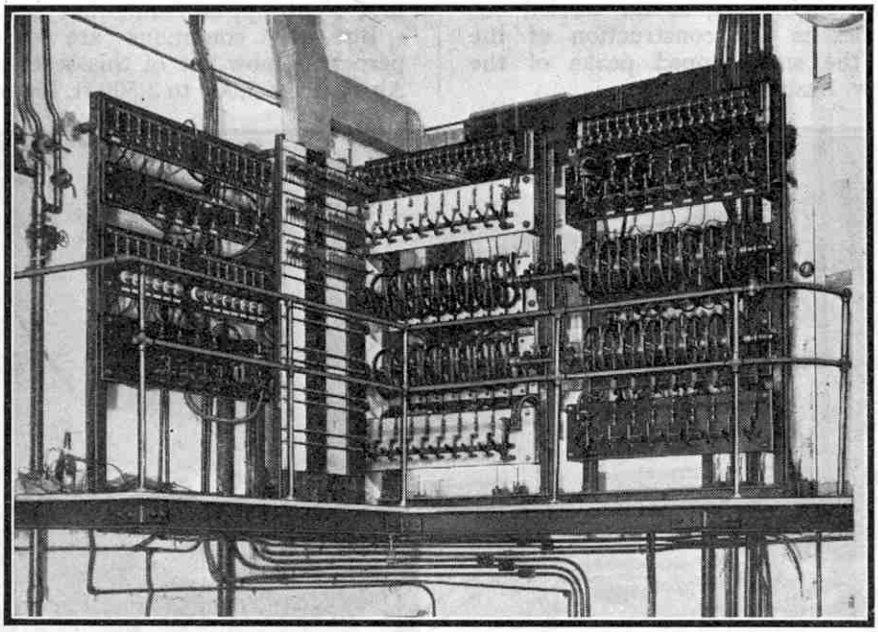
D. Bland (Bristol).

Behind the Scenes

Not long ago I had the privilege of visiting a theatre and examining the stage and all its mechanism.

After visiting the workroom where all the "odd jobs" are done, I went beneath the stage where I saw the scenery packed away for the different shows. I was greatly interested in the various instruments used to produce different sound effects. For rain they use a tub in which rice is placed. The tub is then revolved so that the rice trickles round the side and gives a fine imitation of rain. There was also a tub having flanged pieces all the way round and over the flanges a large piece of heavy canvas, and when this tub is revolved it produces the sound of a strong wind. The sound of a moving train is imitated by running a garden roller over boards nailed to the stage. Each board is a little higher than the preceding one, and so a rumbling sound is produced.

I then went on to the stage itself where the scenery was set for the first act of the next performance. On looking up into the roof of the theatre above the stage, I saw hundreds of different coloured lamps arranged in rows. All these lamps are controlled by a wonderful switchboard, fitted with rows and rows of switches for lighting certain sections of the lamps. At the end of each row was a switch for putting out all lamps of a certain colour and there was also a very large switch for extinguishing at once all the lights on the stage. This last switch was so stiff that I could not move it. When the performance was in progress it was fascinating to watch the electrician in charge simply flying over the switchboard, pulling down a switch here and another there. He also had the job of turning certain wheels that were used to produce the effect of sunrise and sunset.



Courtesy] [Strand Electric Co. Ltd.

A Stage Switchboard in Position

Before my visit terminated I went to the top of the theatre and saw the platform from which the scenery was lowered. It was one mass of ropes, but the stage hands knew exactly what scenery was attached to each rope and never made a mistake.

J. Matson (Hayes).

A Visit to a Cement Works

A short time ago I was included in a party that visited the cement works at Aberthaw near Barry.

We were first shown the quarry, where two large steam shovels were hard at work loading the stone into trucks drawn by a diminutive 0–4–0 T engine. I could have spent the whole afternoon watching these monsters crashing their way into the layers of rock. Above us, on the cliff summit, about 10 ft. from the edge, two more machines were busily engaged in boring two holes 55 ft. in depth in which the charges for blasting were to be placed.

We next visited the mills where the first crushing takes place. The trucks are run, one by one, on to a tipper and their contents shot down on to moving bars that gradually push them to the first crusher. All unwanted earth or other material slips between the bars. The first crusher has a pair of giant jaws that crush the stone with amazing strength. The stone then goes through a second crusher and passes along a belt-conveyor to huge hoppers, where it is stored till required.

From these hoppers the stone is led along a 900 ft. conveyor to another mill where it receives its third crushing. This is effected by rotating cylinders inside which numbers of heavy metal balls are rolling. The stone dust thus made passes down to the "wet mill," where it is mixed with water. The resulting thick liquid, known as "slurry," is led into one of the big storage tanks in which it is mechanically stirred to prevent the sediment from settling.

The slurry next passes into one of the three giant rotating kilns, each of which is 210 ft. in length and 9 ft. in diameter, and then it passes through a jet of burning coal dust and air at a temperature of over 400°C. It now drops down into the cooling cylinders, where it meets a blast of cold air, and comes into sight in the form of an ash known as "clinker." The clinker is ground in several rotating cylinders to a dust so fine that it can pass through a sieve of extraordinarily fine mesh. This dust is the finished product, and in the last shed of all it is automatically packed in the familiar sacks and despatched to its destination.

M. Hallett (Penarth).

A Roman Bath in London

At No. 5, Strand Lane, London, a narrow passage near King's College, is a genuine Roman bath dating from the second century. It originally formed part of a Roman villa and it is one of the few relics of the Roman period to be found in London. It consists of a tank 15 ft. 6 in. in length by 6 ft. 7 in. in breadth, which is filled to a depth of 5 ft. by a continuous flow of spring water. At one end is another tank that originally held the perfume in which the Roman owner dipped his feet after a bath.

It is interesting to know that Charles Dickens used to make his daily plunge into this bath and readers of "*David Copperfield*" will remember that the hero went into it head first to refresh himself on the morning after he had learned of Aunt Betsy's misfortune! His hope was that the brisk treatment would freshen his wits a little. This it certainly did, for the cold plunge stirred him to face with courage the consequences of the loss of his aunt's money.

Except for a casual reference the bath remained unknown until 1841. In 1893 it was lined with marble slabs taken from the adjoining Elizabethan tank, but recently these slabs have been removed to expose the Roman brickwork. The water remains icy cold all the year round.

Richard Manchee (West Molesey).

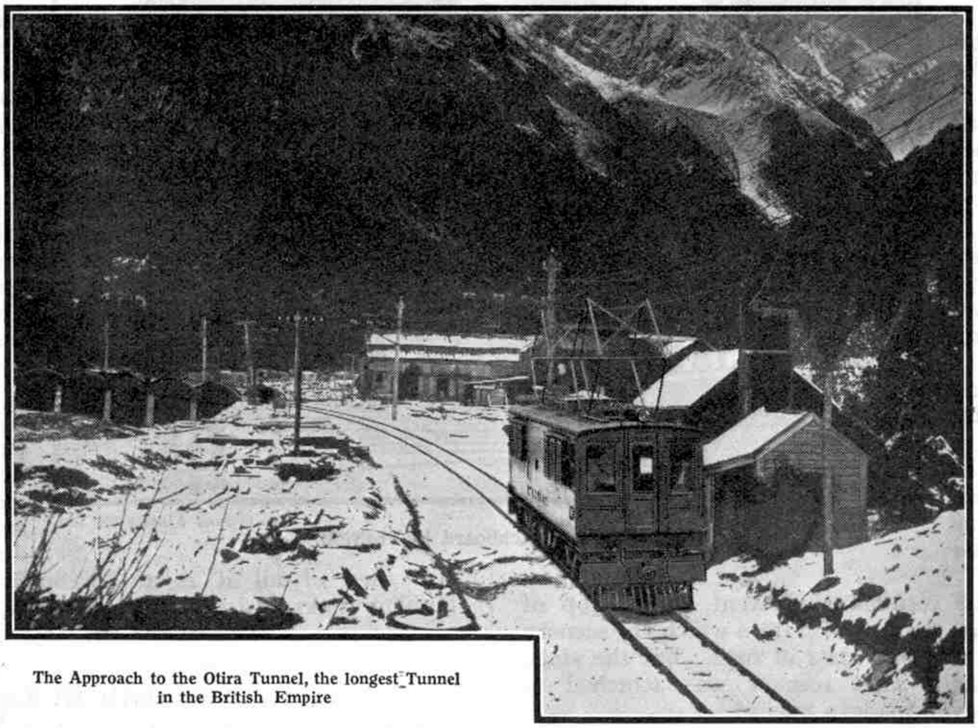
The Empire's Longest Tunnel

A Daring Achievement Amid Snow-clad Peaks

By Harold J. Shepstone, F.R.G.S.

WHAT is without question the most spectacular piece of railway engineering so far carried out in the Antipodes is the construction of the Otira Tunnel, amid the snow-capped peaks of the Southern Alps in New Zealand.

This is the longest tunnel south of the Equator and in the British Empire, and comes seventh in the list of the world's greatest tunnels. It necessitated an expenditure of £1,500,000, and after fifteen years' work was only completed in the summer of 1923, since which time a specially equipped power-station has been erected on the site for working the trains through the tunnel.



The Approach to the Otira Tunnel, the longest Tunnel in the British Empire

Here we must remember that the Britain of the South, as New Zealand is often called, boasts of a lofty chain of mountains running like a huge backbone down through both North and South Islands. As a result the advance of the railway-builder has been beset with abnormal obstacles, recalling the conquests of the Rocky and Cascade Mountains in North America. The moment the engineer has essayed to leave the coast on either side of the islands, the mountains have reared up to dispute his advance, and it has been only by great effort that the railway has been carried over these mighty but picturesque barriers.

No railway venture has exercised the minds of the citizens more than the line which engineers have thrown across the Southern Alps in New Zealand. It called for the construction of a tunnel beneath a snow-swept pass, a feat which proved so formidable that fifteen years were spent in making it. In the following graphic narrative the writer describes the numerous obstacles encountered and how they were finally surmounted

The scene of the feat under notice is in South Island, on the railway that runs from Christchurch on the east coast, to Greymouth on the west, one of the most fascinating railways in the world, passing as it does through magnificent Alpine scenery. The tunnel, which is the crowning engineering feat of this line, is $5\frac{1}{4}$ miles in length. Compared with those mighty openings that have been driven through the Swiss Alps—running up to twelve miles in length in the case of the Simplon—the Otira Tunnel may at first sight appear somewhat insignificant.

But the conditions are entirely different. The perpetual snow-line of this section of the New Zealand Alps is from 3,000 to 3,500 ft. lower than that of Switzerland, while the glaciers descend to a far greater level. It meant that the operations had to be carried out on a snow - swept pass in the heart of what is virtually an unexplored wilderness. Not least, there were the physical difficulties to be overcome, apart from the actual boring of the tunnel itself. To reach the tunnel site deep gorges had to be negotiated, calling for the erection of some clever bridge-work. In a short length of nine miles there are four high steel viaducts—(one of which carries the rails 236 ft. above the floor of the gorge), three bridges, and no less than 17 short tunnels, the longest of which is about 2,000 ft. There is scarcely a mile of level line, and the grades are very severe.

The idea of such a line was suggested as far back as 1874, when the New Zealand Government passed an Act authorizing the carrying out of a survey for the construction of a railway between Christchurch and the settlements on the west coast. The survey was made, but nothing further was done, with the result that the citizens of South Island formed a Railway League. It collected data on the matter, held public meetings, and interviewed the leading shippers, merchants, and others concerning the proposed undertaking. Government commissions were formed, and engineers were sent to inspect tunnel operations in Europe.

Bill after Bill was brought before the Dominion Parliament asking for the sanction of the railway, only to be turned down on some technical point, such as the feasibility of the route or the question of expense. It was typical of the agitation that has marked the inception of many great public undertakings, especially difficult and costly railway ventures. While this agitation for and against the proposed railway over the mountains was going on, the line began to creep out from Christchurch towards the dreaded barrier, linking up scattered dairy settlements with the coast. All these ventures represented private enterprises, but these, like most other railways in New Zealand, have now passed to Government control. At last, in 1908, a contract for the driving of the famous tunnel was let to a New Zealand firm of engineers for the sum of £600,000. By the term of the contract the work was to be completed within five years.

Eleven possible routes over the mountains were available, but it was rightly decided to carry the iron road over the shortest passage, to Greymouth. This was by way of Arthur's Pass, named after Mr. Arthur Dobson, who discovered this opening between the mountains in 1863. It is the meeting-place of two fairly low but precipitous valleys across the flank of Mount Rolleston, a peak of 9,000 ft. On either side of the pass are two deep gorges—on the east the Bealey Gorge, and on the west, nearer Christchurch, the Otira Gorge, from which the tunnel derives its name. The tunnel, in fact, is bored under the pass.

Train passing through the Otira Tunnel. Note the icicles hanging from the roof of the Tunnel

As soon as the contract was given out the engineers lost no time in setting about their great task, though, of course, they could not commence boring the tunnel immediately. Rough trails had to be made to the site, plant and materials accumulated, and accommodation for the workers provided. One member of the firm came to Europe to procure the requisite plant, while another established himself at Otira and commenced the building of a small settlement at each end of the tunnel, and otherwise preparing the way for a prompt prosecution of the boring as soon as the plant arrived.

At that time the Loetschberg Tunnel was in course of construction through the Swiss Alps, and as air drills were being employed they were also adopted by the New Zealand engineers. They were operated by electrical power obtained by harnessing two lofty waterfalls at either end of the tunnel. The boring was conducted from both ends of the tunnel simultaneously, of course, three shifts of men being employed each day, each shift working eight hours. The spoil was taken away in trucks running on rails laid on the tunnel bed.

As the work progressed the constructors found themselves confronted by many unexpected difficulties. One of the worst of these was the encountering of stretches of rotten rock or crumbling shale, necessitating tremendous expenditure in timbering and lining. There were also industrial troubles, including at least one strike, even although good wages were paid and there was in addition a system of wages bonuses according to the progress made.

But toiling amid the snows of the Southern Alps was certainly trying. The winter storms were very severe, and it was dangerous to move far away from the camps. In the spring, when the snow and ice began to melt, the works were frequently flooded, while in the height of the summer the heat was often intense.

So the work continued until the spring of 1912, when the contractors asked to be relieved of their responsibility. Nearly three miles of the tunnel had been excavated, while the more important gorges had been spanned by viaducts and bridges. But the contractors felt the job was above them. They had certainly miscalculated what its cost would be. Realizing the national importance of the undertaking, the Government arranged for the contractors to continue to the beginning of 1913, when the Government definitely took over control.

A year later came the Great War, which naturally hindered the work considerably. Indeed, the staff at the tunnel was reduced from just over 300 men to less than half. Nevertheless, the boring was continued, and on 20th July, 1918, the drillers, working from either side met, the rock barrier having been pierced by an iron rod 11 ft. in length, the tunnel being completed in 1923.

The tunnel enters the mountain-side on the east at an altitude of 2,435 ft. above sea-level, and emerges on the other at an altitude of 1,586 ft. above sea-level. It thus drops 850 ft. between mouth and mouth, a continually falling grade of 1 in 33. It is of horseshoe shape, 17 ft. in height by 15 ft. in width, and is lined throughout with concrete blocks. It runs dead straight, and standing at one portal it is possible to see through it, though the daylight visible at the opposite end is but a pin-hole. The tunnel called for the excavation of 314,816 cubic yards of rocks and 10,700 cubic yards of earth, and, all told, demanded an expenditure of £1,500,000. It carries a single track, the gauge being 3 ft. 6 in., which is the standard gauge in New Zealand.

On account of the length of the tunnel and the steepness of the grades, a 4,000 h.p. generating station was built at Otira and to-day trains passing through the tunnel are driven by 50-ton electric locomotives, capable of hauling a load of 140 tons over the steepest gradient. To house the workers at the power station and also those responsible for the maintenance of this particular section of the line, 61 cottages have been erected at Otira and Bealey.

Such, in brief, is the story of the Empire's longest tunnel, which is fully entitled to rank as one of the most daring achievements in railway engineering.

My Flight to India

By Air Vice-Marshall Sir Sefton Brancker, K.C.B., A.E.C.

We feel sure that our readers will be interested in Sir Sefton Brancker's account of his historic flight to India. The machine left England on the 20th November, returning on the 17th March following, and in over four months' active work covered 18,000 miles. During that time they had not a single forced landing through a material defect and the aeroplane totalled over 200 hours in the air.—EDITOR.

TOWARDS the end of the summer of 1924 a series of events gave me an excuse for flying to India. First and foremost, the Government definitely had decided to embark on an experiment in the operation of airships. This policy necessitated a visit by Air Ministry officials to India, amongst whom, naturally, the Directorate of Civil Aviation had to be represented. Further, it was becoming more and more obvious that the time was ripe—indeed, more than ripe—for some commercial organisation to take over the Cairo-Baghdad air route and extend it to India, and there were other factors also which justified the journey.

A very short consideration of the various problems that were in process of development made it obvious to me that the only way I could investigate them efficiently was by an air journey to India, visiting Paris, Berlin, Warsaw, Bucharest, Constantinople, and the Cairo-Karachi air route on the way. Such a break-away from precedent was, of course, more than any Government Department could be expected to accept without some demur! The de Havilland taxi-service offered to take me to India by any desired route for £1,500, and after some discussion, the Air Ministry agreed to grant £700 towards such a journey.

The selection of pilot and aircraft was not difficult. Cobham stood out as a long-distance air navigator without equal and was himself mad keen to go. I had spent many comfortable and happy hours in a de Havilland 50, behind a Siddeley Puma engine, and was prepared to back that combination for safety and economy anywhere. Our mechanic, Elliot, had done several long trips with Cobham, and knew the D.H. 50 inside out.

We decided at once that we must carry all our spares with us, and must have about eight hours' petrol on board for some of the long jumps we might have to make. For this reason, two of the D.H. 50 seats on the port side were replaced by extra tanks, holding 60 gallons of petrol. A hand pump was fitted in the cabin to raise this extra fuel into the overhead gravity tank and an extra oil tank was fitted, as also was a tropical radiator. A spare propeller was bolted under the fuselage and stream-lined with fabric, and about 50 lbs. of engine spares was stowed under the pilot's cockpit.

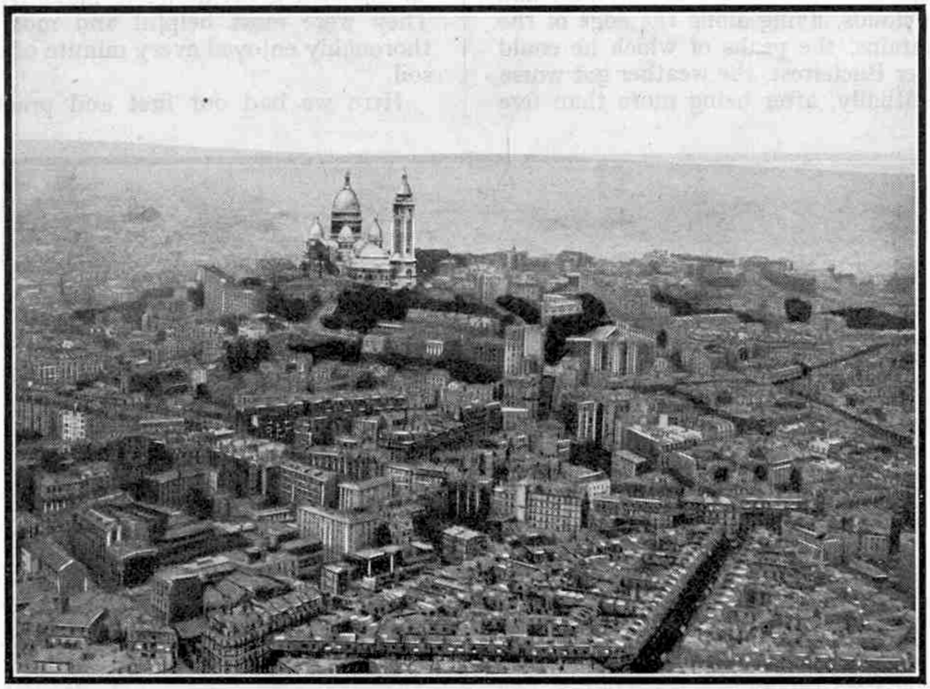
The departure of the de Havilland from Croydon

In addition, we carried ample baggage, for I insisted that, in the interests of air transport, Cobham and I had to be prepared to dress properly for any situation that might arise on the journey. Furthermore, we knew we would have to carry four days' rations and water on some sections of the route.

Our maximum permissible load was 4,200 lbs., which was made up as follows:—Weight of machine empty with water 2,400 lbs. Normal fuel and oil 473 lbs. Weight of pilot 170 lbs.; making a total weight cf 3,043 lbs.

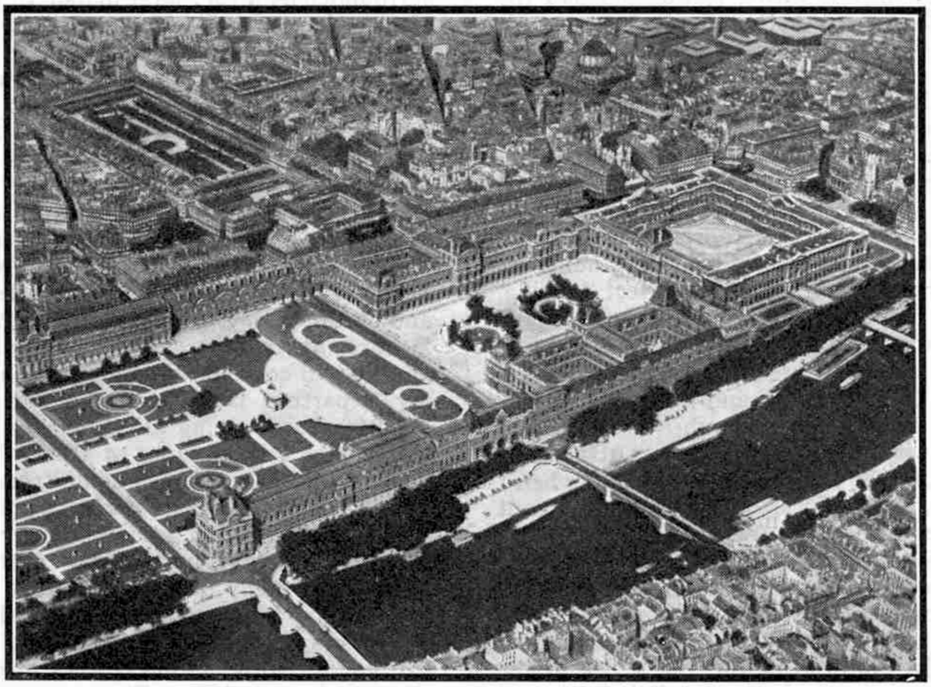
The actual load carried in addition was 1,160 lbs., made up thus:—Weight of passengers 336 lbs. Weight of baggage 200 lbs. Extra petrol and tanks 462 lbs. Emergency rations and water 20 lbs. Engine spares 50 lbs. Engine tools 10 lbs. Extra propeller 30 lbs. Extra weight of large wheels 26 lbs. Extra weight of tropical radiator and water 26 lbs. Giving a total of 1,160 lbs., which, added to the 3,043 lbs. of the machine etc. (as given above) totalled 4,203 lbs.—just over the maximum permissible. As a matter of fact we started without checking these weights very closely. I was of the opinion that it would be better to start with all we thought we required, and then jettison the less necessary articles if we found we were overloaded. We actually "weighed-out" at Berlin, and found that we were practically just within our Airworthiness Certificate weight even with full tanks. Later on we must have been a little overloaded when we had to carry rations.

We started at a peculiarly unpropitious time for regular flying in Europe, and we anticipated plenty of climatic trouble as far as Constantinople. I was therefore anxious to avoid publicity at the start as I realised that our enterprise, with a little bad luck, might well be seriously delayed by fog and snow on the unorganised route we were to follow. Our departure on November 20th was somewhat of an ordeal; it was extremely cold, and the aerodrome was a sea of mud; we had to wait whilst the compass was swung; and in spite of our desire for privacy, a large number of enthusiastic friends and Press representatives had assembled. As we piled in our baggage and took our seats, I began to have fears as to whether we should unstick at all, so wet was the aerodrome; but the machine rose like a bird, and we plunged straight away into a fog, from which we did not emerge until we were forced to land at Poix, as flying beyond that point was absolutely impossible.



Paris from the Air. The Church of Le Sacre Cœur on the hill and the Eiffel Tower in the distance

From thence our journey via Cologne, Berlin and Warsaw was uneventful. At Berlin we went to see what is likely to be the best air port in the world. The German Government have converted the old Tempelhoferfeld—where the Imperial Military Reviews used to take place—into Berlin's Air Port. It offers a magnificent area, only ten minutes' drive from Unter den Linden, and I doubt if any other city in the world will be able to boast of such a fine aerodrome so close to the centre of its activities. The country round Berlin is extremely flat and should be very suitable for regular night flying in the future.



Paris : The first aero photograph taken of Palais de Louvre

We had an easy flight from Berlin to Warsaw, but I confess to quite a thrill when I first sighted the shallow sandy bed of the Vistula with its tremendous history of military endeavour in the past. We struck the river low down and passed over several of the old frontier forts before reaching Warsaw, where we received a tremendous welcome from the Polish Air Force. The Poles believe wholeheartedly in aviation, and they also believe—perhaps with some reason—that they are one of the most important bulwarks of Europe against the Bolshevik hordes, and that the time will come when they will save Europe, as they did once before. In consequence, they have a huge programme of aviation development, and every officer and man I met seemed to be "all out" to make the Polish Air Force a great success.

From Warsaw we started in beautiful weather, intending to push right through to Bucharest. However, after only about an hour's flight, we ran into exceedingly low cloud, and, as we had no weather reports of the area in front of us, we tried to fly underneath it. It got worse and worse, and, after dodging trees and church-steeples for some time, we had to turn back and landed at a large new military aerodrome at Lublin, which has been constructed as a very large aircraft depot, where all overhauls of both engines and aircraft are carried out. Here we received a telegram from Bucharest urging us to wait as the weather was very bad and the aerodrome under heavy snow. Later we had a good weather report from Lemberg, which is about the highest point between Warsaw and Bucharest, and started off once more. We reached Lemberg just as the fog closed down, and as the weather was so bad I went on to Bucharest by train.

When the weather cleared, Cobham arrived, after having a most adventurous journey from Lemberg. He had become impatient with the weather, and had started off over the clouds, flying along the edge of the Transylvanian Mountains, the peaks of which he could see. As he got nearer Bucharest, the weather got worse and worse, and eventually, after being more than five hours in the air, he had to land in a small field at the foot of the mountains. The local inhabitants had never seen an aeroplane before, and gave him a great reception—the local school children assembling round the aeroplane and singing hymns in his honour!

The next day he tried to get off from the field in which he had landed, but found it quite impossible, owing to heavy mud. Eventually, a small boy who had been watching his efforts slowly realised what he was trying to do, and had the intelligence to lead him to another field about a mile away. Here a get-off was just possible in one direction, so the machine was manhandled across ploughed fields and ditches to this field, a really muddy operation. Fortunately the next morning the weather was fine, with a nice breeze blowing from the right direction, and Cobham made a successful take-off.

Constantinople, the capital of Turkey, seen from the air

The Roumanian Flying Corps had cleared a track in the snow at the Bucharest Aerodrome, the rest of the aerodrome being quite impossible for landing or taking-off, and here Cobham made a perfect landing. Elliot set to work immediately to remove some of the mud, with which the machine was liberally plastered.

Communications between Constantinople and Bucharest are bad, to say the least of it, and telegrams usually take two or three days to get through. Eventually I got a despairing wire from the Military Attaché in Constantinople, asking me to try to let him know when I was going to arrive, as the Turks had twice already sent out guards of honour to meet me at San Stefano! We left on the morning of 5th December in fine weather, crossing the Danube very soon afterwards. Here we saw thousands of ducks flying round the frozen marshes near the river banks. Half an hour later the snow had vanished, and we began to get glimpses of the Black Sea in the distance. The weather got better and better, and eventually, when we reached Constantinople we had one of the finest views that I have ever seen from the air. The Bosphorus, the Golden Horn, the hills of Stamboul and Pera, and the endless minarets and domes, all combine to make Constantinople one of the most beautiful cities in the world when viewed from an aeroplane.

We had a surprisingly warm welcome from the Turks, and throughout my visit, everyone I met tried to impress on me their great desire to make friends with England. They were most helpful and most hospitable, and I thoroughly enjoyed every minute of my time on Turkish soil.

Here we had our first and practically only serious touch of engine trouble, in the shape of a leaky water jacket, so I had to leave Cobham to get this right, and went on to Angora, the Turkish capital, by train. Angora was exceedingly interesting. It is a very old city that used to boast of about 30,000 to 35,000 inhabitants. I got various estimates of the present population, and they seemed to average out to about 80,000, including some 200 Deputies from every part of the country. Angora is surrounded by a very large marsh, from which emanates a virulent form of malaria. It rained a good deal whilst I was there, and I have seldom seen a more dismal, dirty place.

The Turks are facing their troubles bravely; the Government is working in the most uncomfortable conditions, but they are working very hard and sincerely. As one of them told me, there was nothing else to do but work in a place like Angora! They are faced with many great problems—they are short of ploughing animals and agricultural implements and considerable tracts of the country are plagued with malaria.

The Turkish aviation Headquarters are at Smyrna, and Mazaffar Bey, who commands, started to fly up and meet me at Angora. Unfortunately he crashed en route and had to come on by train, which somewhat delayed my departure from Angora. But this gave me an opportunity of seeing all there was to be seen, and of making the acquaintance of all the Ministers.

On the 16th we started again from San Stefano Aerodrome, across the Sea of Marmora and round near Brusa, over very wild and mountainous country with some beautiful scenery, particularly near Mount Olympus, which towered up on our right. As we progressed east, the country flattened out, and, after passing Afium Karahissar, it became an ideal aviation country: wide, flat valleys with landing places galore, surrounded by ranges of easy hills. The country everywhere from Afium Karahissar right on to the pass beyond Eregli was very desolate, but water was plentiful, and, if only sufficient population and money existed to develop these plains, this would again become a very prosperous part of the world, as it was centuries ago.

(*To be continued*)


A BEAUTIFUL PAGODA AT MANDALAY.

MY TOUR ROUND THE WORLD

by
FRANK HORNBY

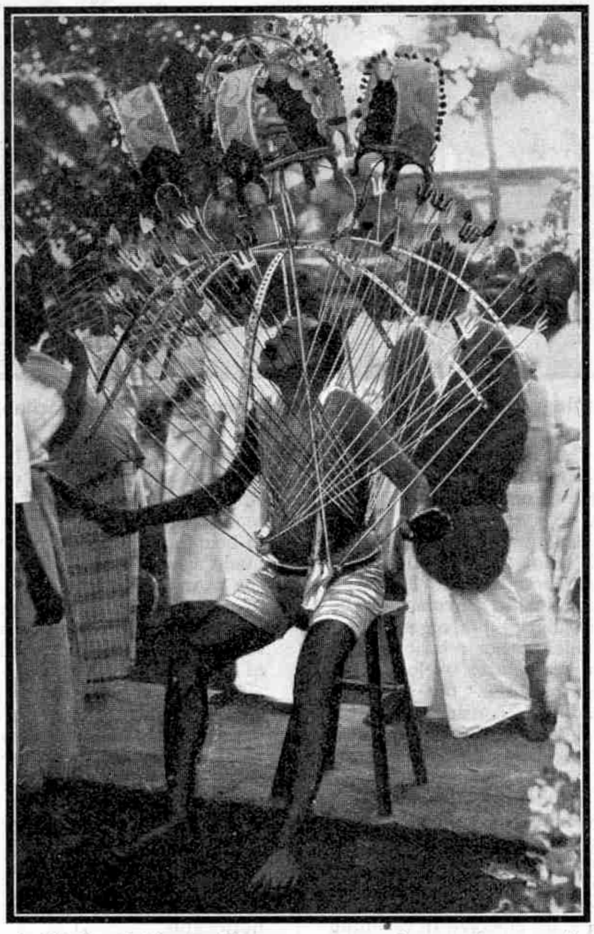

BURMESE BULLOCK CARRIAGE.

VII. The Golden Pagoda at Rangoon. How Elephants work in the Teak Forests. By Steamer up the Irrawaddy. Ruby Mines at Mojok. Bullock Caravans in the wild Shan Country.

LAST month I gave an account of my very interesting and enjoyable stay in Java. On reaching Batavia at the end of my motor tour through the island I returned to Singapore. From there I intended to proceed to Rangoon, the chief port of Burma, but as two or three days elapsed before the steamer for this port left I was able to spend a little more time inspecting the interesting places in and around Singapore.

During this interval I had a most remarkable experience. There is a Hindu community in Singapore known as the Nagarathar Community and they celebrated an important religious festival which the residents of Singapore were invited to witness. The ceremonies occupied three days and included processions with a silver car and a display of fireworks.

During the course of this ceremony holy men, or fakirs, were first drugged and then subjected to a series of penances in the form of torture by sticking into them needles and long sharp-pointed rods! This was a most extraordinary and, to a European, unpleasant performance. The sight of a man standing on the points of nails and with dozens of sharp needles stuck into him gave me a creepy feeling! Others had sharp metal skewers passed through their cheeks and tongues.


A Hindu Fakir in Singapore supporting a framework, somewhat resembling a Meccano structure, on long pointed rods driven into his flesh

The most surprising thing about the performance was that no bleeding took place. The withdrawal of a needle or rod simply resulted in the closing up of the flesh around the space left vacant. This may have been due to the drug or possibly to some hypnotic effect. The interest of the remaining portions of the ceremonies was quite overshadowed by this weird performance.

A day or two after witnessing this extraordinary spectacle I left Singapore for Rangoon. Some time before we reached the latter port the sea became thick with the mud brought down by the Burmese rivers, including the Irrawaddy, the great river that flows throughout the entire length of Burma before entering the Indian Ocean by a large delta. On the banks of one of the eastern streams of the delta stands Rangoon, a large modern town that has sprung into prominence and prosperity since Burma became a British possession.

In the days of Burmese independence Rangoon was only a fishing village, but it is now the port of the country, from which timber, oil, rice and spices are exported. In one sense it is scarcely a Burmese city, as the population is mostly composed of Chinamen, Malays and natives of India. The Burmese do not take kindly to the bustling western civilisation and to find them search must be made in the country districts and the towns further north.

One typical Burmese thing is to be seen in Rangoon, however. Burma is well-known as the land of pagodas and on a low hill rising above the mud flats on which Rangoon is built is the famous Golden Pagoda, one of the wonders of the world. This is a towering pyramidal erection 370 ft. in height. It is gilded from its foundation right up to the tapering summit, while many of the lesser pagodas surrounding it are loaded with gems and adorned with bells of gold and silver. Many travellers who have seen both assert that the Golden Pagoda is more impressive than the Great Pyramid.

The Schwe Dagon Pagoda, to give it its native name, is one of the most sacred places of Buddhism, for it is said to contain four hairs from the head of Buddha himself. They are preserved in a golden casket and crowds of pilgrims have been attracted to the holy spot by the precious relics since the foundation of the Pagoda more than 1,300 years ago.

Among other places in Rangoon, I visited the docks and was particularly impressed with the work of the elephants on the timber wharf. A native called a mahout rides on the head of the elephant, and directs its actions. He is assisted to his position by the elephant itself, which, at a signal puts out its trunk to form a step, which it slowly raises until the mahout is able to mount its head. The only means employed by the latter to direct the actions of the powerful animal are the heel of his right foot and a short staff with a metal point and hook.

It was amazing to me to see the elephant moving enormous logs with no evident strain whatever. As I watched one of these animals at work I was surprised at the intelligence it displayed in the performance of its work. On one occasion a log that was being moved happened to be a little out of place and the elephant with no apparent effort pushed it into position with its foot. It then proceeded to raise a log from the ground to place it on a pile of other logs. It accomplished this by lifting one end on to the pile and then getting under the centre of the log with its tusks, throwing it into place.

One amusing trait I observed was that when the hooter sounded for the midday meal, the elephant dropped the log which it was moving, and declined to do any more work until the meal was over! At some of the wharves elephants are being superseded by mechanical tractors, but in the vast forests of Burma, which extend for hundreds of miles, they cannot be dispensed with. Here, as the accompanying illustration shows, they drag the huge logs through the forest down to the river that carries them to Rangoon.

From Rangoon I travelled north by train to Mandalay, 386 miles distant, arriving there at an early hour on the following morning. Until 1885 this city was the capital of Burma and the residence of the King. The latter commenced his regal career by murdering his brothers, sisters and a few other relations, and paid for these and other cruelties a few years later by losing his kingdom to the British and being exiled to India. His palace is still to be seen at Mandalay, which remains a considerable city. The building is not impressive in spite of the gilt and red paint and the only noteworthy features of it are the stalwart columns of solid teak that support it.

In Mandalay I saw a large number of Buddhist priests making house-to-house visits with bowls in which they collected rice. Burma is full of holy men, or monks, who go about with shaved heads, soliciting the inhabitants for their sustenance. A casual visitor does not form a very good opinion of them but they are held in great veneration by their own people, who consider it a privilege to contribute to their support. They are engaged in teaching and practically every Burman has been a monk at one time or another.

I wished to go from Mandalay to Bhamo, in the extreme north of Burma, and decided to make the journey by water. I found the steamer moored alongside the bank of the river, and boarded her by means of a gang plank pushed out on the bank, this system obtaining at all the landing places at which the steamer stopped. While waiting to proceed I was interested in watching the various occupations of the people who had assembled there. Some had brought their bullock-carts and were filling them with water taken from the river. I was told that this was intended for drinking purposes, and I could not help thinking that the impurities which enter the river from one source and another were not calculated to be very beneficial to the health of those who drank it. Whilst this was in progress, many of the natives in charge of the bullocks and horses were washing their animals in the river and others were bathing or washing their clothes. The whole scene formed a very attractive picture, the interest of which was heightened by the vividly coloured dress of the people and the brilliant sunshine.

On the way up the river there were many enormous rafts of teak logs drifting down with the current, destined for the timber wharves at Rangoon.

Burma is famous for its teak forests. The tree grows very fast in the tropical climate, often attaining a height of ten feet in two years and 60 ft. in 15 years. The wood is golden-yellow, changing to a darker tint on seasoning and it is of extraordinary durability. In India and Burma teak beams in a good state of preservation are often found in buildings several centuries old. In 1811, for instance, two American travellers found pieces of well-preserved teak in the wall of a palace built by a Persian king near Bagdad more than 1,200 years previously, while in some of the temple caves in India pieces of the wood in good preservation have been found that must be more than 2,000 years old.

Monks carrying the bowls in which they collect food from the charitable Burmese

Teak wood contains an aromatic oil that gives it a pleasant fragrance. Possibly the presence of the oil accounts for its remarkable durability. It is probably the most valuable of all woods, as besides being very durable it is not subject to warping. Burma is one of the largest exporters of teak and since the beginning of this export trade, systematic planting of new teak forests has been carried on. Great use is made of the Irrawaddy in bringing the logs down to the saw mills at Rangoon. They are made up into huge rafts that are handled with marvellous skill by the man in charge. So large were the rafts that I met on my journey to Bhamo that they looked like small islands situated in the middle of the stream, and this was made more realistic by each raft having a temporary hut built on it for the accommodation of the men during the trip.

The journey upstream proved full of interest in many ways. Frequent stoppages were made for embarking and disembarking passengers. As the steamer approached a stopping place, two or three of the native crew would jump from the steamer into the water and swim to the bank carrying with them a rope, which they attached to a tree or other available means in order to secure the ship, after which the native passengers would board her, carrying their luggage on their heads, in their hands or on each end of a pole borne on the shoulder. Most, if not all, carried their food with them, and in addition to rice and other strange edibles, long pieces of sugar cane and bundles of cocoanuts were noticeable.

We stopped at a place called Thabeikhyan which is the nearest landing place to the ruby mines situated at Mojok, a distance of about 50 miles away. It is chiefly from the small area around Mojok that the world's supply of genuine rubies has been derived for many years.

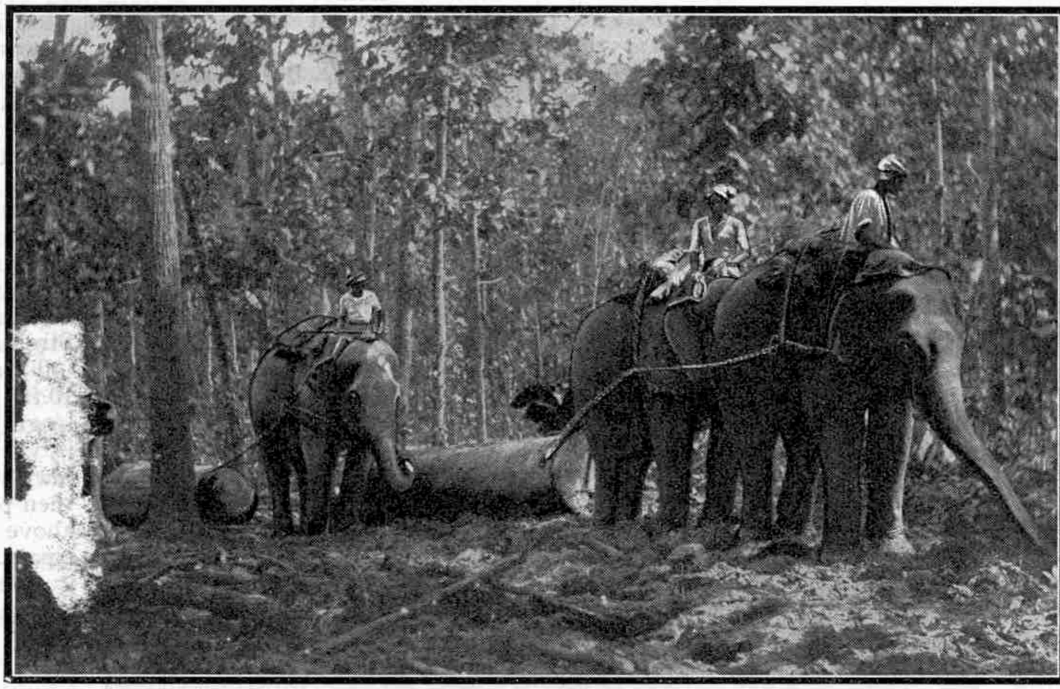
Before the British occupation of Burma all stones above a certain size and value were reserved for the King, who was the owner of all the ruby mines in Burma. He guarded his rights so carefully that it was practically a crime for a private individual to own a ruby of any size. This probably led the finders of large stones to break them up and sell the fragments. Europeans were strictly forbidden to go near the mines in order to prevent jewels from being taken out of the country.

All this was changed when Great Britain annexed Burma.

An area of 400 sq. miles including the Mojok Valley was leased to a British company who sent engineers to commence mining operations. This did not prove an easy matter. The Mojok area was occupied almost completely by native miners and was soon abandoned by the company in favour of a near-by hill supposed to contain ruby-bearing earth in large quantities. The first day's digging yielded a magnificent ruby. Practically nothing further was obtained, however, and it almost seemed as if by some chance the only ruby in the hill had been found at the first stroke!

Operations on another hill a mile away gave better results and later a successful return to the Mojok area was made. Operations were now carried out on a larger scale and a constant supply of rubies was obtained. One splendid gem from the former mine weighed 18½ carats when found and realised as much as £7,000 after cutting had reduced it to 11 carats.

To extract the rubies from the byon, or earth in which they are found, it is churned up with water in a pan by revolving arms provided with teeth. The lighter soil is washed off leaving a deposit of heavy gravel containing the rubies. A further washing treatment finally leaves the stones in association with a small proportion of gravel from which they are picked out by hand and graded according to size and colour.



Elephants dragging heavy logs through the dense forests of Burma

The best rubies are of a bright carmine red colour and are known as pigeon-blood rubies. They are of great value. I was informed that one such ruby that weighed in its rough state no less than 42 carats was found in 1919 and that £40,000 was offered for it immediately and was refused! This is much more than the value of a diamond of equal size.

It is strange what a difference crystallisation and colour make. Rubies, sapphires, emeralds and amethysts are chemically aluminium oxide, or corundum, that has probably been crystallised under pressure. Their various colours are due to small proportions of impurities, the colour of the ruby, for instance, being due to the presence of a small proportion of chromium oxide. Rubies may be made artificially, in fact, by fusing aluminium oxide with a little chromium oxide in an electric furnace and cooling slowly under pressure. The gems thus obtained are very small and are of little value, but they are true rubies in every sense of the word. Emery is also corundum, but as its crystalline form is different, it is not transparent, and its impurities do not confer upon it any beautiful colour, no piece of emery will ever be worth £40,000.

The banks of the river were well-wooded. The rainfall in Burma is very heavy and this in conjunction with the high temperature results in rapid growth of vegetation. In animal life too the country is rich and good shooting may be had with tigers, leopards, bison and elephants, as well as an infinite variety of birds. The country is difficult, however, and during the rainy season is malarial.

The presence of passengers and the frequent stoppages enabled me to see a good deal of the Burmese themselves, and to note their customs. One of the most remarkable of these to me, was that the Burmese women are inveterate smokers of big cheroots. These are about a foot long and fully an inch thick, made of tobacco and leaves covered with a wrapping of leaves. They are smoked with the aid of a mouth-piece of cane.

Bhamo, which was our destination, is 800 miles from Rangoon taking a straight line, but by steamer 1,000 miles on account of the windings of the river. At this place is held one of the most important bazaars in Burma, to which produce is brought by the various tribes in the Northern parts, as well as by the Chinese, whose country here borders on China. It is conveyed by caravans of bullocks or horses having big baskets suspended on each side of them in which they carry the goods. They travel considerable distances, and in the case of a bullock caravan the leading animal has feathers attached to its head and a chain of bells hung around its neck. I was fortunate in seeing a caravan of about 50 bullocks move out of the corral. It is no uncommon occurrence for them to be attacked by bandits on their journey and to guard against a contingency of this kind, the attendants travel fully armed.

From Bhamo I returned by steamer to a place called Katha, about 50 miles down the river, and from there proceeded by a local train to Naba Junction, in order to join the main line train back to Sagaing for Mandalay. Naba Junction is a very small station and is very primitive, being surrounded by a dense jungle. It was dark when I arrived, and there were only three or four small oil lamps to light the station. It was difficult to grope one's way through the motley crowd of natives to find someone who could speak English and direct me to the train by which I was to travel back to Sagaing.

I had a sleeping car reserved for me and in the early hours of the morning I became sub-consciously aware of someone moving about my compartment. On looking around in the dim light, I saw a native with a flash light presumably looking for the lighting switch, the door of my compartment having been inadvertently left unlocked. He had probably entered on account of the other portion of the train being crowded. It was somewhat disconcerting at the time, but I had little difficulty in getting him out.

Returning to Rangoon after my journey through Burma I went on to India, a country that has always been highly interesting to me. The steamer took me from Rangoon to the mouth of the Hugli River, a branch of the great delta of the Ganges, which it was necessary to ascend for 80 miles in order to reach Calcutta.

The Hugli is a treacherous stream. Sandbanks are formed very quickly where previously there was a deep channel and the pilots of boats passing up and down the changeable stream have an anxious task. The Bengal Pilot Service is, however, the finest body of pilots in the world and the accuracy of their surveys enables them to take vessels over the bars with a few inches of clearance only. Three of the important bars are sounded daily and the depths printed on plans that are circulated to the pilots within a few hours.

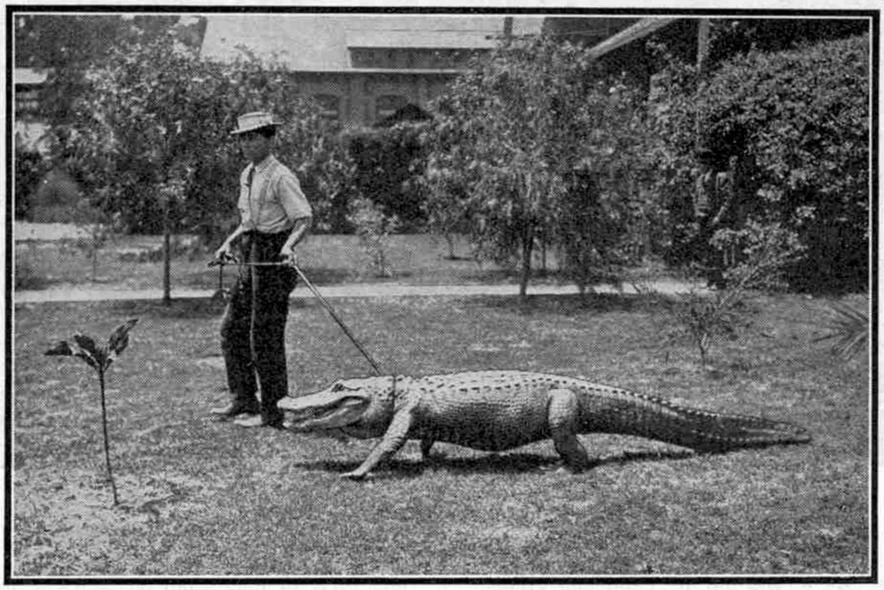
Calcutta is scarcely a typical Indian city. Before the coming of the Europeans it was a mere village. English traders established a factory in it at the end of the 17th Century and it rose later to the position of capital of India, a position recently lost to Delhi. I did not stay here very long, leaving the following day to visit Darjeeling, the well-known hill station in the Himalayas, an excursion that provided a wonderful experience. *(To be continued)*

Alligator Farming in Los Angeles

Reptiles Reared for Their Hides

NOWADAYS there are many curious ways of making a living and among them one of the most remarkable is that of rearing alligators for the sake of their hides. In Los Angeles, in Southern California, Mr. H. J. Campbell, an Englishman, possesses a flourishing alligator farm and has brought the rearing of these reptiles to a fine art.

It was the scarcity of the alligator and the consequent high price demanded for its skin that led Mr. Campbell to commence his strange farm. He began in quite a small way, and at first he had many difficulties to contend with because there was no previous experience to guide him. The venture proved successful, however, and to-day upon his farm may be seen some 500 alligators of all sizes, ranging from newly-hatched babies, scarcely larger than a lizard, to fearsome looking monsters 12 ft. or more in length. The farm is beautifully laid out on the banks of a small mountain stream which in its course has formed a number of little lakes and ponds, thus constituting ideal breeding and stock grounds.



The Alligator Farm. Full-grown alligator being led around like a pet dog

On Sunday afternoons feeding operations on the farm are carried out at a specified time and are watched with keen interest by large numbers of people who crowd out to the ponds from Los Angeles. The compounds are enclosed in wire netting and the creatures have a large area on the banks in which to bask in the sunshine. Thus an excellent view of the feast is obtained by the spectators. The menu consists for the most part of waste meat, which is sent from the great meat-packing yards, with, in addition, dainties such as chickens, ducks and pigeons, which are always killed before being served.

Every afternoon public exhibitions are given showing how the alligators are caught and handled. One of the most remarkable sights is that of trained alligators "chuting the chute." The creatures walk up to the top of the structure, which is about 30 ft. in height, by means of an inclined pathway, ribbed so to enable them to gain a secure foothold. At the word of command they put their feet together and slide down into the water, to the vast delight and amusement of visitors.

One of the alligators has actually been trained to draw a carriage about the farm and every visitor is asked to accept a ride. This alligator is thoroughly well behaved and when he opens his mouth has quite a winning smile, but nevertheless it is very seldom that a visitor can be persuaded to enter the carriage! Very many of the non-performing alligators are quite tame and can be led around the farm like pet dogs at the end of a rope.

The strangest spectacle of all is that of Mr. Campbell hypnotising one of the alligators. Strolling up to a full-grown reptile 10 ft. or 12 ft. in length, he gazes at it very hard for a few minutes and then passes his arm above it. The huge creature then quietly turns over on its back and lies there absolutely motionless until Mr. Campbell moves away!

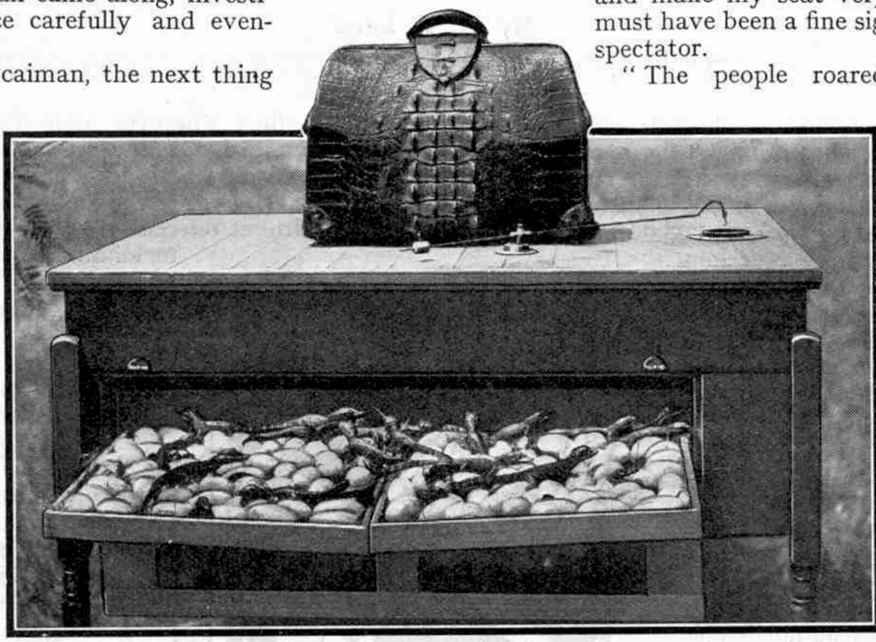
The photograph on next page shows an alligator incubator with a number of babies that have just emerged from the eggs. This is the beginning of their life history—the end is shown above in the shape of a bag made of alligator leather!

The alligator is a member of the crocodile family and it is entirely confined to the American continent and to China. It is a very extraordinary fact that this huge creature, which might be described as a living armoured cruiser, comes from an egg little if any bigger than that of a goose! The Mississippi alligator seldom attains a length of more than 15 ft. but the crocodile proper grows to an enormous size, 35 ft. being not uncommon.

Another member of the crocodile family that closely resembles the alligator is the caiman, which is found in large numbers in Central and South America. Mention of the caiman inevitably recalls the exploit of Charles Waterton, the well-known naturalist and traveller, of riding on the back of one!

In his book "*Wanderings in South America,*" Waterton tells how he and his party were journeying along the dismal banks of the Essequibo River with the particular object of capturing a caiman. For three or four days all their efforts were in vain. Then an Indian came up to Waterton and showed him a device he had made which, in his opinion, would capture one of the beasts. The arrangement was quite simple and consisted only of pieces of wood tied to a rope in such a manner that, if a caiman could be persuaded to swallow the "bait," the more he pulled the more the pieces would widen out and stick into his jaws. The other end of the rope was securely hitched to a stake driven into the ground and the bait was slung close to the water's edge. In due course a caiman came along, investigated the contrivance carefully and eventually swallowed it.

Having caught the caiman, the next thing was to get him out of the water without damaging his armour. At first the party refused to have anything to do with this part of the process, but by a combination of judicious bullying and persuasion —including the chasing of one man for a quarter of a mile over a sandbank—Waterton succeeded in getting them to make the attempt. The first effort only brought the caiman to the surface of the water, but on a second and more vigorous attempt he was hauled steadily to the bank. Waterton's account of the subsequent proceedings is interesting :—



Incubator with baby alligators just emerging from the eggs. Above—their ultimate fate !

"I took the mast of the canoe in my hand (the sail being tied round the mast) and sank down upon one knee about four yards from the water's edge, determined to thrust it down his throat in case he gave me an opportunity. This was an interesting moment. I kept my position firmly, with my eye fixed steadfastly on him. By this time the caiman was within two yards of me. I saw he was in a state of fear and perturbation ; I instantly dropped the mast, sprang up, and jumped on his back, turning half round as I vaulted, so that I gained my seat with my face in a right position. I immediately seized his fore-legs, and by main force twisted them on his back ; thus they served me for a bridle.

"He now seemed to have recovered from his surprise, and probably fancying himself in hostile company, he began to plunge furiously, and lashed the sands with his long and powerful tail.

"I was out of reach of the strokes of it, by being near his head. He continued to plunge and strike, and make my seat very uncomfortable. It must have been a fine sight for an unoccupied spectator.

"The people roared out in triumph, and were so vociferous that it was some time before they heard me tell them to pull me and my beast of burden further inland. I was apprehensive the rope might break, and then there would have been every chance of going down to the regions under water with the caiman. The people now dragged us above forty yards on the sand. It was the first and last time I was ever on a caiman's back. Should it be asked how I managed to keep my seat, I would answer, I hunted some years with Lord Darlington's foxhounds."

The caiman made desperate efforts to regain his liberty but after a while he became exhausted and was firmly secured.

Waterton was such a keen naturalist that he spent over £10,000 in building a high wall to convert his Yorkshire estate into a sanctuary for birds.

It might be thought that a Mississippi alligator would not be very desirable as a domestic pet. Naturally this would be the case with a 15 ft. monster, but it is quite possible to obtain youngsters some 10 in. in length and rear them up to a length of two or three feet. They are extremely interesting creatures to rear and, of course, on account of their small size, are not in any way dangerous.

Conquest of the Air—*(continued from page 111)*

less liable to oscillation. The diameter of the parachute was 34 ft. and it weighed about 400 lb.

The trial took place on 24th July, 1837. Green and a solicitor named Spencer occupied the car of the balloon, beneath which was suspended the open parachute having beneath it a small car in which Cocking was seated. The parachute greatly retarded the ascent of the balloon but eventually a height of about 5,000 ft. was attained, the balloon then being almost over Greenwich. Cocking signalled that he was about to free the parachute from the balloon and then manipulated the catch to effect this. For a few seconds the parachute descended rapidly and without oscillation, and then suddenly it was seen to collapse, crumple up, and fall at a greatly increased speed. At a height of about 20 ft. from the ground the car broke away from the parachute and crashed to earth, Cocking being literally dashed to pieces.

The sudden disengagement of the parachute caused the balloon to shoot upward at a great speed and it was with the utmost difficulty that Green and Spencer succeeded in checking its progress. Subsequently they effected a safe landing in the vicinity of Maidstone and then heard for the first time of Cocking's terrible death.

The Story of Oil—*(continued from page 108)*

companies struck oil at a depth of 1,820 ft., and so prolific was the output that Mexico's reputation as a territory rich in oil was established beyond dispute. The thrilling story of how this great well caught fire and provided one of the most terrible conflagrations ever witnessed upon an oilfield will be related in a subsequent article. In January 1910, an equally vast supply was tapped in another Mexican well, at a depth of 1,911 ft.

These great "strikes" were the signal for a rush of prospectors to the new oilfield. Companies were hastily financed to exploit large tracts of land and when the boom was at its height more than 120 organisations were operating oil wells in Mexico. Of these, about one half ultimately closed down. It is of interest to note that more oil is nowadays brought up in Mexico during 24 hours than 20 years ago was obtained in the course of one week.

This is a sufficient indication of the enormous progress made in drilling machinery. *(To be continued)*

Spinning Tops that Steer Ships

Wonders of the Gyro Compass

By H. F. Lane

FROM very early times until quite recently the magnetic compass has provided the mariners' only means of steering a steady known course when out of sight of land. In spite of the importance of this compass, and the great part it has played in the development of ocean transport, it has certain disadvantages, of which the chief are the errors of variation and deviation.

The two natural magnetic poles of the Earth, between which extend the lines of force of the Earth's magnetic field, are not coincident with the true poles of the Earth, that is the points at which the Earth's axis emerges from the sphere and from which all geographical positions are measured. In consequence the magnetic compass needle, which points to the north magnetic pole, will as a rule point away from the true north pole by an amount known as the "variation." This amount varies on different parts of the surface of the Earth and for it a continuous and varying correction has to be made.

The advent of ships built of iron and steel instead of wood introduced, on account of the magnetic properties of these metals, a further error. The influence of the iron in the near vicinity of the compass is naturally stronger than that of the far-distant magnetic poles, and the compass has a tendency to point to some piece of iron in the ship, such as the funnel, and to turn round with the ship when she alters course, continuing to point to the funnel instead of remaining steadily in the magnetic meridian. This effect is known as "deviation," and it varies with the different directions of the ship's head. It may be largely neutralised by securing near the compass "correctors," the magnetism of which is equal and opposite to that of the ship, but the Earth's influence is so weakened thereby that the compass becomes sluggish and unreliable.

In this connection it is interesting to note that, prior to the invention and perfecting of the gyro-compass, certain vessels for special research in which exceptional accuracy and reliability of the compass were required, were built of phosphor-bronze or some other non-magnetic metal in order to eliminate deviation entirely. The chief disadvantages of such ships were expense of construction and lack of strength as compared with steel. Further, this method of construction had no effect whatever upon variation.

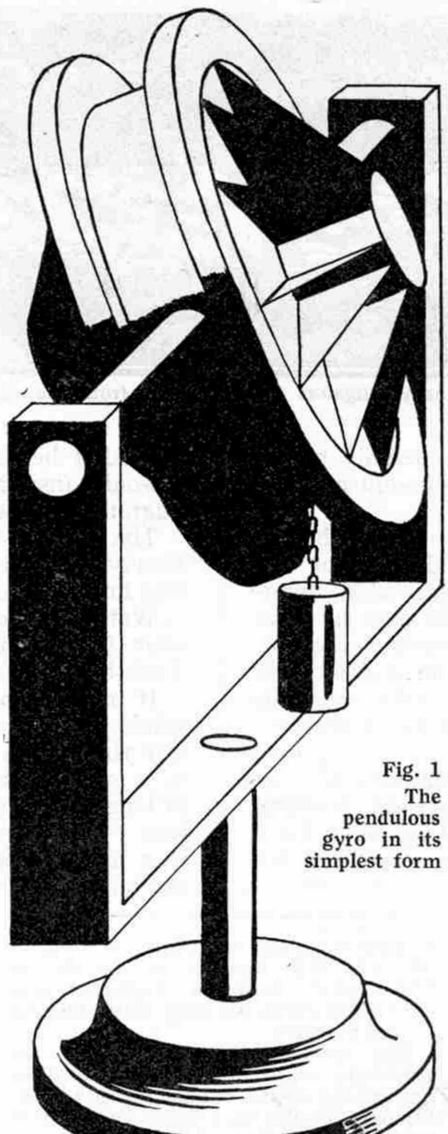


Fig. 1 The pendulous gyro in its simplest form

It remained for the gyro-compass—in which the rotation of the Earth and the force of gravity are harnessed to define the true meridian by mechanical means alone, without reference to the Earth's magnetic field—to eliminate entirely both variation and deviation. In addition, the gyro-compass is more "dead-beat" when the ship is on a steady course and more positive and instantaneous in demonstrating an alteration of course.

Before discussing the fundamentals of the gyroscope it is necessary to understand the meaning of "freedom in three planes." Any perfectly flat surface is a plane surface. A plane is an imaginary flat surface of infinite size but no thickness. Suppose one were to lay an enormous but very thin pane of glass against a wall—as though the wall were a picture behind the glass, but with the glass extending beyond the wall to infinity in all directions—then one could say that that side of the wall lay in the plane of the glass. A label stuck on the glass, not necessarily on that part of it touching the wall, could be said to lie in, or occupy, the same plane as the wall. Now let us suppose the glass to be removed but the label to remain in the same position as before—supported on nothing. The label would still be in the plane of the wall, or in other words the wall and the label would lie in the same plane.

Now imagine a circular paper disc pinned by its centre to the wall and spinning on the pin. The plane of the wall would then be the plane in which the disc is spinning, or, to put it in another way, the plane of the wall would be the "plane of spin" of the disc. If we were to use a long pin bent downward so that, though the bottom of the disc was touching the wall the top stood out from it, the disc would be spinning in a new plane and no longer in the same plane as that of the wall.

A gyroscope is essentially a heavy wheel capable of being spun at a high rate of speed and so mounted in gimbals that its axis may be swung in a horizontal plane or tilted in a vertical plane (see Fig. 2). The resulting state is that of freedom in three planes or three degrees of freedom—to spin, to veer and to tilt. This means that the spinning axle may be pointed in any direction, to one side or the other, or up or down. Assuming for the purpose of argument that the wheel and the gimbal bearings are absolutely frictionless, such an instrument is known as a "free gyro."

Consider the corner of a room. Here we have three planes meeting each at right angles to both the other two. Referring to Fig. 3 we have the wheel spinning in the plane of the side wall, the axis being capable of describing a horizontal or veering circle in the plane of the floor and also a vertical or tilting circle in the plane of the end wall. Actually the analogy holds only so long as the wheel is spinning in a vertical plane with, necessarily, the axis horizontal. If now the mounting of the wheel in Fig. 2 be studied it will be seen clearly that whatever the plane of spin of the wheel—that is however much the axle may be tilted up—the plane in which veering takes place is always horizontal and therefore at right angles to the plane of tilt. The axis, however, is capable of pointing in any direction in space.

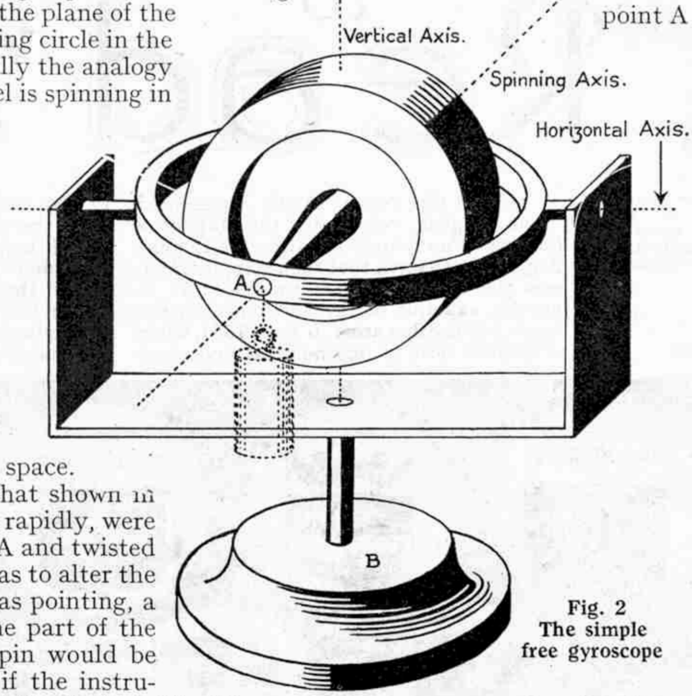


Fig. 2
The simple
free gyroscope

If an instrument such as that shown in Fig. 2, with its wheel spinning rapidly, were picked up by the gimbal ring A and twisted in the hand in such a manner as to alter the direction in which the axle was pointing, a very definite resistance on the part of the wheel to alter its plane of spin would be experienced. Alternatively, if the instrument were held by the pedestal B—that is with tilting and veering axle free to operate—and twisted in a similar manner, no resistance would be experienced because the axle would remain pointing in the same direction and allow the gimbal ring and bearings to move round it.

This is the first great characteristic of the gyroscope—its intense dislike to being twisted out of the plane in which it is spinning—and is known as "gyroscopic inertia" or "gyroscopic rigidity." It is analogous in circular motion to the reluctance of a body moving rapidly in linear motion, that is in a straight line, to change its direction. For example, compare the pull on a sling before the stone is released and the straight path the stone afterwards follows; or the tendency of a motor car to skid if a corner be taken so sharply as to overcome the friction between the tyres and the road.

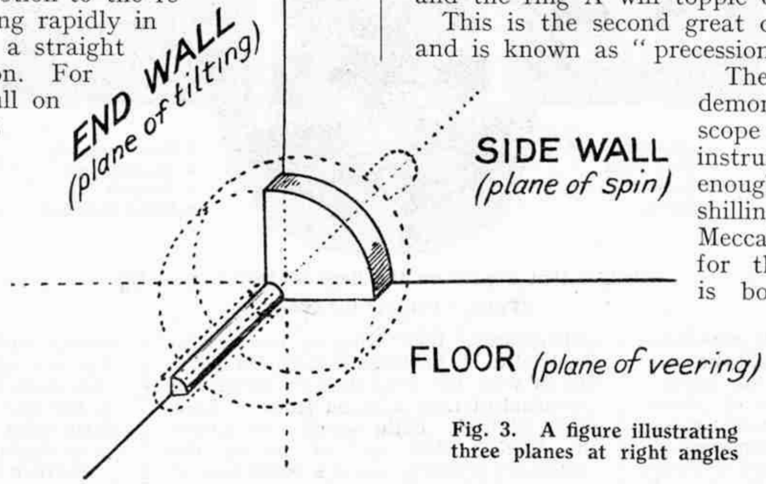


Fig. 3. A figure illustrating three planes at right angles

As will be explained later, gyroscopic rigidity is actually rigidity in space, the axis on which the fly-wheel is spinning continuing to point in a fixed direction in space irrespective of the movement of the pedestal. This property of the gyroscope has led to its use in demonstrations of the rotation of the earth, as the axis of spin will appear to move in a direction opposite to that in which the earth's rotation is carrying it.

On the other hand, no resistance is felt if the whole instrument be moved bodily in any definite direction in a straight line, even though it be held by gimbal ring A, that is with veering and tilting freedom suppressed. The reason for this is that such motion is of translation only and the plane of spin remains parallel to its original plane throughout.

Let us now suspend a weight from point A on the gimbal ring, which will have the effect of trying to tilt down the near end of the axle. Gyroscopic inertia resists this and the weight does not lower at all. Instead, the whole mounting begins to revolve round the vertical axis in the pedestal and will continue to do so as long as the weight is there and the wheel is spinning. A mathematical explanation of the reason for this would be far too involved for the present article, but what really happens is this. If the mounting could turn to make the plane of spin coincide with the plane containing both the centre of the wheel and the weight, there would be no further tendency to tilt the axle, and the wheel would no longer have to support the weight in order to preserve the direction of the axle (the weight would consequently swing to the bottom of the mounting). The gyro starts to turn with this idea, but the weight, being attached to the mounting, is carried around with it, and so the axle continues veering in a hopeless attempt to catch up.

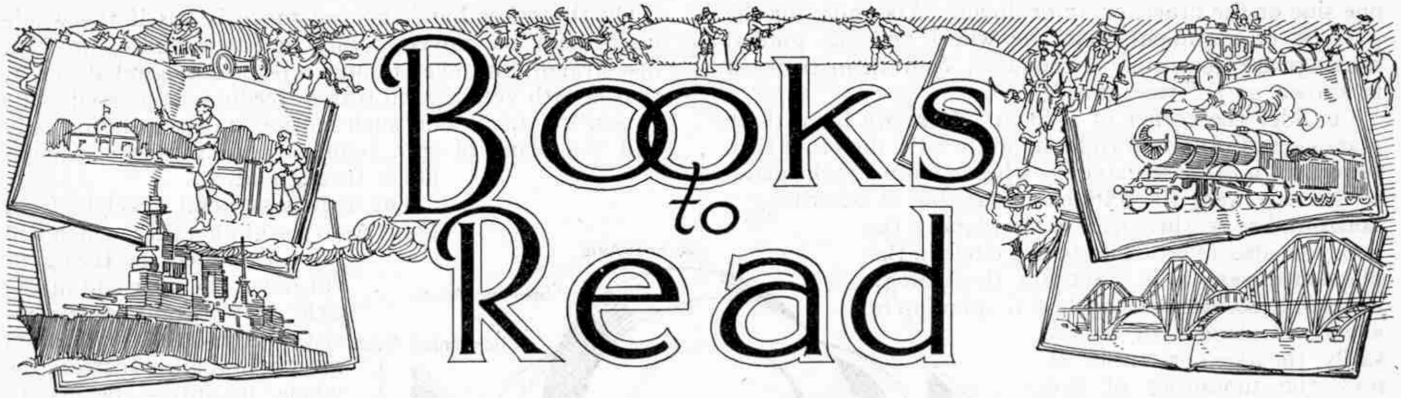
Similarly, if the weight be removed and pressure applied with a finger at A in a horizontal direction, then instead of turning round the vertical axis the wheel and the ring A will topple over in the mounting.

This is the second great characteristic of the gyro and is known as "precession."

The above experiments may be demonstrated with any gyroscope mounted as described and instruments quite accurate enough may be bought for a few shillings. A very interesting Meccano model could be made for this purpose provided it is borne in mind that the wheel must be heavy and mounted in bearings as nearly frictionless as possible so that it does not lose speed too quickly.

To sum up, if we try to make the gyro tilt it will veer; and if we try to make it veer it will tilt. Again, if we want to make it veer we apply a force in a direction which, if we knew nothing about a gyro, we should expect to cause toppling, but actually the gyro will veer instead, and vice versa.

(To be continued)



Books to Read

Readers frequently write asking if we can recommend books that are both of interest and of use. On these pages we review books that will specially appeal to readers of the "M.M." We do not actually supply these books, which may be obtained either through any bookseller or direct from the publishers.—EDITOR.

"Flags of the World"

By W. J. Gordon
(Frederick Warne & Co. Ltd. 6/- net)

There is something about flags that exerts a peculiar fascination over young and old alike, and yet at the same time it is probable that no equally familiar objects are so little understood. Mr. Gordon's book will come as a revelation to those who, while appreciating the fascination of flags, have never taken the trouble to enquire into their meaning and origin.

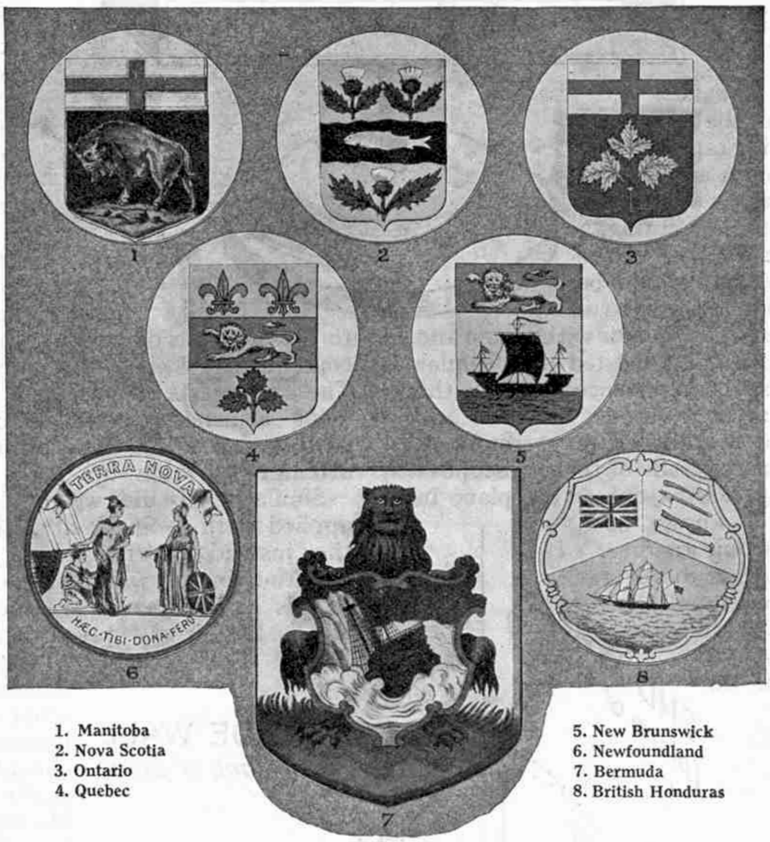
In his introductory chapter the author traces back the origin of flags to the national symbols by which ancient races were distinguished from one another, and we come in contact with the story of some of the most famous banners at a very early stage. For instance, we are told how the famous eagle standard of Imperial Rome was developed from the simple wisp of straw that constituted the original Roman standard. This wisp of straw has now fallen so low as to be used by road menders and hung beneath bridges to indicate "No Thoroughfare!"

By easy stages the author passes on to stories of the banners of the kings and barons, saints and crusaders of the Middle Ages, as well as those of the great city companies and of the naval and military forces. Many of these banners and standards are illustrated, among them the famous Percy and Douglas standards under which the opposing armies fought at the battle of Otterburn. It is interesting to learn that these flags are still in existence in the possession of a descendant of the Douglas who overcame the great Hotspur on the day of Otterburn and captured the rival standard.

One would like to quote many of Mr. Gordon's stories of bygone days but space does not permit of this. We cannot refrain, however, from quoting the following instance of the jealous regard in which the honour of the English flag was held in Tudor times :—

"Under the Tudors, if any commander of an English vessel met the ship of a foreigner who refused to salute the English flag, it was enacted that such ship, if taken, was the lawful prize of the captain. A notable example of this insistence on the respect to the flag arose in May, 1554, when a Spanish fleet of one hundred and sixty sail, escorting their King on his way to England to his marriage with Queen Mary, fell in with the English fleet under the command of Lord William Howard, Lord High Admiral. Philip would have passed the English fleet without paying the customary honours, but the signal was at once made by Howard for his twenty-eight ships to prepare for action, and a round shot crashed into the side of the vessel of the Spanish admiral. The hint was promptly taken, and the Spanish fleet struck their colours and topsails as homage to the English flag."

The succeeding chapters are all full of good things and especially the one dealing with the Royal Standard. The significance of the three golden lions of England, the red lion rampant of Scotland, and the golden harp of Ireland are explained, and the practical suggestion is made that the fourth quarter in which the lions of England are repeated should be filled with some device representative of our Imperial possessions.



1. Manitoba
2. Nova Scotia
3. Ontario
4. Quebec
5. New Brunswick
6. Newfoundland
7. Bermuda
8. British Honduras

Badges that appear on the flags of British Colonies
(From "Flags of the World")

To many readers the chapter on signal flags will make the greatest appeal. It is really excellently written and its bright and cheery manner is exceedingly attractive. A remarkable story is unfolded in connection with the famous signal made by Nelson at Trafalgar. It appears that in 1803 a copy of the Admiralty Signal Book issued in 1799 had fallen into the hands of the French and therefore a change in the signal code was immediately introduced by the Admiralty. Some years later a certain historian who had overlooked this change persuaded the Admiralty that the signal hoisted rainbow fashion over the mast of the "*Victory*" at Portsmouth every Trafalgar day was wrong, and in 1885 and succeeding years the famous signal was made in accordance with the Code Book of 1799. The signal was even flown wrongly outside the United Service Institution during the Nelson Exhibition in 1905, in spite of the fact that in the library of the Institution there is a signal book on which is written : "This is the Signal Book used at Trafalgar," and in which are pasted the flags in the correct order. Fortunately the matter was put right by the Admiralty so that once again Nelson's signal—which is shown in the frontispiece to the book—can be flown with full confidence that it is an exact reproduction of the original.

Another exceedingly interesting section deals with badges that distinguish the British Colonies. Many of these are of great historical or geographical interest. For instance, the badge of Newfoundland, our oldest colony, shows that fishing is, or was, the chief concern of the people. The Bermuda badge represents the wreck of the "*Sea Venture*" under Sir George Somers in 1609. In regard to this, Mr. Gordon remarks that the designer has made a good badge by changing the sunken reef on which the ship struck into a lofty cliff, and placing the shield in the grip of a fearsome red lion. The badges of the Canadian Provinces are aptly distinguished by the presence of the maple leaf and of the buffalo; while British Honduras announces that it is a mahogany country by exhibiting in one section of its badge the tools of the tree-feller.

The story of the gorgeously-designed and coloured flags of the South American Republics and of Africa and Asia is told in detail and many readers will learn for the first time how the national flag of the United States developed from the flag of the old East India Company. The author's quaint humour is well shown in his account of the flag of Paraguay.

"Paraguay," he writes, "is an inland State that has annexed the Dutch flag without permission, and pleads that it really does not matter as the country is so many miles from the sea that its ensign is seldom seen upon it, and that to avoid mistakes it has placed a badge in the centre of the white stripe that is not like that of the Netherlands; and, moreover, to make assurance doubly sure, it has placed another badge on the back of that. No other flag has this peculiar arrangement. The badges on the ensign are oval; that on the front of the flag is a laurel wreath with a star at the top, the wreath enclosing a lion cleverly balancing on his back an upright stick on which is a liberty cap to keep it steady, while Paz y Justicia is lettered around him. . . . Where the lion came from is a subject of contention; as it is the only one adrift in South America it has been suggested that it escaped from a menagerie, and hence the balancing trick."

The house flags of steamship lines are also dealt with and a final chapter of great value describes the flags adopted by the new states that have come into being as a result of the Great War.

One of the most important features of the book is the accuracy of the illustrations, which have been verified from official measurements and represent absolutely correct proportions. The numerous coloured illustrations, of which there are more than 400, are especially fine, every detail being reproduced with faultless accuracy.

* * * *

"The Story of the Canadian Pacific Railway"

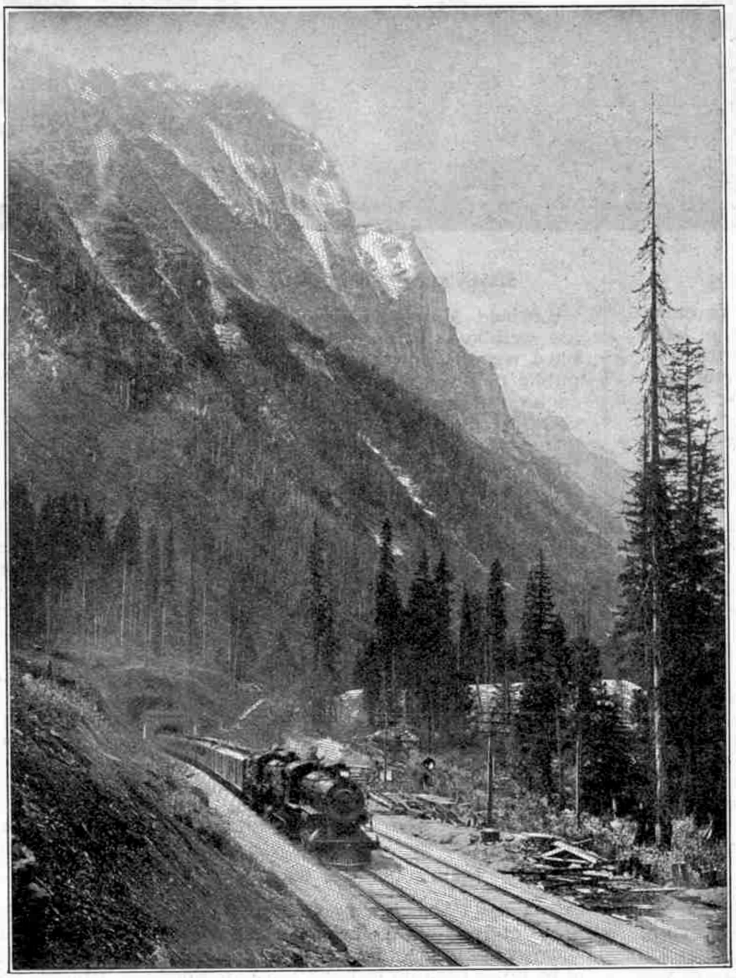
By Keith Morris. (William Stevenson Ltd.)

In this most interesting book the author tells the exciting story of the foundation and development of the Canadian Pacific Railway, which is undoubtedly one of the most remarkable transport organisations in the world. It was not the first railway to cross the American continent, but at the time of its construction the entire population of Canada was only 4,000,000, practically all of whom lived east of the Great Lakes, whereas the first railway to cross the United States was built when the population of that country was 40,000,000, and passed through immense tracts of well settled country.

The Canadian trans-continental railway was not built without a great struggle. Much of the country through which it was to run was unexplored, while the difficulties to be overcome in the marshes north-west of Lake Superior, and in particular among the mountain ranges of British Columbia, seemed almost insuperable. It was only as the result of hazardous explorations that a practicable route through the Rockies was found.

In the first section of the book we read of the efforts of the path-finders that led to the discovery of the famous Kicking Horse, Rogers and Eagle passes, through which the railroad now threads its way, running along the banks of swift moving rivers or round dizzy spiral curves built to overcome difficulties with the gradient, or diving into tunnels cut through gigantic mountains. The scenery in consequence is absolutely superb, and justifies the description given to the country of "60 Switzerlands rolled into one." An amusing story is told of an American lady who was fascinated by the sight of the Illecillewaet glacier. Unfortunately she spoilt the effect by enquiring seriously: "Is it a real glacier, or only one put there by the company for an advertisement?"

The book does not fail to deal with the more solid achievements of the railway. We read how it assisted in the suppression of the Red River rebellion in 1870, although a portion only of the railway was then built. A further achievement was the part that it played in the saving of British Columbia for the Dominion of Canada. One of the conditions under which British Columbia agreed to enter the Dominion was the building of a railway to connect to the east, a project which the Canadian Pacific Company accomplished after the Canadian Government itself had practically failed in the attempt.



Eastern portal of Connaught Tunnel which pierces the Canadian Rockies (From "The Story of the Canadian Pacific Railway")

At the time of the construction of the C.P.R. the Canadian West was practically unsettled and the line was a prime agent in the development of that fertile country. The company extended its activities in many directions. Where the land on either side of the railroad was dry and sterile it embarked on vast irrigation schemes. Subsequently it became the owner of many splendid ocean liners and to-day its transport activities extend in an unbroken line from Europe across the Atlantic and the Pacific to China, Japan, Australia and New Zealand. It is interesting to note that one of the company's ships placed at the disposal of the Government during the Great War was closely concerned with the capture of the German ship "*Emden*."

The story of the development of the Canadian Pacific Railway is practically the story of Canada, and this book is well worth the attention of all those who are interested in the development of the British Empire.

Interesting New Books

We hope to deal with the undermentioned books in an early issue.

"Pioneers of Wireless," *by* Ellison Hawks (Methuen), 12/6

"Mathematics for Technical Students" (Senior course) *by* S. N. Forrest (Arnold), 5/-

"Goldfish Culture for Amateurs" *by* A. E. Hodge & A. Derham (Witherby), 5/-

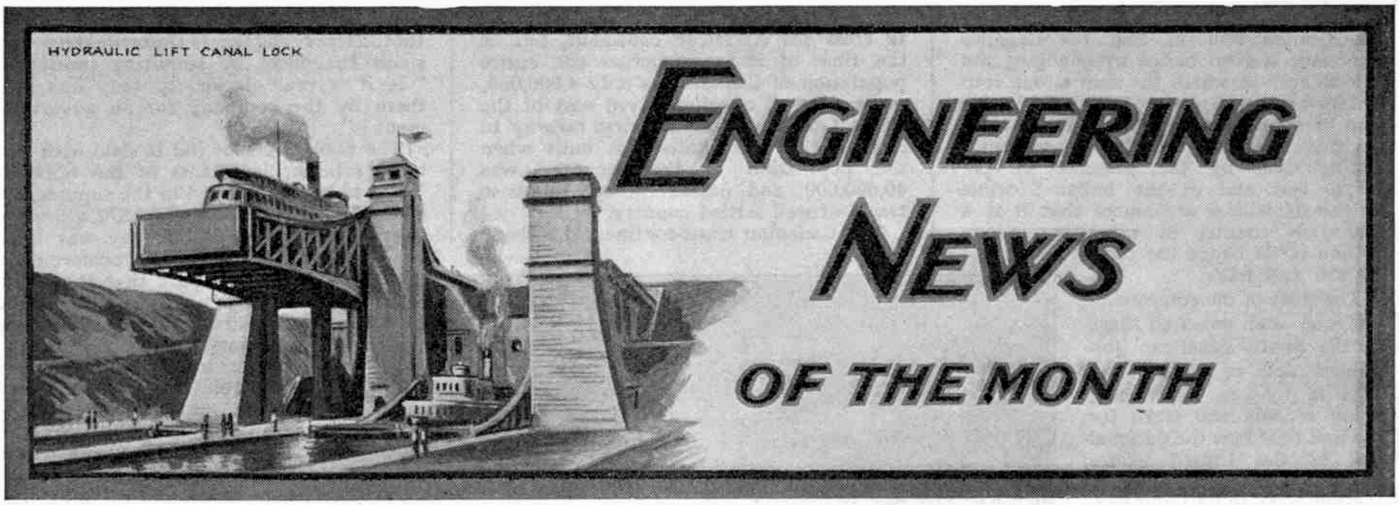
"Sir Isaac Newton" *by* S. Brodetsky, M.A. (Methuen), 5/-

"Essays of a Naturalist" *by* Sir. R. Lankester (Methuen), 2/-

"Drake's Twin Sea Cubs" *by* Protheroe (Epworth Press), 3/6

"Children! Can you Answer This?" *by* G. A. Birmingham (Fisher Unwin), 2/6

"Camp Cooking and Catering" *by* Major J. T. Gorman (Brown Son & Ferguson), 2/6



Trent Bridge Improvements

An important scheme for improvement in the facilities for crossing the River Trent has been in hand for some little time, and the completion of the first stage was marked by the official opening of the Gunthorpe Bridge in November by the Prince of Wales. The bridge is to take the place of the existing Gunthorpe toll bridge, an iron structure some 400 yards further up the river, erected over 50 years ago. This old bridge has been found to be quite inadequate to meet the demands of modern traffic requirements and the new structure is considerably larger. It is 451 ft. in length, and consists of a centre span of 125 ft., two side spans of $101\frac{1}{2}$ ft., and two flood openings. It is built of concrete throughout, and has a width between parapets of 40 ft. In connection with the new bridge, two splendid concrete approach roads, each $1\frac{1}{4}$ miles in length, have been built, one on each side.

With the opening of the new bridge the toll hitherto charged is abolished, the rights of the previous owners having been purchased outright by the Nottinghamshire County Council.

Another bridge at Gainsborough is to be dealt with under the same scheme and has been freed from toll to a certain extent already. Later it will become clear of toll altogether. The Gainsborough bridge was built 140 years ago and cost £12,000. It was purchased recently from the owners by the Gainsborough Urban Council and the Notts and Lindsey County Councils for £130,000, each shareholder receiving £1,000 for a share for which £66 was originally paid.

* * * *

Canadian Timber for London Docks

The Port of London Authority recently placed a large contract with British Columbian timber mills for over 10,000,000 ft. of Douglas fir lumber. This timber is to be used principally in the construction of the new docks at Tilbury, and it is understood that Douglas fir alone is to be employed in the woodwork of all future harbour developments in the Port of London.

* * * *

An electric generator rated at 160,000 kilowatts at 11,400 volts is to be installed by the New York Edison Company in its generating stations at 14th Street and East River. The generator will have a capacity nearly three times as large as that of any other generator now in service.

Six-Cylinder Motor Omnibuses

Leyland Motors Ltd., whose omnibuses are well known throughout the country, have recently introduced a new type of public omnibus propelled by six-cylinder engines. These new vehicles are to be classified as "Tigers," and are being introduced for use in long-distance transport work, where it is considered there is still a very big scope for luxury vehicles.

The "Tiger" bus is rated at 105 h.p. which, combined with a comparatively light chassis and good springing, will make it little inferior to the best class of private car in regard to speed, acceleration and comfort. It is a single-deck bus providing accommodation for 39 passengers. A double-deck counterpart is also to be built. This will be known as the "Titan" and will accommodate 51 passengers. In addition, a rigid six-wheel chassis of the double-deck type equipped with engines of the same type will be known as the "Titanic."

* * * *

India's Greatest Canal

The new Ganagar irrigation canal in the State of Bikanir has been opened by the Viceroy of India. Throughout its length of 85 miles both its bed and sides are lined with ferro-concrete as an experiment in conserving the water supply. It serves to irrigate 620,000 acres, or approximately 1,000 of the 23,000 square miles comprising Bikanir. If the experiment proves successful it is probable that another canal, serving twice the area will be built.

* * * *

World's Largest Oil Tanker

Recent orders for new oil tank ships afford an indication of the steady development of oil as the world's standard fuel. The tonnage recently contracted for is about 600,000. Included among the new vessels is an oil tanker that has just been launched from the Vulcan Yards, Bremen, Germany. The vessel will be the largest motor freighter in the world, for it will have a beam of 75 ft. 4 in. and will be 565 ft. in length. It is designed to carry over 21,000 tons of oil.

* * * *

The present iron suspension bridge over the River Thames at Marlow is shortly to be replaced by a reinforced concrete single span structure.

The Lea Valley Viaduct

The first stage in the completion of what is known as the North Circular Road that is to extend from Kew Bridge in the West to the Thames Valley at North Woolwich on the East of London, was recently completed with the opening of the Lea Valley Viaduct extending from the River Lea at Edmonton across the marshes to Warren Road, Walthamstow.

The great arterial road is designed to run in an irregular semi-circle between the two points mentioned, with Blackfriars Bridge roughly as the centre point from which the arc of the circle is drawn. The total length of road when complete will be $28\frac{1}{2}$ miles, but in fact nearly 20 miles are already in existence, so that the new road will not provide any greatly improved communication route between intermediate points. Its principal value lies in the combination of a number of small schemes into one great link, relieving the congestion in the Central London area by diverting much of the cross city traffic around the outskirts.

The Lea Valley road is a concrete viaduct, raised some 10 ft. above flood level, and stretching for nearly 600 yds. across the marshes. It has a 40 ft. carriageway and 10 ft. pathways on each side. The viaduct is carried upon 600 large reinforced concrete columns supported on concrete bases 6 ft. square, which themselves are placed on 16 in. diameter piles. Over 1,000 piles had to be driven down to reach the firmer ground below the marsh, this quantity being 50 per cent. more than was estimated originally.

* * * *

London Traffic Record

The number of passengers carried by the London General Omnibus Company during October, 1927, was the highest ever recorded for a similar period in the history of the company. The number was 140,155,737, as compared with the previous year's figure of 133,018,254. Altogether the company's 4,000 buses aggregate journeys amounted to 15,353,008 miles.

* * * *

Millions of Days Wasted

The year of 1926 will go down in history as one of British labour's black years, for through industrial disputes approximately 162 million working days were lost. This figure compares with $8\frac{1}{2}$ million in 1924, eight million in 1925 and slightly more than one million during the first 10 months of 1927.

The Oil Danger in Rivers and Harbours

When the Port of London Authority put forward last year a proposal to allow oil tank steamers to proceed further up the Thames than they are allowed to do at present, there was strong opposition on the part of ship-owners and others on the ground of the risk of fire. A committee was appointed to consider the matter and during its deliberations an example of what might occur was afforded by a startling episode in the Mersey.

The "*Seminole*," an oil tanker carrying some 8,000 tons of petrol, went ashore on the Pluckington Bank, a bar of sand in the Mersey. The danger of the ship breaking her back and becoming a total wreck was imminent, but even more serious was the possibility of the petrol tanks leaking and allowing their highly inflammable contents to flow out upon the surface of the river, with the danger of a fire that would be almost impossible to control.

All efforts to move the vessel failed, and after a while a crack developed in her plates with the result that within an hour or two some 2,000 tons of petrol were flowing out on to the river. All possible precautions against fire were taken immediately. Smoking was prohibited on the ferry boats and along the landing stages; all fires and lights were extinguished on the Dock Estate piers, some of which were only 50 yards from the ship; all vessels in the vicinity were warned to keep clear, and fire brigades stood by.

While these measures were being taken it was found that although two of the ship's tanks had been emptied the remainder still held, and the problem then was to empty these safely before further damage developed. It was too risky to bring another tanker alongside the sand bank, and eventually a line of pipes was carried over the dock wall and the river from a tank steamer in the Brunswick Dock to the stranded vessel. Compressed air was forced into the sound tanks and gradually the petrol was pumped away. This clever scheme proved entirely successful and in due course the "*Seminole*" was lightened sufficiently to enable tugs to pull her clear of the bank and into dock.

Notices were placed on all the ferry boats prohibiting smoking and in this connection the following story is told, although we do not vouch for its truth. A youth on one of the boats was observed to light a cigarette and drop his match end to the deck. His fellow passengers stood aghast, and a deck hand promptly called the youth to order and pointed out the notice. "Sorry," replied the offender—and immediately threw his lighted cigarette overboard! A gasp of horror went up, but the fates were kind and nothing happened!

It is an interesting coincidence that earlier in the year the chief of the Liverpool Fire Brigade, addressing a conference of fire brigade chiefs at Liverpool, said that what he dreaded most was the discharge of an oil tanker's cargo into the river. How justified his fears were is shown by a disaster that occurred in America a few days after the stranding of the "*Seminole*." An oil tanker went ashore in a New Jersey harbour and its cargo escaped into the water and in a few minutes was ablaze. Almost instantly the whole surface of the harbour was swept by raging flames. Piers, quays and several ships were seriously damaged, while other vessels owed their escape from complete destruction to prompt and successful handling. The amount of damage was estimated to be over £1,000,000 and it might easily have been many times greater.

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Another Famous Bridge

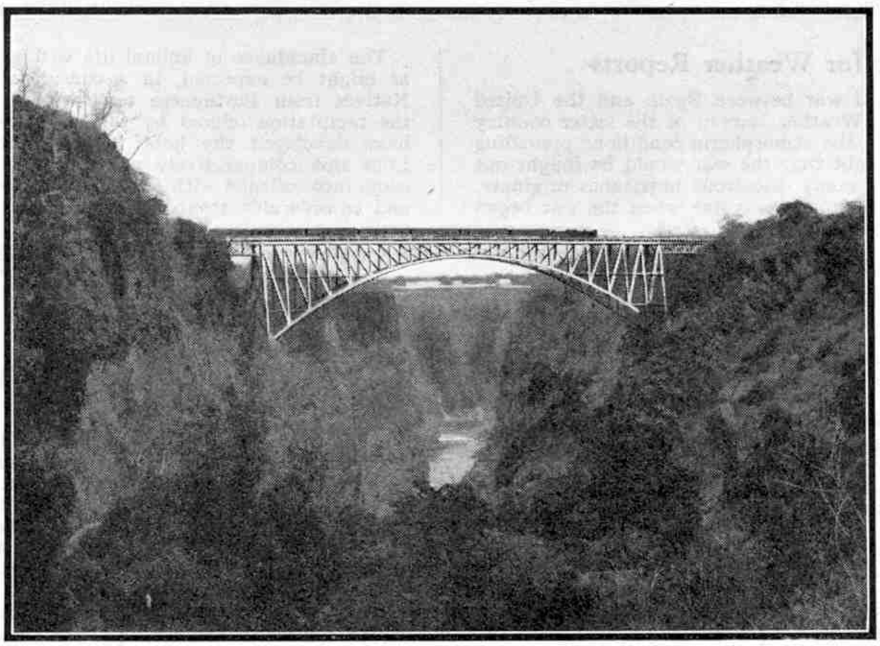

Photo courtesy] [*South African Railways & Harbours*

A train crossing the famous bridge over the Zambesi River just below the Victoria Falls. This bridge, which carries the Cape to Cairo Railway, is 500 ft. in length and 420 ft. above the River

Regional Broadcasting

The British Broadcasting Corporation during recent weeks have had a mobile transmitter on the road, touring the country in search of suitable sites for the erection of new stations under the regional broadcasting scheme. It is proposed to transfer the existing 2LO station to a site north of London to serve London and the south-east counties, and other stations are to be placed in the north of England, Scotland, Western England and Wales, and Northern Ireland.

Smart Salvage Work at Liverpool

An interesting piece of salvage work was carried out recently in the River Mersey. The "*Lochmonar*," a steamship of 9,400 tons, built three years ago for the Royal Mail Steam Packet Company, while steaming slowly in calm weather in some manner piled herself across the revetment wall that guides the Mersey through the sandy bottom of Liverpool Bay. Powerful tugs were quickly on the scene, but in spite of all their efforts the "*Lochmonar*" remained fast with her bow across the wall.

It was then decided to await the next high tide and make another effort to pull the ship clear. This attempt also proved unsuccessful, and the salvage parties then commenced to transfer part of the ship's cargo to other vessels with a view to easing the burden. While the trans-shipment was in progress it was observed that the plates immediately in front of the bridge were giving way. The strain had proved too much for the ship's back and it had broken.

A hasty conference was called, and after experts had examined the ship's position it was decided that there was a slender chance of cutting the ship in two, leaving the bow across the wall and towing the remaining two-thirds into port. Divers were sent down to place charges of explosive in position but it was not until the 30th charge had been fired that the stern part fell clear and floated into deep water. A few hours later watchers on the river banks were rewarded by the sight of the "*Lochmonar*" arriving home, several days late, stern first, minus her bow, but still a ship, carrying the major portion of her cargo and in possession of all her valuable set of Burmeister and Wain Diesel engines. As we write, the "*Lochmonar*" is in dock, but before many weeks have passed she will be out and afloat again in possession of a new bow.

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Improving the Canals

With a view to improving the facilities for canal traffic between London and Birmingham a Bill is to be promoted in Parliament to sanction the linking of the Grand Junction Canal, running from Paddington to Braunston, with the Oxford Canal and a series of other waterways passing from Napton to Birmingham. It is proposed to merge the control of the complete chain into the Regents Canal and Dock Company, a development that is regarded favourably by all the canal-users.

Of General Interest

Strange Use for Weather Reports

Prior to the outbreak of war between Spain and the United States in April, 1898, the Weather Bureau of the latter country did not concern itself with the atmospheric conditions prevailing abroad. There was no doubt that the war would be fought out in the West Indies, where many disastrous hurricanes originate, and as the season for these storms was due when the war began a service of weather forecasts for the West Indian area was inaugurated in order to provide for the safety of the American fleet. This service proved of such immense value that it has been continued ever since, and many lives have been saved by the timely warnings of the approach of hurricanes that have been given to ships in West Indian waters and to towns on the American mainland and in Cuba and other islands.

A strange and unexpected result of the establishment of this weather service was the destruction of a Spanish fleet. During the war a cable between Key West in Florida and Havana in Cuba was opened once daily, by mutual arrangement, for the transmission to Washington of weather observations made in Cuba. American agents in the Spanish lines discovered that the main battle-fleet of the Spaniards had arrived from Europe and was in Santiago Harbour. This valuable information was incorporated in the report of weather observations according to a pre-arranged secret code and was passed on to Washington by the unsuspecting Spaniards in Havana. The American fleet immediately blockaded the harbour of Santiago and eventually sank the Spanish fleet when it tried to break out.

Over a Hundred Years Ago!

"A British Union Jack, with a border of white of one-fifth of the Jack, is to be used in future by all British vessels, as a pilot flag, in all parts of the world."—"HANTS ADVERTISER," 5th Feb., 1827.

Provisions for Arctic Expedition

"His Majesty's ship '*Hecla*,' Captain Parry, bound on a voyage of discovery to West Spitzbergen and the North Pole, is lying at Deptford. The greatest attention has been paid to the victualling department of the ship. Preserved meat, beef, pork, veal, and mutton, besides vegetables, are carried out in tin cannisters, besides two thousand pounds weight of pemmican, a concentrated essence of meat dried by a fire of oak and elm wood, six pounds of the best beef being reduced to one pound. Samples of this quintessence of animal food are shown on board, having the appearance and somewhat the flavour of German sausages, with this difference, however, that the expense of it is said to be 17s. per pound."—"THE OBSERVER," 25th Mar., 1827.

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"The French Government have built two steam vessels of 80 horse-power, two of 50, and are now building two of 160 horse-power, for the service of the Navy."—"HANTS ADVERTISER," 28th May, 1827

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"The letters by Sir Walter Scott, arrived at Liverpool from Africa, state that several vessels with slaves on board have been captured. The French vessels stated to be employed in this traffic are very numerous."—"LIVERPOOL MERCURY," 20th April, 1827.

National Park for South Africa

South Africa will shortly have a great national park in the form of a game reserve. This will rival the famous Yellowstone Park in many respects, while in the diversity and interest of animal life it will be far superior to the famous American reserve.

The South African reserve is known as the Kruger National Park and it is a great tract of bushland where the beasts of the forest have been practically undisturbed for ages. The tract was set aside as an animal sanctuary, its only human inhabitants, beside the Warden and his staff of rangers, being a few wandering natives. It has now been decided to make roads through the reserve and to build rest houses at suitable points. Visitors thus will be enabled to hear the roar of the lion and the howling of the hyena in their native surroundings while still retaining the comforts of civilisation.

The abundance of animal life within the reserve has resulted, as might be expected, in a considerable amount of poaching. Natives from Portuguese territory have been unable to resist the temptation offered by the large herd of game animals and have developed the habit of replenishing their food supplies from this comparatively easy source. When these marauders come into collision with the native police they shoot immediately and considerable trouble is being experienced in checking their raids. An increased number of rangers and strong representations to the Portuguese authorities are expected to put an end to this trouble before long.

The Smallest State in Europe

The Principality of Liechtenstein has the honour of being the smallest State in Europe. It lies amid the mountains on the right bank of the Rhine and forms the boundary between Switzerland and Austria. It is only 65 square miles in area, or less than half the size of Rutland, the smallest county in England. The 11,000 inhabitants of this tiny State have an ideal existence in comparison with the dwellers in larger countries. They have no taxes to pay, wood for their fires and pasture for their cows is free, and at Christmas time their Prince presents them each with a few pieces of silver. In addition, they are not liable for military service.

The Prince, who has ruled for some 70 years, is now very old and not likely to live much longer. Up to the present the essential services of the country have been carried out by arrangement with Switzerland or Austria, and the inhabitants are wondering what is going to happen when their Prince dies. Proposals have been made for joining one or other of the neighbouring countries, but political obstacles stand in the way, and the probability is that Liechtenstein will continue to exist with some form of Government suited to its special needs. It already has a Parliament, for the Prince granted a Constitution when it was seen that Constitutional Government was becoming the fashion in larger countries.

Tourists Bring Their Own Cars Across the Atlantic

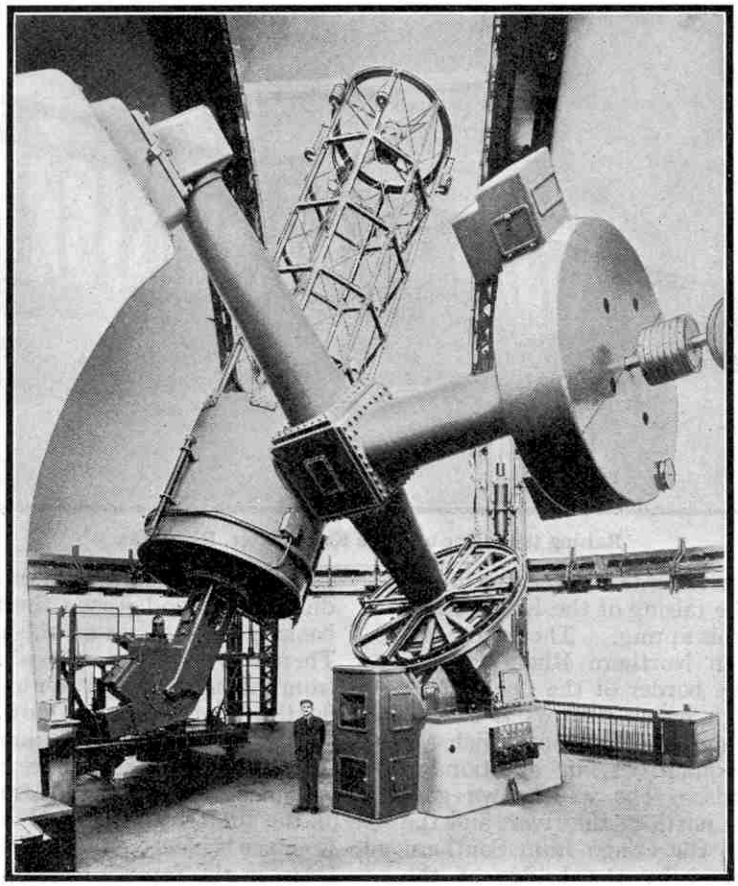
The present season's tourist traffic across the Atlantic has shown a marked increase over preceding years, and the fashion of "bringing your own car" has also grown enormously. In the two services Liverpool-Boston-New York and Liverpool-Quebec-Montreal, no fewer than 150 cars have been carried this season in White Star liners alone. The method of handling these cars, which are uncrated, is to hoist them aboard in specially constructed stretchers that can be adjusted to accommodate various types of car. They are carried " 'tween decks," and so are readily accessible at all times. On arrival at port the cars are ready for the road as soon as they have been lowered over the ship's side.

The Third Largest Telescope

The number of really large telescopes in the world is rapidly increasing. The largest of all is the famous 100 in. reflector at the Mount Wilson Observatory in California, while in the Dominion Observatory at Victoria, British Columbia, is the 72 in. reflector shown in the illustration on this page.

A telescope somewhat less than this has been installed in a splendid observatory recently completed at the Wesleyan University in Ohio. The new telescope is the gift of the late Professor H. M. Perkins and his wife. For more than 50 years Professor Perkins held the Chair of Mathematics and Astronomy in the Ohio University and he and his wife planned and saved over the greater portion of that time with the object, not only of adding a large and magnificent telescope to the equipment of the university, but also of giving the general public an opportunity of seeing the wonders of the heavens with it. Their hopes have now been realised, but only after their deaths. It is satisfactory to know that their aims were practically accomplished before they died, however, for the plans of the new observatory had been completed and the work of erection been in progress for some months.

The instrument is a reflector with a mirror 61 in. in diameter and 9 in. in thickness and it is the third largest in the world. The total weight of the telescope is 37 tons, the mirror alone weighing more than a ton; and four electric motors are incorporated in order to move the huge mass. In its assembly 6,850 parts have been used, the largest of which weighs 6,700 lb., and the smallest only one-thousandth of an ounce!



The 72-inch reflecting telescope at the Dominion Observatory, Victoria, B.C. Compare its great size with that of the man standing near it

The reflector form of telescope is used on account of its light-gathering powers, a refractor using lenses of the same diameter as the mirror being less efficient in this respect. A telescope of this type is specially useful in conjunction with the spectroscope, the wonderful instrument that has taught us so much about the stars by analysing the light received from them. Already many thousands of people have visited the Ohio Observatory, where free lectures and demonstrations are given weekly.

Tinned Foods

The great home of tinned food is the United States, although many other countries are large producers and consumers also. Several hundred different articles, ranging from green peas and spring carrots to soups, sauces and fruits, are produced in Holland, for instance, while sardines come from Portugal and tinned crabs from Japan.

The process used was invented by a Frenchman named Francois Appert a little more than 100 years ago, and was first used in the United States for fish and shellfish about 1819. Since then great strides have been made owing to the introduction of improved mechanical devices and equipment. A great impetus was given to the industry on the outbreak of the American Civil War, when both the Federal Government and the Confederate rebels placed great armies in the field and found that tinned goods offered the best means of feeding them.

To-day preserved foods save an enormous amount of household drudgery and their advocates claim that they are actually superior in many ways to home-cooked foods. This claim is based on the fact that goods are handled in the canning factories while absolutely fresh and sound, and that air is excluded during the cooking process. The result is that the vitamins of such foods as green peas are not destroyed, while there is evidence that the boiling of peas and other vegetables in an open pan lowers the vitamin content considerably.

England's New Forests

No fewer than 157,000 acres of land in England have been planted with young trees since the war ended and before next spring a further 23,000 acres will have been planted. Of the total area about 60,000 acres are privately owned and the rest are under the control of the Forestry Commission. The largest of the forests thus coming into existence is at Thetford in Norfolk. Its area is already greater than that of the historic New Forest in Hampshire, and it is to be extended still further. Altogether nearly 2,000,000 acres of bare or heath-covered land are to be converted into forests.

The proportion of the land surface in England that is forested is not nearly so high as is the case with many other European countries. The present operations may make good in time the losses suffered in the war but it is scarcely likely that England will ever become so rich in forests as France, Germany, Russia, or Scandinavia.

Perhaps the most striking feature of the forests now being planted will be the contrasts they will offer to the type to which we are accustomed in this country. In the New Forest and other typically British forests the trees are chiefly oak, beech, and elm, together with willow and yew; whereas pine, larch, fir, and spruce are the trees chosen for present planting. In addition, the trees in the old forests are scattered irregularly whereas in the new ones they will be arranged in rows in such a manner that each will receive its due share of air and light. The growth of this new system will no doubt change greatly the character of English landscapes in the neighbourhood of forests, giving it a more Continental appearance.

The Secret of the Cuckoo

The secret of the cuckoo's method of placing her eggs in the nests of other birds to be hatched has been revealed at last by two well-known naturalists, who have discovered that the bird does not lay eggs in the nest itself, as was formerly thought, but carries them to the selected nest in her throat.

It was necessary to spend 15 hours in a carefully constructed hiding place in order to solve the mystery. The "hide," which was made of hurdles and straw covered with reeds, was at a distance of eight feet from a reed-warbler's nest. The cuckoo arrived at the nest an hour after the watch commenced and immediately disappeared. Apparently this had been a scouting visit for shortly afterwards she again approached, and clung to the nest with her shoulders level with its top. She thrust her head twice and on withdrawing the second time had a warbler's egg in her beak.

On examining the nest a cuckoo egg was found to have been placed in it. The cuckoo had never entered the nest, nor had her egg been visible as was the warbler's egg taken out. The only possible way in which the egg could have been placed in the nest was by regurgitation from the bird's throat.

Lifting 900-tons through 5 ft.

Big Engineering Feat in South Africa

Raising the bridge over the Kafue River, Rhodesia

ONE of the biggest engineering feats ever attempted in South Africa was the raising of the Kafue River Bridge accomplished this spring. The Kafue is a tributary of the Zambesi, in Northern Rhodesia, and rises in the highlands on the border of the Congo Free State. The district through which it flows is rich in minerals, particularly gold and coal, both of which are extracted in considerable quantities, in addition to silver, copper, and diamonds. The well-known gold field of Broken Hill is to the north of the river, and the railway leading to it and to the Congo from Southern Rhodesia crosses the Zambesi by the bridge at the famous Victoria Falls and then passes over the Kafue River by the bridge that has just been raised.

The importance of the district is growing rapidly on account of its mineral wealth. At present a single line suffices to carry the traffic, even over the Victoria Falls Bridge. It is of interest to note that, although a double track is laid across this bridge, only a single track is used, the tracks being worked alternately for two-year periods in order to equalise the stresses. This double track is to be replaced by a single track laid in the centre of the bridge, but there is no doubt that developments in Central Africa will eventually necessitate the regular use of a double track.

The bridge by which the railway to the Congo Free State crosses the Kafue River has 13 spans, and its length makes it one of the longest in South Africa. The weight of the bridge is 910 tons but little by little this huge weight has been raised 5 ft. above the foundations on which it was built 20 years ago, and this has been done without causing any interruption to traffic.

The lift has been made necessary by the tendency of the Kafue River to overflow. In the rainy season the volume of water flowing down the river is so largely increased that by May it rises up to and above the former level of the track on the bridge and its approaches. Crocodiles and hippopotami abound in the river and during the flood season the former have even been seen basking in the sun on the girders of the bridge itself! There was also a great possibility of damage to the bridge from the pressure of water and impact with the numerous floating islands brought down by the raging floods.

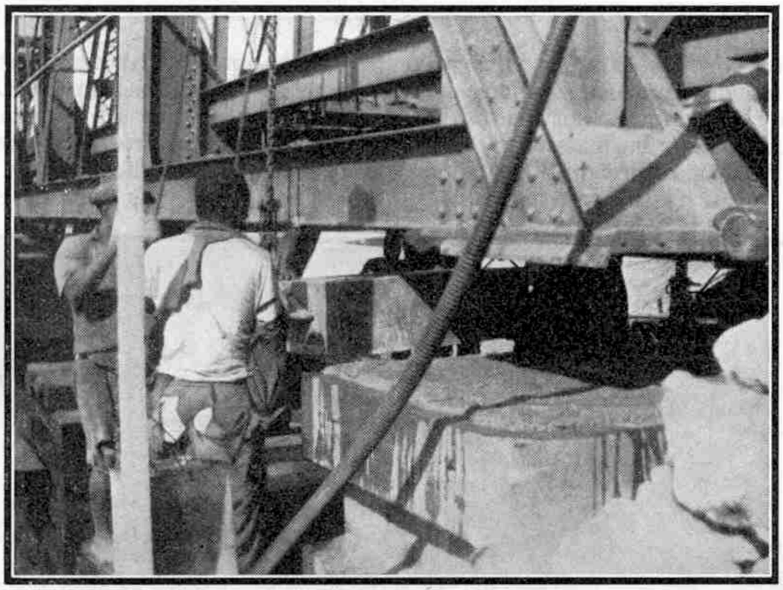
The importance of making the Kafue River Bridge secure against floods arises from the fact that the traffic to and from the Congo forms a considerable proportion of the total traffic carried by the Rhodesian Railways. Reliance is placed almost entirely on the line for transport between the rapidly developing Katanga district of the Belgian Congo and the seaports, and a serious position would arise if any prolonged interruption of traffic took place.

The lifting power required during the operation was supplied by 28 hydraulic jacks, which were placed under the saddle girders joining the spans together. When all was ready the signal to commence lifting was given, and slowly and surely the whole bridge was raised as easily as a motor-car wheel is lifted by an ordinary hand jack. The height to which the bridge was raised in each lift was 10 in., taken in stages of two inches, and huge wooden wedges were inserted during the lifting process to ensure safety. Finally, concrete blocks were swung into position on the top of each pier on which the bridge rested until the next lift.

The operation was apparently simple, but the raising of such a huge mass as 910 tons, spread out over a length of 1,398 ft., requires careful planning and preparation. A crew of natives under the control of a white man was in charge of each jack, two natives manipulating the jack itself while the rest inserted the wedges and drove them home at the earliest possible moment. A steam whistle signalling system was arranged to ensure that all operations were carried out simultaneously. A double whistle was the signal to commence lifting, and it was arranged that if anything went wrong on any one of the piers a red flag was to be raised and a single blast on the whistle stopped all work immediately.

The preliminary operations occupied two months and as the result of minute attention to detail lifting proceeded without a hitch. "Lifting day" in Kafue became a kind of social event, people coming from near and far to see a quarter of a mile of iron girders being raised 10 in. It is interesting to note that the first lift occupied five hours. On that occasion theory was being put into practice, however, and the experience gained resulted in the reduction of the time for the second lift to just over one hour.

A subsidiary operation was the raising of the approach tracks of the railway at each end. This was actually done while the lifting of the bridge was in progress, and the work was quite as successfully carried out as the more difficult operation. The railway from the Cape to the Congo and British Central Africa is now free from interruption by the waters of the Kafue, and the bridge is beyond reach of the crocodiles.



Photos] *[M. Jones, Buluwayo*

Concrete block being added to a pier of the Kafue Bridge while this rests on the jacks

It is interesting to recall similar bridge-moving feats performed in other parts of the world. One interesting case, described in the "*M.M.*" of January, 1926, was the removal of the central span of the temporary bridge erected to enable the necessary repairs to Rennie's Waterloo Bridge in London to be carried out. This was not a case of moving a whole bridge at once, but the task was no easy one, for the span weighed 580 tons. It was first moved a distance of 93 ft. sideways from the place where it was assembled, and then lowered 10 ft. on to its supporting caissons.

Another more recent example is the construction of a railway bridge in the town of Airdrie on the Edinburgh-Glasgow line of the London and North Eastern Railway. A new bridge was rendered necessary by the increasing loads to be carried, and in order to prevent traffic interruption it was first erected on temporary timber trestles alongside the up-line of the permanent way, and when all was ready the old bridge and track were demolished and the new structure jacked up on the bogies that were used for bringing it into position. The existence of a tramcar route under the bridge and other complications made it necessary to construct the bridge 5 ft. above its final level, and when in position the 680-ton mass was lowered by means of jacks on to its permanent bearings.

These two are cases of the reverse operation to that carried out at Kafue. While the weights moved were not inconsiderable, the length of bridge lowered at once in one operation was not nearly so great as that raised in the case of the Rhodesian structure, and it is doubtful if there is any other case on record in which a quarter of a mile of ironwork was moved as at Kafue. The absolute efficiency with which the work was carried out reflects great credit on the engineers of the South African Railways, and it is satisfactory to note that no loss of life or accident of any description marred the proceedings.

Decrepit Soviet Railways

A short time ago Rudzvtak, the People's Commissar for Communications, outlined the position of railway transport in the Soviet Union and his review was a distinctly depressing one. The position as regards rolling stock, he said, was critical. No new tracks had been built during the last years of the war or since the revolution. Works had not yet delivered a single new truck of those ordered in 1925, and there was no hope of receiving any for some time to come—indeed, the works were scarcely yet used to wagon-building.

It would be three years before the output of new trucks would meet requirements. Of the 125,000 trucks which in 1925 lay discarded as beyond repair, only 40,000 remained, the rest having been overhauled and put into service again; but no more could be taken from this source. There were no more reserves to draw upon, and he estimated the figures for 1926 would show a deficiency of 30,000 trucks and 500 locomotives.

The condition of the repair shops, which were fully loaded, was bad. Lathes were almost useless, and much work had to be done by hand. The chief cause of anxiety was, however, the state of the permanent way. In 1923-4 some 400 miles of track were laid, in 1925 some 530 miles, and during 1926 efforts were made to lay about 2,300 miles; but this was a trifle compared with needs—it did no more than keep the main sectors up to the previous year's condition.

Inspection and management are carried out in a slipshod manner, and accidents are on the increase. Drivers and firemen are apt to fall asleep and to pass signals at danger, points are frequently set wrongly, and inspection of trains is neglected. Work generally is "scamped," and fifteen miles of track inspected by the commission a week after it had been relaid had 80 per cent. of the nuts not properly screwed up and 90 per cent. of the spikes not properly driven in!

Apart from all these considerations, the Government had gained the erroneous impression that the railways were a prosperous concern, and had in consequence reduced the Budget allocation to an amount, which did not meet working expenditure!

Model Yachts at Bournville

One of the latest pastimes that have become popular among the employees of Cadbury Brothers Ltd., Bournville, is model yacht building and sailing. Some time ago this firm provided a lake at the Rowheath section of their recreation grounds which has resulted in an enthusiastic development of this pastime. A boat-building class has also been formed and now there are upwards of 30 yachts—five raters, six metre 1 in., and 36 in. models, connected with the club. Yacht building seems to fascinate young and old of both sexes, and sailing appeals equally to spectators and competitors alike. Competitions have been organised during the past summer and have included two series of class championships, with spoon contests, each Saturday, all of which have proved both attractive and successful. The Bournville Yachting Club has also been represented at the International Model Yacht Race trials at Gosport by six metre 2 in. boats belonging to the Club's Commodore.

It is interesting to note that passing from the sailing of these tricky models some members of the club are now turning their attention to the construction of model aeroplanes and gliders, for which the breezy slopes of the playing fields of Rowheath are particularly suitable.

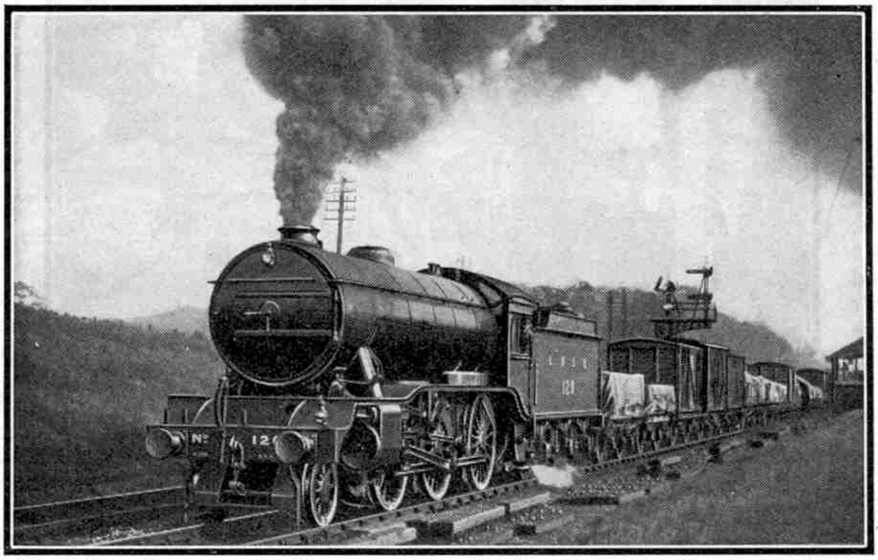
There are, of course, many other educational, recreational and musical activities connected with Bournville from administration courses to girls' boot repairing classes, and from banjo and step-dancing to Gilbert & Sullivan opera. On any Saturday afternoon at Rowheath you may find upwards of 500 girls and boys strenuously engaged in football, hockey, cricket, tennis or net ball.

Moving the Nation's Merchandise

Work of Railway Goods Yards

By J. R. Hind

MOST people are more or less familiar with the everyday operations of passenger stations but few people have any adequate idea of the routine of a busy goods depot unless their business happens to take them there. The running of freight trains does not appear as romantic or as fascinating as that of passenger express trains, but nevertheless it is a fact that the handling of goods, minerals and merchandise is of much greater importance to the nation than the carrying of passengers and their luggage. The unseen manœuvring in railway goods yards, depots and sidings keeps Britain's industries on the move.



L.N.E.R. Fast Goods Express

In the principal railway goods yards, freight trains are worked according to schedule much in the same manner as in large passenger stations; but apart from the loading and unloading docks and warehouses there are no raised platforms. A goods station consists of a collection of railway sidings with road access between.

Let us pay a visit late one afternoon to a busy goods depot. An express goods train is about to start away with its cargo of foodstuffs and perishables for delivery some hundreds of miles away on the following morning. This is quite an aristocrat among freight trains for it is required to obtain speeds up to as much as 60 miles an hour. It is known by a number only—"No. 327 Down"—and it leaves at a regular booked time every day—3.40 p.m.

On the loading-bank warehousemen are wheeling across into the train on one side of the platform, packages from the carts, vans and lorries that have backed up against the other side. Meanwhile checkers at small desks make out bills or consignment notes. Meat, fish and flowers are but a few of the many miscellaneous items that are going by this train of covered trucks. As the loading on each wagon is completed a policeman with a bunch of leaden seals and a pair of pliers makes sure that everything will remain intact en route.

Away at the front of the train a fast freight locomotive gently backs on and the warehouse staff look up from their tasks for a moment. The most critical moment of the hour has arrived; will the driver succeed in "creating the vacuum" throughout the whole length of the train? Freight trains that travel at more than 40 miles an hour are fitted with individual brakes similar to those used on passenger trains; and it is quite possible that in this long train there may be a leaky connection between two of the vans or elsewhere.

The driver pulls over the small handle of his brake ejector and looks at the gauge—it shows 10 degrees only! There is a leak somewhere. A hurried search between the trucks is made by a number of shunters and the guard of "No. 327" looks anxiously at his watch and at the foreman. Will one of the trucks have to be unloaded and replaced by another?

But now the leak is found and rectified and all in readiness for starting. So with green flag and whistle, and signals off ahead, the express goods pulls away into the outside haze.

In the offices nearby numbers of clerks are employed in making out invoices, notes and accounts. Each item of goods whether it be a single sack of grain or several huge steel girders must be "classified," or described so that the correct charge, no more and no less, may be made for its transport. Each item or bunch of items is known as a "consignment." Every consignment has its note, one copy of which accompanies it on its journey, in charge of the guard, while the other is put away for reference at the sending station. As the goods trains come and go, their batches of consignment notes require much attention especially by the checkers on the banks or goods platforms.

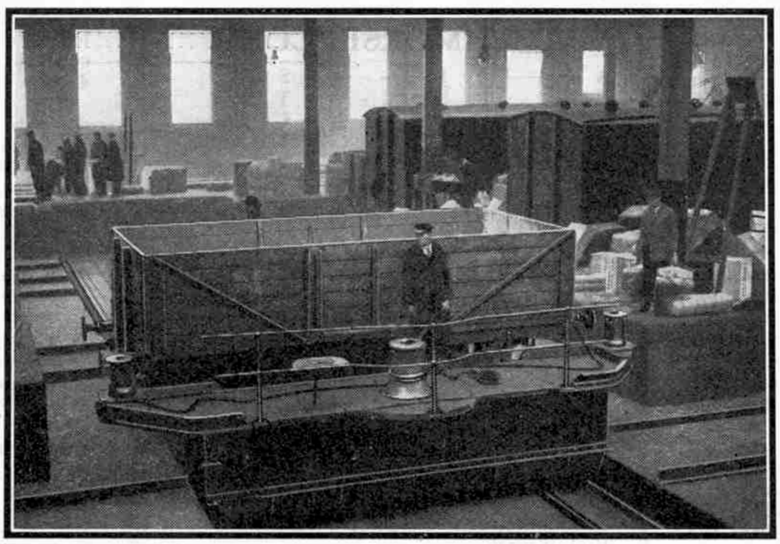
Near to the entrance of the goods stations are the weighbridges on which the vans and wagons are stopped in order that the weights of their consignments may be noted. On each truck is marked the "tare" or empty weight and by subtracting this figure from the total weight of truck and load the net weight of the consignment is obtained. Separate weighbridges are often used for "inwards" and "outwards" traffic. When a long miscellaneous goods train arrives at the depot, couplings are disconnected so that individual wagons may be manœuvred into positions where there loads may be dealt with most readily. For example several wagons may be tucked away on an upper or lower floor by the help of huge lifts fitted with lines and capable of raising a wagon complete. Two ropes coiled around capstans, electrically or hydraulically spun help to haul these wagons to and from the lifts and elsewhere.

In some depots a wagon-carrying apparatus known as a "traverser" is used to move the trucks sideways when necessary. The wagon concerned is run on to a steel frame which travels on its own track at right-angles to the running lines. A tow rope is attached to the traverser, the wagon is fastened so that it will not run off its temporary berth and the whole apparatus with its heavy burden moves over the tracks until the required position is reached. The wagon is then towed off the traverser. All the moving and pulling needed in this operation is carried out by capstans. Traversers save a great deal of shunting.

Potato traffic on the slip line at Sheffield

When the loading and unloading banks of a goods depot are really busy, the scene appears to be one of absolute chaos. This is especially the case on the arrival in the morning of the night freight trains or again when the day's consignments of outward freight have been collected from works and ships in the late afternoon for despatch in the reverse direction. Sometimes full hampers of goods are received at the depots in the early morning and the same hampers are returned empty in the same wagons soon after midday.

Out in the open where the sidings are situated which constitutes the goods "yard" proper, small pilot engines shunt the wagons into their proper sequence so that all the wagons for one place are together and each batch of wagons is in the best position for being detached at its appropriate station. A considerable amount of skill is necessary to marshal the wagons in this manner with the smallest number of engine movements. From 50 to 100 goods trains may come and go at a large depot during 24 hours so that the handling of their many wagons is no small problem.



Traverser at work at Farringdon Street Depot

At a goods depot, two main classes of traffic are dealt with. First of all there is the "S. to S." or "Station to Station" traffic which is brought to and collected from the railway station by the firms concerned. There is also "C. and D." or "Collection and Delivery" traffic in which the railway company does all the cartage to and from the railway.

In order to deal with "C. and D." freight the railways keep numbers of cartage horses, lorries and vans. One British railway alone, in addition to a large number of motor vehicles, maintains a stud of more than 4,500 horses used for this work and for wagon shunting at stations. These railway horses are mainly of the light draught type and are stabled at the depots. Special hospitals and veterinary surgeons look after the welfare of these energetic railway helpers who usually are so well looked after that it is no uncommon thing for them to take prizes at public parades and shows where they may be exhibited.

The vanmen who collect and deliver goods usually have two horses, the first being worked during the morning with consignments brought in by the night trains. He does not usually collect on this round but works his way back to the starting point usually in time for lunch! In the afternoon the vanman's second horse works the collection round.

The preparation and distribution of provender for the large number of horses employed requires considerable organisation and several large factories or depots are maintained by British railways. Forage is sent to these depots from all parts of the country. A comprehensive plant for chopping and cleaning hay, crushing oats, maize and beans, and mixing and weighing the horses rations, makes the provender uniform in composition all the year round. Hundredweight sacks of this provender are sent to all the different goods stations at which horses are employed at the rate of so many sacks per week, and the rations are carefully measured out each day so as to keep the horses in the splendid condition in which we are accustomed to see them.

During recent years the horse-drawn lorry has had to face very formidable competition on the part of the motor lorry. For many purposes it holds its own however and is likely to continue to do so.

Electricity Applied to Meccano

IV.—Meccano Electric Telegraph System

In last month's "*M.M.*" we described how various types of switches and a Coil-winding Machine could be built with the aid of the Meccano Electrical Parts. This month we shall endeavour to show how a simple but extremely interesting telegraphic system may be constructed.

Many "*M.M.*" readers are the happy owners of wireless sets, and at times some may have thought and said things about Morse signals which so often break into an enjoyable broadcast programme. To learn the Morse code requires a good deal of patience and practice, but when one is proficient many enjoyable hours can be passed by listening in to the various Morse stations on the different wave lengths. For example, weather reports—a very useful feature in these days—are frequently sent out in Morse by the Air Ministry, whose call sign is G.F.A. Also much enjoyment can be derived from following the messages from ships and coast stations.

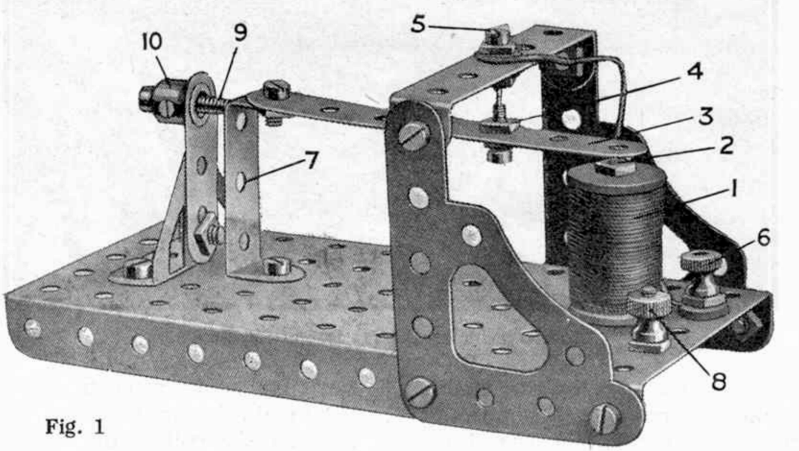


Fig. 1

In order to become an efficient interpreter or sender of messages in Morse, a Morse "key" and "buzzer" are necessary. The former instrument is a type of switch which, when manipulated, causes the buzzer to emit the long and short sounds of the Morse code. Both instruments may easily be made in Meccano and the models about to be described are capable of giving good results if careful attention is paid to their construction.

The magnet coil 1 in the buzzer (Fig. 1) is a Meccano Bobbin wound to capacity with No. 26 S.W.G. Copper Wire. The Meccano coil-winder described last month should be used to wind the Bobbin. The latter is secured to the Flanged Plate by a Core Piece 2, whose upper end forms the pole of the magnet. Above the coil is the $3\frac{1}{2}$" Strip 3 which constitutes the vibrating armature, a Contact Screw 4 being bolted to it as shown in the illustration. A second Contact Screw 5 is mounted on a $2\frac{1}{2}$" Double Angle Strip and insulated from it by means of an Insulating Bush and Washer. One end of the coil winding is brought to this contact 5, the other end being taken to the insulated Terminal 6.

If the Accumulator is connected directly to the Terminals, the current passes through the turns of the coil 1, across the contacts 4 and 5, along the armature 3 and by passing down the $1\frac{1}{2}$" Double Angle Strip 7, which supports the armature 3, it returns to the Accumulator through the Flanged Plate and uninsulated Terminal 8. The current must follow a path of very low resistance in passing through the metal framework of the model. In view of this, the use of nickelled parts is preferable to that of coloured parts, as the enamel on the latter tends to insulate the various parts from each other. If enamelled parts are used, a wire connected between the Contact Screw 4 and the Terminal 8 will assist the flow of the current.

Since the current flows through the coil the latter becomes magnetised, of course, and the armature is attracted to it. This results in breaking the circuit feeding the magnet, for the Contact Screws are drawn apart. But immediately this happens the magnet becomes de-energised and is unable to hold the armature; the latter therefore flies back and makes contact again with the screws 4 and 5. The cycle of operations is then repeated at an extremely rapid rate, and the vibrations of the armature produce a musical note.

A $\frac{3}{4}$" Bolt 9 inserted in a Threaded Crank 10 presses against the $1\frac{1}{2}$" Double Angle Strip 7; by increasing or diminishing the pressure of the bolt on the Double Angle Strip the pitch of the note may be varied to suit individual requirements.

Morse Key

A Morse Key must be capable of two important adjustments, viz., the gap, that is the vertical movement of the bar of the key, and the tension of the spring. In the key about to be described, both these adjustments may be effected.

The front contact 1 (Fig. 3) and the back contact 2 consist of 6 B.A. Bolts insulated from the Flanged Plate, which forms the base of the model, and secured to it by two nuts. The contact 1 is connected to the insulated Terminal 3 by a short length of wire beneath the plate, and contact 2 to the insulated Terminal 4 by a similar means.

The corresponding portions of the contacts 1 and 2 are mounted on the bar of the key as shown in the illustration. That corresponding to the contact 1 consists of a $\frac{3}{4}$" Bolt 5 carried in the spider, or centre collar, of a Universal Coupling that is secured to the bar of the key by two nuts and bolts. A Washer inserted under the head of each bolt prevents their shanks binding on the $\frac{3}{4}$" Bolt 5. By turning this Bolt the vertical movement of the bar, or gap as it is termed, may be diminished or increased according to whether the Bolt 5 is screwed in or out of the "spider." The portion of the contact 2 mounted on the bar takes the form of a 6 B.A. Bolt 6 secured to a Double Bracket 7. Both the contacts on the bar are in electrical connection, through the frame of the model, with the Terminal 8; hence the entire model should be constructed of nickelled parts for the same reasons as those stated in connection with the model buzzer. If enamelled parts are used a wire should be taken from the Terminal 8 to each of the bar contacts.

The $\frac{3}{4}$" Bolt 9 is carried in a "spider" in a like manner to the adjustable front contact bolt 5, and presses on the head of a Spring Buffer 10. By screwing the $\frac{3}{4}$" Bolt in or out of the "spider" the Buffer is compressed to a greater or

THE MORSE CODE

A	. –	J	. – – –	S	. . .
B	– . . .	K	– . –	T	–
C	– . – .	L	. – . .	U	. . –
D	– . .	M	– –	V	. . . –
E	.	N	– .	W	. – –
F	. . – .	O	– – –	X	– . . –
G	– – .	P	. – – .	Y	– . – –
H	. . . .	Q	– – . –	Z	– – . .
I	. .	R	. – .		

Numerals

1	. – – – –	6	– . . . .
2	. . – – –	7	– – . . .
3	. . . – –	8	– – – . .
4	. . . . –	9	– – – – .
5	. . . . . or .	0	– – – – – or –

Punctuations, etc.

Full Stop	. . . . . .
Comma	. – . – . –
Commencement of work	– . – . –
End of work	. – . – .
End of Transmission	. . . – . –
Please send (K)	– . –
Understood (R)	. – .
I have something for you (QTC)	– – . – – – – . – .
I have nothing for you (QRU)	– – . – . – . . . –
Gale Warning (TTT)	– – –
Signal of Distress (SOS)	. . . – – – . . .
Interrogation	. . – – . .

lesser degree. The key may thus be adjusted to suit one's hand, for some people prefer a light, and others a strong, tension on the spring.

Simple Buzzer and Key Circuit

Having constructed both models it only remains to connect them together. The necessary connections for sending in one direction only are shown in Fig. 2. A suitable length of 23 Gauge copper wire is taken from one of the Accumulator terminals and attached to a terminal of the buzzer (it is immaterial which one). The other buzzer terminal is connected to the Terminal 4 of the key, and a length of wire is taken from the Terminal 8 of the key to the remaining terminal on the Accumulator. When the key is depressed the current flows from the Accumulator along the bar of the key, etc., across the back contact 2 (Fig. 3), to the Terminal 4, and then through the buzzer back to the Accumulator.

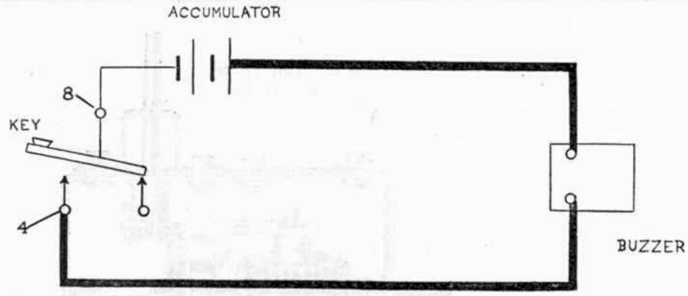


Fig. 2

"*M.M.*" readers would do well to practice the Morse Code on the Meccano set described above. Letters in the code consist, of course, of a series of dots and dashes, which are produced on the buzzer by pressing on the key for short or long intervals. A list showing the Morse equivalents to the alphabet, numerals, and the more important punctuations, etc., is included on these pages.

When sending a message the key should be manipulated by placing the first and second fingers of the right hand on the knob of the key and working the wrist up and down, keeping the fingers perfectly still. A dash should be three times the length of a dot, and until one is proficient it is a good plan to raise the hand slightly from the knob between each letter in order to preserve the correct spacing. A slightly longer interval must occur between each word.

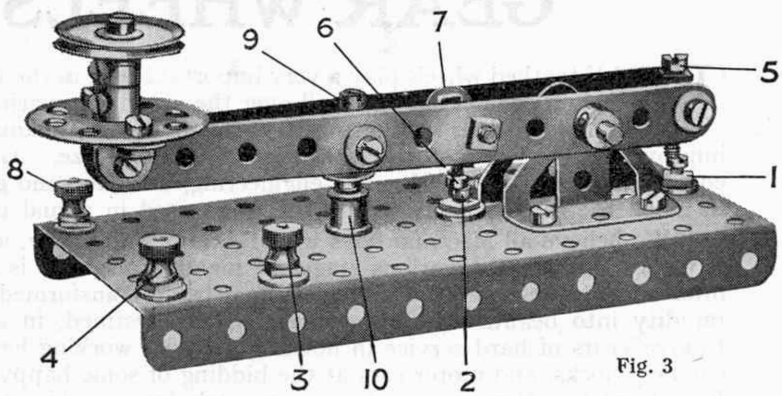


Fig. 3

After a time it should be possible to send and receive Morse code messages at quite a useful speed. One may then endeavour to listen-in to some of the slower Morse stations.

It is well known how resistance affects the current flow in a wire, and why, if the length of wiring in a circuit is increased, it is necessary either to increase the applied voltage or increase the gauge of wire in order to keep the current in the circuit at the same value. Therefore when we are rigging up our stations we must bear in mind that while the 4-volt Accumulator will enable messages to be sent over a distance of approximately 25 yards it would be necessary to double the voltage by connecting two 4-volt Accumulators in series, if it is required to send messages over a distance of 50 yards, and so on. As most boys have not access to two or more accumulators, it is proposed to show how the same results may be obtained by other means.

Supposing two points are connected by a single wire of, say, 23 gauge, having a resistance of two ohms. Then if the two points are joined by a second wire of the same gauge and length as the first, in addition to the latter, we shall find that the resistance is now only 1 ohm. Wires arranged in this manner are said to be in parallel. In the above case the two wires in parallel reduce the resistance by half, and three in parallel would bring the resistance down to one third of the original, because we have in reality increased the cross sectional area of the resultant conductor by adding two or more wires in parallel.

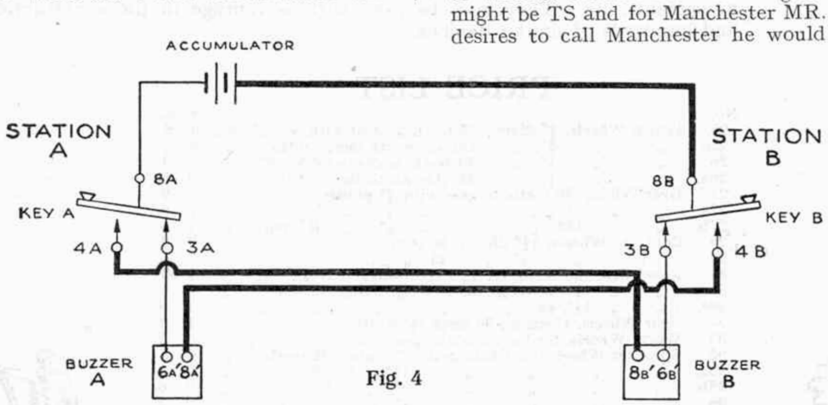


Fig. 4

We have therefore a convenient means of increasing the range of our set without increasing the voltage of the Accumulator. For by having two wires in parallel we should be able to transmit 50 yards instead of the 25 yards possible with only the single wire.

Two-Way Circuit

After making the simple buzzer and key circuit just described, we may devote our attention to the setting up of a double circuit set. Two buzzers and two keys are required, and by arranging the wires two or more in parallel, it should be possible to send and receive messages from a friend's house some distance away. It is scarcely necessary to add that a great deal of fun, not to mention instruction, may be obtained with an arrangement of this kind.

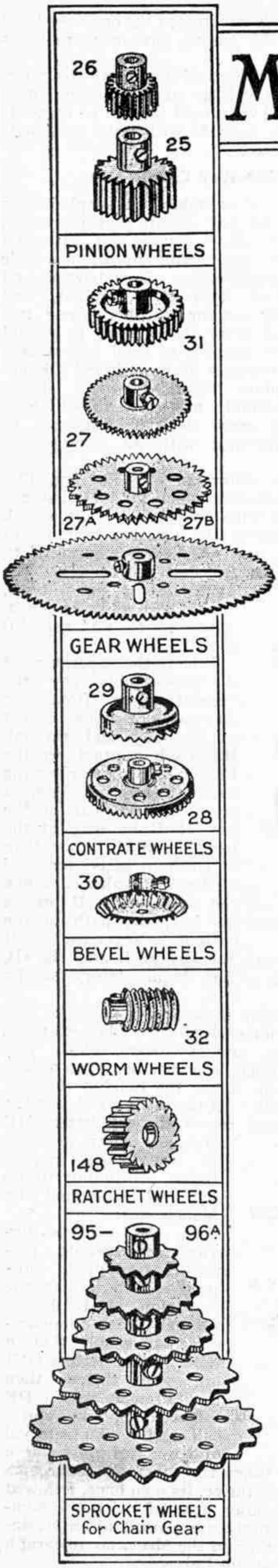
The necessary connections are shown in the diagram, Fig. 4. All lines drawn thick are conductors which for long distance work may be composed of several wires in parallel. Let us call the two stations A and B. Connect the positive terminal of the Accumulator to terminal 8A, and the negative terminal to 8B. Terminal 4A is connected to 8B′ and 8A′ to 4B. The remaining connections, which need only be short, are: 3A to 6A′ and 3B to 6B′.

When the operator at A presses his key the current flows from the Accumulator along the bar of the key and through the back contact to the buzzer at B. After leaving the buzzer, the current passes to the bar of the key at B by way of the front contact, and then on to the negative terminal of the Accumulator. When the operator at B presses his key, the path of the current is reversed, for it flows from the Accumulator through the key at B and via 4B, 8A′, 3A, and the key at A, back to the Accumulator, thereby causing the buzzer at A to sound.

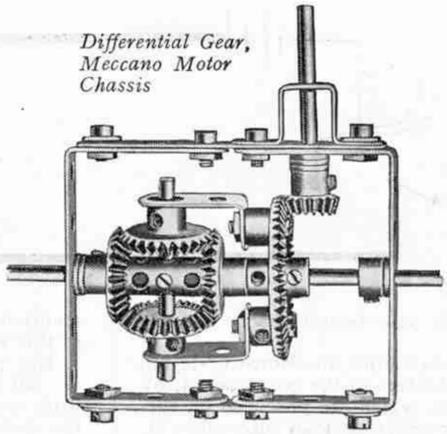
The best way to send and receive messages on a set of this description is to have a call sign for each station. For example, one station might be called ABC and the other XYZ. This procedure is adopted in actual practice, for every telegraph as well as wireless station has a call sign. Thus, for London the sign might be TS and for Manchester MR. If the operator at London desires to call Manchester he would repeat the call letters MR thrice. After a pause he would again repeat them, continuing to do so until answered by Manchester.

In the wireless service a different procedure is adopted. Suppose a ship having the call sign MME desires to get into communication with Niton (GNI). The letters GNI are sent thrice, then the French word DE followed by the ship's call sign. An interval of 3 minutes must elapse before the call can be repeated. When the coast station accepts the call, it sends the ship's call signal thrice, its own once, followed by " K," signifying that the ship may proceed with the communication. Meccano boys may obtain much fun and entertainment by corresponding with each other on the Meccano telegraph set if they follow out the methods outlined above.

MECCANO ACCESSORY PARTS



Differential Gear, Meccano Motor Chassis



GEAR WHEELS

TO-DAY toothed wheels play a very important part in the transmission of power, and engineering firms all over the world are sparing neither time nor trouble in their efforts to perfect the methods of manufacture and to improve the efficiency of gears of every imaginable size. Gear wheels are equally indispensable in Meccano engineering, and Meccano gears are made in much the same manner as are the gears used in actual practice.

We believe all Meccano boys would like to watch, say, a "No. 27" as it passes through the various stages of manufacture. It is certainly very interesting to observe solid pieces of brass being transformed with amazing rapidity into beautifully finished gear wheels destined, in all probability, to give years of hard service in hoisting loads or working hammers, lathes, engines, clocks, and motor cars at the bidding of some happy Meccano boy. Each tooth in a Meccano gear is cut separately by a machine that is a marvel of precision, and the accuracy of the operation, together with the fact that the wheels are made of the finest metals only, explains why Meccano gears work so smoothly.

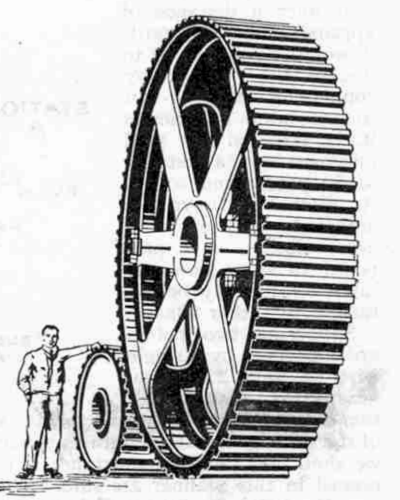
Meccano gears, like all other Meccano parts, are put to innumerable uses in addition to model-building. They are employed by engineers, students and professors of engineering, inventors, builders, and mechanics. Big engineering firms use them to demonstrate the working of the various machines they manufacture, as well as to try out new ideas and movements, etc. They may be used with advantage in the construction of radio sets and hundreds of similar devices.

PRICE LIST

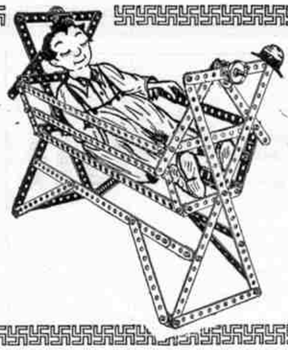
No.			s.	d.
25.	Pinion Wheels, ¾" diam., 25 teeth, to gear with No. 27	each	0	6
25a.	" " ¾" " Double width face, ditto	"	0	9
26.	" " ½" " 19 teeth, to gear with No. 27a	"	0	4
26a.	" " ½" " Double width face, ditto	"	0	6
27.	Gear Wheel, 50 teeth, to gear with ¾" pinion ...	"	0	9
27a.	" " 57 " " " ½" " ...	"	0	9
27b.	" " 133 " " " ½" " 3½" diam.	"	1	6
28.	Contrate Wheels, 1½" diam., 50 teeth	"	0	9
29.	" " ¾" " 25 "	"	0	6
30.	Bevel Gear, 26 teeth, for 1 : 1 right-angle drives ...	"	0	10
30a.	" " ½", 16 teeth, for 1 : 3 right-angle drives ...	"	0	6
30c.	" " 1½", 48 " " " " ...	"	1	3
31.	Gear Wheels, 1" diam., 38 teeth (¼" width)	"	1	0
32.	Worm Wheels, for big reduction gear, etc.	"	0	6
95.	Sprocket Wheels (for Chain gear), 2" diam., 36 teeth	"	0	5
95a.	" " " " 1½" " 28 "	"	0	4
95b.	" " " " 3" " 56 "	"	0	6
96.	" " " " 1" " 18 "	"	0	3
96a.	" " " " ¾" " 14 "	"	0	3
148.	Ratchet Wheels, for Pawl and Ratchet Gear	"	0	9

Ask your dealer for a complete list of Accessory Parts or write for one to

MECCANO LTD., LIVERPOOL



"WHEELS OF INDUSTRY"



Another New Meccano Model-Building Contest

A GREAT OPPORTUNITY FOR MODEL-BUILDERS

FIFTY-ONE valuable prizes, as well as many Certificates of Merit, will be given away in this competition. This means that when the competition has closed, fifty-one Meccano boys will have much larger Outfits than before, and many other competitors will also have something to show as a mark of their success as Meccano model-builders. Have *you* yet won a prize in a Meccano contest ? If not, there is no reason why you should not do so in this month's competition if you set to work right away to build a model that is both new and original.

Hints to Competitors

When about to construct a competition model, many Meccano boys place their Outfits before them and then try to think of a new model that they can build. This procedure is not the best method by which to set about winning a prize, however. What Meccano model-builders should do is to map out their models in their minds long before they start the actual construction. There should be no dearth of ideas for new models ; to the boy who keeps his eyes open new suggestions will present themselves every day. For example, what a number of ideas for new models can be gathered from a short railway journey ! Even a cycle or motor-car ride always produces a host of " brain-waves."

Give your imaginative powers full rein, put forward your best creative effort, and your success in the competition is certain. But do it now. Those who put off the construction of their models until " to-morrow " often find to their sorrow that the closing date of the competition has arrived while " to-morrow " is still just as distant !

Any number of parts may be used in the models submitted. A word of warning is necessary here ; do not make the mistake of thinking that because you have a No. 7 Outfit you naturally stand a greater chance of winning a prize than a competitor who has only a 00 Outfit. As a matter of fact the owner of the 00 Outfit has just as good a chance of winning the First Prize as you have. Similarly, do not think that because you are not as old as another competitor you do not stand such a good chance of success. You do ! For in this competition, as in all Meccano competitions, the age of the competitor is specially considered when the prizes are being awarded.

Having completed your model the next step is to photograph it. If you do not possess a camera get a friend to do it for you. A good clear photo gives the judges more information about your model than several pages of description. The photograph need not be your own work.

If you are unable to obtain a photograph of your model a clear drawing will do just as well. Whether you send a photograph or a drawing you should state what your model is and mention any points of particular interest. If there are any details in your model that are not very clear, you should write out the necessary explanation, using one side of the paper only, and send it along with the photograph or drawing.

Entries should be as neat and straightforward as possible, but naturally the construction of the model is the most important consideration. This must be the result of your own unaided efforts.

Many of our readers seem to be under the impression that in order to win a prize in a Meccano model-building contest one must be something of an inventive genius. This is far from the truth, however. Any boy with average intelligence can enter this competition with the knowledge that he has a good chance of winning a prize.

All models submitted must of course be new (we do not want to find amongst the entries some old friends from the early Meccano Manuals !) and if not of practical use they should be fairly faithful reproductions of their prototypes. If suitable, the prize-winning models will be included in future editions of the Instruction Manuals and other Meccano publications.

Entries will be divided into three separate sections, as follows. Section A, for competitors residing in the British Isles and over 14 years of age. Section B, for competitors residing in the British Isles and under 14 years of age. Section C for competitors residing Overseas.

Important Instructions

Do not send the actual model. A good photograph or a clear drawing is all that is required. Your photographs or drawings, if unsuccessful, will be returned providing that a stamped addressed envelope of the necessary size is enclosed with your entry. It should be noted, however, that photographs of prize-winning models become the property of Meccano Ltd. When sending in your entry remember to write your name and address on the back of each photograph or sheet of paper used, together with your age, name of the competition (" February " Model-building Competition) and the Section in which the model is entered. Address the envelope " February " Competition, Meccano Ltd., Binns Road, Liverpool.

Entries for Section A and B must be received by 31st March, 1928. Closing date for Section C: 30th June, 1928.

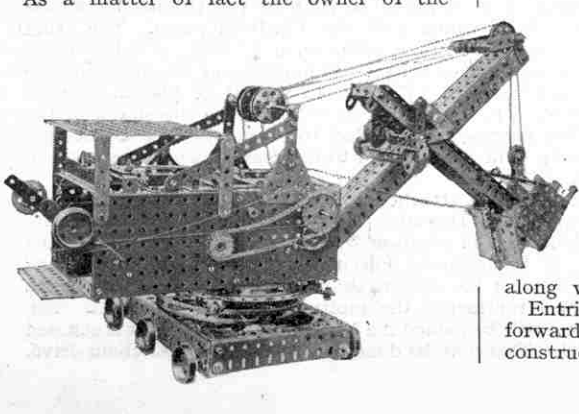
LIST OF PRIZES

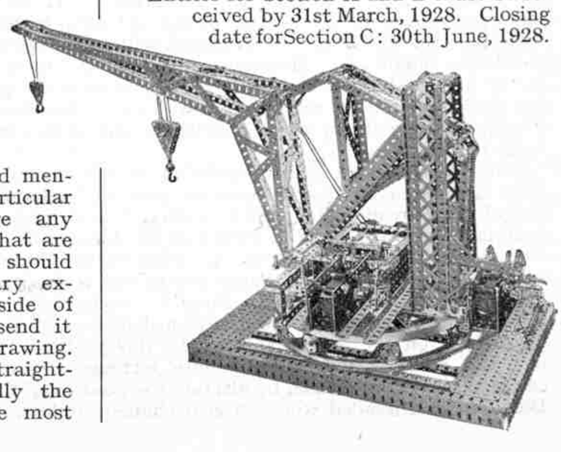
The Prizes to be awarded in Sections A and C are as follows :—

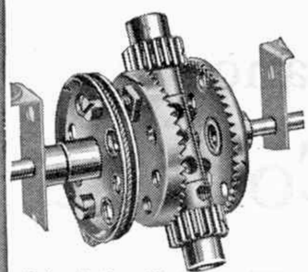
- First Prize ; Cheque for three guineas.
- Second Prize ; Cheque for two guineas.
- Third Prize ; Cheque for one guinea.
- Six prizes, each consisting of Meccano products to the value of 10/6.
- Twelve prizes, each consisting of Meccano products to value 5/–.
- A limited number of Certificates of Merit and complimentary copies of " Meccano Standard Mechanisms " Manuals.

The Prizes in Section B are as follows :—

- First Prize, Meccano products to value two guineas.
- Second Prize, Meccano products to value one guinea.
- Third prize, Meccano products to value 10/6.
- Six Prizes, each consisting of Meccano products to value 5/–.






Epicyclic Gear Clutch Mechanism

Suggestions Section

Edited by "Spanner"

(110)—A New Infinitely-Variable Speed Gear

(F. V. Fowler, Newport, Mon.)

THE articles in the April and May, 1927, issues of the *"M.M."* dealing with the Constantinesco Torque Converter aroused great interest among Meccano boys and many *"M.M."* readers constructed the Meccano model of the converter. Below we describe a new model, submitted by F. V. Fowler, which in many respects is similar to the Constantinesco apparatus.

While constituting no real advance on the Meccano model of the Torque Converter, Fowler's model is extremely interesting and should prove of use in many Meccano models where a variable gear-changing mechanism is required. The main difference between the Meccano version of the Constantinesco Torque Converter and the model illustrated in Fig. 110 is that in the case of the former the speed ratio varies automatically when different loads are placed on the driven shaft, while in the latter model the speed is varied by manipulating the hand wheel 2. Many of our readers will no doubt find a use for this new variable gear in their models. It is often required to vary the speed of the driven shaft, even though the load remains constant.

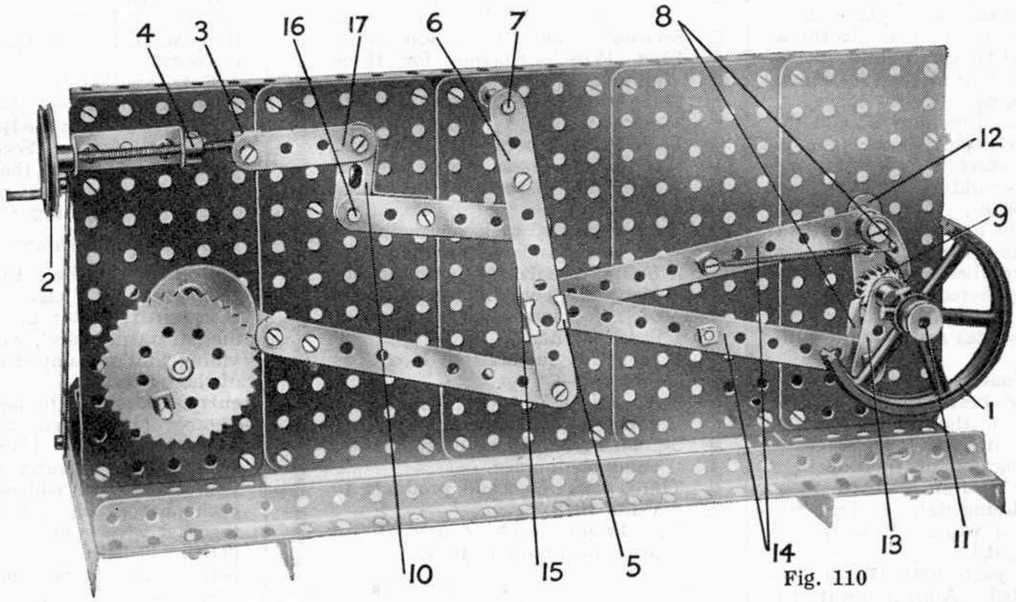


Fig. 110

The operation of the model is as follows. If a heavy load is to be placed on the driven shaft carrying the Flywheel 1 then the hand wheel 2 should be turned in a clockwise direction until the Threaded Boss 3 bears against the Collar 4. This will cause the Eye Piece 5 to slide up the 4½" Strip 6. If oscillations are now transmitted to the bottom of the 4½" Strip 6 the Eye Piece with the two 5½" Strips 14 attached will move through a comparatively small arc. Maximum leverage will then be applied to the driven shaft, since the Eye Piece is near the pivot 7. As the Eye Piece moves, the Pawls 8 will rotate the Ratchet Wheel 9 and, working under these conditions, the model may be said to be in "low gear."

When the hand wheel 2 is rotated in an anti-clockwise direction until the Threaded Boss 3 bears against the Collar fixed on the end of the Threaded Rod, the Eye Piece 5 is pushed down to the bottom of the 4½" Strip 6. Then if the latter is oscillated, the Eye Piece with the 5½" Strips attached moves through a larger arc and consequently the Pawls rotate the Ratchet Wheel at a greater speed, but as the Eye Piece 5 is some distance from the pivot 7 the leverage will be diminished and a smaller force will be exerted on the driven shaft. In this position the model is in "top gear." Many intermediate settings of the Eye Piece can be obtained, of course, by altering the position of the Threaded Boss on the Threaded Rod. A gear-change similar to that found in an automobile may be incorporated if desired by dispensing with the Threaded Rod and hand wheel and fitting a lever to the Bell Crank 10. This lever could work in a slot or quadrant composed of Curved Strips, as in the New Meccano Motor Chassis.

Construction of the Model

The base of the model consists of two Flanged Plates joined together by 12½" Angle Girders, the second Girder being bolted to the Flanged Plates six holes from the front. Five 2½" × 5½" Flat Plates are fastened to this girder and a second Angle Girder is bolted to the top of the Flat Plates.

Two 5" Axle Rods are journalled in the Flat Plates in the positions shown, a further bearing being provided for them by bolting 2½" Triangular Plates to the ends of the base plates.

"M.M." readers who have experimented with the Meccano Torque Converter will no doubt be conversant with the pawl and ratchet mechanism, but for those who have not done so a little explanation may be necessary. The Rod 11 is first held in its bearings by two Collars placed one on each side of the 2½" Triangular Plate. A Crank 12 is then slipped on the rod with its boss against the Flat Plate. This Crank must be allowed to revolve freely on the Rod 11. The Ratchet Wheel 9 is then locked to the Rod next to the Crank and a second Crank 13, with set-screw removed, is pushed into place. The Flywheel 1 is lastly secured to the Rod.

A 5½" Strip 14 is attached to each of the Cranks by means of the Pivot bolts which hold the Pawls in place. The other ends of the Strips 14 are pivoted on a ¾" Bolt, a Collar being slipped between the two Strips. Before passing the bolt through the Collar and Strips a 1½" Strip 15 should be placed upon it. The Eye Piece 5 is secured by its set-screw to the shank of the ¾" Bolt. The bearing for the Rod 16 supporting the Bell Crank 10 is a Double Bent Strip bolted to the rear of one of the vertical Flat Plates.

The 2" Strip 16 is attached to the Bell Crank by a bolt and two nuts while the Threaded Boss 3 is connected to its other end by a bolt held in position by a nut screwed tightly against the Boss. A triple-throw Eccentric, giving a 1" throw, and a 4½" Strip connect the driving shaft and the Strip 6. Although a hand wheel represents the motive power in the illustration, much interest will be gained if a Meccano Electric Motor is coupled to the model. This may be done by using a Sprocket chain drive.

(111)—Automatic Reversing Device

(J. Gladwin, Crosby, Scunthorpe)

Many Meccano boys who have built model motor cars, engines, etc., incorporating the Clockwork Motor will have experienced the annoyance of being unable to control their models once they are set in motion without following closely after them to manipulate the brake and reversing levers. The device illustrated in Fig. 111, however, eliminates the necessity of constant attention to a clockwork-driven model. If placed on the floor of a room directly opposite two walls a model fitted with this device will run to and fro without supervision, for its mechanism is reversed each time it strikes one or other of the walls. Therefore, once the Motor has been wound up and released, the model will travel up and down the room until the spring is exhausted.

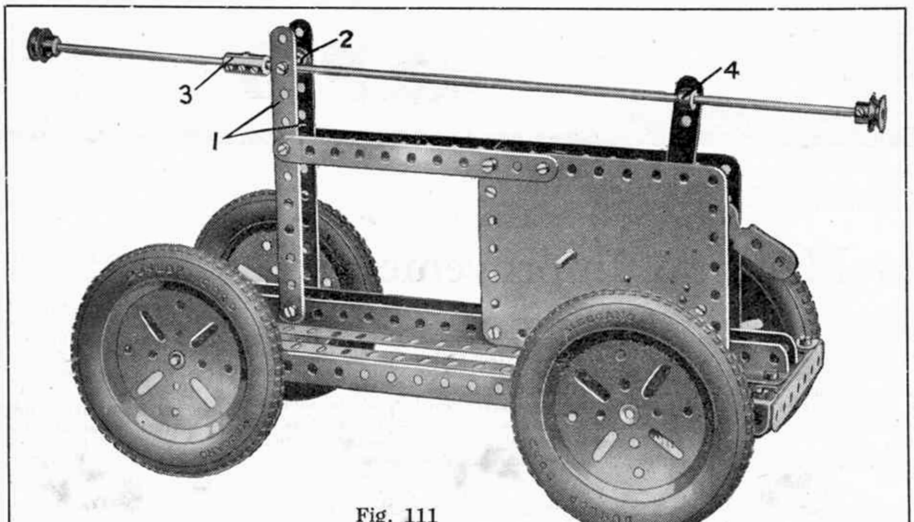


Fig. 111

It should here be noted that the model illustrated in Fig. 111 was designed for demonstration purposes only and a superstructure of any desired type may of course be built upon it. The horizontal Rod must protrude at each end, since it constitutes the reversing apparatus, but it should be quite an easy matter to mount a rod corresponding to it in the complete model so that it is not too conspicuous or unsightly.

The construction of the device is very simple. In the model illustrated, the Motor is mounted on a framework consisting of two 12½" Angle Girders connected together at their ends by two 3½" Angle Girders. Two 5" Axle Rods carry the road wheels, which consist of 3" Pulley Wheels fitted with Meccano Dunlop Tyres.

The Clockwork Motor is bolted to two further 12½" Girders that in turn are fastened to the end 3½" Angle Girders. The drive is transmitted to the road wheels by means of a ½" Pinion and a 57-teeth Gear Wheel, the latter being secured to the axle of the road wheels. Two 5½" Strips 1 are bolted to the 12½" Angle Girders in a vertical position and a Double Bracket 2 is secured between them in the position shown. These Strips are held rigidly by two 5½" Strips bolted to them and also to the Clockwork Motor. An 11½" and a 4½" Rod are joined by a Coupling, and a Collar 4 placed on the former is secured in position by an ordinary bolt passed through the top hole in the reversing lever of the Motor.

A ½" fast Pulley Wheel is fastened to each end of the rod to act as a kind of buffer. It will now be seen that as soon as one of the ends of the horizontal Rod strikes a wall the Collar 4 will move, carrying with it the reversing lever and thereby reversing the direction in which the Motor spindle is driven.

The idea of adapting this automatic reversing device to models driven by an Electric Motor will no doubt present itself to most *"M.M."* readers. There is no reason why it should not be so used. It would only be necessary to connect the horizontal Rod by some means to the operating lever of the Electric Motor in place of the reversing lever of the Clockwork Motor.

(112)—A Meccano Electric Target

(Richard Thompson, Blackburn)

Those of our readers who possess miniature rifles, air guns, etc., will welcome the idea illustrated in Fig. 112. The apparatus is intended to replace the usual paper target, the advantage obtained being that the marksman is always certain whether he has hit the bull's-eye or not, for when he does so an electric bulb automatically lights up. In our illustration the lamp is shown near the target, but of course in practice this should be placed some distance away, thus diminishing the possibility of the bulb being broken by stray shots.

The framework of the target is built up of two 3½" × 2½" Flanged Plates and two 2½" × 2½" Flat Plates. If enamelled parts are used for the frame, a nickelled 2½" Strip 1 should be bolted to one of the Flanged Plates, in the position shown, by a nut and bolt at the top and a 6 B.A. Bolt and nut at the bottom. A Meccano Terminal 2 is screwed on to the shank of the 6 B.A. Bolt. The object of the nickelled strip is to ensure proper electrical contact between the Terminal 2 and the Rod 8, which is journalled in one of the holes in the Strip.

The bull's-eye consists of a circle of cardboard fastened to a Crank 3 by two Angle Brackets. A 2½" large radius Curved Strip 4 is attached pivotally by bolt and lock-nuts to the end of the Crank 3 and has a 1" Rod placed in the hole at its other end. Two Couplings (only one of which can be seen in the illustration) are fastened to the ends of this Rod, one on each side of the Curved Strip. A Bush Wheel 5 is bolted to, but insulated from, the base plate by a 6 B.A. Bolt and an Insulating Bush and Washer, and a wire connected to the Bush Wheel is joined to the terminal 6, which is also insulated from the framework.

The Flanged Wheel 7, which is attached to the Rod 8, should be held firmly against the Strip 1 by means of the Collar on the other end of the Rod. The lamp holder 9 is secured to a Double Bent Strip by a 6 B.A. Bolt, an Insulating Washer being placed between the 6 B.A. nut and the under surface of the Double Bent Strip. Before screwing up the bolt and nut a length of 26 Gauge SCC wire should be placed under the nut so that one end makes contact with the bolt. The other end of the wire is attached to the terminal 2 on the target.

Another terminal 10 is secured to the Flanged Plate forming a base for the lamp, and makes electrical contact with it. If enamelled parts are used a length of wire should join this terminal with the screwed part of the lamp holder.

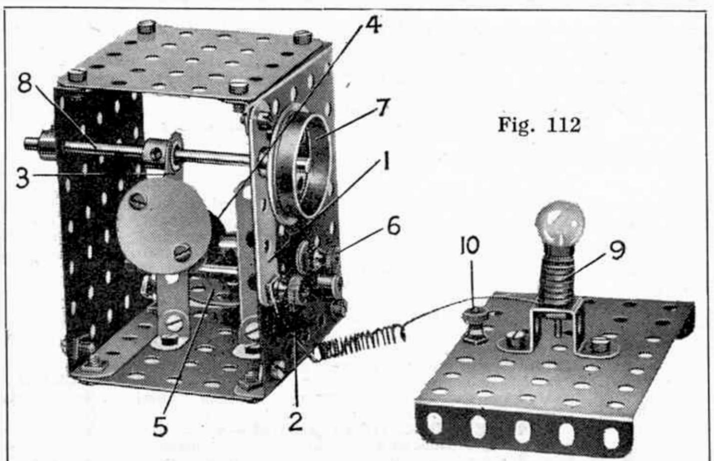
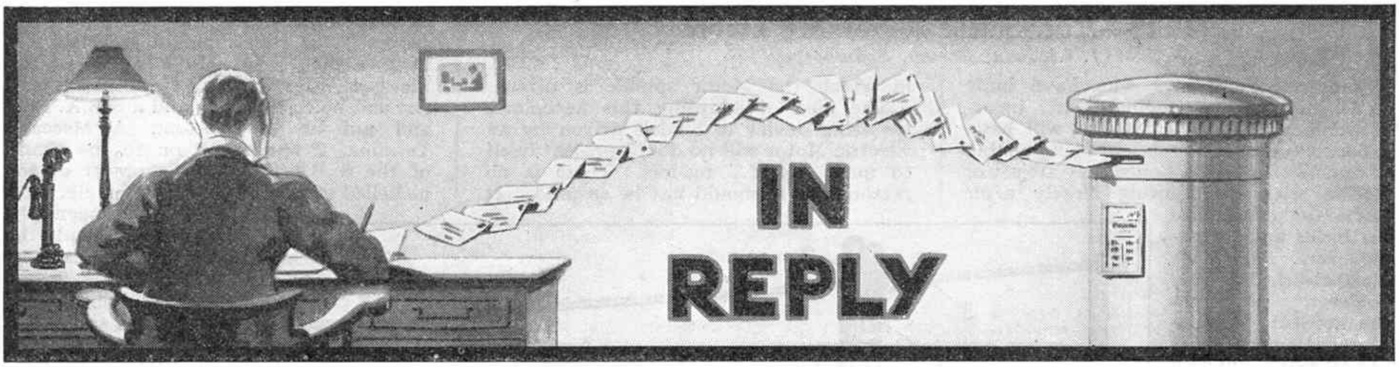


Fig. 112

A 4-volt Accumulator should be connected to the terminals 6 and 10. When the bull's-eye is struck the Couplings on the Curved Strip 4 make contact with the Bush Wheel 5, thereby completing the electrical circuit through the lamp and Accumulator.

To set the target, wheel 7 should be turned so as to lift the Strip 4 and its Couplings from the wheel 5 so that they rest on the 3½" Axle Rod, which can just be seen in the illustration. The Couplings are prevented from falling forward by two vertical 2" Strips placed one on each side of the Crank 3. The bull's-eye should, of course, be incorporated in a larger target, which may be marked with rings in the usual manner.



In these columns we reply to suggestions regarding improvements or additions to the Meccano and Hornby Train systems. We receive many hundreds of such suggestions every week, and consequently we are able to publish only ideas that show particular interest or ingenuity. Suggestions submitted for consideration in this section must be written on separate sheets of paper and the name and address of the sender must appear on each sheet used. Envelopes should be addressed to "Suggestions," Meccano Ltd., Binns Road, Liverpool.

Suggested Meccano Improvements

MECCANO VALVE SETS.—We fear that your suggestion regarding the construction of radio valve sets is impracticable. To be able to construct such sets many "non-adaptable" parts, such as variable condensers, gridleaks, transformers, etc., would have to be introduced. This we are not prepared to do as it would be contrary to our usual practice. *(Reply to B. Morris, Whitchurch).*

LARGER DOUBLE BENT STRIPS.—We do not consider that larger Double Bent Strips are a necessary addition to the Meccano system. Such strips can easily be constructed from existing parts. *(Reply to D. Garnett, Bournemouth).*

MECCANO FLAG.—We note your suggestion regarding the introduction of a Meccano flag. Your idea is quite interesting and we will keep it before us. Can you suggest any suitable design? *(Reply to F. Burton, Barton-on-Humber).*

NEW DUNLOP TYRE.—We consider that a new Meccano Dunlop Tyre, 1½" in internal diameter, is unnecessary as the existing 2" and 3" tyres fulfil all requirements. *(Reply to E. Bamforth, Lincoln).*

5 : 1 BEVEL GEARING.—Owing to the fact that a 5 : 1 ratio seldom is required in right-angle gearing, we do not consider that the introduction of a 2½" Bevel Gear would prove particularly popular. However, we shall give further thought to your idea. *(Reply to E. E. Jones, Northwich).*

NEW RIGHT-ANGLED STRIP.—Does not the Simple Bell Crank, part No. 127, fulfil your requirements? *(Reply to A. W. Godden, Canterbury, Kent).*

MECCANO DYNAMO.—We are afraid that the cost of manufacture of a dynamo capable of lighting the Meccano 4-volt lamps or supplying current for the Electric Motor, would prohibit its introduction to the Meccano system. *(Reply to J. Braithwaite, Sheffield).*

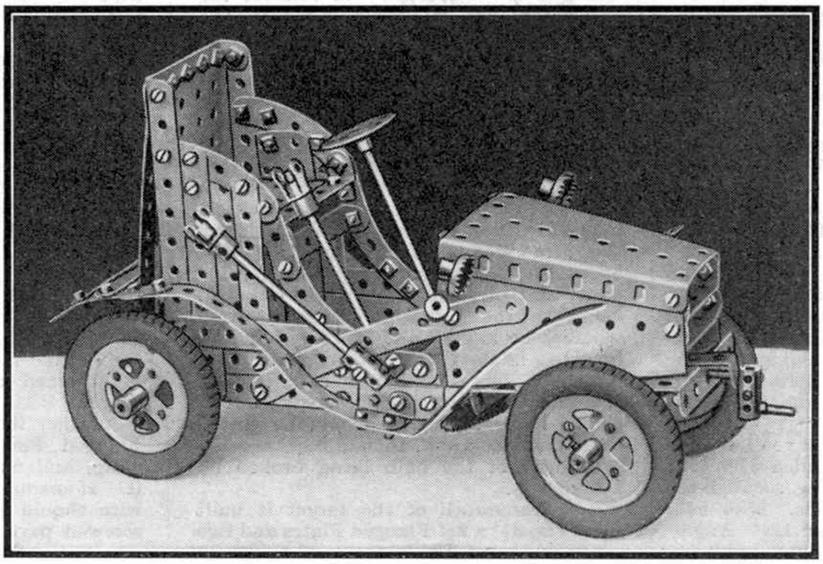
MECCANO STEAM ENGINES.—Your suggestion regarding the manufacture of a Meccano oscillating cylinder is quite interesting. However, as stated before in these pages, we cannot consider the addition of steam plant to the Meccano system for some time yet. *(Reply to W. D. Butler, Redditch).*

IMPROVED PROPELLER BLADES.—We note your suggestion regarding the manufacture of a complete propeller fitted with a boss and set screw. We do not see that such a propeller would be any improvement over a propeller built up from existing parts, however. *(Reply to H. Tallersill, Balham, S.W.12).*

3" CIRCULAR PLATE.—Your suggestion regarding a 3" circular plate will receive further attention. *(Reply to R. Pell, Sherwood).*

DOUBLE CRANE GRAB.—We are unable to discover any advantage that would result from the addition of a double crane grab to the Meccano system. The present Crane Grab (part No. 150) is quite efficient where a friction grip is needed. If, however, a more powerful grip is required then it would be advisable to construct a grab from Meccano parts, such as that illustrated in the July, 1926, "Suggestions Section." *(Reply to Stanley Edwards, Carmarthen).*

MODEL OF AN OLD-FASHIONED MOTOR CAR



This interesting model was submitted by W. R. H. Temple, of Shanklin, I.O.W., in the 1927 "First Summer" Model-building Competition and was specially commended by the judges. It is patterned on the "Swift" motor car of 1904, and it affords a striking illustration of the extraordinarily rapid development of motoring during the past twenty years or so. The model is a faithful reproduction of the "last word" in motor engineering of the period. A striking contrast may be produced by placing it alongside the new Meccano Motor Chassis, the description of which is concluded in this issue. The exhibition of the two models together cannot fail to arouse a great deal of interest

NEW BELL CRANK.—We do not consider that a bell crank made up of rods instead of strips would be of any great use when incorporated in the Meccano system. We agree that such a part would be useful when constructing Ackermann steering gear, but it would be difficult to find other uses to which it could be applied with any real advantage. Moreover, when a bell crank of this type is required particularly, it is a simple matter to build it up from a couple of short Axle Rods and a Coupling. Excellent examples of this type of construction were given in last month's "*M.M.*" in connection with the description of the Ackermann steering gear on the new Meccano Motor Chassis. *(Reply to F. Oakley, Blakewell, Walsall).*

IMPROVED CLOCKWORK MOTOR.—As stated before in these pages we are considering the reconstruction of the Clockwork Motor. We doubt however, whether it could be manufactured to the same shape as the Electric Motor. *(Reply to H. G. Conway, Edinburgh).*

MECCANO STEERING WHEEL.—There appears to be a considerable demand for a motor car steering wheel. While such a wheel would certainly look effective when fitted to Meccano models, we would remind our readers that quite a good substitute can be constructed by fastening a length of Spring Cord, etc., round the rim of a 2" Pulley Wheel. *(Reply to Leslie Pace, London, S.W.16, A. Chalet, Margate, and others).*

AUTOMOBILE BADGES.—We note your suggestion regarding the introduction of miniature "A.A." or "R.A.C." badges and "four-wheel brake" signs to the Meccano system. As these parts would be purely ornamental and would serve no useful purpose, we cannot consider their manufacture. *(Reply to Basil Smith, Oxford).*

FINE CHAIN FOR CRANES.—While adding little to the realism of Meccano cranes, fine chain for use in place of hoisting ropes would be expensive to manufacture. *(Reply to C. Mitchell, Birmingham).*

IMPROVED THREADED PINS.—We doubt whether any advantage would accrue from the lengthening of the threaded shank in the Threaded Pin. Indeed, in many cases a longer shank would prove a distinct disadvantage. *(Reply to F. Lord, Bacup).*

SPRING WASHERS.—We are interested in your suggestion re the introduction of spring washers for locking nuts to bolts. We have no doubt that such washers would be quite useful and we will keep your idea before us. *(Reply to H. Leeming, York, and F. W. Quamby, Keighley).*

IMPROVED HINGE.—We quite agree that extensions to the lugs of the existing Meccano hinges would increase their efficiency. It may be possible to make this alteration in the future. *(Reply to P. G. Wichens, Maidstone).*

MUSICAL BOX.—While serving no really useful purpose a Meccano musical box would be difficult and expensive to produce. We cannot, therefore, consider its manufacture. *(Reply to Boey Pah Yong, Kedah).*

NEW JOURNAL BEARING.—We note your suggestion that a special bracket should be manufactured so as to prevent the Worm Wheel "riding" the gear wheel with which it is supposed to mesh. Such a part would be useful if incorporated in the Meccano system and we will keep your idea before us. *(Reply to L. Yates, Derby).*

GEARS IN CLOCKWORK MOTOR.—We are not in favour of your suggestion regarding the fitting of a gear box into the Clockwork Motor. While adding considerably to the cost of the Motor, internal gears would deprive Meccano boys of the opportunity of designing and constructing gear boxes to suit their individual requirements. *(Reply to O. Charleton, Cheam, Surrey).*

Suggested Hornby Train Improvements

SIX-COUPLED LOCOMOTIVES.—We have been considering the production of a 4-6-0 locomotive similar to your suggested design, for use in connection with the new Pullman Trains, but we have decided to drop the idea, at least for the present. (*Reply to S. J. H. Biles, London, S.W.1, Peter Hollings, Northchurch, Herts., and many others*).

L.N.E.R. AND L.M.S. COACHES.—We are interested in your proposal that we should lithograph the present Hornby Metropolitan coaches to represent also L.N.E.R. and L.M.S. rolling stock. We will give this idea careful consideration. (*Reply to J. D. Short, Bexhill-on-Sea*).

GAUGE 3 MODELS.—The possibilities of Gauge 3 are so restricted and the cost of manufacture of accessories for such a gauge so great, that we fear we cannot consider the production of locomotives suitable for such a railway. (*Reply to G. S. Dunn, Bradford*).

2-4-0 ENGINES.—The existing 0-4-0 locos answer their purpose admirably, and we think that, for those who require one of a larger size the 4-4-0 is the best type of engine in Gauge 0. The construction of a 2-4-0 locomotive is scarcely necessary, and there is certainly little demand for it. (*Reply to A. J. Evans, Bicester, Oxon.*)

HORNBY ELECTRIC LOCOMOTIVES.—We are interested in your suggestion that Hornby electric locomotives should be made in such a way as to enable the reversing gear to be operated from the Resistance Controller. This, however, would necessitate the substitution of permanent magnets in the motor in place of the wound field coils, unless very intricate circuits, with special collectors attached to the engines, were arranged. (*Reply to R. Slight, Southampton*).

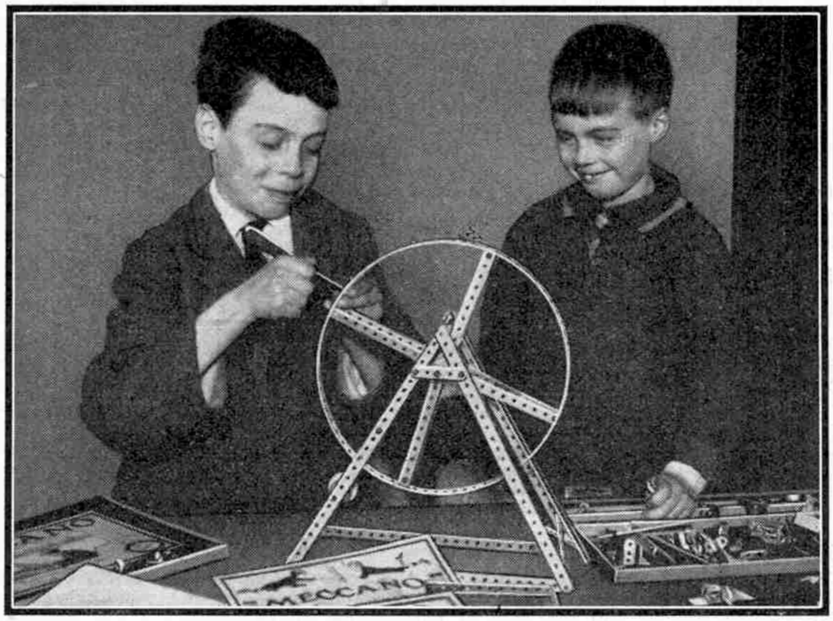
LUMINOUS PAINT ON HEAD LAMPS.—We do not agree that painting the loco head-lamps with luminous paint would not cost much more than continuing with our present practice of painting them with ordinary white enamel. In any case, we are still convinced that the number of Hornby enthusiasts who run their trains in the dark is comparatively small, and so the advantage of this rather expensive alteration would be entirely lost on most Hornby systems. (*Reply to J. Thorburn, Kilmacolm, and Frank Beldan, Toronto, Canada*).

HORNBY PACIFIC LOCOMOTIVES.—We fear that the Pacific type of locomotive, when constructed, would not be able to cope with the present 2 ft. radius curves. However, the whole question of larger and more powerful engines is being reviewed. (*Reply to Claude Yates, Brinscall, Lancs.*)

PECKETT TANK ENGINE.—Your suggestion that we should manufacture a Peckett tank engine is interesting, but the fact that saddle tanks are becoming rarer every day hardly encourages us to produce such a locomotive. (*Reply to Rowland Baxter, Grimsby*).

CLOCKWORK METROPOLITAN LOCOMOTIVES.—You will see that we are now manufacturing a Metropolitan locomotive fitted with clockwork mechanism. The price, which will be found in the current Hornby catalogues, compares favourably with that of the electrically-propelled models. (*Reply to C. Timm, Beckenham, Kent*).

"IT'S SO SIMPLE!"



In this photograph the camera shows very clearly what a happy affair model-building with Meccano is. Leslie Waring, who is just putting the finishing touches to his Meccano Wheel, appears to be telling his brother Marcus how very easy it is to build models like this. Meanwhile Marcus smiles in anticipation of the fun that he is going to get helping his brother to set the model in motion. Both Leslie and Marcus are very keen Meccano boys and they spend most of their spare time in devising new models or improving upon old ones

DETACHABLE DISC INDICATORS.—This type of train indication is rapidly losing favour in actual practice and we think that the introduction of your idea is hardly advisable, therefore. (*Reply to P. Barkham, Redhill*).

2-4-4 TANK ENGINE.—The idea of introducing into the Hornby system a tank locomotive of the 2-4-4 wheel arrangement is interesting, but as we already make a 4-4-4 tank engine, the difference between the two engines would be so small that it would not justify the cost of production. (*Reply to G. Allen, Brisbane*).

LEAD BLOCKS FOR LOCOMOTIVES.—The production of special lead blocks to fit into wheel splashers of locomotives would be very expensive. On the other hand Hornby enthusiasts who wish to prevent their engines skidding by increasing the weight over the driving wheels, should be able to cast or cut suitable weights out of old pieces of water piping, etc. These would answer the purpose just as well and the cost would be nil. (*Reply to K. Hipperson, Towerham, near Norwich*).

SMALL METROPOLITAN ENGINE.—A small locomotive on the same lines as the existing Metropolitan engine would certainly be very attractive, but as the demand is nearly always for larger locomotives rather than smaller ones, we would prefer not to adopt this suggestion for the present. (*Reply to W. S. Walton, Edinburgh*).

ALTERATION OF POINTS.—It would no doubt be an advantage to reduce the length of the projecting curved line on Hornby points. The objection to this alteration is that the points as they now stand are interchangeable with the ordinary curved rails, and if they are shortened they will lose this useful feature. However, we are giving your suggestion careful attention. (*Reply to J. A. Wallace, Leith*).

CATCH POINTS.—We note your suggestion, but we do not think there would be a very great demand for an accessory of this kind. (*Reply to C. Wicks, Leamington Spa*).

ALTERATION TO ANGLE CROSSINGS.—Careful consideration will be given to your suggestion should we contemplate an alteration to our present design of Acute-angle Crossing. It would certainly be useful to make the Crossing interchangeable with a 2 ft. or 1 ft. radius Curved Rail, as the case may be. (*Reply to H. B. Howard, Watford*).

OUTDOOR HORNBY RAILWAYS.—Your suggestion that we should manufacture outdoor model railway appliances is interesting, although we doubt whether the demand for such accessories would justify the adoption of your idea. (*Reply to N. Blake, Auckland, N.Z.*)

No. 2 LOCOMOTIVES WITH OUTSIDE CYLINDERS.—We have been considering the possibility of rebuilding the No. 2 Locomotives on the lines you suggest and we hope to make an announcement on the subject shortly. (*Reply to H. Marr, Neston*).

PASSENGER AMBULANCE COACH.—This kind of coach is, happily, rarely seen on our railways, and therefore we are convinced that a model of it would not prove popular. (*Reply to H. B. Egerton, Exmouth*).

COUPLED WHEELS ON No. 1 LOCOS.—You will be pleased to know that these locomotives are now being fitted with coupled driving wheels. (*Reply to L. S. Forbes, London, S.W.9*).

"ROYAL SCOT" TRAIN SETS, ETC.—We do not agree with your suggestion that we should either make perfect scale models of these trains or none at all. (*Reply to M. Denton, Guildford*).

ELECTRIC FREIGHT LOCO.—Your suggestion that we should make an electric freight locomotive is interesting, and we shall give it careful consideration. Meanwhile the Metropolitan engine should satisfy your needs quite well. This engine is exceptionally powerful, and will cope with almost any Gauge 0 load. (*Reply to P. Smith, Stockport*).

No. 2 TANK ENGINE RECONSTRUCTION.—This engine would certainly look very attractive if fitted with a trailing pony truck instead of a bogie. We are considering your suggestion carefully. (*Reply to O. W. Lamballe, York*).

TRAIN COUPLINGS.—Owing to the difficulty of negotiating sharp curves with scale model couplings, we think that it is advisable to continue producing train couplings according to our present design. (*Reply to D. Garnett, Bournemouth*).

HANDLE OF RESISTANCE CONTROLLER.—We think that it would facilitate distant operation of the Resistance Controller if Meccano standard holes were drilled in the handle. We will consider this suggestion carefully. (*Reply to D. Garnett, Bournemouth*).

CURVED CONTROL RAILS.—We cannot see the advantage to be gained from the use of a curved Control Rail. The locomotive would be stopped on a curve, and unless it had a considerable amount of power in reserve, it would be hampered in starting off again, owing to its unfavourable position on the track. (*Reply to P. Booth, Ashton-under-Lyne*).

DOUBLE LINE CROSSINGS.—This kind of accessory costs a considerable amount to produce and we doubt whether the ensuing demand—necessarily minimised by the comparatively high market price—would justify our adoption of your idea. (*Reply to R. Slight, Southampton, and Ernest Parker, Marylebone, N.W.8*).

HORNBY POINTS.—We think that the inclusion of Hornby Points having levers on the inside of the curve would prove popular, and we are therefore considering your suggestion carefully. (*Reply to H. G. Quincey, Hampstead, N.W.3*).

LEFT-HAND CROSSOVER.—There is doubtless much to be gained by introducing left-hand Crossovers, to be used in conjunction with those we now manufacture. We shall give your suggestion further consideration later. (*Reply to Ernest Parker, Marylebone, N.W.8*).

LOWER BUFFER BEAMS.—We are interested in your suggestion to the effect that Hornby locomotive buffer beams should be lowered. This would certainly increase the beauty of the engine, but our objection to your idea is that the height of all Hornby buffer beams must be the same. (*Reply to K. Hipperson, Towerham, near Norwich*).

LETTERING ON HORNBY TENDERS.—We note your criticisms regarding the arrangement of the initial letters of the company and serial numbers of the engines on certain Hornby Trains. You will be pleased to learn that the method of lettering has been revised in the new Pullman train sets, and you will find many of your suggestions adopted in connection with these trains. (*Reply to E. T. Bryant, London, N.8*).

Results of Meccano Model-Building Contests

By Frank Hornby

"Meccanograph Design" Competition, "Home" Sections

THE entries in the novel Meccanograph Design Competition, which was announced in the October "*M.M.*," were of a standard that exceeded my most sanguine expectations. With all my experience of the ingenuity displayed by Meccano boys, I cannot help being astounded at the excellence of the designs submitted; in fact, it seems scarcely possible that things of such beauty can be produced by purely mechanical means.

The neatness, regularity, and originality of the designs submitted were such that the judges found it impossible to decide in the favour of any one competitor. (Any reader who requires corroboration of this fact has only to glance at the reproductions on this and the following page!) The number and value of the prizes, therefore, have been greatly increased. The names of the prize-winners in Section A (for competitors in the British Isles) are as follows:—

THREE PRIZES, each consisting of Meccano products to the value of one guinea: Ernest H. Bradshaw, Attercliffe Common, Sheffield; W. R. Marsh, Bladud Buildings, Bath; G. S. Marsh, Thornton, Blackpool.

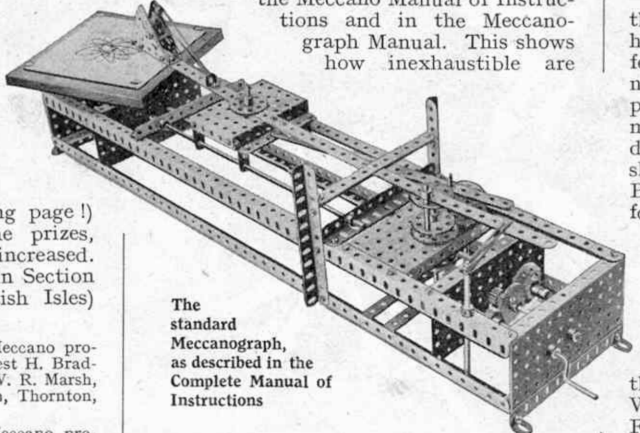
FOUR PRIZES, each consisting of Meccano products to the value of half a guinea: E. Arscott, Exmouth, Devon; J. Nichols, Darlington; G. D. Coxhead, London, E.11; L. E. Harris, London, S.W.11.

FOUR PRIZES, each consisting of Meccano products to the value of five shillings: G. K. Holland, Liverpool; C. Jenkins, London, S.W.; W. Atterbury, Nelson, Lancs.; W. Wilkinson, Mosborough, near Sheffield.

SPECIAL COMMENDATION (Certificates of Merit): G. N. O'Neill, Dublin; Stanley S. Ellam, Sheffield; S. Riley, Stowmarket; W. Bolland, Rugby; Raymond Taylor, Shaw, Lancs.; J. Pleasance, London, N.W.3.

Extraordinarily Interesting Model

Many of the prize-winning competitors made radical changes in the well-known design of the Meccanograph; on the other hand, some of the best results were obtained with very little alteration to the standard models as described in the Meccano Manual of Instructions and in the Meccanograph Manual. This shows how inexhaustible are the possibilities of this extraordinarily interesting model.



The standard Meccanograph, as described in the Complete Manual of Instructions

In the case of particularly interesting variations from the standard model, I shall describe the chief changes made, but as it is impossible to give in the limited space at my disposal a detailed account of each model, readers who wish to reproduce the prize-winning designs must have recourse to their own experience and ingenuity to fill in the details; the correct adjustments can be found by experiment. I may add here, however, that we intend to revise our existing Meccanograph at the earliest opportunity, and we shall embody in the new model numerous ideas and improvements culled from the hundreds of entries in this competition.

Ernest Bradshaw, who is one of the three competitors who share the first honours, has incorporated many new features in his Meccanograph. The most novel of these is the substitution of carbon paper and a vertical pointed rod for the more usual fountain pen or pencil. The designs submitted are very clear, and show that this system works perfectly. As Bradshaw points out, the expense of a fountain pen and the continual re-sharpening of pencils are eliminated. The carbon paper is held flat on the white paper by means of two 5½" Strips pressed down by springs formed of bent Strips. These springs are attached to Meccano Hinges, which make it a simple matter to remove and replace the paper. The Bush Wheel or 1½" Pulley Wheel of the crown head is replaced by a Face Plate, into which several Threaded Pins may be screwed in an almost infinite variety of arrangements, causing a corresponding variety of designs to be produced.

The table is steadied by means of a special screw-operated brake consisting of a large Pulley Wheel, the motion of which is retarded by a cord tied to the end of a slightly extended tension Spring. The "pencil" is an ordinary Meccano Axle

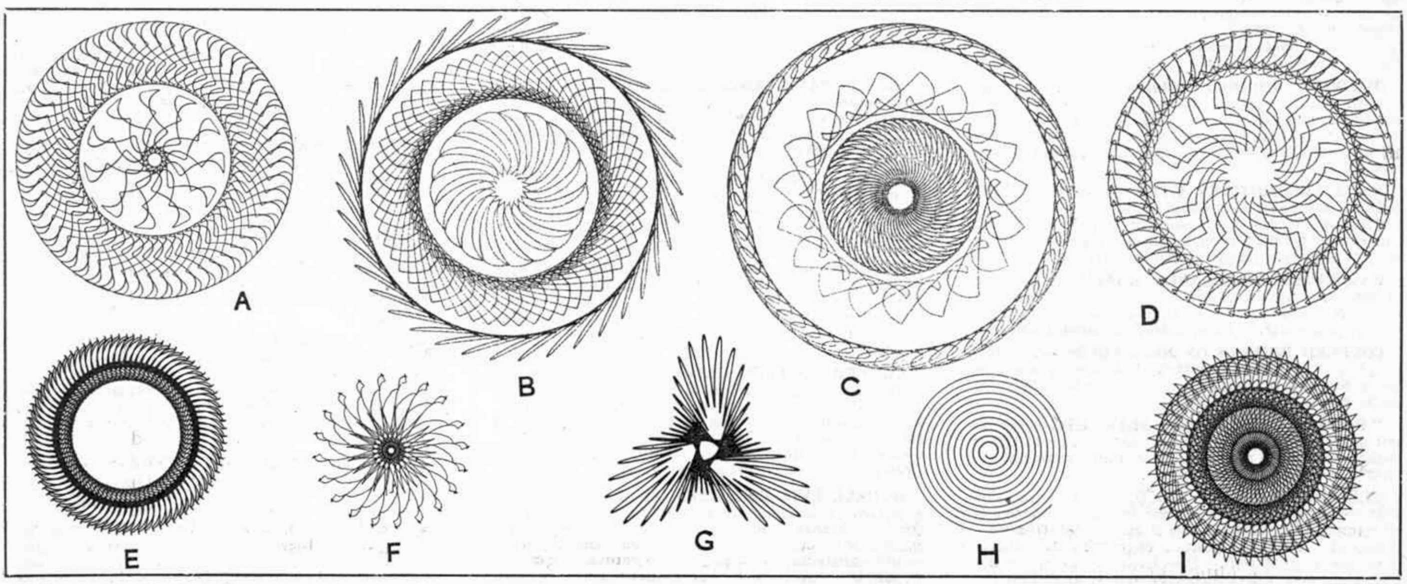


Fig. 1. A few of the Prize-winning Designs. Those marked A and I were submitted by George S. Marsh. Designs B, C, and D are the work of Ernest H. Bradshaw; F and H are by William R. Marsh; E by L. E. Harris; and G by Walter Atterbury

Rod ground to a point at one end and attached to the arm of the machine by means of a Crank. The necessary pressure of the "pencil" on the paper is provided by the weight of a Flanged Wheel and a Worm Wheel secured to the Rod immediately above the Crank.

Four of Ernest Bradshaw's prize-winning designs are included in the accompanying illustrations.

Designs A, I, and M are typical of those submitted by G. S. Marsh. The machine on which they were executed is very similar to the standard Meccanograph, but two crown heads are used. These rotate side by side in the same direction, and the carriage has both sliding and transverse movements.

Special Pen Adjustments

William R. Marsh's Meccanograph also is similar in principle to our own model, but the operating mechanism has been almost entirely reconstructed. The pen is held in a special holder attached to the end of a Crank Handle, which is fixed to the table by means of a Coupling and a Crank. By means of this handle the length of the arm holding the pen can be adjusted minutely. The wheel of the crown head is replaced by a 3" Sprocket Wheel having a choice of sixteen holes, in any one of which may be inserted the pin that actuates the writing arm.

A to-and-fro movement is imparted to the carriage by a Crank driven from the axle of the Sprocket Wheel. A tension spring stretched between the carriage and the arm eliminates "play" at the pivot, while a band and pulley brake controlled by a length of Spring Cord and applied to a Pulley Wheel under the revolving table, prevents any jerky movement of the latter. By these means all the lines of the design are produced with a perfectly smooth and regular stroke.

The system of gearing in W. R. Marsh's model also shows ingenuity. No clutches or sliding rods are used, but five different speeds are obtainable. The five different sets of gears are mounted on two Axle Rods. The gear wheels on one Rod are permanently secured, but the corresponding wheels, though continually in mesh with their respective gears, are left loose on their axle. When any particular speed is required, the set-screw of one gear wheel is tightened up until it grips the Rod, and the wheel then operates the mechanism, while the remaining loose wheels revolve idly. This method will work perfectly in any machine which, like the Meccanograph, needs only an occasional change of gear that may be carried out while the machine is stationary.

Examples of W. R. Marsh's work are shown at F, H, O, P, and Q. The spiral (H) is obtained by a special arrangement that causes the pen to move slowly toward the centre of the revolving table. In this particular case the device used to produce the spiral involves the use of parts other than Meccano standard parts, but several other competitors submitted similar spiral designs, and it should not be difficult for any Meccano boy to devise the necessary apparatus from standard parts.

The designs J and K were produced by G. D. Coxhead, who just fell short of securing one of the First Prizes. Design E was sent in by L. E. Harris, and that shown at N is the work of Eddie Arscott. These three competitors built their Meccanographs exactly in accordance with the instructions in the Meccanograph Manual, and the only change made by J. Nichols, who secured a similar award, lies in the substitution of a Face Plate for the Pulley Wheel or Bush Wheel of the crown head. The advantages of this alteration seem to have occurred to a considerable number of competitors.

The very original design marked G in Figure 1 secured a well-deserved prize for Walter Atterbury. Walter has hit upon the bright idea of using a Meccano Triple-throw Eccentric in his Meccanograph, and most "*M.M.*" readers will admit that he has produced results quite different from anything previously obtained.

To make designs of this type, first disengage the strip that actuates the sliding carriage, and lock the latter in position. Then replace the top $3\frac{1}{2}'' \times 2\frac{1}{2}''$ Flanged Plate of the carriage by a transverse $3\frac{1}{2}''$ Strip on which an Eye Piece is free to slide. A Triple-throw Eccentric is secured to a Rod that is journalled in the $3\frac{1}{2}''$ Strip and Flanged Plate of the carriage, (*Continued on page* 167)

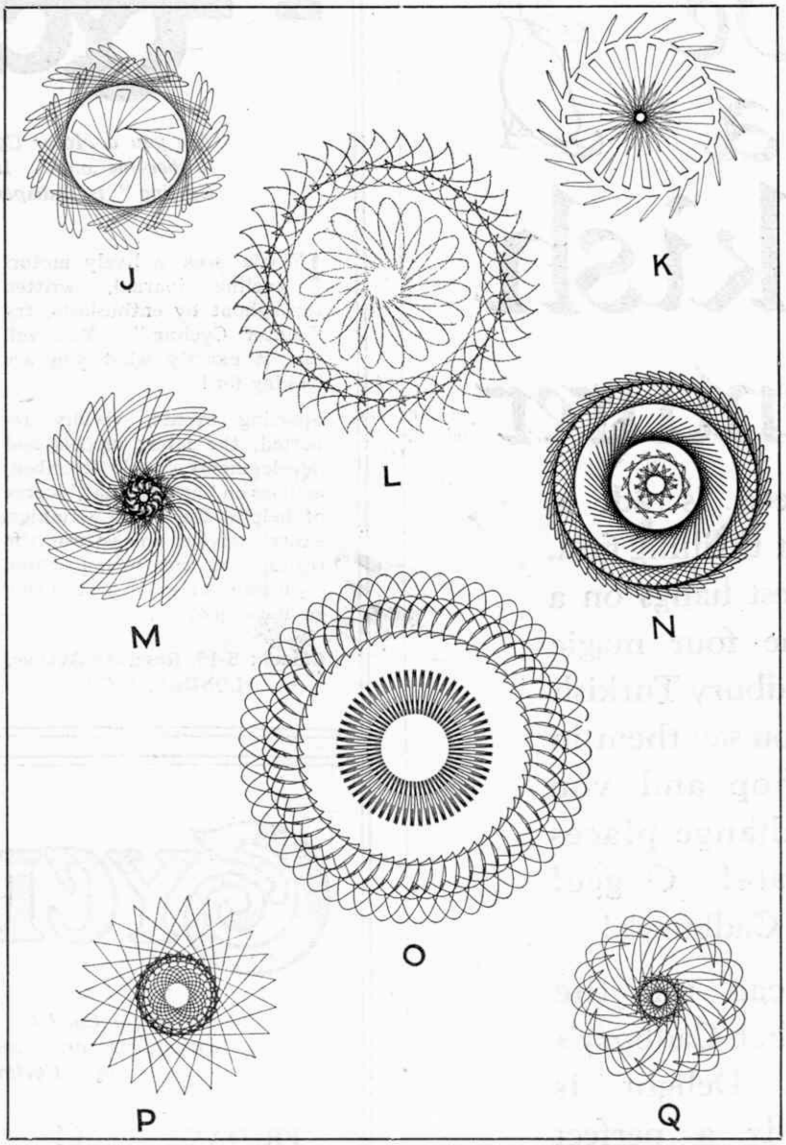


Fig. 2. A further selection of successful entries. Designs J and K were sent in by G. D. Coxhead; L is another design by Ernest H. Bradshaw; and M is a third effort submitted by G. S. Marsh. The design shown at N is the work of Eddie Arscott and O, P, and Q are further examples of W. R. Marsh's work

Meccanograph Painting Competition

The number of entries received in the Meccanograph "Painting" Competition fell short of the tremendous total submitted in the "Design" Contest. This fact seems to indicate that the minds of Meccano boys are more mechanically than artistically inclined, and that they prefer to produce beauty by turning a handle rather than by wielding a brush! Of course, this is exactly what one should have expected, for there is little doubt that the great army of Meccano boys includes most of our engineers of the future!

In the "Home" Section, Ronald Artingsall, Manchester, and Leonard Reid, Southampton, each sent in six beautifully-coloured designs, and each will receive a prize consisting of Meccano products to the value of half a guinea, while Cyril Jenkins, London, S.W., Bertram Unné, Harrogate, and F. N. Shimmin, Leeds, who also sent in excellent paintings, will each be awarded Meccano products to the value of five shillings.

The following readers, whose work was specially commended by the judges, will each receive special Certificates of Merit:—S. T. Temple, London, S.W.; S. B. Richards, Hull; K. Freeman, Coventry; B. Collins, Frinton-on-Sea; P. S. Smith, Dover.

I hope that future competitions of the "artistic" kind will meet with a support just as hearty as that accorded to model-building contests. Even if your work does not seem to you to be quite up to prize-winning standard, your own modesty may be deceiving you. Send it (the work, not the modesty!) to the competition judges and remember that you have as good a chance of securing a prize as anyone else.

Be a Turkish Adventurer

All you need is 2d. to make a most thrilling find. But this quest hangs on a request—the four magic words "a Cadbury Turkish please." You say them in a sweet shop and you would'nt change places with a pirate! O gee! O glee! It's Cadbury's!

P.S. You can tell the mater that Cadbury's Turkish Delight is practically a perfect food. What luck!

Cadbury's Turkish Delight

2d 2d

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See the name 'Cadbury' on every piece of chocolate.

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IF you seek a lively motor-cycling journal, written throughout by enthusiasts, try "Motor Cycling." You will find it exactly what you are looking for!

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"CYCLING" is the only public cycling journal in England. It is the acknowledged authority on the sporting, recreative and technical sides, and tells cyclists where and how to ride, and how to make the most of the benefits of the pastime.

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All cycling enthusiasts should possess a copy of "Cycling Manual," the text book of the bicycle and the only book of its kind. 1/- net, or 1/2 post free from the publishers.

Send for this New Book

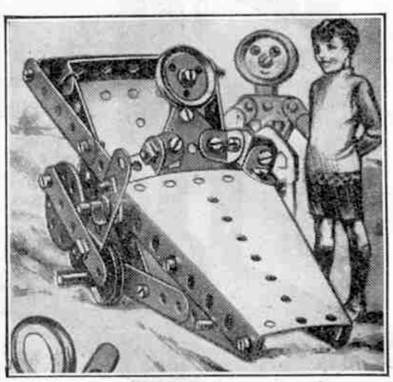
Every Meccano boy who has read the story of "Dick's Visit to Meccanoland" will be interested to know that we have now published a new booklet telling of Dick's further adventures in this wonderful country. On this occasion Dick's strange experiences take place in a dream, which is the result of a too hearty indulgence in cakes and other delicacies provided at his birthday party!

In the narrative he describes the quaint people he met and tells of the various exciting incidents that occurred during his travels, throughout which he was accompanied by King Meccano the Great, complete with Bodyguard.

New Meccano Models

The story is profusely illustrated with humorous sketches depicting the extraordinary inhabitants of Meccanoland. Apart from the pleasure derived from reading the book, Meccano boys will find great enjoyment in building up and operating the many different models that are the principal feature of the illustrations. All the models may be made with a No. 1 Outfit and one of the illustrations is reproduced at the foot of this column.

The price of the book is 2d. post free. All applications should be accompanied by stamps for this amount and addressed to Meccano Limited, "Adventures," Binns Road, Liverpool.



Dick and King Meccano talk with the oldest inhabitant of Meccanoland

Competition Results

Xmas Stamp Competition

First Prizes: Section A, J. Jennings (Dublin); Section B, E. M. Knapman (London, S.W.11). Second Prizes: Section A, L. G. Wilkins (Anfield, Liverpool); Section B, A. J. Burgess (Formby, Nr. Liverpool).

Fireworks Essay

First Prizes: Section A, J. Tomlinson (London, W.14); Section B, W. U. Hill (Alloa, Clackmannanshire). Second Prizes: Section A, G. S. Marsh (Thornton, Blackpool); Section B, A. W. Plowman (New Barnet, Herts.) Consolation Prizes: W. G. Ainslie (Northfield, Birmingham); C. N. Beattie (Lewes, Sussex); D. Hollinshead (Middlewich, Cheshire); Mark Lee (Leicester); A. Turner (New Ferry, Cheshire); E. H. Whittleton (Harlow, Essex).

November Painting Competition

First Prizes: Section A, R. M. Clark (Wallasey); Section B, H. Lane (Stokesley, Yorks.) Second Prizes: Section A, F. W. Caws (Westend, Nr. Southampton); Section B, 4/6 added to prize money and divided equally between H. Henshaw (Bolton) and P. R. Poole (Newport, Mon.) Consolation Prizes: Section A, J. Ashton (Pendleton, Manchester); A. Drummond (London, S.W.3); G. J. Gaw (Bangor, Co. Down); W. C. Wills (Ely, Cambs.) Section B, T. R. Abbott (Norton, Stockton-on-Tees); G. Aspley (Harborne, Birmingham); J. Roland (New Ferry, Cheshire).

Overseas Results

Doublets No. 3

1. J. G. Gnanadurai (Trichinopoly, S.I.); 2. B. C. King (Ontario, Canada); Third Prize divided between W. Russell and R. Russell (Whangarei, N.Z.) Consolation Prizes: J. A. Gomes (Bombay, India); B. Carnson (Capetown, S.A.)

My Most Interesting Holiday Experience

First Prizes: Section A, J. Whitehead (Waikato, N.Z.); Section B, Ong Teck Chiang (Singapore). Second Prizes: Section A, J. S. Tomlinson (Capetown, S.A.); Section B, E. Hincks (Ontario, Canada).

Loco Puzzles

1. J. Sharpley (North Island, N.Z.); 2. R. G. Henderson (Croydon, N.S.W.); 3. P. Picot (Victoria, Australia); 4. H. R. Brookes (Auckland, N.Z.) Consolation Prizes: E. B. Mowbray (Sunny Corner, N.S.W.); J. Stenhouse (Otago, N.Z.)

32nd Photo Contest

First Prizes: Section A, K. Langsdorf (Queensland, Australia); Section B, N. Inglis (Johannesburg, S.A.) Second Prizes: Section A, W. H. C. Williams (Punjab, India); Section B, R. H. Smith (Victoria, B.C.)

33rd Photo Contest

First Prizes: Section A, F. Van Bulck (Paris); Section B, S. Johnston (Sydney). Second Prizes: Section A, S. Galdes (Valletta, Malta); Section B, A. McPherson (Toronto).

Civil Aviation as a Career—

(Continued from page 125)

aviation. Most of these have either drifted in by irregular routes or have come into it from the Air Force, and there has been so far no regular source from which to draw skilled men. The opportunities already open for learning to fly provide such a source and now is the time for entry into this comparatively new profession under the best conditions. Any young man entering it will find himself in an absorbingly interesting career, and one moreover of tremendous national importance; and provided he is prepared to work hard he will find in it opportunities superior to those to be found in any other industry at the present time.

The Aircraft of the Future—

(Continued from page 121)

this construction include detachability and easy replacement of a blade in the event of damage, and small size when dismantled and packed for transport.

Another well-known firm that has constructed aeroplanes entirely of metal is Vickers Ltd. The spars and ribs used in the Vickers-Wibault system are made of duralumin, the spars being built up, while the ribs are simply made of plate duralumin. The covering of the planes is of duralumin sheet and is folded over the ribs and secured by rivets, so that both heads of the rivets are visible. It is this that gives the characteristic ribbed effect to the wings.

With the exception of the steel for the axles and the engine mounting, duralumin is the only metal used throughout. A typical Vickers-Wibault all-metal single-seater Flying Scout weighs 3,060 lb. when fully loaded, and is guaranteed to attain a speed of 139 miles per hour at a height of 14,760 ft., to which height it can climb in 125 min. Its "ceiling" under favourable conditions should be 25,000 ft.

Sufficient work has now been carried out with metals in the construction of aircraft to show that they can be successfully employed for almost any purpose for which wood is now used, and that their introduction promises improvements impossible with the old methods of construction.

Leading Dimensions of North British Type "Atlantic" Locomotives, L.N.E.R.

Cylinders (2)	Diameter	21 in.
	Stroke	28 in.
Driving Wheels, Diameter		6 ft. 9 in.
Heating Surface, Tubes		1,619 sq. ft.
,, ,,	Firebox	185 ,,
,, ,,	Superheater	385 ,,
,, ,,	Total	2,189 ,,
Firegrate Area		28.5 ,,
Working Steam Pressure		180 lb. per sq. in.
Tractive Effort (at 85% Wkg. Press.)		23,325 lb.
Adhesion Weight		40 tons
Total Weight of Engine		76¾ ,,
Water Capacity of Tender		4,240 gals.
Coal ,, ,,		7 tons
Weight of Engine and Tender (in working order)		122 ,,

Meccanograph Design Competition—

(Continued from page 165)

as well as in a 5½" Strip bolted to the bottom pair of 24½" Angle Girders of the frame. This Eccentric is actuated by a ½" Pinion engaging a Worm Wheel secured to the shaft that causes the table to revolve. The end hole of the Eccentric arm is slipped over a Threaded Pin fixed to the sliding Eye Piece, and the writing arm of the Meccanograph is placed over the same pin. By altering the throw of the Eccentric, changing the position of the carriage on its rails, and placing different holes of the arm over the Threaded Pin, countless variations of this novel design may be effected.

Each of the modifications of the original Meccanograph that I have just described has been used with considerable success by at least one of the competitors, and now that they have been published together, obviously it is possible for all "*M.M.*" readers to obtain still better results. Several of the alterations could easily be combined in a single Meccanograph, and I have no doubt that many Meccano enthusiasts will decide to do this.

New Meccano Models

Further Interesting Examples for the Smaller Outfits

LAST month we published photographs of seven simple models, together with detailed instructions for building them. Models of this kind always prove interesting and popular and in this article we propose to deal with some additional examples of a similar type. Further new models will appear in each issue of the "*M.M.*" in the future and from time to time more complicated structures will be inserted for the benefit of those readers who possess larger Outfits. As in the previous article, each of the models described below may be built from a No. 0 Outfit with the addition, in certain cases, of two Trunnions.

The Mechanical Hack Saw illustrated in Figure 1 is a reproduction of the machines used for sawing through steel or other metals. In the actual machine, of course, the saw is driven usually from an engine, but the model is operated by hand. The frame consists of a 5½″×2½″ Flanged Plate raised from the floor on four 2½″ small radius Curved Strips, to the ends of which are bolted two 2½″×½″ Double Angle Strips. Two Double Brackets fixed to one flange of the Plate serve as guides for the saw (a 5½″ Strip).

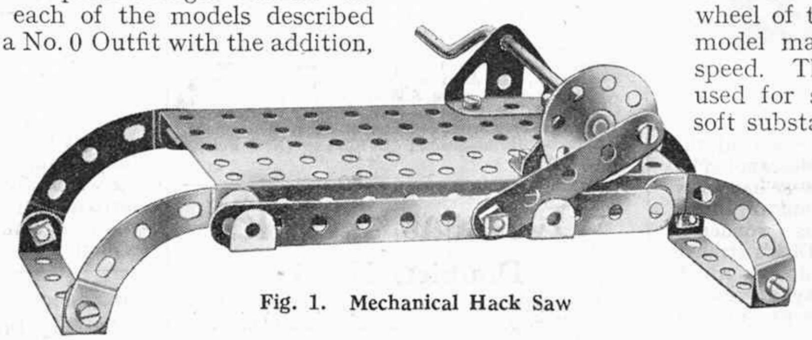


Fig. 1. Mechanical Hack Saw

A 2½″ Strip is attached pivotally to the saw by means of a bolt and lock-nuts (see detail No. 263 in the Standard Mechanisms Manual) and is pivoted in a similar manner to the face of a Bush Wheel that is secured to the Crank Handle. Two Spring Clips prevent the latter from sliding in its bearings. The material to be cut is placed directly beneath the saw, which is drawn backward and forward on rotation of the Crank Handle.

Figure 2 shows a simple type of Bench Lathe. The two vertical 5½″ Strips that carry the overhead shafting are bolted to one flange of the 5½″×2½″ Flanged Plate and to a third 5½″ Strip secured between the two rear legs of the bench. The face plate of the lathe consists of a Bush Wheel secured to a 2″ Rod that rotates in bearings consisting of a pair of Trunnions bolted to the Flanged Plate. A 1″ fast Pulley Wheel is fixed to the 2″ Rod and connected by a belt to a similar Pulley Wheel on a 3½″ Rod above, and two further 1″ Pulley Wheels, also secured to the overhead shafting, may be driven by a belt (not shown) from the main operating shafting.

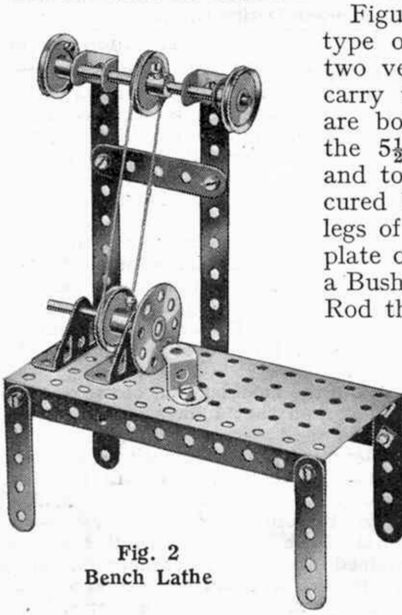


Fig. 2 Bench Lathe

The tool-holder is represented by a Reversed Angle Bracket. This model should prove invaluable to those boys who are fortunate enough to possess a Meccano Clockwork or Electric Motor, or even a small steam engine, for by connecting one of the overhead Pulley Wheels of the lathe to the driving wheel of the Motor or engine, the model may be driven at a high speed. The lathe may then be used for shaping wax and other soft substances, provided that the driving belts are kept tight enough to prevent slipping.

The Punching Machine reproduced in Fig. 3 has its prototype in many different industries; similar machines are in constant use in the Meccano factory. Two Trunnions bolted to a 5½″×2½″ Flanged Plate form supports for a pair of vertical 5½″ Strips, which are extended 1″ at their upper ends by means of two 2½″ Strips. Two Double Brackets secured between the vertical members are bolted, in turn, to Angle Brackets and Flat Brackets, as shown. The Flat Brackets form bearings for the punch itself, which is represented by a 3½″ Rod.

A 5½″ Strip is pivoted to one of the vertical members by means of a bolt and lock-nuts (S.M. 263), and carries at its shorter end a 2″ Axle Rod on which two 1″ fast Pulley Wheels are secured. The longer arm of the 5½″ Strip is attached pivotally to a Double Bracket held between two Spring Clips on the punch rod.

The bench on which the work is laid consists of a 2½″×½″ Double Angle Strip bolted to the base plate and supporting two 2½″ Strips joined at right-angles by a pair of Angle Brackets. The punch is caused to bear upon the work by pulling down the end of the 5½″ Strip. The weight of the two 1″ Pulley Wheels should be sufficient to return the punch to its original position as soon as the lever is released,

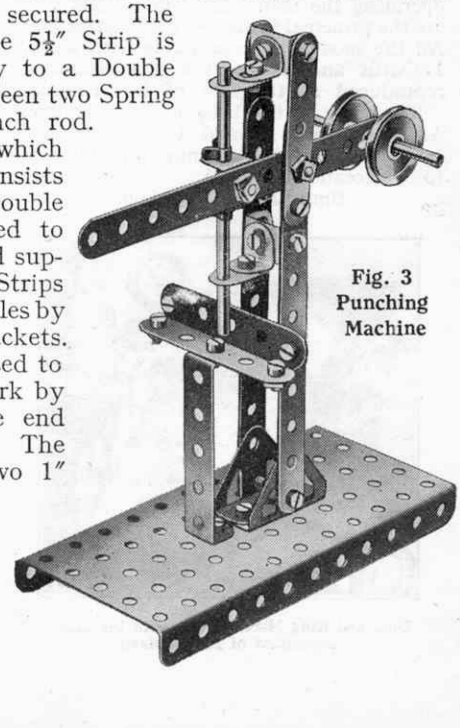


Fig. 3 Punching Machine

but it may be found advisable to increase the weight by adding further Pulley Wheels.

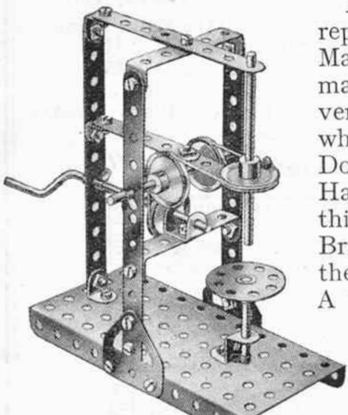


Fig. 4
Drilling Machine

In Fig. 4 we illustrate a representation of a Drilling Machine. The frame of the machine is composed of three vertical 5½″ Strips, two of which are joined by 2½″×½″ Double Angle Strips. A Crank Handle is journalled in the third 5½″ Strip and in a Double Bracket bolted to the lower of the two Double Angle Strips. A belt is passed around a 1″ fast Pulley Wheel on this Crank Handle, and then is led over two further 1″ Pulley Wheels and around a similar wheel secured to a vertical 3½″ Axle Rod that represents the drill. This Rod passes through the end holes of two arms, each consisting of a pair of 2½″ Strips overlapped two holes. The 2″ Rod that supports the drilling table (a Bush Wheel) carries a Spring Clip, the lugs of which press against the Reversed Angle Bracket, as shown, and thereby prevent the table from revolving.

It will be noticed that the four models just described all represent types of manufacturing machinery, and any boy possessing one of the larger Meccano Outfits will be able to build all four models, which, representing as they do four important industrial processes, will form the basis of a very fine model factory. If this idea is adopted, the Mechanical Hack Saw and the Drilling Machine may be converted to power operation by substituting Axle Rods and Pulley Wheels for the Crank Handles; the machines may then be operated simultaneously by belt drives from a common driving shaft that, in turn, is rotated by the Motor or engine.

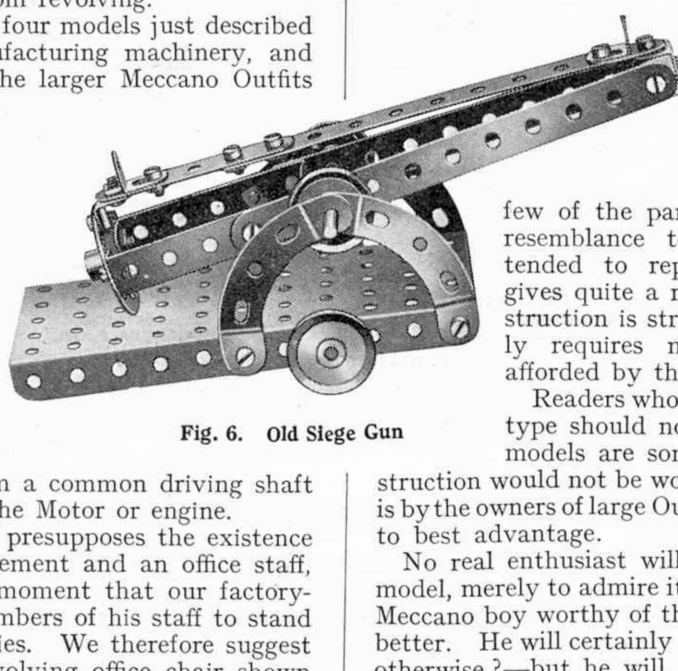


Fig. 6. Old Siege Gun

The existence of a factory presupposes the existence also of some form of management and an office staff, and we do not think for a moment that our factory-builder would expect the members of his staff to stand whilst carrying out their duties. We therefore suggest that he should build the revolving office chair shown in Fig. 5! But perhaps we ought to point out that if the occupant of the chair is made to the same scale as the Lathe or the Drilling Machine, he will require a ladder by which to climb into his seat! Moreover, if the builder studies the convenience of his staff he will probably provide the chair with a cushion, as the heads of bolts protruding from the seat of a chair do not add materially to its comfort. We would also advise the constructor of this model to keep an eagle eye on the whereabouts of the chair, as sisters are apt to find such articles—revolving or otherwise—very useful for the accommodation of their dolls.

Fig. 5
Revolving Office Chair

Most of our younger readers will quickly find a use for the old-fashioned Siege Gun depicted in Fig. 6. It will prove a valuable addition to any miniature fortress, and as may be seen from the illustration, its appearance and general lines reproduce very faithfully those of its prototype. The sides of the barrel are composed of 5½″ Strips and 2½″ × ½″ Double Angle Strips overlapped two holes, while the top consists of a 5½″ Strip and a 2½″ Strip. The 5½″ Strips are bolted together at the muzzle by means of two Double Brackets, and the other end of the barrel is completed by a Bush Wheel. The gun is balanced on a 3½″ Axle Rod, which carries two 1″ fast Pulley Wheels and is supported on the gun-carriage by four 2½″ small radius Curved Strips.

A further contribution to the Meccano boys' store of defensive armaments is the battleship illustrated at the foot of this page. It will be seen that, although few of the parts show separately any close resemblance to the objects they are intended to represent, the complete model gives quite a realistic impression. Its construction is straightforward, and consequently requires no explanation beyond that afforded by the photograph (Fig. 7).

Readers who possess Outfits of an advanced type should not imagine that because these models are somewhat elementary their construction would not be worth while. On the contrary it is by the owners of large Outfits that they can be employed to best advantage.

No real enthusiast will be content, after building a model, merely to admire it and then dismantle it. Every Meccano boy worthy of the name will try for something better. He will certainly admire his model—could he do otherwise?—but he will then proceed to reproduce as closely as possible the actual environments of its prototype, and the conditions under which it works. He will build as many additional models as he can, and arrange them so that they form the component parts of a complete system.

A good example of this idea is the factory suggested above. Our more ambitious readers could elaborate still further by erecting a suitable Meccano structure to house the machinery! Similarly, with the aid of simple models of this type, a miniature shipyard or dock could be completely equipped with cranes, ships, gangways, etc.

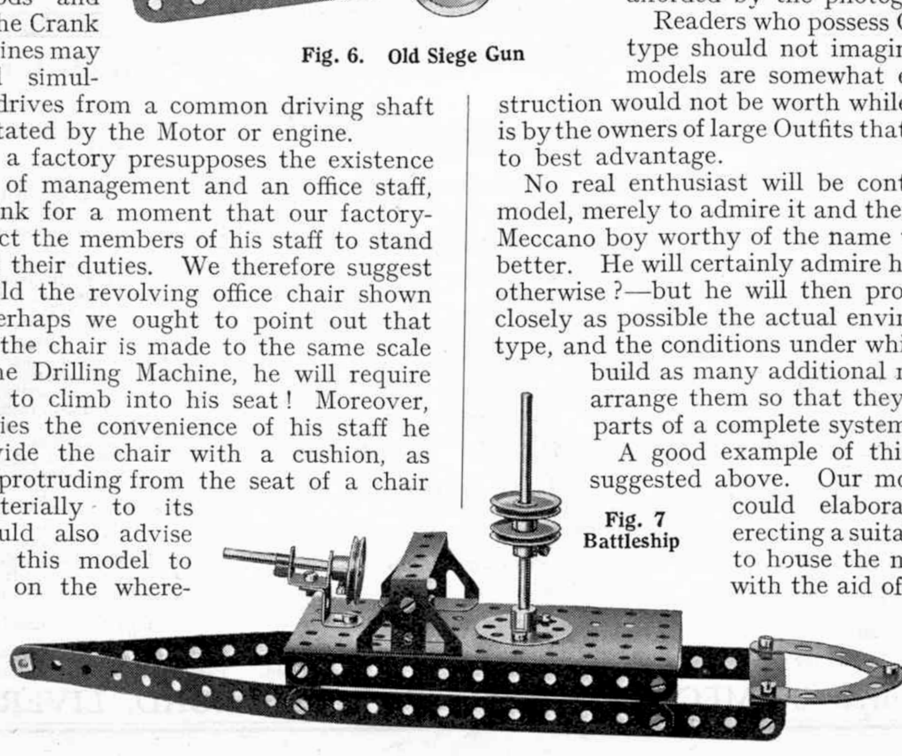


Fig. 7
Battleship

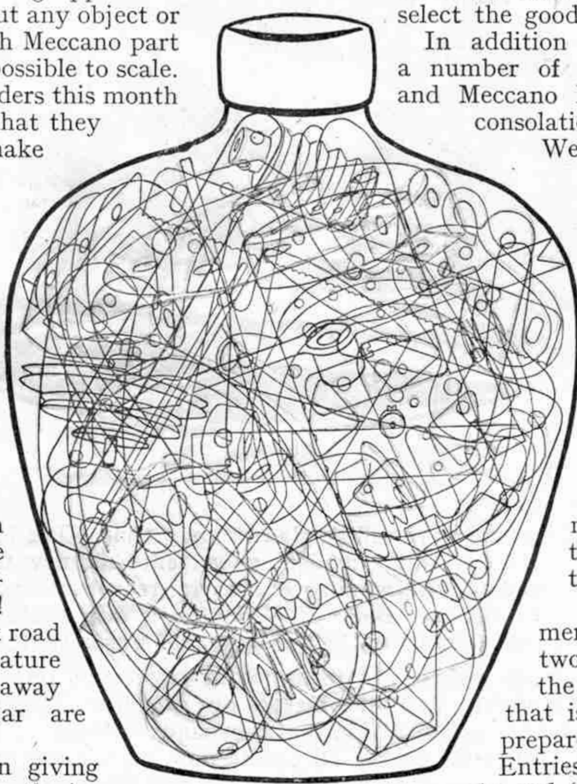
Competition Page

Bottled Meccano Parts!

Another Stiff Test For Sharp-Eyed Readers

The jar illustrated here is unique in the fact that it is crammed as full as it will hold with standard Meccano parts. At first sight the whole thing appears to be a confused tangle of lines without any object or design, but as a matter of fact each Meccano part is accurately drawn and as far as possible to scale.

The problem that we set our readers this month is to make a list of all the parts that they can find in the jar. In order to make the puzzle still more interesting we do not give any indication of the number of parts contained in the jar, and therefore each competitor must scrutinize the jar with the most minute care and identify the parts one by one until he can find no more.



It will be found that a certain number of parts are quite obvious, but when these have been disposed of the task of identifying the remainder becomes more difficult with each one; in fact we believe that the task of recognising the last half-dozen or so will prove a real teaser! So far as we know there is no quick road to success in a contest of this nature and it is necessary to keep pegging away until all the secrets of the jar are revealed.

To the reader who succeeds in giving the most accurate list of the parts in the jar we will present Meccano Parts or Hornby Railway Goods to the value of £1/1/-. Similar prizes to the value of 15/- and 10/6 respectively will be awarded to the senders of the second-best and third-best lists. In each case the winner will be allowed to select the goods to be sent to him as his prize.

In addition to the above-mentioned prizes, a number of Meccano Crystal Receiving Sets and Meccano Headphones will be awarded as consolation prizes.

We take this opportunity of again reminding competitors that entries must be written on one side of the paper only, and that the competitor's name and address must appear on the back of every sheet of paper used. We have emphasised this fact on many previous occasions, but scarcely a month passes without a number of entries—some of them in the prize-winning class—having to be disqualified because they do not contain the slightest indication of the name or address of the sender.

A further point that may be mentioned is that in the case of two or more entries tying for a prize the award will be made to the one that is the neatest and most carefully prepared.

Entries for this competition should be addressed "Bottled Parts Contest, Meccano Magazine, Binns Road, Liverpool," and must reach this office by 29th February. Overseas closing date, 31st May.

24th Drawing Contest

One of the most interesting experiences of our drawing competition work has been to observe how eagerly readers have entered contests in which fast moving vehicles have been the subject and how excellently they have contrived to give the appearance of speed to their subject.

For that reason the subject of the contest this month will prove popular. It is "THE SUPERMARINE S5 MONOPLANE," the winner of the 1927 Schneider Trophy Race. Last month's article on this great British victory included several excellent photographs of the machine, and competitors may base their drawings on those views if they wish.

Prizes of Drawing Materials or Meccano products (to be chosen by the winners) to the value of 10/6 and 5/- will be awarded to the competitors who submit the best sketches in each of the usual two sections; A for readers of 16 and over and B for those under. Each competitor must give his name, address and age, on the back of his entry.

Entries must be addressed to "24th Drawing Contest, Meccano Magazine, Binns Road, Liverpool," and sent to reach this office not later than 29th February. Overseas closing date, 31st May.

Results

Xmas Presents Competition

As usual the votes for this competition came in in a continuous stream day after day from the time that the Christmas number of the magazine appeared until the closing date. The work of examining the entries proved much heavier than in previous years.

A final analysis of the voting revealed that the Hornby Flying Scotsman engine was easily the most popular item, followed by the Bowman Model engine, the Pathe Baby Cine, the Hobbies Pioneer Launch, the Alfa-Romeo Car, and the No. 7 Meccano Outfit.

The first prize was awarded to ALEC PEEL, of 239, Holly Mount, Manchester Road, Nelson. We are pleased to mention also that on learning the result of the competition Messrs. Bowman Models immediately offered to present a prize to the competitor whose list was second best. This was M. LAKER, 16, Routh Road, Wandsworth Common, London, S.W.18.

7th Stamp Contest

1. C. J. SNOW (Streatham Hill); 2. J. M. BALDRY (St. Leonards-on-Sea); 3. F. C. TREND (Peckham, S.E.15).

Silhouettes No. 1

First Prize: A. J. LEESE (Bromyard, Worcester); Second: C. SWANN (Didsbury); Third: P. SMITH (Dublin); Fourth: G. CAMPBELL (St. Leonards). Consolation Prizes: H. BOWMAN (Wanstead, E.11); M. PRESTON (Cheltenham); T. B. ROBSON (Liverpool); H. B. WILKINSON (Sheffield); A. WILLIAMS (Llanelly); C. H. B. WILLS (Mill Hill, N.W.7).

Silhouettes No. 2

First Prize: E. NICE (Golders Green, N.W.11); Second: A. PURSLOW (Wolverton, Bucks.); Third: D. W. HALES (Eastbourne); Fourth: J. SHAW (Heswall, Cheshire). Consolation Prizes: A. MEE (Leicester); K. LONG (Scunthorpe, Lincs.); E. E. DIXON (Scunthorpe, Lincs.); H. PICKSTONE (Anfield, Liverpool).

We are sure that all keen Meccano boys will be glad to know that " The Meccano Book of New Models " is now in course of preparation. Nearly all the models, movements and new model-building ideas illustrated in this book are the direct outcome of prize-winning entries in recent competitions. They cover a wide range of interesting subjects. The Meccano Book of New Models also contains details of the best of the suggestions and ideas that have been published in the *Meccano Magazine* during recent months.

Large numbers of suggestions and bright ideas for new Meccano improvements reach us every day from Meccano boys all over the world. It is the task of our model-building department to select the best of these and to improve them as much as possible so that thousands of Meccano boys may benefit by becoming acquainted with their fellow-enthusiasts' work. Of course, few models are reproduced exactly as they are submitted by their designers—as a matter of fact several of the new models shown in the new book incorporate the ideas of three or four different Meccano boys.

It should be understood that this book is entirely supplementary to the ordinary Instruction Manuals, and many of the models illustrated are published for the first time.

Ready in February

The new book will be ready for distribution about the end of February, price 7d. post free. There is sure to be a big demand and to make quite certain of getting your copy you should send along your order *now*. All orders received will be dealt with in strict rotation, as soon as supplies are ready.

How to Order the Book

Address your orders to " New Model Book," Meccano Limited, Binns Road, Liverpool, and please write your name and address clearly.

As already mentioned, the price of the book is 7d. post free, and a remittance in stamps for this amount should be sent. Orders will not be acknowledged.

Orders from Overseas

There will be a special edition of the Meccano Book of New Models for Overseas. It will be ready for despatch by the end of February and supplies will be sent to our agents for distribution. The price Overseas is 9d., or 10d. post free. Readers in Australia, New Zealand or South Africa who require copies should address their orders to our agencies as detailed below.

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With the Secretary

Interests for All Members

While reading through the reports that come in regularly from certain clubs I have been struck with the wide range of their activities. A club is, of course, in the first place a group of boys with whom Meccano is the common interest and the foundation of their association, but boys' tastes differ so much that it is a mistake to restrict their activities in any way. This is well understood in most clubs, with the result that facilities are given for other hobbies such as Model Railway Building, Fretwork, Stamp Collecting, or Wireless, in addition to games such as Draughts, Chess, or Table Tennis.

The extension given in this manner has proved of unbounded benefit to those clubs that have worked along the lines indicated, while larger clubs have carried the principle still further and have formed separate sections, each under its own sub-leader, which devote attention to one subject only. It is not usually difficult to think of interesting things to do, as the members themselves are generally full of ideas. I may mention one feature, however, that is sure to interest members of all clubs, and this is air rifle shooting.

Air Rifle Shooting

I do not know of any more attractive feature for the syllabus of a club than air rifle shooting and I should greatly like to see its general adoption. Apparently some club leaders hesitate about introducing this feature, either on account of inexperience or because of a fear that a heavy financial outlay would be involved. One of the earliest Meccano clubs to take up air rifle shooting was the First Herne Bay Club. Recently I asked the secretary to give me a short description of the lines upon which they work, and I now pass on his remarks for the benefit of all clubs that are interested in this matter.

First of all there should be no anxiety on the ground of expense, for the total outlay to begin with need not exceed 25/- and the range will pay for itself after a few months' use.

The range can be fixed up quite easily along one side of the club room, occupying its entire length. The width of the range need only be about 3 ft. A curtain of some heavy material is required and for this purpose art serge is very suitable. The curtain should be almost the length of the room and about 5 ft. or 6 ft. in height, and it should have small brass rings 12 in. apart along the top. A length of material of this width, shop-soiled or with some other defect can often be purchased quite cheaply. This curtain serves the double purpose of keeping any rebounding shots within range and of keeping the range fairly dark. It also prevents members from absentmindedly straying into the line of fire!

In order to fix the curtain two large strong cup hooks, costing 1d. each, should be bought and fixed one at each end of the room about 3 ft. from the corner and at a height of 5 ft. or 6 ft. according to the height of the curtain. A length of about No. 8 stranded wire cable, sufficient for the length of the room, and costing about one shilling must also be obtained. A loop is made at each end of this cable. A strainer is also required to enable the cable to be tightened and this costs about 9d. The strainer is a small edition of those gadgets that one sees near the bottom of telephone and electric cable post stays. Having obtained all these necessaries, the next thing is to fix the ringed curtain on the cable. Place one loop of the cable on one cup hook and the other on the strainer, which in turn is attached to the second hook. The strainer is then manipulated until the cable is tightened sufficiently.

We now come to the air gun. If a new one is to be purchased it is very advisable to obtain a breech-loader, as these are infinitely superior to any other kind, and are well worth the slightly higher cost. A good gun of this kind can now be obtained for 10/- or 12/6. If a really first-class gun with a properly bored barrel is desired, the cost will be from 25/- upward, but the cheaper weapon will suffice to start off the range and a better gun may be obtained later when funds permit.

Scheme Adaptable to any Club

It is extremely desirable that the club Leader should be present at firing practices. If this is not always possible he should nominate some responsible person, such as a senior member of the club, to take charge of the proceedings. Firing in a standing or kneeling position has many drawbacks and it is much better to fire in a prone position. For this purpose a mattress to lie on is very suitable, but if this cannot be obtained a rug or a blanket may be used with a cushion to support the elbows.

As regards the arrangements at the other end of the range, the simplest plan is to pin the card target on to a board, using the ordinary light of the room for its illumination. This arrangement is frequently unsatisfactory however, and at Herne Bay it has been abandoned in favour of a special lamp box which is extremely effective. This may be constructed easily and cheaply and I hope shortly to give the necessary details.

The scheme devised by Herne Bay works satisfactorily but, of course, it is not necessarily the one best suited to the requirements of every club. There should be little difficulty, however, in adapting the scheme outlined above to fit local conditions and if any Leader experiences trouble in this matter I shall be very glad to give him any assistance in my power. At the same time I shall be very glad if clubs that already have taken up air rifle shooting will let me know their experiences and their views upon the methods adopted at Herne Bay.

Proposed Clubs

Attempts are being made to form Meccano Clubs in the following places and boys interested should communicate with the promoters whose names and addresses are given below :—

AUSTRALIA.—J. E. Wood, 366, Sydney Road, Brunswick, Melbourne, Australia.

EDINBURGH.—Robert Croall, 16, Banyholm Avenue, Trinity, Edinburgh.

EDINBURGH.—W. Williamson, 14, Greenbank Crescent, Edinburgh.

LONDON.—Ernest Blackburn, 116, Leyton Green Road, London, E.10.

LONDON.—John Hayman, 28, Somali Road, London, N.W.2.

LONDON.—W. Masters, 100, Avenue Road, Swiss Cottage, Hampstead, London, N.W.3.

MARGATE.—R. Tyler, 68, Grange Road, Margate, Kent.

OGMORE VALE.—John Symons, 9, Moira Terrace, Ogmore Vale, Nr. Bridgend.

PETERBOROUGH.—S. A. Watson, 58, Broad Bridge Street, Peterborough.

ROMFORD.—E. D. Bailey, "Les Marguerites," Clydesdale Road, Romford, Essex.

SANQUHAR.—James Rigg, Crawick Lea, Sanquhar, Dumfriesshire.

SHEFFIELD.—J. A. Kelso, 204, Rock Street, Pitsmoor, Sheffield.

SOUTHBOROUGH.—R. L. Jones, 72, Springfield Road, Southborough, Kent.

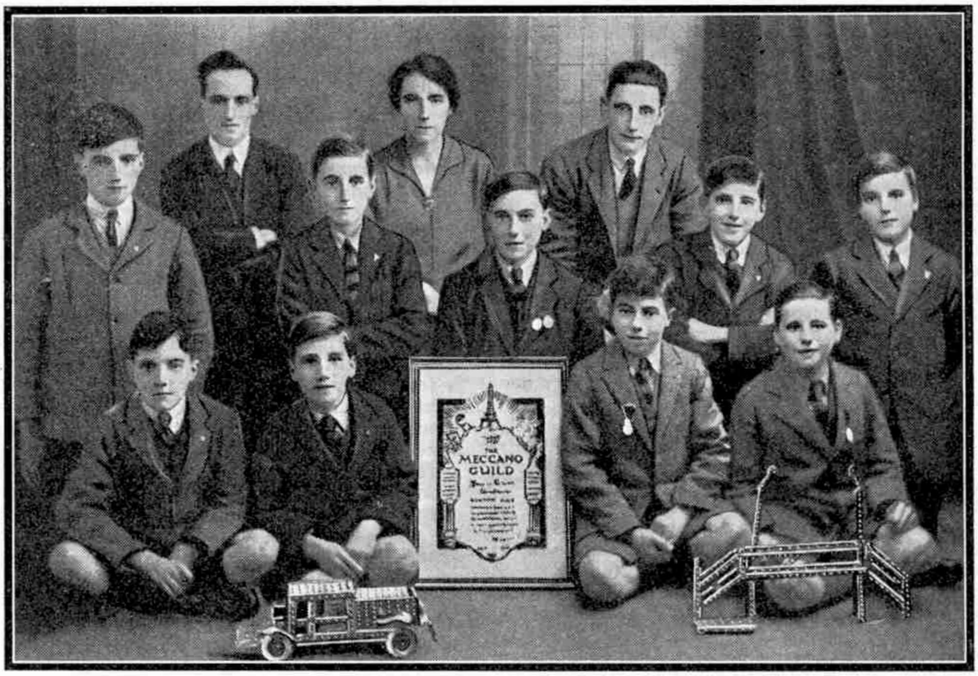
STOWMARKET.—D. Eldridge, Beech Place, Violet Hill, Stowmarket.

King Edward's School (Birmingham) M.C.—Several very interesting lectures have been given recently including one on "*The Morris Works*" and another entitled "*Bradshaw's Guide.*" These were greatly appreciated by the members. A meeting is to be held to discuss plans for the future and it is hoped to arrange several competitions. Club roll: 15. *Secretary*: David H. Lewis, The Mount, Bilston, Staffs.

Northwood M.C.—Evenings are spent in Model-building and Games, and a Camp Fire evening proved highly successful. "Is Soccer better than Rugger?" was the subject of a debate recently held and this aroused much interest. Community singing is popular and at a recent meeting the Leader and one of the members impersonated a ghost, causing a great deal of merriment. An exhibition is proposed, to take place in the near future, but nothing definite has yet been decided. An effort is on foot to recruit new members and any boy wishing to join the club should communicate with the secretary, who will be pleased to give full particulars. Club roll: 18. *Secretary*: A. S. Whiddington, 5, Sandy Lodge Way, Pencarrow, Northwood, Middlesex.

Haslingden Secondary School M.C.—An interesting feature of this club are short papers given by the members on various subjects. It is hoped that in the near future Senior and Junior Sections will be formed. The secretary recently delivered a very interesting lecture on "*A Visit to a Dye-Works.*" On the same evening a very successful Mock Court was held. Club roll: 30. *Secretary*: K. G. Tupling, 16, Alexandra Terrace, Haslingden, Rossendale, Lancs.

Links Boys' (London) M.C.—Since the club's affiliation excellent progress has been made. At a local exhibition one of the members gained a prize for a very good model of an aeroplane. Draughts tournaments are popular and the members take a keen interest in the game. It is hoped that an exhibition of models can be arranged for next month. Club roll: 38. *Secretary*: R. Donaldson, 38, Eastbourne Road, Tooting, London, S.W.17.



Our photograph of a group of members of Great Baddow M.C., includes the secretary, Miss D. K. French, on the right of whom is Mr. J. Pitts, the Leader

Albert Village M.C.—A very interesting lecture on "*The Suez Canal*" was given by G. Heath, who found the articles in the "*Meccano Magazine*" useful. Hornby Train nights are very popular and layouts are loaned by members on these occasions. A Model-building contest and several Games tournaments have been arranged. Club roll: 12. *Secretary*: L. C. Adey, 239, Occupation Road, Woodville, Nr. Burton-on-Trent.

Sandwich M.C.—Model-building continues to be a prominent feature of the work of the club. It is hoped to arrange Games tournaments in conjunction with the Herne Bay M.C. Club roll: 22. *Secretary*: William Barlow, 9, Paradise Row, Sandwich.

Morison Memorial (Clydebank) M.C.—Has had a most successful session although unfortunately many of the older members have been obliged to leave. On the last Saturday in each month a Model Competition is held in three sections according to age and experience. Marks are given for the models and the member in each section having the highest marks at the end of the session is to be given a special award. Many interesting lectures have been given on engineering subjects. The club has a "Charity Fund" to which each member contributes one penny monthly. Two Meccano Outfits have already been sent to the Orphanage Homes. Club roll: 43. *Secretary*: George Gerrard, Yarrow, Montrose Street, Clydebank.

Whitby P.M. (Cheshire) M.C.—The club night has been changed from Wednesday to Tuesday and although the numbers are small the members are all keen. It is hoped to start a Library presently. Club roll: 12. *Secretary*: T. A. Smeatham, "Clifton," Whitby Heath, Whitby, Nr. Birkenhead.

1st Herne Bay Meccano and Hobbies Club.—The Rifle Range has been improved and the club has been presented with a Tennis Table by a lady who takes a kindly interest in the club. The library has increased considerably and the club store is becoming more popular. Stamp collecting is a new feature that has now become very prominent and many accessories have been supplied for use on Stamp evenings. Fretwork is another feature of the syllabus, while Games tournaments are held frequently and are greatly enjoyed. Club roll: 37. *Secretary*: C. W. Russell, 4, Clifton Villas, Herne Bay, Kent.

Diss Church M.C.—Model-building still remains a very popular feature of the club and many excellent models are produced. A most interesting lecture on "*Submarine Cables*" was delivered by Mr. Bordeaux and this was greatly appreciated by all present. The club has joined the League of Nations Union. Club roll: 28. *Secretary*: J. J. Maling, 6, Mount Pleasant, Diss, Norfolk.

Ilfracombe M.C.—Is making satisfactory progress. Draughts tournaments are arranged from time to time and are very popular. The President very kindly loaned a Bagatelle Table and 1d. is charged for each game. A Mock Trial recently held was highly amusing. Club roll: 23. *Secretary*: R. Trawin, 33, Victoria Road, Ilfracombe.

Royal Grammar School (High Wycombe).—The membership has reached the high total of 153. During the past session interesting lectures and talks have been given on "*The Organ,*" "*Eddystone Lighthouse*" and "*A Visit to the Hebrides,*" the last named illustrated by photographs taken by the lecturer, Mr. H. C. Rolfe. The club Leader provided a very interesting evening by showing a number of slides which he had made from his own and members' photographs taken at camp. Another interesting and instructive lecture was given by Capt. Lawson Smith on "*Deep Sea Diving*" and was illustrated by the exhibition of diving apparatus. An enjoyable concert and a visit to the Museum at South Kensington were other features of the session. Club roll: 153. *Secretary*: T. W. Earis, 18, Dashwood Avenue, High Wycombe, Bucks.

Sheffield M.C.—The membership shows a steady increase and a Stamp Section has now been formed. The club has been very fortunate in securing the services of Mr. Traylen as President, and the members are going forward with renewed interest. Contractors' Nights are to be prominent features in the programme. Club roll: 20. *Secretary*: K. Stacey, 128, Peveril Road, Sheffield.

Westbury M.C.—The Westbury C.C. School recently gave a play entitled "*Cinderella*" and many of the club members helped to make this a success. A model of the Motor Chassis was loaned from Headquarters and created great interest among the members. Club roll: 29. *Secretary*: Eric Moye, 24, Burnell Rise, Letchworth, Herts.

Wallaseyan M.C.—The programme is a most attractive one and Model-building is popular. Tournaments for Draughts, Table Tennis and Chess have also been arranged. Club roll: 23. *Secretary*: C. Goodall, 1, Eaton Avenue, Wallasey.

United Schools (Melton Mowbray) M.C.—The last session was a great success, the programme including several interesting lectures. Many good models were built by the members, two that deserve special mention being a Double Pit Head Gear and a Carpenter's Workshop complete with Saw, Drill, Planer and Grindstone. Both models were worked from a high voltage motor that has been purchased for club use. Club roll: 24. *Secretary*: A. H. Pepper, 26, Stafford Avenue, Melton Mowbray.

Italy

Siena M.C.—The club appears to be making excellent progress and several new members have been enrolled. The members have all been very busy practising for a recital of one of Italy's greatest dramas entitled "*Romanticismo,*" in four acts. Meetings are well attended and the secretary reports that all the members are very enthusiastic. Club roll: 11. *Secretary*: V. Bruchi, 29, Via Ricasoli, Siena, Italy.

Straits Settlements

Singapore Chinese M.C.—A suitable club-room has now been secured and it is hoped to have this ready for club use immediately. The programme which has been drawn up is a very attractive one and includes Model-building, "*Meccano Magazine*" evenings, and Conjuring. A most enjoyable picnic was recently held at Sungei Post, when swimming and games were an important feature of the day. A debate has been arranged on the question of corporal punishment in schools. The general arrangement of the club is to have meetings fortnightly and an outing once every month. It has been arranged to hold a concert to advertise the club and many very interesting items have been suggested. Club roll: 35. *Secretary*: Choo Boon Hoe, "Grasslands," 8, Saint Thomas' Walk, Singapore, Straits Settlements.

New Zealand

Dunedin (New Zealand) M.C.—Good progress is reported and club nights are devoted to competitions of various kinds. Stamp Evenings are frequently held. It has been decided to cease Model-building for a short time as the boys are very keen cricketers and wish to put in as much time as possible at the game. Club roll: 9. *Secretary*: Tony MacLachlan, Art Studio, 65, Albany Street, Dunedin, New Zealand.

The Origin of Guilds

The Splendid Ideals and Traditions of the Ancient Companies

MAN has always been a sociable being, even from the very earliest times. In far-distant ages men formed themselves into tribes for mutual protection against their enemies and against the fierce wild animals that roamed the countryside. As civilisation dawned and gradually spread, the tribes drew together into larger and still larger bands, and so in time nations came into existence. But during all this banding together there remained in the larger bodies small groups of men drawn together by some strong common interest, and in these little groups we find the origin of Guilds.

We have been asked repeatedly why we chose the name "Guild" for the great Meccano organisation. The answer is that we wished our movement to be based upon the splendid ideals and traditions of the old Guilds—good fellowship and comradeship and unselfish working for mutual benefit. The old Guilds are dead, but the spirit that animated them is as much alive to-day as ever, and we believe that spirit animates the members of the Meccano Guild. As long as its members remain true to its ideals, the Meccano Guild will live and prosper and become an ever-widening influence in the world of modern boyhood.

Craftsmen from Flanders

A Guild may be described briefly as a union of men formed for mutual benefit, responsibility and protection. It cannot be claimed that Guilds originated in England, but it was in England that they reached their highest development.

After the conquest of England by William I, traders and skilled artisans began to come from Flanders and northern France to settle in what was then a comparatively thinly populated country. These men were masters of their respective crafts and were also very industrious, and consequently in time they became very prosperous. Those were lawless times, and the wealth of these merchants soon attracted the attention of the robber bands that infested the country. The merchants therefore found it necessary to band themselves together for mutual protection of their lives and property, and so a number of Guilds came into being.

Formation of Merchant Guilds

As time went on and the state of the country became more peaceful, the need for combining against robbers gradually disappeared. By this time, however, the merchants had realised that there were many other advantages in such combinations, and so the Guilds already in existence were kept going, and from time to time others were formed. In the twelfth century Merchant Guilds received Royal authorisation, and thus were placed upon a sound basis.

The Merchant Guilds were formed primarily for trading purposes, and the members passed many stringent rules regulating trade in various towns and villages. For instance, only members of the Guild were allowed to sell goods to the inhabitants of a town. A stranger might bring in goods, but he could only sell them to members of the Guild, and anyone found breaking this rule was very severely punished. It might be thought that the merchants, protected by Royal authority and strongly organised in this manner, would make exorbitant charges, as there was no competition and no restraint. This was not the case, however, for wise rules were drawn up by all the merchants assembled together, and any member disregarding these for his own profit had his privilege of membership taken away and was thus deprived of the means of livelihood.

Gradually the scope of the Merchant Guilds widened, and when the liberties of the townsmen were threatened there were large assemblages at the Guild Hall to consider ways and means of defending their rights. Thus the Guild's affairs became more and more the town's affairs, and later on we find that the Guild Halls became Town Halls and the Merchant Guilds became Town Councils.

Even to-day the municipal buildings of many towns are known as Guildhalls. The famous Guildhall of London is one example. When the erection of the original building was commenced in 1411 it was intended for the meeting hall of the Merchant Guilds. To-day it contains the common council chamber and several courts of justice, in addition to the great hall used for banquets and receptions. Among other historic cities in which the municipal building is known as the Guildhall are York and Bristol, both of which were famous for the strength of their Merchant Guilds in earlier times.

Unfortunately the Merchant Guilds showed a tendency to become tyrannical as their power and wealth increased. They excluded the landless men of the handicrafts with the result that these united among themselves to form Craft Guilds.

Craft Guilds and Apprentices

As the Merchant Guilds gradually changed in character, the Craft Guilds soon entirely replaced them as far as trading interests were concerned. The Craft Guilds, as was the case with the Merchant Guilds, were governed by very strict rules. Each member held himself directly responsible for the actions of his fellow members and this naturally led each one to consider his conduct very carefully.

The rules and regulations were drawn up on the vote of the majority, and were framed for the welfare of the community as a whole, and for the religious and moral good of the individual. They demanded that each member should lead an upright, honest life, giving succour to anyone in distress (particularly a fellow member of his Craft) and doing his utmost to live up to the high ideals of the Craft. Should a member find his business failing through the markets going against him, it was the duty of his fellow members to help him and save him from going to moneylenders, who charged exorbitant interest for their assistance.

A determined effort to break down class distinctions was made through the introduction of the apprenticeship system. No matter how rich and influential a man was, he could not buy the right of entry to the Guild for his son, who must serve his apprenticeship, live, sleep, have his meals and his games with his fellow apprentices. Promotion to the various offices in the Guild was given on merit alone, and it was possible for the son of the poorest parent to gain the highest honours the Guild had to bestow.

As in the case of the Merchant Guilds, the interests of the Craft Guilds widened, and in addition to the ordinary commercial and social obligations they took a deep interest in religious and educational matters. Not only did they strive to make the Church services beautiful, but they spent endless time, energy, and wealth in beautifying the buildings in which the services were held, and many churches and chapels bear evidences of their efforts to this day. In some old churches there are wonderful examples of wrought-iron work, marvellous wood carvings and tapestries and priceless specimens presented by the old Goldsmiths and Silversmiths. In educational affairs they spent huge sums in founding and endowing schools and colleges, and they usually engaged the very finest masters it was possible to get.

The Livery Companies of London that have inherited much of the wealth of the Guilds are to-day greatly interested in educational work.

This religious tendency is still reflected in the Church, for to-day there is scarcely a church or chapel in the Kingdom without a Guild of some sort or other.

The Dissolution

The Guilds, in the oldest and best sense, received their deathblow in the reign of Henry VIII. A Bill was introduced in Parliament authorising the King to acquire all the property and lands belonging to churches and the Guilds. The Guild members banded themselves together and used all their great influence and power to resist the Bill, but although they managed to retain a great many of their rights and privileges from a commercial and social point of view, their colleges, churches and chapels were seized and confiscated.

The Guilds never recovered from this blow. The former strict rules were gradually relaxed, and little by little unscrupulous men won their way to power. They altered everything completely, and soon the Guilds became leagues or companies of employers and capitalists, who used them for grinding down the poor workmen and townspeople for their own profit. Efforts were made in Elizabeth's reign to restore the Guilds to their former purity of purpose, but without success, and it is doubtful if they can ever exist again as they did hundreds of years ago.

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Stamp Advertisements continued on page 192

WAR VESSELS OF ANCIENT DAYS

THERE is no more fascinating sight to boys born in a maritime country than that of some old-time ship, ploughing her way through the sea with billowing canvas and creaking ropes. Romance is written large across her canvas and it is one of the greatest regrets of every lover of the sea that the smart sailing ships of early years are slowly but very certainly disappearing from the highways of commerce. The stamp collector, however, can rejoice in the possession of a veritable shipping museum, in which are preserved pictorial records of all types of trading and war vessels, ranging from the galleys of the great empires of Rome and Carthage to modern battleships and mercantile palaces.

The earliest known form of sea transport was the rowing galley and it is to these striking ships that we propose to devote our comments this month.

From the far-off days of the siege of Troy, up to comparatively modern times, galleys have been used both as war vessels and trading ships. They were low, flat vessels, their bows and sterns generally being raised considerably above the level of the single deck. Usually they had one mast fitted with a single square sail for use when favourable winds were blowing, but for all practical purposes they were driven through the water by great oars ranging from 14 to 59 ft. in length, according to the size of the vessel. Mounted high on the stern platform was a brilliant-hued canopy under which the ship's commander reposed while directing the movements of his vessel. Out behind his canopy usually there was an elaborate carving of the vessel's patron deity, and on a flagstaff the vessel's ensign. The platform at the bow was occupied by officers supervising the working of the ship and the slaves pulling at the oars.

Jutting out from the bow there was a figure head of fearsome appearance that served, incidentally, to support the bowsprit. This custom has been handed down throughout the ages and to-day still clings among sailing yachts; modern steamers do not carry the bowsprit. Below the water line projecting well ahead of the ship was a powerful ram to which was fastened a cleaver or some other awful instrument of destruction. A great feature of the galleys was the richness of the carved panelling that ornamented the sides.

So much for the general appearance of a galley. It will be observed from the reproductions on this page that only in certain small details did the galleys of different races vary one from the other; the main features are strikingly alike.

An excellent view of an ancient Maltese galley is given on the 5d. value of the Maltese 1899 issue. This differs slightly from other Mediterranean galleys in that it carries three masts. A particularly interesting feature of this stamp is the Maltese flag displayed from the tip of the main mast. The 1 franc value of the Tunis (French Col.) issue of 1906 shows a splendid view of a Carthaginian galley. One of the old Venetian galleys is shown on the 45 cent value of the Fiume charity issue of 18th May, 1919. This issue was made to commemorate the 200th day of the declaration of peace between Austria and Italy on 30th October, 1918. Unfortunately, we were unable to secure a copy of this stamp for illustration purposes.

Just as the great steamships of to-day vary considerably in size, so there were large and small galleys. Some were driven by but 50 oarsmen, while the great galley of Caligua required 1,600! It must not be assumed that the number of oars necessarily determined the size of the galley; it is impossible to indicate a standard for gauging dimensions. A typical French slave galley of the 17th century, in appearance resembling closely the ancient Genoese and Venetian galleys, required the services of 300 oarsmen and was but 150 ft. in length and 30 ft. in breadth, and this size is believed to approximate to that of the average galley of the ancients.

This particular ship had its slaves chained to 50 oars placed 25 on each side. The probable length of the oars would be about 39 ft., of which one-third would be inboard. The slaves were seated on benches placed obliquely from the ship's bulwarks to provide a clear passage down the centre, and it is easy to calculate that six slaves were allotted to each oar. The 59 ft. oars mentioned previously were so clumsy that handles had to be provided to enable each of the 10 slaves working the oar to take hold, and lead filling had to be packed into the handles to provide counterbalance for the enormous weight outside the oarport.

It is interesting to know that the galleys were classed according to the number of banks or rows of oars they worked, just as our early British warships were classified according to the number of guns carried. The rows were arranged one above the other, and the average large vessel had from three to five banks.

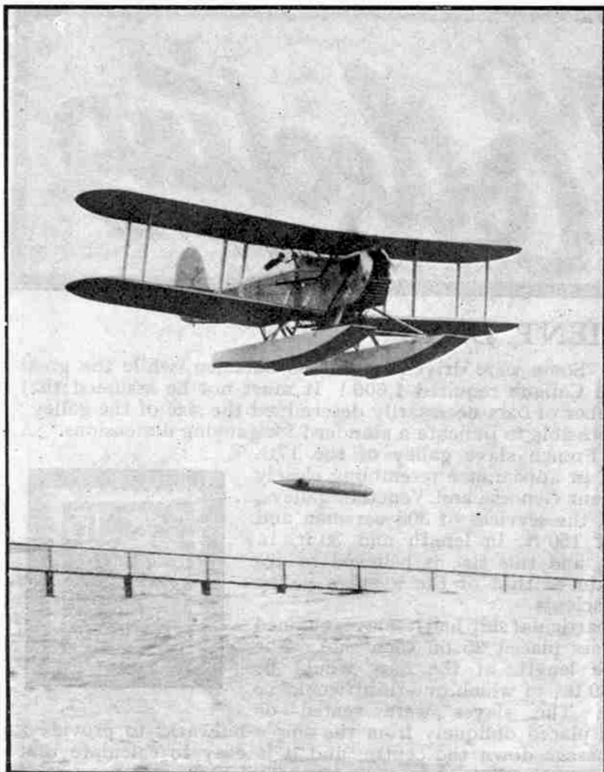
The Viking ships of the early Scandinavian sea rovers, although of much smaller size, come within the scope of this article for they also were propelled by oars. The striking resemblance between the Viking ships and the Mediterranean galleys is clearly shown by a comparison of the Esthonian stamp of the 1919-20 issue and the 5 milliemes stamp of the Egyptian International Navigation Congress commemorative issue, 1926. The Egyptian stamp illustrates an ancient Egyptian galley, as depicted on a piece of statuary preserved in the Temple of Deir-el-Bahari. The 15 cent stamp of the Danish 1927 issue shows a Viking ship of the later days of these great sea raiders.

Fortunately for students of the Viking galleys, many of these ships have been found embedded in the shores of the Scandinavian fjords, and very precise details of their construction are available. Probably the best known discovery is that of the ship known as the "*Gokstad*," found near Sandefjord at the entrance to the Kristianafjord in 1880. This had an overall length of 101 ft., and of 85 ft. at the waterline, and was 16 ft. 7 in. in breadth. Its draught was 3 ft. 8 in. and with a crew of 40 men and their equipment and stores it displaced 30 tons. It was built of oak, and in addition to its single square sail it was propelled by 32 oars, 16 on each side. The "*Gokstad*" was a "longship" built for war and doubtless took part in many a raid on the English coast. Up to the year 1000 A.D. the largest "longship" built was the "*Long Serpent*," 160 ft. in length and said to have possessed 32 pairs of oars.

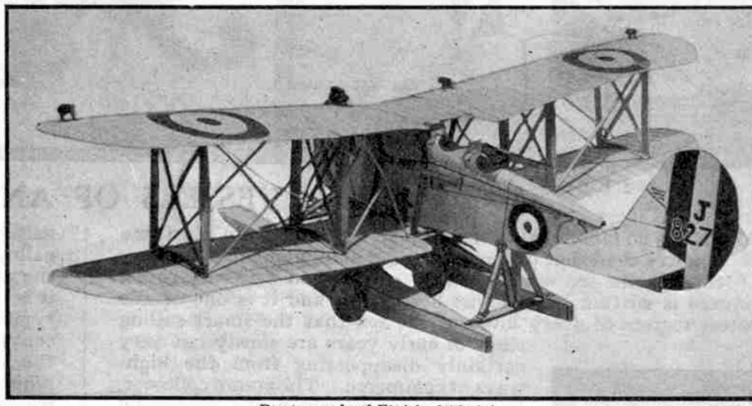
Following the practice of the Mediterranean seamen, the Vikings built their trade ships to a design differing only slightly from their ships of war. Usually the traders had a greater beam and draught to enable them the better to withstand the buffetings of Atlantic storms.

The

Model Blackburn Seaplane



Photograph of Actual Machine ["*Flight*" Photo



Photograph of Finished Model

By kind permission of the Blackburn Aeroplane Co. Ltd., we are able to supply parts for making a fine model of their "Velos" Torpedo Seaplane. The model has been designed from the blue prints of the real machine. It is a big model, being 24" span, 19" long and 8" high, and has silverfoil engine cowling, dummy torpedo, elastic motor inside fuselage, shock absorbers on the four aluminium wheels. These wheels are only fitted to the model to facilitate a landing, as it is not advisable to fly the model over water. All necessary struts, bearings, propeller blank, wire spindles, elastic, and coloured cardboard parts are included in the set, which makes a model exactly as shown in the illustration.

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(Postage to S.A. and Australia 1/10, U.S.A. and India 2/-, N.Z. and Canada 2/3 extra).

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Dear Sirs.—The last plane I had was a Blackburn Velos Seaplane which was **a good model in all details.**—Yours truly, G.L.G., Guildford, Essex. 12/7/27.

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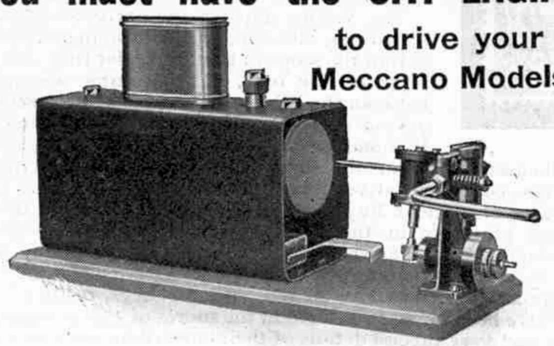

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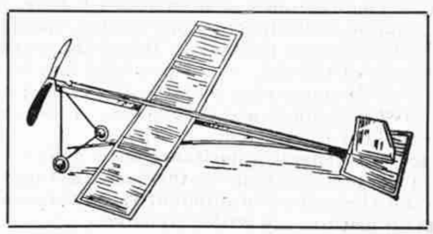

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The No. 0 "PUSHER" MONOPLANE, selling at 5/6, can be adjusted for all manner of flights, i.e., Elevator can be flattened out for long distance flying, or adjusted for sharp rising, or again for turning left or right. This Machine is practically unbreakable.

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Stamp Gossip

The Pony Express

Interest in the pony mail express, one of America's earliest forms of mail-carrying, has been re-awakened by the appearance of the Canadian 20 cent Confederation stamp on which the various forms of mail transport used in the Dominion from its earliest days up to the present day are depicted.

The pony express was inaugurated as the result of a wager made by a Mr. W. H. Russell, that the time taken in carrying mails across the continent could be cut by half. The service was commenced on 3rd April, 1860, over a route 1,950 miles in length between St. Joseph, Missouri and San Francisco, and the first pouch reached San Francisco just a few hours under a complete ten days. Each rider was a picked horseman and was expected to cover 75 miles before delivering up the mail pouch to the next rider in the chain. In this manner the total journey was made in ten days. There were no beautifully made roads in those days. Oftentimes the trail led over dim and lonely prairies and up through mountain passes, but whatever the difficulties every horseman—and one horsewoman!—was obliged to ride all out over the whole route.

Later the period was cut to eight days, but the service was so costly that it did not pay despite a charge of five dollars per letter. At such a high rate obviously only the most important mail was sent overland and with the opening of the telegraph line to the Pacific Coast in 1861 the doom of the pony express was sealed. It existed for only 17 months and among the riders were some of the remarkable characters of American history. Undoubtedly the most famous of these riders was "Buffalo Bill," whose name is known throughout the whole world. On one occasion he rode 320 miles without a relief!

It is worth recording that even Buffalo Bill's remarkable feat has been surpassed. An old Mongol named Tzeren was once sent from Uliasutai in Central Mongolia to Peking with important despatches. His instructions were to allow nothing to stop him, and he was armed with a special permit that gave him authority to demand from all post stations the best two horses, one to ride and one fully saddled to lead as a change, together with two guards to accompany him to the next station. In his cap he bore three eagle feathers as a sign that he had received orders to "fly like a bird." He stayed at each station only long enough to have the horses and guards changed, and thus he rode for 1,800 miles!

Stamps in Billions!

When one encounters reports of the numbers of stamps of various values issued in connection with commemorative issues—500,000 of this, 300,000 of the other, and so on—it comes as an amazing revelation that the value of the stock of British postage stamps held in stores never falls below £56,000,000! In addition to this vast quantity, there are the stocks held at post offices up and down the country. In Birmingham alone, to quote one example, the value of the stock of small denominations is never less than £250,000!

These amazing figures were recently given by the Birmingham Postmaster in opening a philatelic exhibition in that city.

* * * *

The Stamp that Located the Panama Canal

Few of the readers of our recent articles on the Panama Canal will be aware of the part that a simple postage stamp played in settling the ultimate location of the canal. In the "battle of the routes" both Nicaragua and Panama possessed very determined advocates in the U.S. Senate. The supporters of Nicaragua made great capital of the terrible earthquake menace at Panama, claiming that Nicaragua was comparatively immune from volcanic disturbances. They asserted that there had been no eruption since 1835, and that even then the Cosquina Mountain emitted smoke and ashes but no lava.

Philippe Banau Varilla, a brother of the French civil engineer who was associated with the canal operations for many years, and part proprietor of the famous French newspaper "*Le Matin*," at this juncture made an interesting discovery. He found that the 1900 issue of Nicaraguan stamps used as its design a view of the Momotombo Mountain pouring forth a great volume of smoke and, in addition, a very accurate picture in the foreground of the very dock that had been destroyed only a few days before by a volcanic eruption! Varilla searched every Washington stamp dealer's store and eventually secured sufficient copies of this stamp to supply every senator with definite evidence of the inaccuracy of the Nicaraguan statement.

Three days later the American Senate passed a bill naming Panama as the location for the proposed canal, provided the French company could be bought out and that Colombia would grant the necessary facilities. Thus a postage stamp helped to shape history.

Smyrna Exhibition Overprint

We illustrate herewith a specimen of the 6 gr. (piastre) stamp of the Turkish 1926 issue, overprinted for use at the recent Smyrna Exhibition. The overprinted issue does not cover the full range of the major issue, only the 1, 2, 2½, 3, 5, 6, 10, 15, 25, 50 and 100 grouch stamps being used. The 25 and 50 gr. values are overprinted in silver, the 100 gr. in gold, and the lower values in black. The stamps nominally were sold only in complete sets, but at one or two post offices the 2½ and 6 gr. values can be bought separately. The object of retailing only in complete sets is to raise money for state purposes, a laudable practice common to several countries within recent years, but one that is seriously to be condemned from a practical philatelist's view-point.

* * * *

New Esperantist Issue

In honour of the 40th anniversary of the introduction of Esperanto as a practical international language, Russia has issued a new stamp. The design shows an industrial town in silhouette, this portion of the stamp being coloured green, while a portrait of Dr. Zamenhof, the inventor of the language, is shown on the right of the stamp in brown. Immediately below the silhouette of the town the word "Esperanto" is emblazoned in large letters, while the star, the Esperantists' emblem, appears in the background. Zamenhof's idea arose out of the confusion that existed in the Bielostok territory of Russia, in which he spent his early days. The area was inhabited by Russians,

Poles, Germans and Jews, each race speaking a different language.

This is the third Russian issue of stamps connected with the Esperanto language. The "Popoff" issues of 1925 bore Esperanto inscriptions, while there was a special issue in 1926 to commemorate the holding of the International Esperanto Congress

SHARING THE BLAME

The chief had recently taken his son into partnership and was somewhat annoyed at the youngster's rather overbearing manner in the new position.

"Look here, young man," he said one day, "you must drop this attitude of yours. Let's have a little less of the 'I' and a little more of the 'we' in this business."

"H'm," agreed the boy. "I suppose I am only the junior partner," and he resolved to take his father's advice.

A few days later he burst in on his parent, looking just a trifle anxious.

"I say, dad!" he exclaimed. "We've done it now! We've married the typist—Miss Browne!"

* * * *

Film Director: "In this part you have to do a number of funny falls. How are you on falls?"

Applicant (confidently): "I rank next to Niagara!"

* * * *

"Did you hear the explosions yesterday?"

"No, what happened?"

"Why, the wind blew up the river."

* * * *

MISCONSTRUED

The vicar of a Durham church asked his clerk to give out the following announcement:—

"Sunday next there will be no morning service as the vicar is going to officiate for another parson."

Being somewhat deaf, the clerk misconstrued the message. Imagine the vicar's consternation when he heard the following announcement:—

"Next Sunday there will be no morning service as the passon is a-going a-fishing with another passon."

Weekly Telegraph.

* * * *

ACCORDING TO ORDER

The auctioneer was holding up a pair of silver candlesticks.

"Give me a start!" he cried.

"Fourpence!"

"What!"

"Ah!" said the bidder, "I thought that would give you a start!"

* * * *

The boy had been stealing to find money for the "pictures."

"And why did you take the shilling?" asked the magistrate, sternly.

"P-p-please, sir," said the boy, between sobs, "I wanted to see 'The Ten Commandments.'"

TO A MOTORIST

If you can drive through crowds and never falter,
And miss pedestrians by an inch or two;
If you can wear a smile that will not alter
When five and ten ton vans lurch out at you;
If you can see your wheels and mudguards crumped,
And greet the man who did it with a grin
You'll have no trouble driving in the City—
But you're a better man than I am, Gunga Din!

—London Opinion.

* * * *

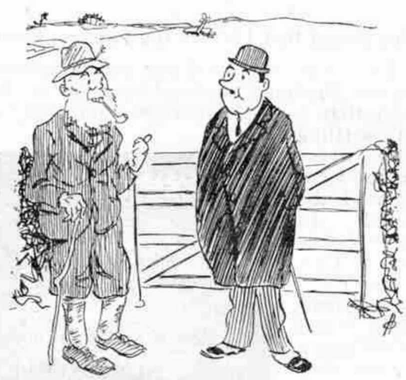
Two London barbers were talking together, after the departure of a customer.

"I say, Tommy," said one, "that was a nasty gash you gave the old boy."

"Yes," agreed Tommy. "You see, I'm courting his maid, an' that's just my way o' telling her I'll be free on Tuesday night."

* * * *

DESCRIPTIVE



Stranger: "So you've had an aeroplane crash here?"

Farmer: "Yes, one of them sky-writers came down sudden-like a few days ago. Reached a 'full-stop,' as you might say."

Stranger: "Oh, is he much hurt?"

Farmer: "Well, it said in the paper something about him still being in a state of 'comma.'"

* * * *

The magician's turn at the pantomime was not going at all well, but he stuck to his task in the face of rows of people more resigned than amused.

"Now," he beamed, wiping his hands on a gaily-coloured handkerchief, "if any lady or gentleman can oblige me with an egg, I will perform a truly amazing trick."

For a second or two there was a complete silence. Then from the gallery a voice rang out loud and clear:

"If anybody 'ere 'ad an egg, you'd 'ave 'ad it long ago!"

* * * *

WORKED UP

"I've been congratulating the Colonel. He's just been appointed governor of a prison," said a guest at the banquet.

"Really?" replied the humorous one. "Now for a job like that do you need influence or do you start as a convict and rise from the ranks?"

* * * *

A trembling class faced the inspector as he rapped out questions like a machine gun. But the boys were not to be caught napping, and the replies came back very well until he asked one boy whether he would prefer one-sixth or one-seventh of a lemon.

"I would prefer one-seventh, sir," answered the boy.

"One-seventh, eh?" said the inspector, grimly, and proceeded to explain that, although that fraction sounded larger, it was really the smaller of the two.

"I know that, sir," said the pupil. "That's why I chose it. I don't like lemons!"—*Tit-Bits.*

WHERE HE DREW THE LINE

Mr. Giltstock had made his pile and, as was only natural, decided that he must live in a better and bigger house; also, this house had to be built by the best architect to be found.

In due course the architect arrived with a batch of elaborate plans, which he explained to the merchant prince.

"Look here," he said decisively, "I must draw the line somewhere. You've made plans for a smoking-room when I don't smoke at all; a study which I'll never use because I've nothing to study; a nursery when I haven't got a nurse; and a pantry when I never pant; and I'm blowed if I'm going to let you put up a music-room when I can't even play a note on a mouth-organ!"

* * * *

A prosperous pork butcher, recently created a J.P., was paying a visit to a school and questioning the children on subjects of general knowledge.

"And now, my boys," he said, pride in his voice, "can anyone tell me what the letters J.P. after my name stand for?"

Bright Boy: "Judge of Pork, sir!"

* * * *

WE KNOW

When a plumber makes a mistake, he charges twice for it.

When a Lawyer makes a mistake, it is just what he wanted, because he has a chance to have the case tried over again.

When a Carpenter makes a mistake, it is just what he expected.

When a Doctor makes a mistake, he buries it.

When a Judge makes a mistake, it becomes the Law of the Land.

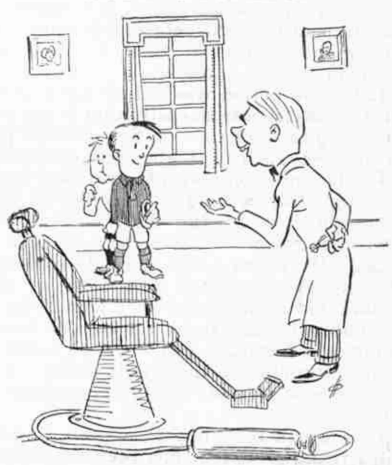
When a Preacher makes a mistake, nobody knows the difference.

But when the Editor makes a mistake—good-night!

Ideas.

* * * *

NOT HIS FUNERAL



Boy (accompanied by smaller boy): "I want a tooth out, an' I don't want gas, 'cos I'm in a 'urry."

Dentist: "That's a brave young man! Which tooth is it?"

Boy: "Show 'im yer tooth, Albert!"

* * * *

M'Tavish went into a Glasgow antique dealer's shop to buy a pair of antlers that had taken his fancy.

After a certain amount of haggling the dealer reduced the price from five guineas to two. But even then M'Tavish was not satisfied.

"Heck, mon," he complained, "are they no' awfu' dear?"

"Of course they're off a deer," roared the man behind the counter. "Did ye think they cam' frae a rabbit?"

HIS CHRISTMAS CUSTOMER

A genial and hospitable innkeeper posed as Father Christmas. An enormous pork pie graced his bar counter, and customers were invited to help themselves. One Christmas Eve a stranger walked in, sat down, and cut off a huge slice.

Half an hour later the man was eating as ravenously as ever, and the landlord could stand it no longer.

"You'll excuse me, sir," he remarked, tapping him on the shoulder, "but I don't remember your face. You're not a customer."

"Pardon me," was the polite response, as the stranger helped himself to another slice. "I was here last Christmas Eve, and"—with his mouth full of pie—"if all goes well I shall be here next!"

* * * *

Our negro charlady says: "Done heard ob a man being killed in an Italian vendetta. I never would trus' maself in one of dem little boats, nohow."

* * * *

Major: "Why do you write 'Col.' before your name? You're not a Colonel."

Rastus: "No, suh. Dat 'Col.' done stand fo' cullud."

A FAIR QUESTION

A professor of chemistry was extremely hard of hearing and just as extremely anxious to conceal his infirmity. It was a habit of his never to have a student repeat anything; he always pretended to have heard the first time.

One day, after explaining a reaction on the blackboard, the professor enquired if anyone wished to ask further questions. One of the boys picked up the pointer, and indicated a stage in the formula.

"What I want to know," he shouted, and then suddenly dropped his voice to a conversational tone as he moved the pointer over the successive steps of the problem, "is why they let such an old fool as you teach something you don't know anything about?"

The class burst into a laugh, and the professor, turning a reproving glance upon them, said "I can see no reason for amusement. That is a perfectly sensible question!"

* * * *

Bigknutt (with newspaper): "Do you know, every time you draw your breath some one dies?"

Smallhed: "Well, I'm sorry, but I can't help it. If I stop drawing my breath I die too."

TIT FOR TAT

A certain great painter had a bloodhound to which he was greatly attached. One day his pet contracted an affection of the throat, whereupon the artist sent for a specialist, a famous Harley Street doctor.

The doctor, when he found he had been called in to treat a dog, was far from pleased. However, he examined the animal's throat, prescribed for it, and, after pocketing a substantial fee, departed.

A day or two later he sent hurriedly for the painter, who dropped his work and rushed off to Harley Street.

On arrival, the specialist said gravely: "How do you do? I wanted to see you about having my front door painted!"

* * * *

Counsel: "After all, my client is only charged with simple theft."

Defendant (indignantly): "Simple, I'd like to see you do it!"

* * * *

Tutor: "Can your Highness tell me any famous proverb?"

Prince: (returns no answer).

Tutor: "That's right—'Silence is golden.'"

* *

"Just a minute, where are you going?"

"Sorry, but I haven't time to stop. I'm catching the nine-thirty."

"My goodness, you'll have to hurry. I've just missed it."

* *

"Is this called a fast train?" demanded an irate passenger.

"It is," answered the guard proudly.

"Well, in that case, do you mind if I get off to see what it is fast to?"

* *

"What are you thinkin' of doin' with your boy, Joe?"

"Eh? Well, I thought of tryin' to get him into the police."

"The police? Why?"

"Well, they're sure to 'ave 'im—one way or another!"

* *

Policeman (to small boy stealing view of football match from top of wall): "Hey, what's the game?"

Boy: "No score yet!"

* *

Circus Man (hunting runaway elephant): "Have you seen a strange animal round about here?"

Farmer Giles: "Oi have. There's been an injur-rubber bull eating my carrots wid 'is tail."

* *

Bill: "I fell on the piano last night."

Tom: "Did you get hurt?"

Bill: "No, I fell on the soft pedal."

* *

A PRIVATE ZOO

"It's funny, ain't it, that everybody in our family is some kind of an animal."

"Some kind of an animal, indeed! What do you mean?"

"Why, mother's a dear, you know."

"Yes, certainly."

"And my baby sister's mother's little lamb; I'm the kid; dad's the goat, and the gardener's an ass."

* *

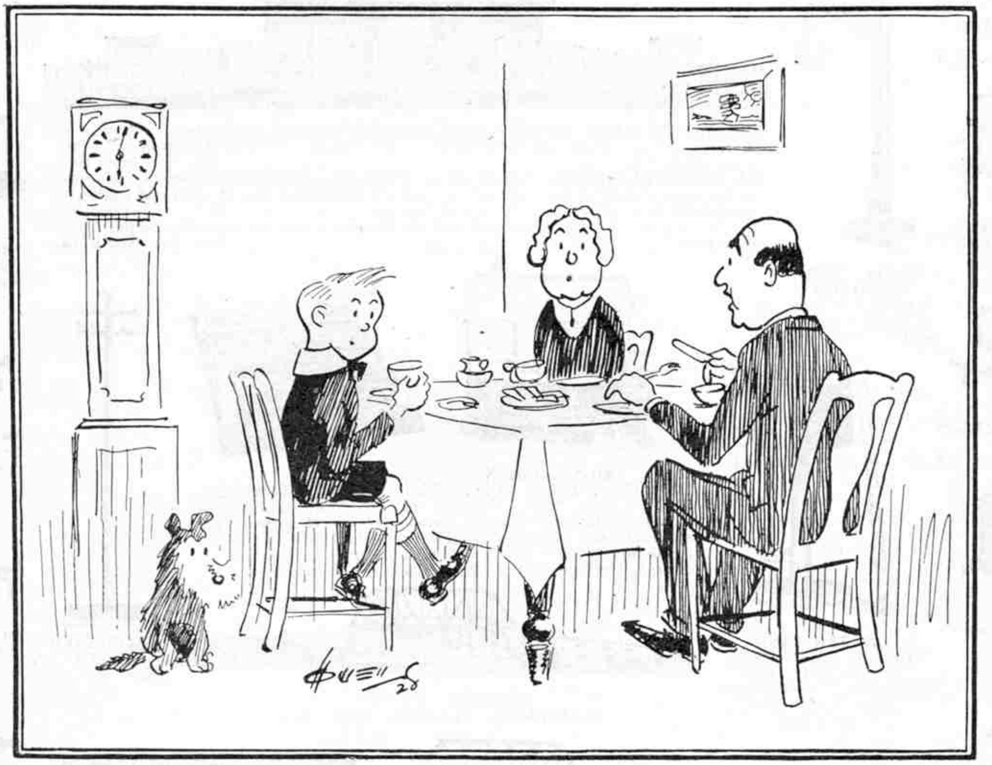
QUITE LOGICAL

Flanagan, the local builder, was constructing a brick wall at the end of a client's garden. The ground in this vicinity was inclined to be boggy.

"Good heavens!" exclaimed the man living next door. "I should have thought you knew better than to build a wall there, Flanagan. It'll fall over in a day or two."

"Indade," retorted the builder angrily, "and who cares if ut does? Oi'm makin' her five feet high and six feet wide, so if ut does topple over, begorrah, it'll be a foot higher than it was before."

* *



ENTIRELY FOREIGN

"How are you going on at school, Henry?" asked his father.
"Fine," said Henry. "I have learned to say 'thank you' and 'if you please' in French."
"Good," said the father, "that's more than you ever learned to say in English!"

A golf course not many miles from London receives a mild invasion of clergymen each Monday. As a rule they play with more heartiness than accuracy and give the caddies a fairly exhausting day of it.

On one recent Monday a drove of padres was observed from the caddies' hut.

"Now then, boys," said the head caddie, "get ready to chant: 'We plough the fields and scatter.'"

* * * *

TRUE SPORTING SPIRIT

The sad-looking man at the corner table had been waiting a very long time for his order. At last a waiter approached him and said:—

"Your fish will be coming any minute now, sir."

"Oh, yes," said the man, looking interested. "And what bait are you using?"

* * * *

He was always boasting about his ancestors, and eventually decided upon employing a genealogist to hunt them up.

In due course the connoisseur of pedigrees returned and was cordially received by his patron.

"So you have succeeded in tracing back my ancestors? What is your fee?"

"Forty guineas," replied the other.

"H'm!" murmured the patron dubiously. "Isn't that rather dear? What's it for?"

"Principally," responded the genealogist, "for keeping quiet about them. One was hanged at Tyburn."

THE MISSUS MISSING!

He was on his way home with his new car, which was absorbing all his attention, when it suddenly struck him that he had forgotten something.

Twice on the way he stopped, counted his parcels, and searched his pocket-book, but finally decided he had everything with him.

When he reached home his daughter ran out, stopped with a surprised look on her face, and cried: "Why, father, where's mother?"

* * * *

The Agent: "Barnstormer, I have a part here might suit you. Do you think you could do the landlord in 'The Lady of Lyons'?"

The Actor: "My dear lad, I have done landlords all over the country!"

* * * *

A certain famous conjurer when giving his magic show to children loves to produce a small rabbit which, in pretending to wrap up for a small girl, he changes for a box of candy.

The audiences usually note the child's disappointment and sympathise with her, but rabbits are too hard to find to be given away at each performance.

In the latter part of one performance, the conjurer used a big lion.

"Would you like to have this nice lion as a pet?" the magician asked a small girl.

The child nodded her head, but a warning voice came from the gallery:

"Hey, kid, don't let him wrap that up!"

First Small Son: "I think there is company downstairs."

Second ditto: "Why?"

First Small Son: "I just heard mamma laugh at one of papa's jokes."

* * * *

The Hopeless Bore: "And when I took up golf the doctor had just told me that I had only two years to live."

The Momentarily Hopeful Victim: "Oh, tell me quick, Mr. Earbender, how long ago was that?"

* * * *

GETTING ON WITH THE JOB

During the Great War, a certain American Army Corps was held up in its advance awaiting the construction of a river bridge. The American General sent for his chief engineer.

"Are those goldarned plans finished for the bridge we're waiting for?"

"I don't know about the plans, General," was the answer, "but the goldarned bridge is finished!"

* * * *

Charlady: "She wanted me to 'ave a finger in the pie, but I smelt a rat an' nipped it in the bud."

Cook: "Lor', Mrs. Jones, 'ow you do mix your semaphores."

* * * *

Old Gentleman: "You've evidently seen better days. Have you no friends?"

Tramp: "No sir. I was a football referee."

Meccano & Hornby Train Supplies

All the dealers whose advertisements appear on this page carry full stocks of Meccano Outfits, Accessory Outfits and Meccano parts, Hornby Trains and Hornby Train Accessories all the year round. The names are arranged in alphabetical order of town.

HARRY BROWN,
1, Moss Lane,
ALTRINCHAM.

J. WOODHALL,
256, Grange Road,
'Phone : B'head 621 BIRKENHEAD.

HOBBIES LTD.,
9a, High Street,
BIRMINGHAM.

MERCER'S DOLLS' HOSPITAL,
68, Darwen Street,
BLACKBURN.

BATESON'S SPORTS DEPOT,
Abingdon Street,
BLACKPOOL.

SELLEN'S BAZAAR,
54, Waterloo Road,
BLACKPOOL, S.S.

J. MORRIS, F.C.O.,
70, Knowsley Street,
Tel. 1074 BOLTON.

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BRADFORD.

HOBBIES LTD.,
68, London Road,
BRIGHTON.

JOHN TAYLOR,
28, Preston Street,
Tel. : Brighton 957 BRIGHTON.

BRISTOL TOY EXCHANGE,
92b, Whiteladies Road,
Clifton, BRISTOL.

GYLES BROS. LTD.,
Tel. 2888 24, Bridge Street, BRISTOL.
188, Whiteladies Road, Clifton, BRISTOL.
Tel. 143

JOHN HALL (TOOLS) LTD.,
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CARDIFF. SWANSEA.

SALANSON LTD.,
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4, High Street, CARDIFF.

SAM TAYLOR,
Silver Street,
Tel. 320 BURY.

HAROLD HUNT,
38, Spring Gardens,
Tel. 202 BUXTON.

HOBBIES LTD.,
385½, Yonge Street, Toronto 2,
CANADA.

H. W. GILL,
23 & 24, Pittville Street,
CHELTENHAM SPA.

THOMAS JAMES & SON,
High Street,
CINDERFORD.

R. H. JEPSON,
1, Cross Cheaping,
COVENTRY.

PURSEY & MOCKRIDGE,
The Sports Outfitters,
Tel. Dartford 173 DARTFORD.

HENRY WHALLEY,
195, Duckworth Street,
DARWEN.

RATCLIFFES TOYERIES,
19, Osmaston Road,
DERBY.

C. E. MELLER,
"Dolls' Hospital,"
55, Hall Gate, DONCASTER.

JAMES L. DIXON,
14, Suffolk Street,
(off Grafton St.), DUBLIN.

DIXON'S,
41, High Street,
DUNDEE.

DRAFFEN & JARVIE LTD.,
Nethergate,
DUNDEE.

BASSETT-LOWKE LTD.,
5, Frederick Street,
EDINBURGH.

WRIGHT'S DOLLS' HOSPITAL,
14, High Street,
ERDINGTON.

ROBERT BALLANTINE,
103½, St. Vincent Street,
GLASGOW.

CLYDE MODEL DOCKYARD,
22-23, Argyll Arcade, GLASGOW.
Model Makers to the Admiralty, the Railway Coys., etc.

HOBBIES LTD.,
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GLASGOW.

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110, West Nile Street,
GLASGOW.

FLETCHER'S TOYLAND,
77, Deardengate, HASLINGDEN.
Grand Building, RAWTENSTALL.

H. POULTON, Toyland,
75 & 77, High Street,
HOUNSLOW, Middlesex.

GAMLEYS,
The Hove Hornby Train Store,
78, Church Road, HOVE.

HAMMOND'S LTD.,
Paragon Square,
HULL.

W. J. S. CARPENTER,
13 & 15, Queen Victoria Street,
LEEDS.

HOBBIES LTD.,
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PEARSON & DENHAM (PHOTO) LTD., 6, Bond Street,
LEEDS.

A. WRIGHT, The Garage,
200/2, Dewsbury Road,
Tel. 22719 LEEDS.

ROBOTHAM,
"Baby's Kingdom,"
Tel. 4809 LEICESTER.

BYCROFTS EMPORIUM,
366, High Street,
LINCOLN.

C. LUCAS, Hobbies Depôt,
35, Manchester Street,
LIVERPOOL.

Reliance Cycle & Motor Co.,
29/31, Manchester St., Liverpool.
Argyle & Conway Sts., Birkenhead.

Meccano & Hornby Train Supplies

The thirty-four dealers whose advertisements appear on this page carry full stocks of Meccano Outfits, Accessory Outfits and Meccano parts, Hornby Trains and Hornby Train Accessories all the year round. The names are arranged in alphabetical order of town.

DEMPSEY & CO.,
69, South Side, CLAPHAM,
'Phone: Brixton 3022 **LONDON, S.W.4.**

The ARUNDEL CYCLE & SPORTS STORE, 52, Church Road, Upper Norwood, LONDON, S.E.19.

HOBBIES LTD.,
65, New Oxford Street,
Tel. Mus. 1656 **LONDON, W.C.**

HOBBIES LTD.,
147, Bishopsgate,
Tel. London Wall 7350 **LONDON, E.C.**

HOBBIES LTD.,
79, Walworth Road,
Tel. Central 2457 **LONDON, S.E.**

W. HUMPHRYS & SON,
269/271, Rye Lane,
Estab. in 1840 **PECKHAM, S.E.15.**

LEDWITH BROS.,
42 & 44, Walworth Road,
Nr. ELEPHANT AND CASTLE, **LONDON, S.E.17.**

F. R. POTTER & SON,
43, Market Place,
LOUGHBOROUGH.

H. G. PARTRIDGE & CO.,
10, Chapel Street,
Tel. 234 **LUTON.**

BARRS, Children's Paradise,
49, Deansgate,
Telephone 165 City. **MANCHESTER.**

A. FRANKS LTD.,
95 & 97, Deansgate, MANCHESTER.
90, Bradshawgate, BOLTON.

HENRY'S Toy & Game Stores,
22, King Street,
Tel. 3004 Central **MANCHESTER.**

HOBBIES LTD.,
10a, Piccadilly,
MANCHESTER.

A. INMAN, MANCHESTER.
105, Lapwing Lane, Didsbury. Tel. 1518.
179, Dickenson Rd., Rusholme. Tel. 2241.

JOHN NESBITT LTD.,
42, Market Street,
MANCHESTER.

H. WILES LTD.,
124, Market Street,
MANCHESTER.

R. SCUPHAM & SONS,
35, Linthorpe Road,
MIDDLESBROUGH.

WILLIAM OLLIFF,
13, Grainger Street West,
NEWCASTLE-ON-TYNE.

W. MARK & CO. LTD.,
27, The Drapery,
NORTHAMPTON.

J. R. NORRIS,
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9, Pelham Street, NOTTINGHAM.

JANES & ADAMS,
13, The Promenade,
And Branches. PALMERS GREEN.

DEAN & HOLT,
78, Yorkshire Street,
ROCHDALE.

A. E. HAIG,
16, Northenden Road,
SALE, CHESHIRE.

HOBBIES LTD.,
214, West Street,
SHEFFIELD.

THE REDGATE CO. (SHEFFIELD) LTD.,
Tel. 22806 **Moorhead, SHEFFIELD.**

SHEFFIELD PHOTO COMPANY,
6, Norfolk Row (Fargate),
'Phone 23891 **SHEFFIELD.**

WILSON, GUMPERT & CO. LTD.,
57, Fargate,
Tel. 489 **SHEFFIELD.**

BIRMINGHAM & COVENTRY CYCLE CO., 140 & 151, Above Bar, SOUTHAMPTON.

HOBBIES LTD.,
25, Bernard Street,
SOUTHAMPTON.

OSBORN & CO.,
9, High Street,
SOUTHAMPTON.

S. T. SIMPSON & SON,
589-595, Lord Street,
Tel. 999 **SOUTHPORT.**

H. W. GINN,
The London Motor, Cycle & Sports Co.,
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E. M. COLLINS,
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Complete mould ready for work 2/6.
RODWAYS, 102, Long St., Birmingham
Mention "Meccano."

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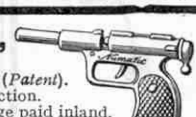

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Nett Cash £1:18:6
This set supplied with polished Oak or Mahogany 40-in. high Cabinet as shown, or Jacobean Pedestal.
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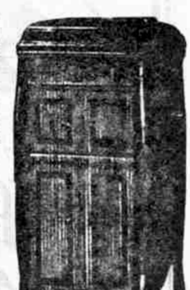

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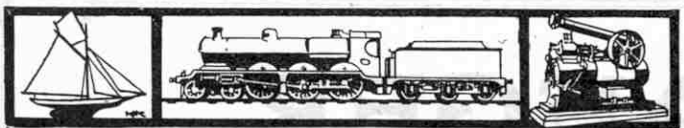

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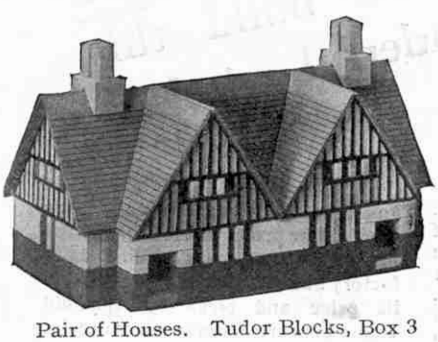

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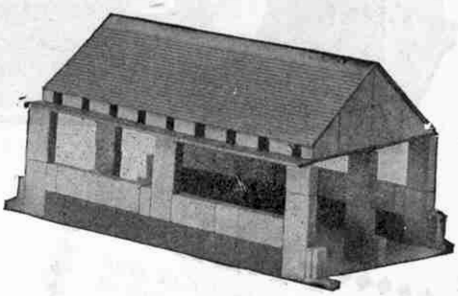

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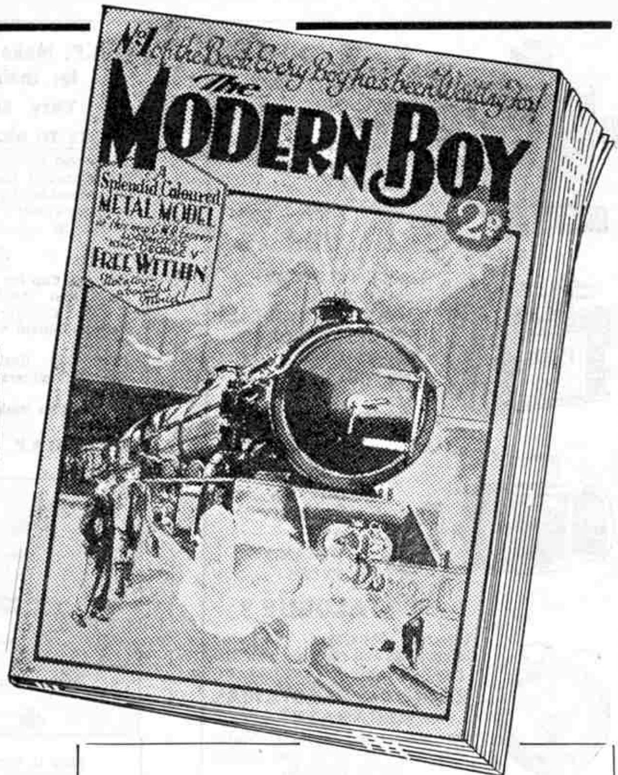

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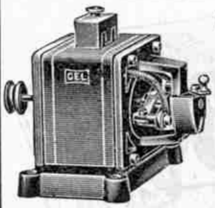

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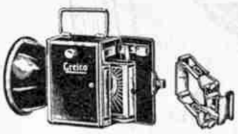

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11/6 each

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Useful for sports and theatricals, also great protection against burglars and foot pads.
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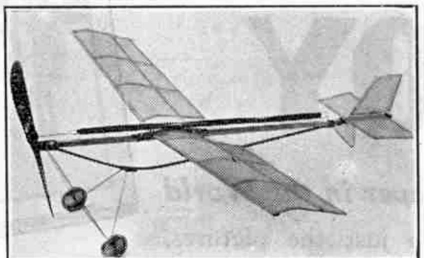

This is our No. 6 Tractor Monoplane.

Length 24 ins., Span 22 ins., which will fly 150 yards. (Distance doubled under favourable conditions). Fitted with a D.A.P. Hand Carved Propeller (not bentwood). This Model will rise from the ground. Price **10/6.** Carriage and Packing U.K. **9d.** extra.

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COMPRESSED AIR ENGINE for working small models, Meccano, etc. It can be unscrewed from base and fitted to boat, aeroplane, etc. Charged with compressed air by ordinary cycle pump. Great speed. Excellent value. Price **4/6.—H. J. Mallett, Elvin Road, East Dereham, Norfolk.**

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Perfect repeating action. Fires 20 shots with force and accuracy. Bright Nickel finish as illustrated.
6 Shot—heavy model. Black finish, 1/3
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Good supply of ammunition with each pistol.
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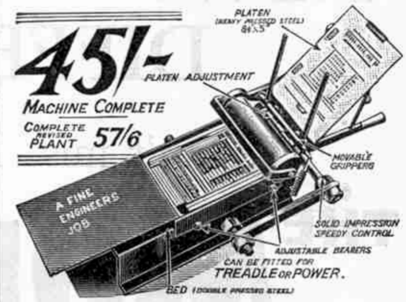

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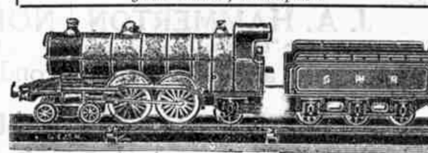

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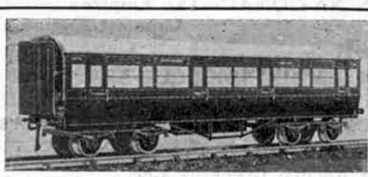

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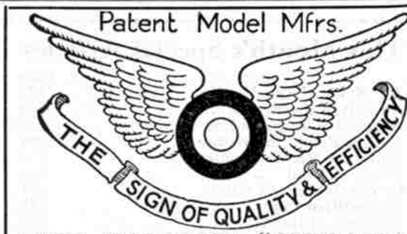

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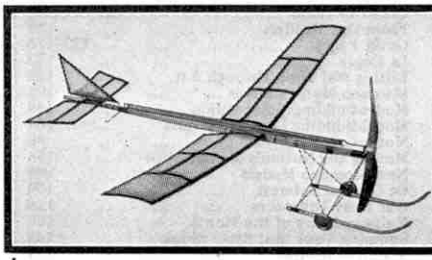

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No. 0	Price 18/6	No. 3	Price 8/6
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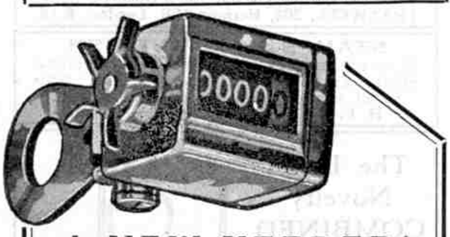

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Wanted. Correspondence with boys boarding at Public or Private Schools. Write—L. H., Fern Leigh, Hatfield Road, Weston-Super-Mare, Somerset.

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MECCANO MAGAZINE

Registered at G.P.O., London, for transmission by Canadian Magazine Post.

EDITORIAL AND ADVERTISING OFFICES:—
BINNS ROAD, LIVERPOOL.
Telegrams: "Meccano, Liverpool."

Publication Date. The "*M.M.*" is published on the 1st of each month and may be ordered from any Meccano dealer, or from any bookstall or newsagent, price 6d. per copy. It will be mailed direct from this office, 4/- for six issues and 8/- for twelve issues.

To Contributors. The Editor will consider articles and photographs of general interest and payment will be made for those published. Whilst every care will be taken of articles, etc., submitted, the Editor cannot accept responsibility for any loss or damage. A stamped addressed envelope of the requisite size should be sent where the contribution is to be returned if unacceptable.

Advertisements

Readers' Sales and Wants. Private advertisements (i.e., not trade) are charged 1d. per word, minimum 1/-. Cash with order. Editorial and Advertising matters should not be dealt with on the same sheet of paper (see important notice below).

Small Advertisements. 1/- per line (average seven words to the line), or 10/- per inch (average 12 lines to the inch). Cash with order (see important notice below).

Display. Quotations for space bookings, and latest circulation figures, will be sent on request.

Press Day, etc. Copy should be sent as early in the month as possible for insertion in following issue. We usually close for press on or before 10th of each month for following issue. Half-tone blocks up to 100 screen.

Proofs of advertisements will be sent when possible for space bookings of not less than half-an-inch.

Voucher Copies. Sent free to advertisers booking two inches or over. Other advertisers desiring vouchers should add 8d. to their remittance and should order voucher copy at same time.

Remittances. Postal Orders and Cheques should be made payable to Meccano Ltd.

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The Readers' Sales and Wants column is reserved for advertisements dealing only with collections of stamps as a whole. A collection that is being disposed of on approval sheets, or by packets or sets, should be advertised in the small advertisement column, the rate for which is 1/- per line, average seven words to the line. Although the advertiser may not be actually conducting a stamp business, such advertisements are not to be classified under Readers' Sales and Wants.

Advertisers are asked to note that private advertisements of goods manufactured by Meccano Limited cannot be accepted.

Ordering the "*M.M.*" Overseas

Readers Overseas and in foreign countries may order the *Meccano Magazine* from regular Meccano dealers, or direct from this office. The price and subscription rates are as above, except in the case of Australia, where the price is 1/- per copy (postage extra), and the subscription rates 7/- for six months and 14/- for 12 months (post free).

IMPORTANT.

Overseas readers are reminded that the prices shown throughout the "*M.M.*" are those relating to the home market. Current Overseas Price Lists of Meccano Products will be mailed free on request to any of the undermentioned agencies. Prices of other goods advertised may be obtained direct from the firms concerned.

CANADA: Meccano Ltd., 45, Colborne Street, Toronto.
AUSTRALIA: Messrs. E. G. Page & Co., 52, Clarence Street, Sydney, N.S.W.
NEW ZEALAND: Models Ltd., Kingston & Federal Streets, Auckland.
SOUTH AFRICA: Mr. A. E. Harris (P.O. Box 1199), 142, Market Street, Johannesburg.

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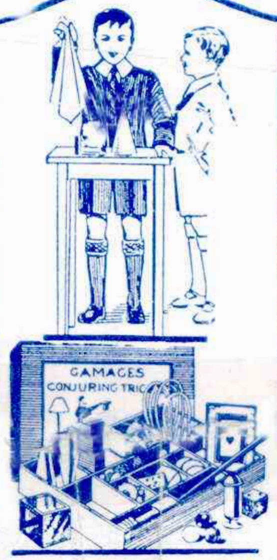

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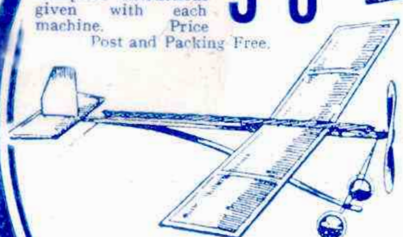

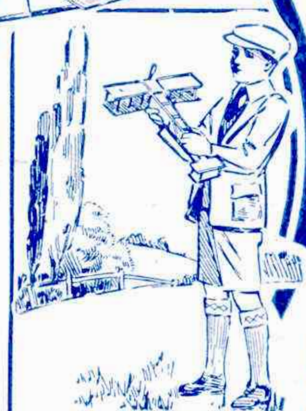

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Special 5XX Daventry Coil for same **2/9** extra.

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B.B. Shot, 6d. per Box.
Darts, 6d. per doz.

Single Shot **7/6** 350 Shot Repeater **9/6** Carr. 9d.

The Famous Motor Hydroplane "Maple Leaf V"

The hull is constructed of selected yellow pine and has mahogany spray hood and deck fittings, brass rudder, tiller and rack, and strong wire guard to protect the brass propeller. Enamelled in a beautiful shade of green, the hood, deck and fittings being varnished, 26 in. long. Fitted steam engine and boiler. "Maple Leaf V" will run for 30 minutes and cover a long distance. Post Free. Price **22/6**

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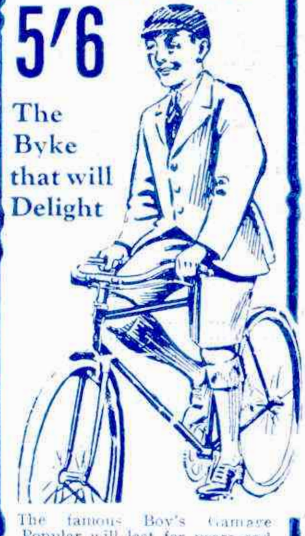

The famous Boy's Gamage Popular will last for years and stand up to hard usage, with a good specification and beautifully finished throughout. Price Carriage Paid **85/-**

A. W. GAMAGE LTD., HOLBORN, LONDON, E.C. 1

"Royal Scot"

"Flying Scotsman"

"Cornish Riviera"

Three New Hornby Trains

The three Train Sets described below are the latest additions to the range of Hornby Trains. They are distin- in design, beautifully enamelled in correct L.M.S.R., L.N.E.R. and G.W.R. colours and are guaranteed to give the utm satisfaction.

Each locomotive carries the name of a famous British locomotive on the front wheel guard at each side. A specia feature of the Pullman Coaches is the corridor connection, which gives the Trains a most realistic appearance.

In each case the Train Set is available with either Clockwork or 4-volt Electric Motor. Gauge 0.

HORNBY No. 3E G.W. "CORNISH RIVIERA" is enamelled in Great Western Colours and the locomotive is named "*Caerphilly Castle.*" The set contains an Electric Loco (4-volt), Tender, two Coaches, Resistance Controller and Electrical Rails. The electric motor in the Loco is operated from a 4-volt Accumulator or from a suitable transformer connected to the main (alternating current only).

Hornby No. 3E G.W. "Cornish Riviera," complete, well boxed ... Price **85/-**

HORNBY No. 3C G.W. "CORNISH RIVIERA" has a similar finish to the No. 3E G.W. "Cornish Riviera." This set contains Clockwork Loco, Tender, two Coaches and set of rails including a No. 2 Control Rail. The Loco is fitted for Hornby Control.

Hornby No. 3C G.W. "Cornish Riviera," complete, well boxed ... Price **70/-**

HORNBY No. 3E L.N.E.R. "FLYING SCOTSMAN" is enamelled in green and the locomotive is named "*Flying Scotsman.*" The contents of the set are similar to those of the No. 3E G.W. "Cornish Riviera" Train Set.

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HORNBY No. 3C L.M.S. "ROYAL SCOT" is finished similarly to the No. 3E L.M.S. "Royal Scot." The contents of this set are as those of the No. 3C G.W. "Cornish Riviera" Train Set.

Hornby No. 3C L.M.S. "Royal Scot," complete, well boxed ... ... Price **70/-**

Important

The components of the No. 3E and No. 3C Train Sets may be purchased separately if required. Prices are as follows :—

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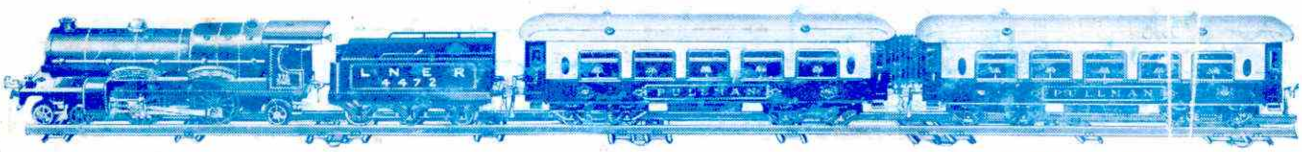
Loco	Price 37/6	Tender	Price 3/6
Coach	" 16/6	Resistance Controller ...	" 3/6

No. 3C G.W., L.N.E.R. or L.M.S.

Loco	Price 27/6	Tender	Price 3/6
Coach	Price 16/6		



No. 3C L.N.E.R. "Flying Scotsman"

HORNBY TRAINS

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